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ORIGINAL ARTICLE

Household crowding and psychosocial health among Inuit in Greenland

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Abstract
Objectives Poor housing conditions experienced by many Indigenous peoples threaten their health and well-being. This study examines whether household crowding is associated with poorer psychosocial health among Greenlanders, and the mediating role of social support. It also assesses whether Inuit men and women are differently influenced by their housing conditions.
Methods Data on more than 3,000 Inuit aged 18 years and older are from the Inuit health in transition Greenland survey. Associations between household crowding and composition, and mental well-being and binge drinking were examined using logistic regression models, adjusting for individuals' characteristics.
Results Household crowding was associated with poorer mental well-being. Binge drinking was more common among people living in households without children. These effects were more important for women than for men. The association between household crowding and mental well-being was significantly mediated by social support. This suggests that having a strong social network may buffer the deleterious impacts of household crowding.
Conclusions Targeting housing conditions and fostering social support as part of population health interventions might contribute to improving psychosocial health and well-being in Greenland.

Keywords Indigenous health · Inuit · Housing · Crowding · Psychosocial health · Greenland

Introduction

Over the past decades, the rapid sociocultural changes experienced by Indigenous peoples have been paralleled by an increase in the prevalence of non-communicable diseases, such as mental health problems (Kirmayer and Guthrie Valaskakis 2009; Waldram et al. 2006). Rates of suicide, mental illness, substance use, violent behaviors and unintentional injuries are often higher among Indigenous peoples (Kirmayer and Guthrie Valaskakis 2009; Waldram et al. 2006), including the Inuit (Young and Bjerregaard 2008). Among socio-environmental factors influencing Indigenous health, housing conditions have been identified as a key determinant (Bailie and Wayte 2006; Gracey and King 2009). Since the imposition of settlement living and history of environmental dispossession, poor housing quality, substantial housing shortages and resulting overcrowding are commonplace in many Indigenous communities, threatening peoples' health and well-being. This study examines household crowding as a determinant of psychosocial health among Inuit living in Greenland (Greenlanders).

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Housing in Greenland

Under Danish colonial system from 1721 to 1953, Greenland has had Home Rule since 1979 and a self-governing status since 2009. Urbanization started in the early 20th century and has increased rapidly since the 1950s. In 1951, 68 % of the population lived in villages with less than 500 inhabitants; by 2010, this proportion decreased to 15 %. Today, the total population of Greenland is about 56,400 of whom 90 % are ethnic Greenlanders. All of Greenland's 80 communities are located on a narrow coastal strip (Bjerregaard and Stensgaard 2008; Statistics Greenland 2013).

Despite the increasing share of private ownership, the majority of dwellings (apartment blocks or single gable-roofed timber houses) are owned by public organizations, e.g., by the Government of Greenland, the municipalities, or by large companies (Hansen et al. 2013). Historically, small houses designed by non-Inuit accommodated large households. Despite improvements in dwelling size and quality, and a decrease in household sizes over time, household crowding remains a concern in Greenland, especially in small remote villages (Bjerregaard et al. 2008).

Household crowding and Indigenous health

Research on housing conditions and Indigenous health has mainly focused on outcomes such as respiratory health, especially among children, and tuberculosis (TB). For example, the prevalence of lower respiratory tract infection (LRTI) and hospitalizations due to LRTI are significantly higher among Inuit infants and children living in more crowded households in Canada (Banerji et al. 2009; Kovesi et al. 2007) and Greenland (Koch et al. 2002). Elevated risk of TB in relation to household crowding has been observed among First Nations communities in Canada (Clark et al. 2002; Larcombe et al. 2011) and among Greenlanders (Søborg et al. 2011). In Australia, household overcrowding has been associated with ear infections among Aboriginal and Torres Strait Islander children, potentially compromising their development and school achievement (Australian Government Department of Families Housing Community Services and Indigenous Affairs 2013).

In several international studies, household crowding has been associated with poorer mental health (Evans et al. 2003). The hypothesized relationship between housing conditions and mental health draws from research on the psychosocial environment of the workplace, where issues of control, for example, have been associated with physical and mental health outcomes, including stress (Siegrist and Marmot 2004). In crowded dwellings, the lack of privacy and the impossibility of withdrawing from (unwanted) social interactions may limit the ability of controlling one's home situation and lead to "over-arousal" possibly eliciting mental ill-health (Evans 1979). In Western Australia, poor housing quality was identified as an important stressor with repercussions on Aboriginal and Torres Strait Islander children's mental health (Shepherd et al. 2012). In Nunavik, Canada, higher levels of chronic stress were observed among Inuit living in overcrowded dwellings (Riva et al. 2014). The issue of 'control' within the home environment has particular resonance in the context of Indigenous housing and health research, where the imposition of settlement living, endemic housing shortages, overcrowding and poor housing quality are likely to have repercussions on psychosocial health.

