

ORIGINAL ARTICLE

The effect of household crowding and composition on health in an Inuit cohort in Greenland

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Abstract

Aims: This study aims to investigate the association between household crowding and household composition and self-rated health and mental health (GHQ scale) among the Inuit in Greenland. Poor housing conditions are a concern in Greenland, especially in the villages, where socioeconomic standards in general are lower. **Methods:** A cohort of 1282 adults participated in two population-based surveys in Greenland, the Inuit Health in Transition survey 2005–2010 (baseline) and The Health Survey in Greenland 2014 (follow-up). Associations between household conditions at baseline and health outcomes at follow-up (poor self-rated health and mental health measured by the GHQ scale) were examined using logistic regression models, adjusting for covariates at baseline. **Results:** Participants living in an overcrowded dwelling (more than one person per room) at baseline were more likely to report poor self-rated health at follow-up (OR 1.47; 95% CI 1.09; 1.99) compared with those not living in an overcrowded dwelling. In addition, participants who lived alone at baseline were more likely (OR 1.98; 95% CI 1.09; 3.58) to experience poor mental health at follow-up compared with those who lived with children. **Conclusions: Results indicate that household conditions are related to health in Greenland. Public health authorities should work to ensure affordable housing of good quality in all communities.**

Keywords: *Indigenous health, crowding, household composition, self-rated health, mental health, Greenland*

Background

In 2018, the World Health Organization (WHO) has identified the improvement of poor housing conditions as required to reduce health risks in the home, both in developing and in developed countries [1]. Across the circumpolar North, the prevalence of household overcrowding is generally high. In Greenland large households have, historically, been accommodated in small dwellings. But despite improvements in dwelling size and quality over time, poor housing conditions and especially overcrowding remain a public health concern [2].

Most studies concerning household crowding and health among the Inuit in Greenland have focused on respiratory diseases, as shared physical proximity is

associated with the spread of infectious and chronic respiratory diseases [3]. Household overcrowding has been associated with increased prevalence of tuberculosis, especially among children. The prevalence of lower respiratory tract infections (LRTI) and hospitalizations due to LRTI are higher among Inuit infants and children living in more crowded households [4]. In other Indigenous populations, overcrowding has been associated with other measures of health. Among Inuit and First Nation children in Canada, household overcrowding was found to be associated with poor parent-rated child health [5,6]. A recent study conducted in Nunavik and Nunavut, Canada, shows that rehousing, that is, relocating to a newly built social housing unit, is associated with

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reduction in psychological distress and perceived stress in daily life 15 to 18 months after the move. There was no change in self-rated health. Perceived control over one's life, significantly improved after the move [7]. Similar associations between household overcrowding and general measures of health have not, to our knowledge been investigated recently among Inuit in Greenland.

In several international studies, household overcrowding has been associated with poor mental health and is often described as a stressor, eliciting poor mental health responses [8]. Living in an overcrowded household has been associated with poor mental wellness among Inuit youth and poor physical and poor mental health among Inuit children before adjustments for sociodemographic and socioeconomic factors [5]. A single cross-sectional study investigated the association between household overcrowding and well-being among Greenlandic Inuit; results showed that the risk of reporting depressive symptoms was higher among participants living in crowded households [2].

The above-mentioned studies have all been cross-sectional; few have investigated the association in a longitudinal study design. A study among 11,500 households in New Zealand examined the impact of housing factors (household tenure, household crowding and housing affordability) on psychological distress cross-sectionally and longitudinally. They found a strong cross-sectional association, but the longitudinal analysis showed little or no effect. A recent study among Inuit adolescents in Nunavik investigated the association between household overcrowding in childhood and psychological distress in adolescents; the results showed no longitudinal or cross-sectional effect [9]. Possible explanations for these non-conclusive results include the unknown duration of the exposure, as the durations of living in poor housing conditions have shown to affect health [10], and the absence of adjustment for household composition which has been identified as an important risk factor for health. Indeed, a study among young Sami in Sweden found elevated odds of feeling healthy, sleeping well and feeling calm among persons who lived with others, while the odds of having negative feelings such as worries and sadness was twice as high among persons who lived alone [11]. The composition of the household may also be important to consider as the effect of overcrowding might vary between sex and age group [2,12].

