International Journal of Public Health (2019) 64:399–409
https://doi.org/10.1007/s00038-018-1167-6

ORIGINAL ARTICLE

Residential moves and its association with substance use, healthcare needs, and acute care use among homeless and vulnerably housed persons in Canada

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Received: 23 March 2018 / Revised: 3 July 2018 / Accepted: 15 October 2018 / Published online: 31 October 2018

Abstract

Objectives To determine the relationship between housing instability, as measured by the number of residential moves, with problematic substance use, unmet healthcare needs, and acute care utilization.

Methods A cohort of homeless or vulnerably housed persons from Vancouver (n = 387), Toronto (n = 390), and Ottawa (n = 396) completed interviewer-administered surveys at baseline and annually for 4 years from 2009 to 2013. Generalized mixed effects logistic regression models were used to examine the association between the number of residential moves and each of the three outcome variables, adjusting for potential confounders.

Results The number of residential moves was significantly associated with higher acute care utilization [adjusted odds ratio (AOR) 1.25; 95% confidence interval (CI) CI: 1.17–1.33], unmet healthcare needs (AOR 1.14; 95% CI: 1.07–1.22), and problematic substance use (AOR 1.26; 95% CI: 1.16–1.36). Having chronic physical or mental conditions and recent incarceration were also found to be associated with the outcomes.

Conclusions Housing instability increased the odds of all three poor health metrics, highlighting the importance of stable housing as a critical social determinant of health.

Keywords Health · Homelessness · Housing · Housing instability · Residential moves · Substance use · Unmet healthcare needs · Acute care utilization · Hospitalization · Emergency department

Introduction

There is substantial cross-sectional (Frankish et al. 2005; Hwang 2005; Leaver et al. 2007; Lee et al. 2005) and longitudinal (Aubry et al. 2015, 2016; Baggett et al. 2013; Hwang 2000; Sadowski et al. 2009) evidence that demonstrates homelessness is associated with poor health outcomes. Individuals who are homeless tend to suffer from higher rates of illness, substance use disorders, injuries, assaults, and mortality (Aubry et al. 2015, 2016; Baggett et al. 2013; Frankish et al. 2005; Hwang 2000, 2005; Leaver et al. 2007; Lee et al. 2005; Sadowski et al. 2009). To compound the higher burden of disease and

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mortality, homeless individuals experience barriers in accessing care (Costa et al. 2012; Khandor et al. 2011; Krausz et al. 2013). Obstacles to care include stigma, prejudice, inflated wait times, transportation limitations, stress associated with living in shelters, poor connection to services, cost of medications, and, in the USA, lack of health insurance (Costa et al. 2012; Krausz et al. 2013). However, less is known about the health of individuals who are vulnerably housed (i.e., individuals who have experienced prior homelessness or frequent housing transitions, living in single-room occupancy hotels and rooming houses) and the impact of housing transitions on health.

The associations between housing instability and health variables need to be examined in more detail, in part, because housing instability is not defined or operationalized in consistent ways across the extant literature (Jaworsky et al. 2016; Kushel et al. 2006; Stahre et al. 2015; Weinreb et al. 1998, 2006). In some research, housing instability is conceptualized as a sense of 'insecurity' (i.e., individuals worry about or self-report being unable to maintain stable housing due to financial constraints; Kushel et al. 2006; Stahre et al. 2015). In other research, housing instability focuses on the more granular experience of instability associated with frequency of moving from one type of housing to another (e.g., from a rooming house to a shelter; Jaworsky et al. 2016; Weinreb et al. 1998, 2006). More rarely, research has tried to combine the two conceptualizations (Duchon et al. 1999).

Kushel et al. (2006) and Stahre et al. (2015) operationalized housing instability as self-reported difficulties in paying rent, mortgage, or utility bills in the past year. They both demonstrated that a subjective sense of housing insecurity increased participants' likelihood of postponing needed medical care and healthcare service utilization. Reid et al. (2008) operationalized instability quite differently. They created an ordered (ranked) variable of economic and housing instability to represent progressively poorer income and housing status and showed that having worse economic and housing instability was associated with postponing needed care and medication and higher rates of hospitalization. Duchon et al. (1999) operationalized residential instability as previous use of shelters and history of mobility and demonstrated that history of residential instability was associated with increased ED utilization. Other researchers have examined residential stability in terms of moving frequency during the previous year of study (Jaworsky et al. 2016; Kirby and Kaneda 2006; Suglia et al. 2011) and found poorer health metrics among participants with residential instability, including increased odds of unmet healthcare needs, increased ED utilization, and increased odds of anxiety and depression, respectively (Jaworsky et al. 2016; Kirby and Kaneda 2006; Suglia et al. 2011).