Psychosocial health responses to living in crowded households may differ by gender (Gabe and Williams 1986; Gove and Hughes 1983), with women expressing more internalized distress (e.g., depression and anxiety), and men more externalized responses such as substance use and aggressive behaviors (Regoeczi 2008). Inuit women are largely responsible for caring for children and looking after the home (Healey and Meadows 2007; Stern 2005) and, in addition to holding a job, these multiple roles may be especially burdensome in crowded dwellings. Among men, 'household demand overload', e.g., the (social) pressure of providing to a large household, including several children, may lead to increased stress levels (Riva et al. 2014) with repercussion of mental health and (unhealthy) coping behaviors. Considering the gender-specific health effects of crowding is thus warranted.

International studies conducted among non-Indigenous populations have examined mechanisms, such as withdrawal and social support, through which household crowding may influence mental health (Gove and Hughes 1983; Lepore et al. 1991; Wells and Harris 2007). It is posited that crowding erodes social support which, in turn, has negative consequences on psychosocial health. Social support is an important determinant of Indigenous health (Richmond 2009; Richmond et al. 2007) and its protective role for mental health, and for health more generally, has long been established (Cohen and Syme 1985). Studies have yet to examine whether social support mediates the association between household crowding and psychosocial health among Indigenous populations.

Objectives

This study examines the association between household crowding and psychosocial health in Greenland, and whether this association is modified by sex and settlement type (given possible unequal housing conditions between towns and villages). A second objective is to assess the role of social support as a mediator of the association between household crowding and psychosocial health.

Methods

The Inuit health in transition Greenland survey

Data are from the Inuit health in transition Greenland survey, collected as part of a countrywide cross-sectional health survey in Greenland. A full description of the study methodology is available elsewhere (Bjerregaard 2010), and is only summarized here. Participants were selected through stratified random sampling. Greenland was divided into strata based on region (South west coast; Central west coast; North west coast; East Greenland; North Greenland) and community size (larger towns with ≥2,000 inhabitants; smaller towns with <2,000 inhabitants; and villages with <500 inhabitants). From each stratum one or more towns and two to three villages were randomly selected. From each town, a random sample was drawn from the central population register to obtain around 300 participants; this number represented the practical limit for a research team during a 4–6 weeks' visit. In the selected villages, all adults were invited to participate. More than one person per household could participate in the survey.

Information on adults aged ≥18 years and born in Greenland or Denmark was collected between 2005 and 2010 in 9 towns and 13 villages. Ethnicity as Greenlander or Dane was determined at enrolment based on the primary language of the participant and self-identification. A total of 3,108 Greenlanders participated in the study with a participation rate of 66.7 % and 144 Danes with a participation rate of 41.1 %. The study surveyed 9.2 % of the adult, Greenland-born population. The current study focuses on Greenlanders only and excludes people living in communal establishments (e.g., retirement homes, student residences, etc.; $n = 42$) ($n = 3{,}066$). Data were collected using clinical procedures, sampling of biological media, and interview and self-administered questionnaires which provided information about socio-demographic factors, physical and psychosocial health. Questionnaires were developed in Danish, translated into Greenlandic, back translated and revised. Interviews were conducted in the language of choice of the participant, most often in Greenlandic, by native Greenlandic speaking interviewers who had been trained in the study procedures. The study received ethical approval from the Committee for Research Ethics in Greenland. After being informed about the study orally and in writing, participants gave their written consent.

Psychosocial health: mental well-being and alcohol consumption

In the interview questionnaire, two variables were available to assess mental well-being. Participants reported whether, in the 2 weeks preceding the interview, they had been bothered by: (a) anxiety, nervousness, agitation, or fear; or (b) feeling depressed or unhappy. Two dichotomous variables were created identifying people reporting 'feeling anxious' or 'feeling depressed' either a little or a lot, vs. those who did not. In a previous study, the prevalence of these variables was significantly higher among people scoring ≥2 on the General Health Questionnaire (Lynge et al. 2003), an instrument validated against standardized clinical interviews (Goldberg and Williams 1988).

Data for alcohol consumption are from the self-administered questionnaire, which had lower response rates than the interview questionnaire. Although there is no consensus on the definition of binge drinking, previous studies have defined binge drinking as an intake of five or more drinks for men, and four or more drinks for women, on one occasion at least once over a 2 week period (Wechsler and Nelson 2001). It was not possible to exactly replicate this measure in the dataset because the same questions (with thresholds) assessing frequency and quantity of alcohol consumption were asked to women and men. Binge drinking was identified as having more than five drinks on the same occasion at least two or three times per month in the past year. As a large proportion of the sample had missing information on this variable (39.3 %), binge drinking was extended to include people reporting more than five drinks in one occasion during the week preceding the interview.

Household crowding and composition

Participants reported on the number of people living in the household, broken down in adults and children aged <18 years, and on the number of rooms in the house or flat (not counting kitchen, bathroom and entrance hall). From this information, household crowding was defined as the number of person per room (PPR), i.e., the ratio of household size to the number of rooms, to which we added one room for the kitchen. This was done to make this indicator comparable to PPR indicators used in other Arctic regions (Minich et al. 2011; Riva et al. 2014). To unpack household crowding, the composition of the household was further considered, as living arrangements might differently influence psychosocial health. A categorical variable contrasted households with adults and children, households with one adult, and households with cohabiting adults without children.