Knowledge about the impact of housing conditions on self-rated health (SRH) and mental health among the Inuit in Greenland is limited. Previous studies in the population are cross-sectional and

recommend the association to be further investigated in a longitudinal study design. There is a direct call for more research on the effect of household crowding and mental health, especially for Indigenous populations where the prevalence of overcrowding and psychological distress are high [1].

Aims

The objective of this study is to investigate the association between household crowding and household composition and SRH and mental health among an Inuit cohort in Greenland.

We hypothesize, based on previous findings in the population, that living in an overcrowded dwelling in 2005–10 is associated with poor mental health and poor SRH in 2014. In addition, it is expected that living alone in 2005–2010 is associated with both poor mental health and poor SRH in 2014.

Methods

Greenland

Greenland, or Kalaallit Nunaat 'Land of the Greenlandic People', has a population of 56,081, of whom 90% are ethnic Greenlanders (Inuit). Most of the population (87%) live in towns, whereas 12% in villages and about 1% in smaller settlements [13]. Greenland was under Danish colonial rule, a process which started in 1721 and ended in 1953. Home Rule was instated in 1979, and Self Government in 2009.

During the post-colonial years, profound changes took place in Greenland and modern houses with running water and bathrooms were built to replace the traditional stone-and-turf houses [14]. Although housing conditions have improved, they still vary; housing conditions are a health concern especially in villages, where conditions are poorest [15]. In the 1990s, housing surveys showed that 50% of people living in towns and 72% of people in villages complained about cold dwellings and especially cold floors. Furthermore, 20% of all houses in villages were in need of major repairs, and 20% were beyond repair [15,16]. To our knowledge, more recent housing surveys have not been conducted in Greenland.

Sample

A cohort of 1282 Inuit adults (≥ 18 years old) was constructed based on two population surveys, the Inuit Health in Transition survey 2005–2010 (IHIT) [17] (baseline) and the Health Survey in Greenland 2014 (B2014) [18] (follow-up). Cohort participants

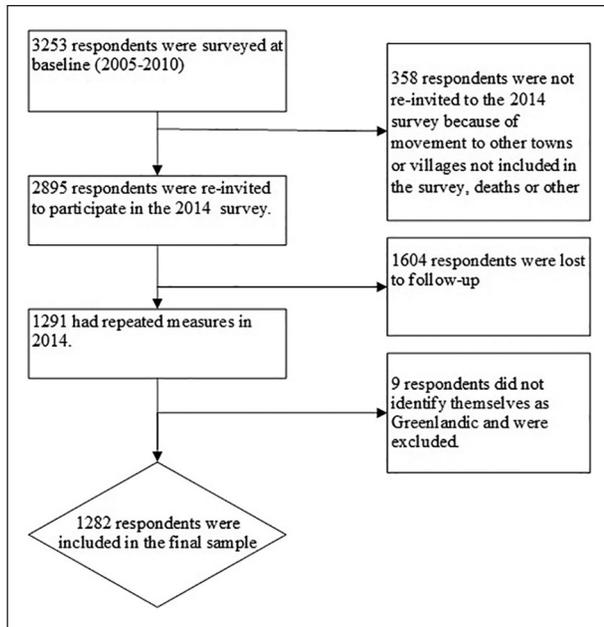


Figure 1. Cohort inclusion process between baseline (Inuit health in transition Greenland survey, 2005–10) and follow-up (The Health Survey in Greenland, 2014).

took part in both surveys, lived in Greenland at the time of the surveys, and were born in either Greenland or Denmark. Participants were included in the cohort if they identified themselves as Greenlandic in either survey. The cohort inclusion process is shown in Figure 1.

Baseline data: The Inuit Health in Transition survey

The IHIT survey is a cross-sectional population-based survey conducted from 2005 to 2010 among Inuit in Greenland. A full description of the study is available elsewhere [17]. Survey participants were recruited through a stratified random sampling of adults (≥ 18 years). Greenland was divided into strata based on geography and community size. In each stratum or region, several towns and villages were selected as being representative of the region regarding living conditions. In each town, a random sample of 11–22% of the adult population was drawn from the central population register to obtain around 300 participants. In the selected villages, all adults were invited to participate [17]. A total 3253 persons from 22 communities participated in the survey for a participation rate of 68%. Nine percent of the adults living in Greenland were included in the IHIT survey [17].