However, more individual and longitudinal data that define housing instability by residential moves are required to better understand its association with a variety of health metrics. In the present study, we used Health and Housing in Transition (HHiT) Study 5-year longitudinal data to examine the association between housing instability defined by residential moves, and three metrics of health status: problematic substance use; self-reported unmet healthcare needs; and acute care utilization. We operationalized housing instability as the number of residential moves (i.e., moving from one type of housing to another) that the participant experienced during the year preceding each annual interview. This intuitive definition of housing instability provides a more granular analysis at the individual level, beyond the current categorical definitions derived predominately from epidemiologic census data (Kushel et al. 2006; Reid et al. 2008; Stahre et al. 2015; Weinreb et al. 1998). We hypothesize that those individuals who experience more residential moves will have higher rates of problematic substance use, unmet healthcare needs, and acute care utilization in keeping with the theory of competing priorities where subsistence needs circumvent health and wellness.

Methods

Design

The HHiT study was a prospective cohort study from 2009 to 2013 of homeless or vulnerably housed adults. Details on study design and procedure have been previously described (Hwang et al. 2011). In brief, participants were recruited from three of Canada's largest cities, Ottawa, Toronto, and Vancouver. We enrolled 1190 single adults (aged 18 years or older) between January and December 2009 and all study participants provided written informed consent and were reimbursed $20 CDN for each interview. At baseline, 595 were vulnerably housed and 595 were homeless. Being vulnerably housed was defined as moving two or more times in the past year while living in one's own room, apartment, or place. These individuals were recruited at SROs in Vancouver, and licensed rooming houses in Toronto and Ottawa. We also recruited at in-meal programs, drop-in centers, and community health centers. Homelessness was defined as not living in one's own home within the last week and currently living in a shelter, public space, vehicle, abandoned building, or someone else's home. These individuals were recruited at shelters and meal programs, using sampling methods designed for this target population (Ardilly and Le Blanc 2001). The Research Ethics Boards at the University of British

Columbia, the University of Ottawa, and St. Michael's Hospital in Toronto approved this study.

Survey instrument

Participants underwent 60–90 min in-person structured interviews, and were re-interviewed approximately every 12 months over the 4-year period following their baseline interview (Hwang et al. 2011). The initial interview was conducted by trained research personnel and was completed immediately following recruitment and informed consent. Data were collected on socio-demographic characteristics, lifetime prevalence of having received a mental health diagnosis at baseline, and chronic health conditions at baseline. Chronic health conditions were those that were diagnosed by a healthcare professional and had persisted for 6 months or longer.

At each survey, participants were asked if, in the past 12 months, they had a primary care provider as well as their employment and incarceration history over that time period. Details on age, gender, ethnicity, and city of recruitment were also gathered. At each interview, housing status and housing transitions during the past 12 months were determined through the Housing Timeline Follow Back Calendar, a validated method for the collection of accurate housing history information (Tsemberis et al. 2007). The Alcohol Use Disorders Identification Test (AUDIT) (Maisto et al. 2000) was used to assess problematic alcohol use (AUDIT score $\geq$ 20) (Barbor et al. 1992). The 10-item Drug Abuse Screening Test (DAST-10) (French et al. 2001) was used to identify problematic drug use (DAST-10 score $\geq$ 6). These survey tools have been previously validated for use in similar populations (Maisto et al. 2000).

Follow-up procedures

Details on the tracking and follow-up strategies used in the study are described in Gerlitz et al. (2017). Trained interviewers collected detailed contact information, aliases and handles participants used when accessing services. We requested permission as part of the consent process to have personal information released from the Ministry of Social Development that disburses Income Assistance. Participants also were provided business cards with the study name, phone number and next follow-up date, which increased the probability of the participant staying in contact with the research team. The interview team developed strong relationships with staff community service agencies that many participants used through communicating regularly about the study aims and progress. Interviewers also used Facebook to locate participants, particularly the younger demographic.

Main explanatory variable

The housing history data were classified based on methods adapted from Tsemberis et al. (2007). Each residence in a participant's housing history was classified into one of 25 types of primary residence, which were then categorized into one of three mutually exclusive residence categories: housed, institution, and homeless. Periods of time spent in institutions were considered periods of being homeless or housed based on a functional classification previously described (HHiT Study Team 2015). We used the number of residential moves that the participant experienced during the year preceding the interview to assess housing instability. Residential moves were defined as the number of moves between types of primary residences (e.g., apartment to jail, jail to SRO would be counted as two residential moves).