Individual characteristics

Age, sex, household wealth, marital status and settlement type were considered as covariates. Household wealth was measured using a continuous index of ownership of household items (Lear et al. 2014) previously validated among this population (Bjerregaard and Dahl-Petersen 2008). Participants reported owning (or not) a: video/DVD

player, computer, landline telephone, refrigerator, microwave oven, washing machine and dishwasher. Household wealth was calculated as the sum of these items. Marital status contrasted people in a relationship (married or not) to those not in a relationship (single, divorced, separated or widowed). Participants were identified as living in towns or in villages.

Social support was measured using five items linked to concepts of positive interaction (get together with people to play games, sports, or other recreational activities, excluding bingo; someone to have a good time with; spend time with family; spend time with friends) and emotional support (someone to talk to when feeling troubled or needing emotional support). Respondents indicated how often each type of support was available to them. Those responding "very often" or "often" were considered to have high levels of social support (and were attributed a score of 2); those responding "sometimes" to have some levels of social support (and were attributed a score of 1), and those responding "rarely" or "never" to have low levels of social support (and were attributed a score of 0). Score for each item was summed into an index of social support and dichotomized to contrast participants with low (score <7) vs. high (score ≥ 7) social support. Social support was not measured in one community ($n = 295$; 9.5 %) and 45 people (1.4 %) had missing data. Although items composing the social support index have not been validated among this population, similar items have been used to measure social support (Richmond 2009) and its association with thriving health (Richmond et al. 2007) among Inuit in Canada.

Statistical analysis

Data were analyzed using logistic models, on the full sample then stratified by sex and settlement type (towns vs. villages). Models were tested separately for each outcome and for each main exposure variable (i.e., household crowding and composition), on a subsample of data without missing information on individual covariates (sample sizes vary by health outcomes). To account for the stratified sampling design (communities, respondents), analyses were run using survey design commands ('svy') in Stata 11 (StataCorp 2010). The mediating role of social support on the association between household crowding and psychosocial outcomes was then tested using mediation analysis with binary outcome and mediator variable (MacKinnon and Dwyer 1993).

For 25 % of the respondents, more than one person per household participated in the survey. To examine whether this clustering influenced results, analyses were replicated on a subsample composed of only one respondent per household. Results of these analyses are reported in "Appendix 1–3" in electronic supplementary material.

Table 1 Descriptive statistics of the overall sample of 3,066 Greenlanders (Inuit health in transition Greenland survey, 2005–2010)

Individual characteristics	
Feeling anxious [n(%)]	985 (32.1)
Missing	7 (0.2)
Feeling depressed [n(%)]	895 (29.2)
Missing	16 (0.5)
Binge drinking [n(%)]	989 (32.3)
Missing	599 (19.5)
Sex [n(%)]	
Men	1,356 (44.2)
Women	1,710 (55.8)
Age	
Mean (SD)	44.3 (14.6)
Median; range	44; 18–95
Household wealth	
Mean (SD)	4.3 (1.73)
Median; range	4; 0–7
Missing [n(%)]	11 (0.4)
Marital status [n(%)]	
Single	973 (31.7)
In a relationship	2,064 (67.3)
Missing	29 (1.0)
Social support	
Mean (SD)	6.1 (2.6)
Median; range	6; 0–10
Low social support [n(%)]	1,440 (47.0)
High social support [n(%)]	1,288 (42.0)
Missing [n(%)]	338 (11.0)
Settlement type [n(%)]	
Towns	2,336 (76.2)
Villages	730 (23.8)
Household crowding and composition	
Size (adults + children)	
Mean (SD)	3.4 (2.1)
Median; range	3; 1–18
Missing [n(%)]	15 (0.5)
Number of children per household (for participants in households with children, 52 %)	
Mean (SD)	2.1 (1.3)
Median; range	2; 1–11
Missing [n(%)]	2 (0.1)
Crowding (person per room)	
Mean (SD)	0.9 (0.5)
Median; range	0.8; 0.1–4.7
Missing [n(%)]	21 (0.7)
Household composition [n(%)]	
Households with children	1,590 (51.9)
Households with one adult	428 (14.0)
Households with ≥ 2 adults	1,037 (33.8)
Missing [n(%)]	11 (0.4)

Results

Descriptive statistics of the study sample appears in Table 1. About 30 % of respondents reported having felt anxious, depressed and binge drinking. More women (56 %) than men participated in the study and 53 % of the sample was younger than 45 years. Household size ranged from 1 to 18 individuals, with a median of 3 people per house. About half of respondents lived in households with children, with an average of 2.1 children. There was an average of 0.9 PPR, but this significantly varied between towns (0.8 PPR) and villages (1.2) ($p < 0.001$; results not tabulated).

Psychosocial health, household crowding and composition

Results of associations between psychosocial health outcomes and household crowding and composition, for the full sample and adjusted for individual characteristics (but not social support), are presented in Table 2. Predicted probabilities (and confidence intervals) for these outcomes by increasing values of PPR are plotted in Fig. 1. Increasing levels of crowding are significantly associated with higher odds of reporting feeling depressed. Conversely, higher crowding is significantly associated with lower odds of binge drinking.