Two survey questionnaires were used for data collection: (1) an interviewer-administered questionnaire and (2) a self-administered questionnaire containing sensitive questions about suicide, alcohol and marijuana consumption, sexual abuse, and

gambling [17]. Interviews were administered in Greenlandic or Danish and were conducted by native Greenlandic-speaking interviewers.

Follow-up data: The Health Survey in Greenland 2014

The Health Survey in Greenland 2014 (B2014) is a cross-sectional population-based survey conducted in 2014. A full description of the study is available elsewhere [18]. The survey was designed as a follow-up of the IHIT survey and included participants from previous population-based surveys in Greenland (1993–94, 1999–2001, 2005–2010) and a new randomly drawn sample from the central person register of individuals between 18–25 years old. For logistic reasons, settlements and towns with an expected number of participants of fewer than 25 in settlements and fewer than 60 in towns were excluded from the overall sample. Data were collected similarly to the IHIT survey protocol. A total of 2102 people participated (participation rate of 63%), of whom 1862 (89%) answered the self-administrated questionnaire [18]. Thus out of the 3253 persons who participated in the IHIT survey and the 2102 persons who participated in the B2014 survey, a total of 1282 persons made up the cohort because they participated in both surveys (Figure 1).

Ethics

Both surveys were approved by the Scientific Ethics Committee in Greenland. All participants were informed orally about the content and process of the survey and signed an informed consent form [17,18].

Health outcomes

SRH was assessed by asking respondents at both times: ‘In general would you say your health is?’. SRH was analysed as a dichotomous measure contrasting those reporting very good or good health, versus those reporting moderate, bad or very bad health [18].

In 2014, mental health was assessed using the 12-item General Health Questionnaire (GHQ) in the self-administered survey. The GHQ is a self-administered screening tool designed to detect current mental disturbances and disorders [19]. At follow-up participants reported the frequency of having felt 12 feelings such as useful, unhappiness and worthlessness in the two preceding weeks. Each of the 12 items was rated on a four-point scale (less than usual, no more than usual, rather more than usual, or much more than usual). A score of 1 was attributed to reports of experiencing negative symptoms rather

more than usual or much more than usual and experiencing positive symptoms less than usual or no more than usual, creating a scale ranging from 0–12. The GHQ scale was analysed as a dichotomous measure; a cut-off at ≥ 3 identifies individuals with poor mental health.

Overcrowding and household composition

Household overcrowding was measured as the number of persons per room (PPR), the ratio between the number of persons to the number of rooms in the dwelling. At baseline, respondents reported the number of persons (adults + children) living in the dwelling and the number of rooms (all rooms except the kitchen, bathroom and entrance hall). However, in other studies in Arctic regions, the number of rooms also counts the kitchen. An extra room was therefore added to the room count, to make the indicator comparable with these other studies [2,20].

Because of ongoing debate on the measure of overcrowding in Indigenous populations [21], different variables for overcrowding were included in the analyses. The PPR measure was included in the analyses as a continuous and as a dichotomous variable. The dichotomous variable contrasts participants living in a dwelling with more than one person per room, and hence deemed overcrowded, to those who were not. The number of persons in the household (adults + children) were also included in the analysis as a measure of household size.

The composition of the household was included separately as living arrangements might influence health [2,11]. Household composition was included as a categorical variable with three levels: households with children, adult-only households, and single-person households.

Covariates

Covariates were all defined in 2005–10. Information about sex and age was derived from the participant's civil registration number.

Research has shown that a continuous measure of ownership of household items is a good proxy for socioeconomic position in Greenland [22]. Respondents were asked about ownership of any of the following items: video/DVD player, computer, phone (landline), refrigerator, microwave, washing machine or dishwasher. 'Household assets' was calculated as the sum of these items.

The GHQ scale was not included in the IHIT survey questionnaire. Alternatively, participants reported whether they had been bothered in the 2 weeks preceding the interview by: (a) anxiety, nervousness, agitation or fear; or (b) feeling depressed or unhappy. A

categorical variable was constructed to reflect the participants' mental health status at baseline with three levels: "no anxiety or depressive symptoms", "have been bothered by symptoms of anxiety and/or depression" or "have been bothered a lot by symptoms of anxiety and/or depression".

As the IHIT survey stretches over 5 years (2005–2010), and time to follow-up may vary for each participant, the regression models are adjusted for time to follow-up (linearly). Time to follow-up was derived through information about individual survey dates.