Outcome variables

Problematic substance use was determined by participants scoring $\geq$ 20 for alcohol use on the AUDIT questionnaire, and/or scoring $\geq$ 6 on the DAST questionnaire for drug use (Maisto et al. 2000). Unmet healthcare needs (physical or mental) were defined as answering "yes" to either of the following: "During the past 12 months, was there ever a time when you felt that you needed health care but you didn't receive it? Have you needed mental health care in the past 12 months but were not able to get help?" These questions were based on the definition of unmet healthcare needs used in other national surveys including the Joint Canada/US Survey of Health (Lasser et al. 2006), and the National Population Health Survey (Sanmartin et al. 2002). They have also been used to assess unmet healthcare needs among homeless adults (Baggett et al. 2010). Acute care utilization was a binary variable defined as whether or not, at least once, the participant reported receiving health care from an Emergency Department (ED) and/or was admitted to hospital overnight or longer in the previous 12 months. Homeless adults have been found to be reliable in recounting their healthcare use (Hwang et al. 2016).

Statistical analysis

For descriptive statistics, we used the Chi-square test for categorical variables, and one-way ANOVA or Kruskal–Wallis test for continuous variables. Denominators were adjusted accordingly for missing data (i.e., participant missing, or did not know or refused to answer). Of the 1190 participants, we excluded transgender participants whose small count would not allow for adjusted analysis by

transgender identity, leaving 1173. Of the 1173 respondents, the multivariate models included 1119 participants with complete data, which was 95% of our participants (clustered by year) and 95% of the 4919 observations over the 4-year follow-up period. We examined the association between baseline participant characteristics and number of residential moves categorized as 1–2 moves versus 3 or more in previous 12 months. Generalized mixed effects logistic regression models were used to individually examine the association between number of discrete residential moves (count variable) and the following dichotomous outcome variables over time: (1) problematic substance use; (2) unmet healthcare needs; and (3) acute care utilization. Each model was adjusted for the following baseline variables: age, sex, city, ethnicity, lifetime history of a mental health diagnosis, and having 3 or more chronic health conditions. We also adjusted for employment, incarceration, and having a primary health provider as time-varying variables. Furthermore, an interview time point variable was included, given that responses spanned a 4-year follow-up period.

Results

Study participants

Figure 1 depicts the participant flow over the 4 years of follow-up at baseline where we achieved an overall follow-up rate of $> 80\%$. Table 1 presents the baseline demographic characteristics of the participants with 1–2 residential moves, compared to 3 or more in the previous year. Participants with 3 or more moves were younger on average (41.3 years vs. 43.6 years, $p < 0.001$). A higher proportion of participants from Vancouver (34.4%) and Ottawa (36.9%) experienced more than 3 moves compared to Toronto (28.7%). A higher proportion of individuals reporting employment (44.2% vs. 34.2%, $p < 0.001$) and incarceration (32.5 vs. 23.4%, $p < 0.001$) in the previous 12 months had 3 or more residential moves. In contrast, having a primary care provider was associated with fewer moves (57% vs. 64.3%, $p = 0.01$). The highest median number of residential moves was at the baseline interview; by the fourth follow-up interview, the median number of residential moves was similar among the three outcome variables, although the 75th percentile was higher for those endorsing the variables of acute care use and problematic substance use. Figure 2 presents the distribution of each of the health outcomes over the 4-year follow-up period; all outcome variables declined in frequency over time.