Considering the composition of the household offers some explanations for the counterintuitive association observed between household crowding and binge drinking. Compared to households composed of adults and children, the risk of reporting binge drinking is significantly higher in adult-only households. Respondents living in households with two or more cohabiting adults without children have almost twice the risk of reporting binge drinking compared to those living with children. Household crowding and composition were not significantly associated with feeling anxious. Replicating these analyses on a subsample with only one respondent per household yielded similar results ("Appendix 1").

Modification by sex and settlement type

The association between housing conditions and psychosocial health was not modified by settlement type. However, effects were significantly modified by sex. Living in more crowded dwellings is associated with greater odds of feeling depressed (OR 1.41; 95 % CI 1.11–1.78) and lower odds of binge drinking (OR 0.69; 95 % CI 0.50–0.97) among women compared to men (results not tabulated). Stratification by sex (Table 3) shows that higher household crowding is significantly associated with greater odds of reporting feeling depressed among women, but not among men. Compared to women living in households with children, those living alone are less likely to report feeling depressed. Although women living in more densely populated household are, on the whole, significantly less likely to engage in binge drinking, women living on their own or cohabiting with other adults are more than twice as likely to engage in binge drinking compared to women living with children. A similar pattern is observed for men, with the odds of binge drinking being 61 % higher among men cohabiting with other adults. Similar results were obtained when these analyses were conducted on a subsample with only one respondent per household ("Appendix 2").

Mediation by social support

The next set of analysis examines the role of social support as a mediator of the association between household crowding and feeling depressed only, as social support was not significantly associated with binge drinking (OR 0.94; 95 % CI 0.79–1.14; results not tabulated). Results are presented in Fig. 2a for the full sample and Fig. 2b for women. As reported in the top part of Fig. 2a, the direct effect of higher household crowding on feeling depressed is statistically significant. Yet, this association appears to be mediated by social support (bottom part of Fig. 2a). Higher household crowding is associated with lower odds of having good social support (OR 0.70; 95 % CI 0.59–0.83). In turn having good social support is associated with lower odds of feeling depressed (OR 0.61; 95 % CI 0.51–0.73). This indirect effect of household crowding on mental well-being through reduced social support is small, though statistically significant (coeff 0.015; 95 % CI 0.007–0.025). The direct effect of crowding on mental well-being remains marginally significant ($p < 0.10$). Among women, (Fig. 2b) social support also mediates the association between household crowding and feeling depressed, though the direct effect of household crowding remains statistically significant ($p < 0.01$). Sensitivity analysis conducted on a subsample with only one respondent per household shows similar (though stronger) results ("Appendix 3").

Discussion

The objective of this study was to examine whether household crowding is associated with psychosocial health among Greenlanders, and whether social support mediates this association. We also assessed whether men and women are differently influenced by their housing conditions.

Findings showed significant psychosocial health inequalities associated with household crowding among Greenlanders. As reported elsewhere (Evans et al. 2003),

Table 2 Results of associations between psychosocial outcomes and (a) household crowding and (b) household composition, adjusted for individual characteristics (Inuit health in transition Greenland survey, 2005–2010)

	Feeling anxious		Feeling depressed		Binge drinking	
	OR	(95 % CI)	OR	(95 % CI)	OR	(95 % CI)
(a) Household crowding	(n = 3,006)		(n = 2,998)		(n = 2,425)	
Number of person per room	1.10	(0.93–1.31)	1.22	(1.03–1.43)*	0.65	(0.48–0.88)**
Sex						
Men	1.00		1.00		1.00	
Women	2.17	(1.89–2.50)***	2.02	(1.66–2.47)***	0.59	(0.51–0.68)***
Age	0.99	(0.99–0.99)***	0.99	(0.98–1.00)**	0.98	(0.98–0.99)**
Household wealth	0.97	(0.91–1.04)	0.85	(0.80–0.90)***	0.78	(0.72–0.84)***
Marital status						
Not in a relationship	1.00		1.00		1.00	
In a relationship	1.13	(0.96–1.34)	0.97	(0.82–1.14)	0.78	(0.62–0.99)*
Settlement type						
Town	1.00		1.00		1.00	
Village	1.36	(0.96–1.92)†	0.96	(0.55–1.68)	0.82	(0.42–1.60)
(b) Household composition	(n = 3,013)		(n = 3,005)		(n = 2,433)	
Households with children	1.00		1.00		1.00	
Households with one adult	0.89	(0.65–1.21)	0.78	(0.54–1.12)	1.64	(1.12–2.40)*
Households with ≥2 adults	0.88	(0.69–1.12)	0.82	(0.66–1.02)†	1.90	(1.52–2.37)***
Sex						
Men	1.00		1.00		1.00	
Women	2.16	(1.88–2.49)***	1.99	(1.63–2.43)***	0.62	(0.53–0.71)***
Age	0.99	(0.99–0.99)***	0.99	(0.98–1.00)*	0.98	(0.97–0.99)***
Household wealth	0.97	(0.90–1.04)	0.84	(0.78–0.89)***	0.80	(0.74–0.87)***
Marital status						
Not in a relationship	1.00		1.00		1.00	
In a relationship	1.14	(0.93–1.39)	0.97	(0.80–1.18)	0.75	(0.61–0.92)**
Settlement type						
Town	1.00		1.00		1.00	
Village	1.38	(0.96–1.99)†	1.00	(0.57–1.75)	0.77	(0.40–1.48)

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; † <0.10

poorer mental well-being was observed among people living in more crowded households, independent of individual characteristics. Perhaps counterintuitive, findings demonstrated that higher household crowding was significantly associated with lower risk of binge drinking. These results were explained when household composition was considered. Indeed, binge drinking among both men and women were more likely in houses with cohabiting adults without children. Multigenerational living is common among Inuit families. Cohabiting adults, who also live with their parents or parents-in-law, can create a variety of stressful constraints influencing psychosocial health.