Statistical analysis

Descriptive statistics are presented for the full sample. Associations between housing conditions and each health outcome were tested in separate logistic regression models for each main exposure variables and adjusted for covariates (identified via Directed Acyclic Graphs (DAGs), see Supplemental Materials) and time to follow-up. The DAGs represent the assumed causal pathways between housing conditions and, respectively, SRH and mental health. Health at baseline is included in the analysis as a confounder as it is unclear whether the effect of housing conditions on health at baseline are in fact reversely causal. Analyses were conducted on a subsample of data without missing information on individual covariates, the sample therefore varies by health outcome. In the logistic model comparing participants living in an overcrowded dwelling versus participants not living in an overcrowded dwelling at baseline, participants who were living alone at baseline were excluded from the analyses to make the two groups more comparable and avoid confounding bias (as health of those living alone, and therefore not living in overcrowded conditions, might be different from those who are not living alone due to the loss of a spouse, divorce, etc.).

To investigate possible non-random selection into the cohort, baseline characteristics between those included in the cohort were compared with those lost to follow-up.

In 2014, 20% of the participants were living in the same household. To adjust for this clustering, the standard errors were clustered in households. Household clusters were identified using the participant's house number, derived through information about the participant's address. All statistical analyses were performed using the software Stata SE version 14.0 [23].

Results

Descriptive statistics of the participants at baseline and follow-up are shown in Table I. Almost half of the population (41%) reported poor SRH in 2014;

Table I. Characteristics of the 1282 participants at baseline (Inuit health in transition survey, 2005–10) and follow-up (The Health Survey in Greenland, 2014).

Individual Characteristics	Baseline (2005-10)	Follow-up (2014)	<i>p</i> -values ^a
<i>Self-rated health [n (%)]</i>			<0.001
Good	847 (66.1)	732 (57.1)	
Poor	433 (33.7)	531 (41.4)	
Missing [<i>n</i> (%)]	2 (0.2)	19 (1.5)	
<i>Mental health (GHQ) [n (%)]</i>			
Good mental health (GHQ <3)		806 (62.9)	
Poor mental health (GHQ ≥3)		192 (15.0)	
Missing [<i>n</i> (%)]		284 (22.1)	
<i>Mental health [n (%)]</i>			<0.001
No anxiety or depressive symptoms	683 (53.3)	792 (61.8)	
Have been bothered by symptom of anxiety and/or depression	537 (41.9)	399 (31.2)	
Have been severely bothered by symptom of anxiety and/or depression	62 (4.8)	91 (7.0)	
<i>Sex [n (%)]</i>			
Men	480 (37.4)		
Women	802 (62.6)		
<i>Age</i>			<0.001
Mean (SD)	42.9 (12.9)	50.5 (13.0)	
Median; range	43; 18–89	50; 23–97	
Household characteristics			
<i>Region [n (%)]</i>			<0.001
South	233 (18.2)	226 (17.6)	
Central	421 (32.8)	462 (36.0)	
North	437 (34.1)	417 (32.5)	
East	183 (14.3)	177 (13.8)	
Avanersuaq	8 (0.6)	-	
<i>Community type [n (%)]</i>			<0.001
Village	279 (21.8)	226 (17.6)	
Town	785 (61.2)	783 (61.1)	
Nuuk	218 (17.0)	273 (21.3)	
<i>Household assets</i>			<0.001
Mean (SD)	4.5(1.7)	4.7 (1.7)	
Median; range	5; 0–7	5; 0–7	
Missing [<i>n</i> (%)]	6 (0.47)	19 (1.5)	
<i>Household size (adults + children)</i>			<0.001
Mean (SD)	3.6 (2.2)	3.2 (1.8)	
Median; range	3; 1–18	3; 1–11	
Missing [<i>n</i> (%)]	5 (0.4)	26 (2.0)	
<i>Number of persons per room</i>			<0.001
Mean (SD)	0.9 (0.6)	0.8 (0.4)	
Median; range	0.8; 0.1–4.5	0.7; 0.1–4.5	
Missing [<i>n</i> (%)]	5 (0.4)	26 (2.0)	
<i>Overcrowded households (more than one person per room) [n (%)]</i>			<0.001
Not overcrowded	993 (77.5)	1029 (80.3)	
Overcrowded	284 (22.5)	227 (17.7)	
Missing [<i>n</i> (%)]	5 (0.4)	26 (2.0)	
<i>Household composition [n (%)]</i>			<0.001
Households with children	742 (57.9)	567 (44.2)	
Adult-only households (≥2 adults)	405 (31.6)	516 (40.2)	
One-person households	130 (10.1)	173 (13.5)	
Missing [<i>n</i> (%)]	5 (0.4)	26 (2.0)	