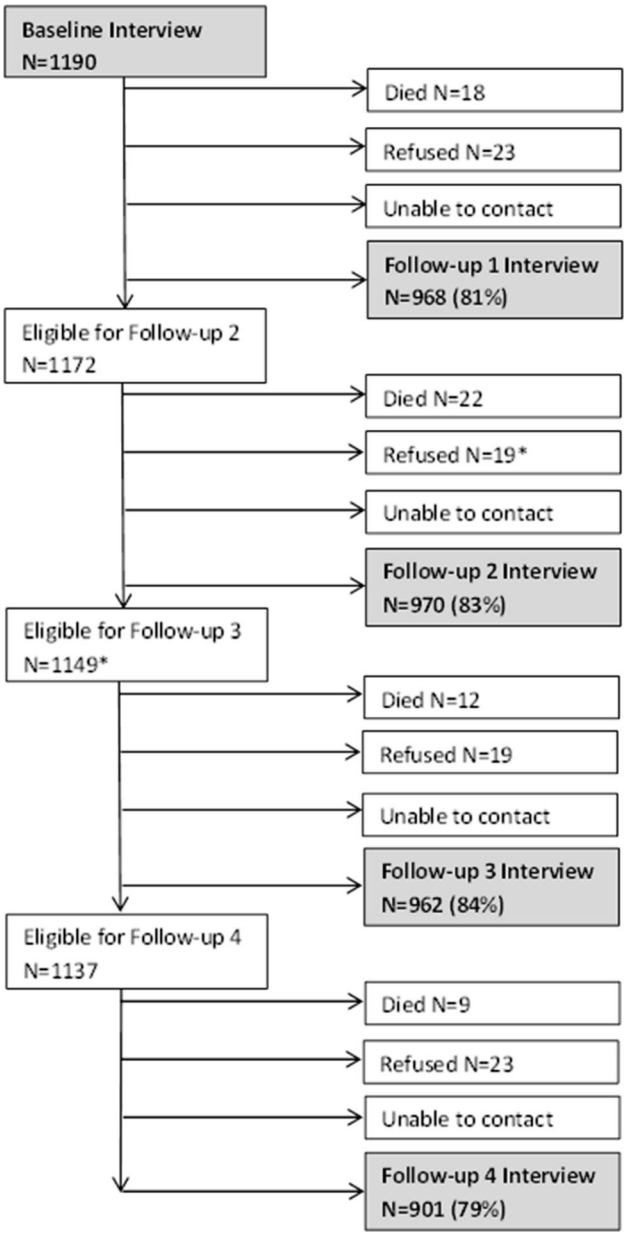

Fig. 1 Health and housing in transition study participant status at each follow-up interview: Vancouver, Toronto, and Ottawa, Canada (2009–2013). *1 participant withdrew from the study during follow-up 2

Residential moves and problematic substance use

At the baseline interview, there were 437 (37%) participants who reported problematic substance use and the mean number of residential moves was higher among those reporting problematic substance use versus those who did not (3.1 vs. 2.7). The rate of problematic substance use slowly declined throughout the follow-up periods; 34% at year 1, 31% at year 2, 29% at year 3, and 28% at year 4. In

Table 1 Baseline participant characteristics by number of residential moves: Vancouver, Toronto, and Ottawa, Canada (2009–2013)

Participant characteristics	All participants	Number of residential moves		
	n = 1173	1 or 2 (n = 503)[a]	3 or more (n = 669)	p value
Age (mean, SD)	42.2 (10.5)	43.6 (10.1)	41.3 (10.8)	< 0.001
Female [n (%)]	385 (32.0)	166 (33.0)	219 (32.7)	0.95
Ethnicity				0.1
White [n (%)]	717 (63.0)	291 (59.8)	426 (65.4)	
Black/African Canadian n (%)	105 (9.2)	55 (11.3)	49 (7.5)	
Indigenous [n (%)]	197 (17.3)	89 (18.3)	108 (16.6)	
Other [n (%)]	120 (10.5)	52 (10.7)	68 (10.5)	
3 or more chronic health conditions [n (%)]	584 (49.8)	250 (49.7)	333 (49.8)	0.99
City				< 0.001
Toronto [n (%)]	390 (33.2)	197 (39.2)	192 (28.7)	
Ottawa [n (%)]	396 (33.8)	149 (29.6)	247 (36.9)	
Vancouver [n (%)]	387 (33)	157 (31.2)	230 (34.4)	
Ever had a mental health problem [n (%)]	593 (51.3)	242 (48.6)	351 (53.4)	0.10
Employed in past 12 months [n (%)]	467 (39.9)	172 (34.2)	295 (44.2)	< 0.001
Incarceration in the past 12 months [n (%)]	333 (28.6)	117 (23.4)	215 (32.5)	< 0.001
Has a primary health provider [n (%)]	704 (60.1)	323 (64.3)	381 (57.0)	0.01

[a]1 participant had no moves

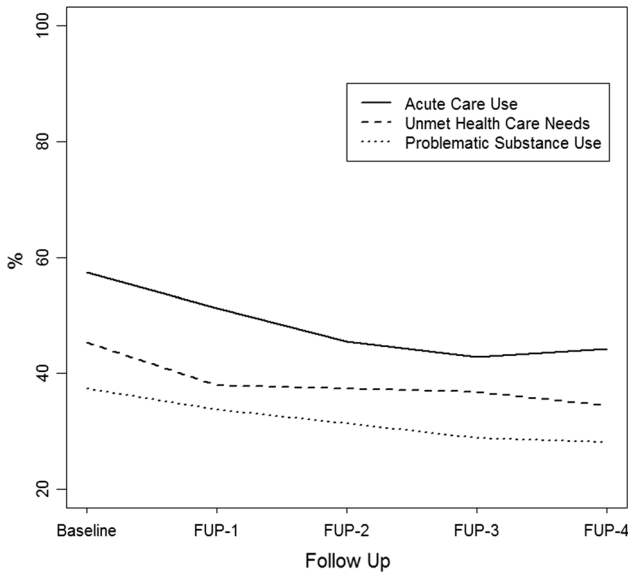

Fig. 2 Distribution of health outcomes over the follow-up periods (FUP): Vancouver, Toronto, and Ottawa, Canada (2009–2013)

the longitudinal bivariate models, the number of residential moves (OR 1.43; 95% CI: 1.33–1.54) was associated with increased odds of problematic substance use (Table 2).