Although household crowding was, overall, higher among participants living in villages compared to towns, the deleterious effect of crowding on psychosocial health did not significantly vary by settlement type. Yet, the effect of crowding was more important for women's than for men's health. In line with previous studies (Regoeczi 2008), women did express different responses to crowding stress than men, with women living in more crowded households being more likely to report having felt depressed. Gender stratification, roles and division of labor in the house could explain these results. As women's social roles still relate to domestic labor and emotional work, an elevated level of felt demands in more densely populated households could lead to a lower sense of control, resulting in symptoms of depression and anxiety (Griffin et al. 2002; Regoeczi 2008). Other studies in Greenland indicate that women in general, but also women with small children, might be especially vulnerable to the deleterious effects of crowded living. A report from the national program for early intervention in pregnant families in Greenland

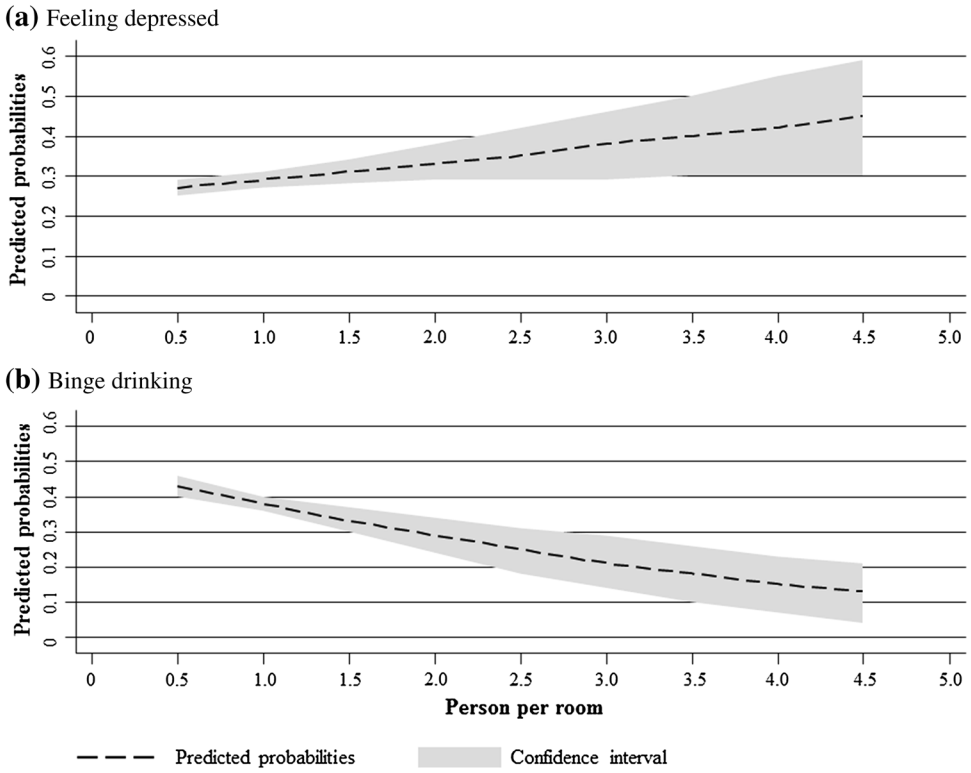

Fig. 1 Predicted probabilities (and confidence intervals) of the association between household crowding (Inuit health in transition Greenland survey, 2005–2010)

showed that most families struggled with inadequate housing and one out of two families were without a home or forced to live with friends and family (PAARISA 2011). More research is needed to investigate potential gender differences in response to crowding stress and applied coping strategies, using other psychosocial health indicators that might be more prevalent among men, e.g., withdrawal, violent behavior.

This study provides a first view of the potential role of social support as a mediating mechanism through which household crowding influences psychosocial health among Inuit populations. It has been suggested that poor housing conditions, such as crowding, may disrupt/erode social support networks and/or lead occupants to socially withdraw as a way of coping with the situation (Gove and Hughes 1983; Lepore et al. 1991) or because they are embarrassed by their living conditions (feel that their home is too small, poorly maintained, or otherwise inadequate for entertaining) (Wells and Harris 2007). In our study, household crowding was significantly associated with lower social support, especially among women, whereas social support was significantly associated with better mental well-being. These results suggest that fostering social support may buffer, to some extent, the deleterious effect of poor housing conditions.