^aBased on paired *t*-test for continuous measures and χ^2 for categorical measures.

an increase since baseline (34%). In total, 15% experienced poor mental health in 2014. Yet 24% ($n=284$) of participants had missing data on the GHQ scale; this was due to the low response rate in the self-administered questionnaire in the B2014

survey. In 2005–2010, 42% reported symptoms of either anxiety or depression and 5% reported severe symptoms. Women were overrepresented in the cohort (63%) and the average age in 2005–10 was 43 years. At both times, most of the population were

Table II. The association between baseline housing conditions (Inuit Health in Transition Greenland survey, 2005–10) and poor self-rated health at follow-up (The Health Survey in Greenland, 2014)**.

n=1251	n (%)	Model 1 Unadjusted		Model 2 ^b	
		OR	95% CI	OR	95% CI
<i>Number of persons living in dwelling (adults + children)</i>	†	1.06	[1.01; 1.12]*	1.06	[1.00; 1.12]*
<i>Number of persons per room</i>	‡	1.35	[1.10; 1.66]*	1.27	[1.02; 1.60]*
<i>Crowding status^a</i>					
Not overcrowded	844 (75.15)	1.00		1.00	
Overcrowded	279 (24.84)	1.55	[1.18; 2.03]*	1.47	[1.09; 1.99]*
<i>Household composition</i>					
Households with children	726 (58.03)	1.00		1.00	
Adult-only households (≥2 adults)	397 (31.73)	0.98	[0.77; 1.26]	0.94	[0.71; 1.24]
One-person households	128 (10.23)	0.93	[0.64; 1.37]	0.85	[0.56; 1.29]

†mean 3.62; SD 2.20;

‡mean 0.90; SD 0.55;

^aone-person households (n=128) are excluded from the analysis.

^badjusted for individual characteristics (age, sex, household assets, self-rated health at baseline) and time to follow-up.

* $p < 0.05$.

**Based on logistic regression analyses.

living on the central west coast and in towns. During follow-up, the participant's access to specific assets had increased from 4.5 on average at baseline to 4.7 at follow-up. Household size had decreased during follow-up (from 3.6 persons to 3.2), resulting in fewer participants living in crowded conditions (23% at baseline, 18% at follow-up). The youngest age groups were more likely to live in overcrowded dwellings. More participants lived alone at follow-up, with men and older participants overrepresented in this group (results not tabulated).

Self-rated health and household overcrowding and composition

Results of the association between housing conditions in 2005–10, that is, household overcrowding and composition, and SRH in 2014 are presented in Table II. Increased household size and overcrowding (measured as the number of PPR categorically and continuously) in 2005–10 are statistically associated with elevated odds of poor SRH in 2014, in the fully adjusted model. No association was observed between household composition in 2005–10 and poor SRH in 2014.

Mental health and household overcrowding and composition

The associations between housing conditions in 2005–10 and mental health in 2014 are presented in Table III. The results showed no statistical association between household crowding in 2005–10 and poor mental health in 2014. In comparison with participants living in households with children, the odds

of poor mental health in 2014 was significantly higher among those living alone in 2005–10. Estimates in the two models changes noticeably after the adjustment for covariates, especially after the adjustments for age (results not tabulated), suggesting that age is a confounding factor in the association between housing conditions and mental health.

Discussion

The objective of this study was to investigate the effect of household crowding and composition on SRH and mental health among a cohort of Inuit adults. The results showed that living in an overcrowded dwelling in 2005–10 was associated with poor SRH in 2014 and that living alone in 2005–10 was associated with poor mental health in 2014.

The findings support results from previous studies finding that poor housing conditions has a negative effect on health [3,24] and that living alone has a negative effect on mental health [11]. No association was found between household composition and poor SRH in this study. Others have observed that the association between social isolation and mortality was mediated through social support, which often has been associated with mental well-being [25]. This suggests that household composition might be more important for mental health than for SRH.