After adjusting for age, gender, ethnicity, 3 or more chronic health conditions, city of recruitment, lifetime history of mental health problems, employment, incarceration, having a primary health provider and interview time point, the number of residential moves remained significantly associated with problematic substance use (adjusted OR 1.26; 95% CI: 1.16–1.36). In the adjusted model, Indigenous ethnicity, presence of three or more chronic health conditions, Vancouver compared to Toronto and Ottawa as city of recruitment, ever being diagnosed with a mental health problem, and incarceration were positive predictors of problematic substance use, whereas age, Black/African Canadian ethnicity, and interview time point were negatively associated with problematic substance use (Table 2).

Residential moves and unmet healthcare needs

At the baseline interview, there were 528 (45%) participants with unmet healthcare needs and the mean number of residential moves was higher among those with unmet healthcare needs compared to those without (3.0 vs. 2.7). The rate of unmet healthcare needs, although remaining high, decreased slightly in the follow-up periods: 38% at year 1, 37% at year 2 and 3, and 34.5% at year 4. In the longitudinal bivariate models, the number of residential moves (OR 1.25; 95% CI: 1.18–1.33) was associated with increased odds of unmet healthcare needs (Table 3).

After adjusting for age, gender, ethnicity, 3 or more chronic health conditions, city of recruitment, lifetime history of mental health problems, employment, incarceration, having a primary health provider and interview time point, the number of residential moves was still

Table 2 Multivariable generalized logistic mixed effects regression model to estimate the independent effect of residential moves on problematic substance use over time: Vancouver, Toronto, and Ottawa, Canada (2009–2013)

	Problematic substance use[a]		Unadjusted	Adjusted
	Yes (n = 437)	No (n = 733)	Odds ratios[b] (95% CI)	Odds ratios[b] (95% CI)
Number of residential moves in the past 12 months[c] (mean, SD)	3.1 (1.3)	2.7 (1)	1.43 (1.33, 1.54)	1.26 (1.16, 1.36)
Age (mean, SD)	39.7 (9.5)	43.8 (10.8)	0.93 (0.92, 0.95)	0.94 (0.92, 0.96)
Female [n (%)]	157 (35.9)	227 (31)	1.1 (0.75, 1.61)	0.75 (0.51, 1.1)
Ethnicity				
White [n (%)]	271 (63.6)	446 (62.7)	Reference	Reference
Black/African Canadian [n (%)]	20 (4.7)	85 (12)	0.28 (0.14, 0.56)	0.37 (0.19, 0.73)
Indigenous [n (%)]	97 (22.8)	99 (13.9)	2.97 (1.86, 4.74)	2.67 (1.68, 4.24)
Other [n (%)]	38 (8.9)	81 (11.4)	0.74 (0.41, 1.36)	0.78 (0.44, 1.4)
Three or more chronic health conditions [n (%)]	250 (57.2)	333 (45.4)	2.11 (1.47, 3.03)	1.81 (1.26, 2.61)
City				
Toronto [n (%)]	114 (26.1)	276 (37.7)	Reference	Reference
Ottawa [n (%)]	149 (34.1)	245 (33.4)	1.74 (1.12, 2.71)	1.04 (0.67, 1.62)
Vancouver [n (%)]	174 (39.8)	212 (28.9)	2.96 (1.9, 4.62)	1.74 (1.12, 2.68)
Ever had a mental health problem [n (%)]	261 (60.6)	330 (45.7)	2.3 (1.6, 3.31)	1.82 (1.27, 2.59)
Employed in past 12 months[c] [n (%)]	168 (38.5)	299 (40.8)	0.88 (0.7, 1.11)	0.79 (0.62, 1.01)
Incarceration in the past 12 months[c] [n (%)]	188 (43.4)	145 (19.9)	3.31 (2.59, 4.22)	2.43 (1.89, 3.13)
Has a primary health provider[c] [n (%)]	288 (65.9)	414 (56.6)	1.03 (0.81, 1.31)	1.15 (0.89, 1.47)
Interview time point				0.88 (0.82, 0.94)

[a]At baseline

[b]Each variable is regressed on the prevalence of problematic use at each interview time point

[c]Time-varying variables

significantly associated (adjusted OR 1.14; 95% CI: 1.07–1.22) with unmet healthcare needs. In the adjusted model, 3 or more chronic health conditions, lifetime history of mental health problems, and incarceration in the past 12 months remained positive predictors of unmet healthcare needs, whereas having a primary care provider, Black/African ethnicity, and later interview time point were negatively associated with unmet healthcare needs (Table 3).