It has been hypothesized that overcrowding might influence health through processes such as control, identity, and stress. These processes might be especially relevant to understand the crowding and health association among Indigenous populations, within a historical context of sedentarization and government housing provision. Historically and still today, houses built in the Arctic are most often designed by non-Inuit, are small but accommodate large households, all to meet with State's concern to strike a balance between comfort and costs for construction and maintenance. House design in the Arctic has been criticized for not being aligned with, and conducive to, Inuit culture (Dawson 2006). This situation may influence psychosocial processes such as identity, self-esteem, self-efficacy (Dunn 2002; Evans et al. 2003; Kearns et al. 2011) with consequences for mental well-being. In Greenland and Canada, Inuit populations mostly live in social housing units rented from the municipality or government, thus limiting the choice and control one has over their home environment, two important processes linking housing conditions to health (Dunn 2002; Kearns et al. 2011). More research is needed to understand pathways through which housing conditions might influence Inuit, and more broadly, Indigenous peoples' health.

Limitations

Although indicators of mental well-being in this study were previously associated with common mental disorders as defined by the General Health Questionnaire (Lynge et al. 2003), these are not standardized measures of anxiety and

Table 3 Sex-stratified associations between psychosocial outcomes and (a) household crowding and (b) household composition (separate models), adjusted for individual characteristics (Inuit health in transition Greenland survey, 2005–2010)

	Feeling depressed		Binge drinking	
	OR	(95 % CI)	OR	(95 % CI)
Men				
(a) Household crowding	(n = 1,321)		(n = 1,116)	
Number of person per room	0.97	(0.74–1.26)	0.77	(0.53–1.12)
(b) Household composition	(n = 1,323)		(n = 1,119)	
Households with children	1.00		1.00	
Households with one adult	1.26	(0.78–2.10)	1.32	(0.74–2.34)
Households with ≥2 adults	0.76	(0.56–1.03)†	1.61	(1.22–2.13)**
Women				
(a) Household crowding	(n = 1,677)		(n = 1,309)	
Number of person per room	1.43	(1.20–1.70)***	0.54	(0.36–0.80)**
(b) Household composition	(n = 1,682)		(n = 1,314)	
Households with children	1.00		1.00	
Households with one adult	0.51	(0.37–0.72)***	1.96	(1.19–3.24)*
Households with ≥2 adults	0.86	(0.69–1.08)	2.14	(1.44–3.19)**

Models are adjusted for age, marital status, household assets and settlement type

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, † <0.10

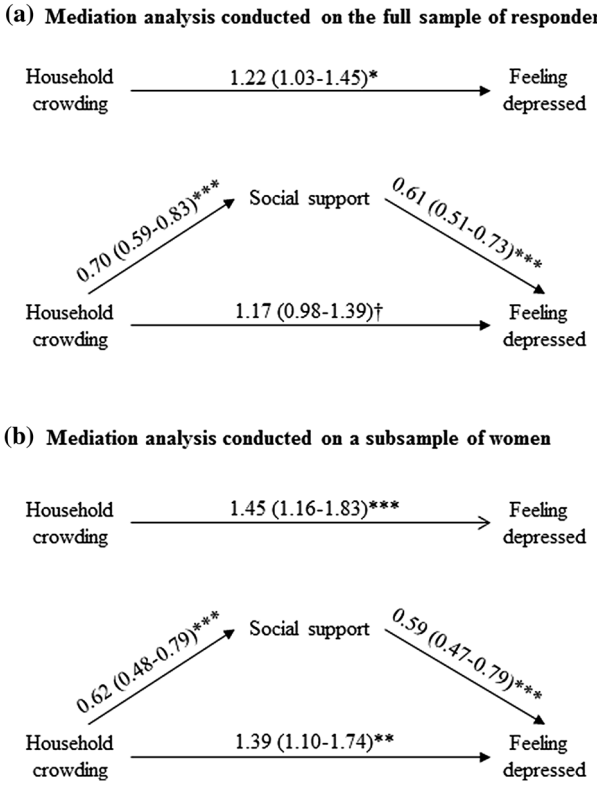

Fig. 2 Examining social support as a mediator of the association between household crowding and feeling depressed, adjusted for individual characteristics (Inuit health in transition Greenland survey, 2005–2010); odds ratios (95 % CI) models are adjusted for age, sex, marital status, household assets, and settlement type. ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, †<0.10

depression, and should not be interpreted as such. Nonetheless, these variables are indicative of perceived mental well-being of the participants and are similar to single-item measurement used elsewhere in housing and health research (Dunn 2002). Long-term effect of social and cultural trauma(s) is also likely to play a part in explaining inequalities in psychosocial health (Bjerregaard and Curtis 2002), but these were not examined in the context of this study.

Because of the cross-sectional design, this study does not allow the assessment of the temporality of events linking household crowding to social support to psychosocial health. Relatedly, 'health selection' cannot be ruled out, i.e., whether living in crowded dwellings leads, over time, to poorer psychosocial health, or whether 'sick' individuals are more likely to move into poor housing. In Greenland the housing shortage and the large proportion of subsidized housing market reduce the likelihood of health selection processes as there may be no alternative dwellings to move to.