No association was found between household overcrowding in 2005–10 and poor mental health in 2014. Existing literature has noted a cross-sectional association between increased psychological distress and poor housing conditions in the population [2]. This discrepancy could be explained by the study

Table III. The association between baseline housing conditions (Inuit Health in Transition Greenland survey, 2005–10) and poor mental health at follow-up, GHQ cut-off at ≥ 3 (The Health Survey in Greenland, 2014)**.

n=972	n (%)	Model 1 Unadjusted		Model 2 ^b	
		OR	95% CI	OR	95% CI
<i>Number of persons living in dwelling (adults + children)</i>	[†]	1.05	[0.98; 1.13]	0.98	[0.91; 1.06]
<i>Number of persons per room</i>	[‡]	1.29	[0.98; 1.70]	0.97	[0.71; 1.33]
<i>Crowding status^a</i>					
Not overcrowded	679 (76.20)	1.00		1.00	
Overcrowded	212 (23.79)	1.09	[0.74; 1.62]	0.77	[0.50; 1.18]
<i>Household composition</i>					
Households with children	608 (62.55)	1.00		1.00	
Adult-only households (≥ 2 adults)	283 (29.12)	0.90	[0.62; 1.30]	1.28	[0.86; 1.90]
One-person households	81 (8.33)	1.38	[0.80; 2.37]	1.98	[1.09; 3.58]*

[†]mean 3.62; SD 2.19.

[‡]mean 0.89; SD 0.55.

^aone-person households ($n=81$) are excluded from the analysis.

^badjusted for individual characteristics (age, sex, household assets, mental health at baseline) and time to follow-up.

* $p < 0.05$.

**Based on logistic regression analyses.

design, as the current study is the first to investigate the association between housing and health in an Inuit cohort in Greenland and therefore attempting to rule out health selection. In their New Zealand study (not focusing on an Indigenous population), Piersé and colleagues observed a strong cross-sectional association between housing factors and psychological distress, but a similar association was not observed in longitudinal analysis [26]. The authors conclude that the findings of the cross-sectional analysis are likely to be confounded and that the role of housing conditions on psychological distress is not as straightforward as cross-sectional studies might imply [27]. The results in the current study are in accordance with the findings by Pepin et al. [9], who reported no association between childhood household overcrowding and psychological distress in adolescents. Neither Pepin et al. or Piersé et al. investigated the effect of household composition on mental health. Future research may also focus on gender differences in the association between household crowding and mental health [2,12].

The discrepancy from previous cross-sectional results might be explained by different measures of mental health. In this study mental health was assessed by the GHQ scale. Although we report results for the cut-off at 3, which is commonly used in general populations [28], we also considered a cut-off at 2 which has been previously validated in the Greenlandic population [29]. When comparing associations between these two cut-offs and other indicators for poor mental health (e.g. suicidal ideations) available in B2014 (results not tabulated), strongest associations were observed for the cut-off at 3; this cut-off was therefore retained in the analyses. It is

recommended to revalidate the GHQ-scale in the population. Some (22%) of the participants had not completed the GHQ questionnaire. These participants reported depressive symptoms more often, were older, had poorer SRH and lower socioeconomic status compared with those who answered the questionnaire. This could underestimate the results, as the participants in the cohort might have better mental health than the original population.

Overcrowding was measured as the ratio of the number of PPR, with overcrowded defined as dwellings with >1 PPR. The results showed only minor variation between the different measures of overcrowding. Overcrowding was measured at one point in time and may therefore represent a single snapshot of living conditions, which may not represent the housing experiences of participants from 2005 to 2014. This may influence the results as the duration of living in poor housing has been shown to have a cumulative impact on health [10].

Our findings should be considered in the light of some limitations. Results of this study might be influenced by selection bias, as 60% of the baseline population were lost to follow-up. Results of the comparison of baseline characteristics between those included in the cohort and those lost to follow-up show that the selection was not random (Table IV). In general, participants included in the cohort were younger, female, had access to more household assets, and lived in larger households than those who were lost to follow-up. We did not observe baseline differences in SRH between cohort participants and those lost to follow-up. However, differences were observed in symptoms of anxiety, where cohort participants experienced anxiety symptoms more often

Table IV. Baseline characteristics of cohort participants ($n=1282$) compared with baseline characteristics of participants lost to follow-up ($n=1962$) (Inuit Health in Transition survey, 2005–10).