Residential moves and acute care utilization

At the baseline interview, there were 673 (57%) participants who reported acute care utilization (ED visit: N = 642; hospital admission: N = 31) and the mean number of residential moves was similar among those with acute care use compared to those without (2.9 vs. 2.8). During the follow-up periods, acute care utilization decreased slightly but remained high at: 51% in year 1, 46% in year 2, 43% in year 3, and 44% in year 4. In the longitudinal bivariate models, the number of residential moves (OR 1.35; 95% CI: 1.27–1.43) was associated with increased odds of acute care utilization (Table 4).

After adjusting for age, gender, ethnicity, 3 or more chronic health conditions, city of recruitment, lifetime history of mental health problems, employment, incarceration, having a primary health provider and interview time point, the number of residential moves was still significantly associated (adjusted OR 1.25; 95% CI: 1.17–1.33) with acute care utilization. In the adjusted model, 3 or more chronic health conditions, lifetime history of mental health problems, incarceration in past 12 months, and having a primary care provider remained positive predictors of acute care utilization, whereas age and later interview time point were negatively associated with acute care utilization (Table 4).

Discussion

This longitudinal study found that the number of residential moves was independently associated with increased unmet healthcare needs, acute care utilization, and problematic substance use among persons who were homeless or vulnerably housed in both the unadjusted and adjusted model. Other authors, predominantly with cross-sectional data,

Table 3 Multivariable generalized logistic mixed effects regression model to estimate the independent effect of residential moves on unmet healthcare needs over time: Vancouver, Toronto, and Ottawa, Canada (2009–2013)

	Unmet healthcare needs[a]		Unadjusted	Adjusted
	Yes (n = 528)	No (n = 635)	Odds ratios[b] (95% CI)	Odds ratios[b] (95% CI)
Number of residential moves in the past 12 months[c] (mean, SD)	3.0 (1.2)	2.7 (1.1)	1.25 (1.18, 1.33)	1.14 (1.07, 1.22)
Age (mean, SD)	41.4 (10.4)	42.9 (10.6)	0.99 (0.98, 1)	0.99 (0.98, 1)
Female [n (%)]	184 (34.9)	198 (31.2)	1.17 (0.92, 1.5)	1.06 (0.82, 1.37)
Ethnicity				
White [n (%)]	336 (65.6)	371 (60.1)	Reference	Reference
Black/African Canadian [n (%)]	39 (7.6)	66 (10.7)	0.51 (0.33, 0.79)	0.61 (0.39, 0.95)
Indigenous [n (%)]	91 (17.8)	106 (17.2)	0.95 (0.69, 1.3)	0.84 (0.62, 1.16)
Other [n (%)]	46 (9)	74 (12)	0.83 (0.56, 1.23)	0.86 (0.58, 1.27)
Three or more chronic health conditions [n (%)]	332 (62.9)	247 (38.9)	2.29 (1.82, 2.89)	2.32 (1.81, 2.97)
City				
Toronto [n (%)]	152 (28.8)	235 (37)	Reference	Reference
Ottawa [n (%)]	187 (35.4)	207 (32.6)	1.19 (0.89, 1.58)	0.92 (0.69, 1.24)
Vancouver [n (%)]	189 (35.8)	193 (30.4)	1.3 (0.97, 1.74)	1.24 (0.92, 1.66)
Ever had a mental health problem [n (%)]	320 (61.4)	267 (42.7)	2.04 (1.62, 2.58)	2.38 (1.87, 3.02)
Employed in past 12 months[c] [n (%)]	218 (41.4)	244 (38.4)	1.19 (0.98, 1.43)	1.19 (0.98, 1.43)
Incarceration in the past 12 months[c] [n (%)]	179 (34.4)	151 (23.9)	1.77 (1.44, 2.17)	1.57 (1.27, 1.94)
Has a primary health provider[c] [n (%)]	309 (58.6)	388 (61.2)	0.69 (0.57, 0.84)	0.75 (0.62, 0.91)
Interview time point				0.92 (0.87, 0.98)

[a]At baseline

[b]Each variable is regressed on the prevalence of unmet healthcare needs at each interview time point

[c]Time-varying variables

have also demonstrated a deleterious relationship between housing instability defined either as 'insecurity', low socioeconomic strata, or actual moves and health. However, our results suggest that the number of residential moves, as a more refined marker of housing instability, can be considered an important distinctive risk factor.

Our data suggest the residential moves increased the risk of problematic substance use, which is somewhat in keeping with the literature. While the Housing First did not consistently reduce drug use despite improved residential stability (O'Campo et al. 2016), HHiT participants who had moderate and severe use drug problems experienced higher rates of homelessness during the follow-up periods compared to those without drug use problems (To et al. 2016). A similar finding was made previously among veterans in the USA (O'Connell et al. 2008). It is unclear whether a higher number of residential moves results in increased problematic substance use or are sequelae of it. Regardless of the direction of this relationship, vulnerably housed and homeless individuals with substance use disorders represent a particularly high-risk population, and interventions that increase stable housing for these individuals should continue to be instituted and evaluated.