The cultural relevance of indicators such as the PPR has been criticized to measure residential crowding in the Arctic (Lauster and Tester 2010) and more largely in Indigenous context (Memmott et al. 2011). Although it has been suggested that subjective experience of crowding might be a more culturally appropriate indicator (Lauster and Tester 2010; Memmott et al. 2011), studies have yet to empirically examine the associations between alternative measures of household crowding and health outcomes.

More research is needed to conceptualize, operationalize and validate measures of household crowding in coherence with the Inuit culture, and with Indigenous cultures more broadly to inform population health research, but also housing assessments and interventions.

Conclusion

This study contributes to the limited knowledge on the impacts of housing conditions, including crowding, on Inuit psychosocial health. Results suggest that exposure to crowded living conditions may contribute to explaining the high prevalence of mental symptoms and comorbid behaviors among Inuit, and especially among Inuit women. Findings also indicate that having a strong social network may buffer the deleterious impacts of household crowding. Targeting housing conditions and fostering social support as part of a wider public health strategy might be a key in improving psychosocial health and well-being in Greenland. Such initiatives would require cross-sectorial coordination within and between administrations and governments. Health promotion actions might also be more effective if targeting groups of people distinguished by their living conditions, e.g., cohabiting adults without children or single women with dependent children, as these groups might be more vulnerable to inadequate housing conditions.

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References

Australian Government Department of Families Housing Community Services and Indigenous Affairs (2013) Footprints in time: the longitudinal study of Indigenous children. Report from Wave 4. Available at: http://www.dss.gov.au/our-responsibilities/Indigenous-australians/publications-articles/families-children/footprints-in-time-the-longitudinal-study-of-Indigenous-children-lsic/key-summary-report-from-wave-4

Bailie RS, Wayte KJ (2006) Housing and health in Indigenous communities: key issues for housing and health improvement in remote Aboriginal and Torres Strait Islander communities. Aust J Rural Health 14:178–183

Banerji A, Greenberg D, White L, Macdonald W, Saxton A, Thomas E et al (2009) Risk factors and viruses associated with hospitalization due to lower respiratory tract infections in Canadian Inuit children : a case–control study. Pediatr Infect Dis J 28:1–5

Bjerregaard P (2010) Inuit health in transition—Greenland survey 2005–2009. Population sample and survey methods. http://www.si-folkesundhed.dk/upload/metoderapport_endelig.pdf. Accessed 2 Sep 2014

Bjerregaard P, Curtis T (2002) Cultural change and mental health in Greenland: the association of childhood conditions, language, and urbanization with mental health and suicidal thoughts among the Inuit of Greenland. Soc Sci Med 54:33–48

Bjerregaard P, Dahl-Petersen I (2008) Befolkningsundersøgelsen i Grønland 2005–2007 (Population health survey in Greenland 2005–2007. In Danish). National Institute of Public health, Writings on Greenland, Copenhagen

Bjerregaard P, Stensgaard T (2008) Greenland. In: Young TK, Bjerregaard P (eds) Health transitions in Arctic populations University of Toronto Press. Canada, Toronto, pp 23–38

Bjerregaard P, Berner J, Odland JO (2008) Environment and living conditions. In: Young TK, Bjerregaard P (eds) Health transitions in Arctic populations University of Toronto Press. Canada, Toronto, pp 23–38

Clark M, Riben P, Nowgesic E (2002) The association of housing density, isolation and tuberculosis in Canadian First Nations communities. Int J Epidemiol 31:940–943

Cohen S, Syme LS (eds) (1985) Social support and health. Academic Press, San Diego

Dawson PC (2006) Seeing like an Inuit family: the relationship between house form and culture in northern Canada. Inuit Studies 30:113–135

Dunn JR (2002) Housing and inequalities in health: a study of socioeconomic dimensions of housing and self reported health from a survey of Vancouver residents. J Epidemiol Community Health 56:671–681

Evans GW (1979) Behavioral and physiological consequences of crowding in humans. Appl Soc Psychol 9:27–46

Evans GW, Wells NM, Moch A (2003) Housing and mental health: a review of the evidence and a methodological and conceptual critique. J Social Issues 59:475–500

Gabe J, Williams P (1986) Is space bad for your health? The relationship between crowding in the home and emotional distress in women. Sociol Health Ill 8:351–371

Goldberg DP, Williams P (1988) The user's guide to the General Health Questionnaire, 1st edn. Windsor, United Kingdom

Gove WR, Hughes M (1983) Overcrowding in the household: an analysis of determinants and effects. Academic Press, New York

Gracey M, King M (2009) Indigenous health part 1: determinants and disease patterns. Lancet 374:65–75

Griffin J, Fuhrer R, Stansfeld S, Marmot M (2002) The importance of low control at work and home on depression and anxiety: do these effects vary by gender and social class? Soc Sci Med 54:738–798

Hansen KG, Bitsch S, Zalkind L (2013) Urbanization and the role of housing in the present development process in the Arctic. Nordic Center for Spatial Development, Stockholm, Sweden. Available at: http://www.nordregio.se/en/Publications/Publications-2013/Urbanization-and-the-role-of-housing-in-the-present-development-process-in-the-Arctic/