Individual Characteristics	Cohort participants	Participants lost to follow-up	<i>p</i> -value ^a
<i>Self-rated health [n (%)]</i>			0.14
Good	847 (66.1)	1240 (63.2)	
Poor	433 (33.8)	709 (36.1)	
Missing [n (%)]	2 (0.2)	13(0.7)	
<i>Anxiety within the two preceding weeks [n (%)]</i>			0.002
Yes	443 (34.6)	573 (29.2)	
No	838 (65.4)	1382 (70.4)	
Missing [n (%)]	1 (0.1)	7 (0.4)	
<i>Depressed within the two preceding weeks [n (%)]</i>			0.10
Yes	387 (30.2)	539 (27.5)	
No	890 (69.4)	1412 (72.0)	
Missing [n (%)]	6 (0.5)	11 (0.6)	
<i>Sex [n (%)]</i>			<0.001
Men	480(37.5)	988 (50.4)	
Women	802(62.6)	974 (49.6)	
<i>Age</i>			<0.001
Mean (SD)	42.9 (12.9)	45.6 (15.8)	
Median; range	43; 18–89	45; 18–95	
Household characteristics			
<i>Region [n (%)]</i>			<0.001
South	233 (18.2)	406 (20.7)	
Centre	421 (32.8)	700 (35.7)	
North	437 (34.1)	409 (20.8)	
East	183 (14.3)	170 (8.7)	
Avanersuaq	8 (0.6)	277 (14.1)	
<i>Community type [n (%)]</i>			0.37
Village	279 (21.8)	461 (23.5)	
Town	785 (61.2)	1195 (60.9)	
Nuuk	218 (17.0)	306 (15.6)	
<i>Household assets</i>			<0.001
Mean (SD)	4.5 (1.7)	4.20 (1.8)	
Median; range	5; 0–7	4; 0–7	
Missing [n (%)]	6 (0.5)	5 (0.3)	
<i>Size (adults + children)</i>			<0.001
Mean (SD)	3.6 (2.2)	3.2 (2.0)	
Median; range	3; 1–18	3; 1–18	
Missing [n (%)]	4 (0.3)	14 (0.7)	
<i>Number of persons per room</i>			0.0003
Mean (SD)	0.9 (0.6)	0.8 (0.5)	
Median; range	0.8; 0.1–4.5	0.7; 0.2–4.7	
Missing [n (%)]	5 (0.4)	19 (1.0)	
<i>Overcrowded households (more than one person per room) [n (%)]</i>			0.04
Overcrowded	284 (22.2)	373 (19.0)	
Not overcrowded	993 (77.5)	1570 (80.0)	
Missing [n (%)]	5 (0.4)	19 (1.0)	
<i>Household composition [n (%)]</i>			<0.001
Households with children	742 (57.9)	900 (45.9)	
Adult-only households (≥ 2 adults)	405 (31.6)	698 (35.6)	
One-person households	130 (10.1)	350 (17.8)	
Missing [n (%)]	5 (0.4)	14 (0.7)	

^aBased on *t*-test for continuous measures and χ^2 for categorical measures.

than those who were lost to follow-up. This selection can result in an overestimation of the results.

However, it is uncertain if the mental health measures at baseline are a robust indicator for mental

health at follow-up. A previous study did show that the prevalence of reporting anxiety and depression were significantly higher among people scoring ≥ 2 on the GHQ scale [30]. The possible issues with the differing mental health measure at baseline and follow-up are viewed as a limitation in this study and could lead to residual confounding, as mental health in 2005–10 may not be adequately adjusted for in the analyses. Many confounding factors may influence health at follow-up including a change in marital status, death in the family, additional children, etc. Supplementary analysis showed that changing housing conditions during follow-up, such as fewer or more people in the household, did not significantly affect SRH or mental health at follow-up.

Conclusions

This study, the first among an Inuit cohort in Greenland, suggests that living in an overcrowded dwelling is associated with poor SRH, but not with mental health. In Greenland, and possibly elsewhere, the aetiological role of household composition in mental health might be more important than household crowding. The results are in accordance with the WHO guideline concluding that the evidence relating crowding to adverse mental health effects, including stress, was assessed as moderate to low [1]. Policymakers should consider housing conditions in health-related policies to improve public health in Greenland, as around 20% of the population lived in overcrowded dwellings in 2014.

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Supplemental material

Supplemental material for this article is available online.

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