Similar to studies that defined housing instability as self-reported difficulty in paying rent, we also found that the number of residential moves was also associated with unmet healthcare needs (Kushel et al. 2006; Stahre et al. 2015) and reduced access to health care (Reid et al. 2008). Jaworsky et al. (2016) found, among HHiT participants, that residential stability (defined as living in the same place for at least 6 months) was associated with a lower likelihood of having unmet physical-heath care needs. Our more granular definition of housing instability builds on this literature given that less than 25% of participants achieved residential stability at all four interview time points (Jaworsky et al. 2016). It is important to note that the large majority of participants continued to live in extreme poverty throughout the study and this situation can be expected to have contributed greatly to their housing instability. Health policy should focus on both reducing housing instability by addressing poverty and developing strategies to increase access to care for those who are at risk or experiencing housing instability.

Table 4 Multivariable generalized logistic mixed effects regression model to estimate the independent effect of residential moves on acute care utilization over time: Vancouver, Toronto, and Ottawa, Canada (2009–2013)

	Acute care utilization[a]		Unadjusted	Adjusted
	Yes (n = 673)	No (n = 500)	Odds ratios[b] (95% CI)	Odds ratios[b] (95% CI)
Number of residential moves in the past 12 months[c] (mean, SD)	2.9 (1.2)	2.8 (1.1)	1.35 (1.27, 1.43)	1.25 (1.17, 1.33)
Age (mean, SD)	41.6 (10.3)	43.1 (10.8)	0.98 (0.97, 0.99)	0.98 (0.97, 0.99)
Female [n (%)]	234 (34.8)	151 (30.2)	1.35 (1.07, 1.71)	1.08 (0.85, 1.37)
Ethnicity				
White [n (%)]	404 (61.2)	313 (65.3)	Reference	Reference
Black/African Canadian [n (%)]	57 (8.6)	48 (10)	0.68 (0.46, 1.01)	0.82 (0.55, 1.21)
Indigenous [n (%)]	133 (20.2)	64 (13.4)	1.44 (1.08, 1.94)	1.27 (0.95, 1.7)
Other [n (%)]	66 (10)	54 (11.3)	1.02 (0.7, 1.48)	1.07 (0.75, 1.53)
Three or more chronic health conditions [n (%)]	395 (58.7)	189 (37.8)	2.42 (1.95, 3)	2.39 (1.91, 3)
City				
Toronto [n (%)]	214 (31.8)	176 (35.2)	Reference	Reference
Ottawa [n (%)]	224 (33.3)	172 (34.4)	1.09 (0.83, 1.43)	0.8 (0.61, 1.05)
Vancouver [n (%)]	235 (34.9)	152 (30.4)	1.22 (0.93, 1.61)	0.86 (0.66, 1.13)
Ever had a mental health problem [n (%)]	386 (58.5)	207 (41.7)	1.99 (1.6, 2.48)	1.68 (1.35, 2.1)
Employed in past 12 months[c] [n (%)]	260 (38.6)	207 (41.6)	1.05 (0.88, 1.25)	1.07 (0.89, 1.28)
Incarceration in the past 12 months[c] [n (%)]	231 (34.6)	102 (20.6)	1.97 (1.62, 2.4)	1.5 (1.22, 1.84)
Has a primary health provider[c] [n (%)]	424 (63.2)	280 (56)	1.21 (1.01, 1.45)	1.24 (1.03, 1.5)
Interview time point				0.88 (0.83, 0.93)

[a]At baseline

[b]Each variable is regressed on the prevalence of acute care utilization at each interview time point

[c]Time-varying variable

We found that the number of residential moves increased the likelihood of acute care utilization (ED and hospital admission), which is consistent with other studies. Duchon et al. (1999) demonstrated that history of housing instability (defined by frequency of shelter use) increased ED use. Similarly, among HHiT study participants, Jaworsky et al. (2016) demonstrated that attainment of residential stability was associated with reduced ED use. Policy makers should note the potential added economic benefit that stable long-term housing may offer secondary to decreased healthcare costs.

Our findings may be consistent with the concept of competing priorities; individuals who are forced to transition from one residence to another are in a position whereby their subsistence needs interfere with healthcare needs (Cunningham et al. 1999). In short, the immense stress of moving and the time required to undertake a residential transition consumes energy that individuals could otherwise invest in self-care, accessing primary care, and addiction treatment programs. Gelberg et al. (1997) found that increasing subsistence difficulty was associated with lack of primary care and delays in accessing care. We found a higher number of residential moves increased the odds of reporting unmet physical and mental healthcare needs and increased acute care utilization (ED use and hospitalization), even with adjustment for having a primary care provider. Further exploring the stress of moving in future studies examining housing instability and health are needed to assess this theory more specifically.