Healey GK, Meadows LM (2007) Inuit women's health in Nunavut, Canada: a review of the literature. Int J Circumpolar Health 66:199–214

Kearns A, Whitley E, Mason P, Petticrew M, Hoy C (2011) Material and meaningful homes: mental health impacts and psychosocial benefits of rehousing to new dwellings. Int J Public Health 56:597–607

Kirmayer LJ, Guthrie Valaskakis G (eds) (2009) Healing traditions. The mental health of aboriginal peoples in Canada. UBC Press, Vancouver

Koch A, Sorensen P, Homoe P, Mølbak K, Pedersen FK, Mortensen T et al (2002) Population-based study of acute respiratory infections in children, Greenland. Emerg Infect Dis 8:586–593

Kovesi T, Gilbert N, Stocco C, Fugler D, Dales R, Guay M et al (2007) Indoor air quality and the risk of lower respiratory tract infections in young Canadian Inuit children. CMAJ 177:155–160

Larcombe L, Nickerson P, Singer M, Robson R, Dantouze J, McKay L et al (2011) Housing conditions in 2 Canadian first nations communities. Int J Circumpolar Health 70:141–153

Lauster N, Tester F (2010) Culture as a problem in linking material inequality to health: on residential crowding in the Arctic. Health Place 16:523–530

Lear SA, Teo K, Gasevic D, Zhang X, Poirier PP, Rangarajan S et al (2014) The association between ownership of common household devices and obesity and diabetes in high, middle and low income countries. CMAJ 186:258–266

Lepore S, Evans G, Schneider M (1991) Dynamic role of social support in the link between chronic stress and psychological distress. J Pers Soc Psychol 61:899–909

Lynge I, Munk-Jørgensen P, Pedersen A, Mulvad G, Bjerregaard P (2003) Psykisk helbred hos patienter i Grønlands sundhedsvæsen (Mental health among patients in Greenland. In Danish). National Institute of Public Health, Copenhagen

MacKinnon DP, Dwyer JH (1993) Estimating mediated effects in prevention studies. Eval Rev 17:144–158

Memmott P, Birdsall-Jones C, Go-Sam C, Greenop K, Vanessa Corunna V (2011) Modelling crowding in Aboriginal Australia. Australian Housing and Urban Research Institute. Queensland Research Centre and Western Australia Research Centre. AHURI Positioning Paper No. 141

Minich K, Saudny H, Lennie C, Wood M, Williamson-Bathory L, Cao Z et al (2011) Inuit housing and homelessness: results from the international polar year Inuit health survey 2007–2008. Int J Circumpolar Health 70:520–531

PAARISA (2011) Mid-term evaluation and status report 2010. Evaluation report for 'Early intervention in pregnant families' (Danish only). Government of Greenland. Available at: http://www.paarisa.gl/media/18450/midtvejsevaluering_2010_tidlig_indsats.pdf. Accessed 2 Sep 2014

Regoeczi WC (2008) Crowding in context: an examination of the differential responses of men and women to high-density living environments. J Health Soc Behav 49:254–268

Richmond CAM (2009) The social determinants of Inuit health: a focus on social support in the Canadian Arctic. Int J Circumpolar Health 68:471–487

Richmond CAM, Ross NA, Egeland GM (2007) Social support and thriving health: a new approach to understanding the health of Indigenous Canadians. Am J Public Health 97:1827–1833

Riva M, Plusquellec P, Juster RP, Laouan-Sidi EA, Abdous B, Lucas M et al (2014) Household crowding is associated with higher allostatic load among Inuit. J Epidemiol Community Health 68:363–369

Shepherd CC, Li J, Mitrou F, Zubrick SR (2012) Socioeconomic disparities in the mental health of Indigenous children in Western Australia. BMC Public Health 12:756

Siegrist J, Marmot M (2004) Health inequalities and the psychosocial environment-two scientific challenges. Soc Sci Med 58:1463–1473

Søborg B, Andersen AB, Melbye M, Wohlfahrt J, Andersson M, Biggar RJ et al (2011) Risk factors for Mycobacterium tuberculosis infection among children in Greenland. Bull World Health Org 89:741–748

StataCorp (2010) Stata/SE 11.0 for Windows. College station, TX, USA

Statistics Greenland (2013) Greenland in figures 2013. Statistics Greenland. Available at: http://www.nordregio.se/en/Publications/Publications-2011/Megatrends/

Stern P (2005) Wage labor, housing policy, and the nucleation of Inuit households. Arctic Anthropology 42:66–81

Waldram JB, Herring DA, Young TK (2006) Aboriginal health in Canada: historical, cultural, and epidemiological perspectives, 2nd edn. University of Toronto Press, Toronto

Wechsler H, Nelson T (2001) Binge drinking and the American college student: what's five drinks? Psychol Addict Behav 15:287–291

Wells NM, Harris JD (2007) Housing quality, psychological distress, and the mediating role of social withdrawal: a longitudinal study of low-income women. J Environ Psychol 27:69–78

Young TK, Bjerregaard P (2008) Health transitions in Arctic populations. University of Toronto Press, Toronto