Our analysis also showed that additional variables were consistently associated with problematic substance use, unmet healthcare needs, and acute care utilization. These included a history of 3 or more chronic health conditions, lifetime mental health diagnosis, and incarceration in the past 12 months. This is consistent with the literature; Schinka et al. (2016) demonstrated in homeless veterans that having a mental health or chronic health condition increased the risk of death; Russolillo et al. (2016) showed that having a diagnosis of schizophrenia or bipolar disorder were independent predictors of hospital admissions; and Binswanger et al. (2007) found an adjusted risk of 3.5 for all-cause mortality following a release from prison in the USA, and that the leading causes of death were drug overdose, cardiovascular disease, homicide, and suicide.

We also found that homeless and vulnerably housed participants who identified as Indigenous had greater odds of problematic substance use compared to other groups. This is a recognized issue in the Canadian literature and is summarized by Firestone et al. (2015) in a recent review paper. There is a disproportionate burden of substance use among Indigenous peoples as well as significant gaps in the data, particularly in reserve settings, as none of the Canadian primary population heath data sources reliably capture information there (Firestone et al. 2015). Our study provides some insight into problematic substance use among participants who identified as Indigenous in urban settings. Community-centric research with Indigenous peoples' involvement is required to more deeply explore this relationship.

Limitations of this study include our inability to infer causation given that the analyses examined associations between residential moves and the outcomes at each time point. It is possible that other variables related to residential moves are contributing to negative health outcomes. The chronic health conditions were determined by self-report, and we did not conduct diagnostic clinical interviews to ascertain mental health problems in this population, resulting in a possible underestimate of these conditions. Despite using the DAST-10 and AUDIT, which are validated tools to identify problematic drug use and alcohol use that would merit intensive assessment, we may have underestimated prevalence due to social desirability bias. Linkage to health administrative data to correlate hospital and ED use would be an additional consideration to achieve a higher level of evidence, although accuracy of self-reported ED use among homeless individuals is 80–83% (Hwang et al. 2016).

A strength of the study is that we captured 4 years of longitudinal data on granular housing history (i.e., capturing the number of moves between distinct residences per interview period). This study has a large sample population of homeless and vulnerably housed persons. Furthermore, sampling took place in three geographically distinct Canadian cities, which offer different services and have unique housing policies. Lastly, despite this being a challenging population to follow, the attrition rate was less than 23% over the 4-year follow-up period due to the tracking and retention strategies used in the HHiT study (Gerlitz et al. 2017). These high-quality data increase the validity of the reported relationship between residential moves and the studied health outcomes.

Conclusion

This study highlights the association of residential moves with several important measures of health and healthcare among homeless or vulnerably housed individuals: problematic substance use, unmet physical and mental healthcare needs, and acute care utilization. Public housing, health care, and income support policies must focus on developing long-term, stable housing, for homeless and vulnerably housed populations. This study identified important risk factors that interact with housing instability and are associated with worsening health. Consideration must be given to those homeless or vulnerably housed persons with mental health problems, chronic health conditions, recent incarceration, and those who identify as Indigenous, as they have the highest risk for poor health outcomes.

Acknowledgements We would like to acknowledge the following individuals from our community partner organizations: Street Health—Laura Cowan, Erika Khandor, Stephanie Gee; PHS Community Services Society—Liz Evans, Clare Hacksel; Ottawa Inner City Health—Wendy Muckle. The authors also thank the study coordinators and interviewers in each of the three cities as well as the shelter, drop-in, and municipal and provincial staff for their assistance with participant recruitment and follow-up. We also thank Dr. Hubert Wong for his guidance on the statistical analyses. We are especially grateful to the Health and Housing in Transition study participants for their contribution to these data.

Funding This study was funded by the Canadian Institutes of Health Research Operating Grant Award Number: MOP-86765. This project was supported by an operating Grant (MOP-86765) and an Interdisciplinary Capacity Enhancement Grant on Homelessness, Housing and Health (HOA-80066) from the Canadian Institutes of Health Research. The Canadian Institute for Health Research had no role in the study design, in the collection, analysis or interpretation of data, in the writing of the report, or in the decision to submit the article for publication.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval and consent to participate All study participants provided informed written consent and were reimbursed $20 CDN for each interview. The Research Ethics Board at St. Michael's Hospital, the University of Ottawa, and the University of British Columbia approved this study. All procedures performed involving human participants in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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