Clinically significant substance use and residential stability among homeless or vulnerably housed persons in Canada: a longitudinal cohort study

Trudy E. Nasmith¹, Anne Gadermann², Denise Jaworsky¹, Monica Norena², Matthew J. To³, Stephen W. Hwang^{3,4}, Anita Palepu^{1,2}

¹Department of Medicine, University of British Columbia, Vancouver, BC V5Z 1M9, Canada

²Centre for Health Evaluation and Outcome Sciences, St. Paul's Hospital, Vancouver, BC V6Z 1Y6, Canada

³Centre for Research on Inner City Health, St. Michael's Hospital, Toronto, ON M5B 1W8, Canada

⁴Department of Medicine, University of Toronto, Toronto, ON M5G 2C4, Canada

Address correspondence to Trudy Nasmith, E-mail: trudynasmith@gmail.com.

ABSTRACT

Background We examined clinically significant substance use among homeless or vulnerably housed persons in three Canadian cities and its association with residential stability over time using data from the Health and Housing in Transition study.

Methods In 2009, 1190 homeless or vulnerably housed individuals were recruited in three Canadian cities and followed for 4 years. We collected information on housing and incarceration history, drug and alcohol use, having a primary care provider at baseline and annually for 4 years. Participants who screened positive for substance use at baseline were included in the analyses. We used a generalized logistic mixed effect regression model to examine the association between clinically significant substance use and residential stability, adjusting for confounders.

Results Initially, 437 participants met the criteria for clinically significant substance use. The proportion of clinically significant substance use declined, while the proportion of participants who achieved residential stability increased over time. Clinically significant substance use was negatively associated with achieving residential stability over the 4-year period (AOR 0.7; 95% CI 0.57, 0.86).

Conclusions In this cohort of homeless or vulnerably housed individuals, clinically significant substance use was negatively associated with achieving residential stability over time, highlighting the need to better address substance use in this population.

Keywords alcohol use, Canada, homeless, substance use, vulnerable population

Introduction

An estimated 235 000 Canadians experience homelessness each year and ~35 000 individuals are homeless on any given night.¹ Studies of United States (US) veterans and homeless populations in Australia have determined that substance use is associated with an increased risk of homelessness.^{2–5} The relationship appears to be bidirectional, leading to a repetitive cycle of substance use, homelessness, and further substance use.^{4,6,7} A recent Canadian study reported a 20–40% prevalence of substance use disorder among the homeless or vulnerably housed in five cities.⁸ Among street-involved youth, higher levels of alcohol and illicit drug use were associated with unstable housing,^{9,10} and the continued use of illicit substances

hindered the attainment of stable housing in Australian and US studies.^{3,6}

Substance use disorders and mental illness frequently coexist among homeless populations, contributing to significant health problems.¹¹ A systematic review of homelessness in high-income countries found that the most common

Trudy E. Nasmith, MDCM, Clinical Assistant Professor UBC

Anne Gadermann, PhD, Assistant Professor, UBC

Denise Jaworsky, MD, Clinical Instructor, UBC

Monica Norena, MSc, Statistician, CHEOS

Matthew J. To, Researcher, Centre for Urban Health Studies, St Michael's Hospital, Toronto

Stephen W. Hwang, MD, Director, MAP Centre for Urban Health Solutions

Anita Palepu, MD, Professor, UBC

mental health disorder was drug and alcohol use disorder.¹² Homeless or vulnerably housed persons generally have poorer health outcomes than the average population, and those with substance use disorders have higher mortality rates.¹³

Longitudinal data on homeless or vulnerably housed persons in Canada are limited. The At Home/Chez Soi study followed homeless individuals with mental health disorders for 2 years after randomization into a Housing First intervention or treatment as usual and found improved residential stability in the Housing First arm, with substance use not predictive of having poorer outcomes.^{14,15} A qualitative study of 43 Vancouver at home participants, however, found that reducing and controlling substance use were a challenge for many, and among those who lost their housing, heavy substance use was cited as the primary reason.¹⁶ This did not translate into differences in residential stability between participants who had concurrent substance use disorders and those who did not.¹⁷

The association of substance use with housing transitions over time in an observational setting in Canada has not been previously explored. The objective of this study was to examine the association of clinically significant substance use with achieving residential stability over a 4-year period in the Health and Housing in Transition (HHiT) study. We hypothesized that among homeless or vulnerably housed individuals who screened positive for substance use at baseline, those who did not report clinically significant substance use during follow-up were more likely to achieve residential stability than individuals with continued substance use.

Methods

This study used data from the HHiT study, a prospective cohort study of homeless or vulnerably housed single adults in the Canadian cities of Vancouver, Toronto and Ottawa. The design of the study has been previously described in detail.¹⁸

Participants and recruitment

In 2009, 596 homeless and 594 vulnerably housed single adults (18+ years) were enrolled. Homelessness was defined as living within the last 7 days at a shelter, public place, abandoned building, vehicle or someone else's place, and not having one's own place. Recruitment of homeless adults occurred at shelters and meal programs using sampling methods designed for this population.¹⁹ Vulnerably housed individuals were recruited at rooming houses, single room occupancy (SRO) hotels and meal programs. Individuals were considered vulnerably housed if they were living in their own

room or apartment but had been homeless and/or had two or more moves in the previous 12 months. 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.

Survey instrument

Full details of all survey instruments used in the HHiT study have been previously published.¹⁸ Immediately following recruitment and informed written consent, research personnel conducted structured in-person interviews. At baseline, data were collected on sociodemographic characteristics (age, gender, race/cultural group, education), number of chronic health conditions (0, 1, 2, ≥ 3), lifetime duration of homelessness and lifetime prevalence of diagnosis with a mental health problem. Chronic health conditions listed in the survey tool were adapted from the Canadian Community Health Survey²⁰ and included hypertension, heart disease, obstructive lung disease, cirrhosis, chronic diarrhea, viral hepatitis, peptic or duodenal ulcers, urinary incontinence, inflammatory bowel disease, arthritis, physical disabilities limiting mobility, human immunodeficiency virus, tuberculosis, epilepsy, fetal alcohol syndrome, migraines, traumatic brain injury, stroke, glaucoma, cataracts, hearing impairment, cancer, diabetes, anemia and dermatologic conditions. Mental health conditions were not included in chronic health conditions. Participants were asked about these mental health problems with the following question: 'Have you ever been diagnosed with a mental health problem?'

At baseline and each follow-up interview, participants were asked about their housing history using the Residential Time-Line Follow-Back Inventory²¹ (with a timeframe of past 24 months at baseline and past 12 months at follow-up interviews), having a primary care provider (PCP), substance use, incarceration history, income (all past 12 months) and employment (current and past 12 months). Follow-up interviews were conducted annually for 4 years. Participants provided information for multiple contacts as well as consent to track them through staff at shelters, meal programs, SRO hotels, drop-in centers and other community agencies. We also obtained contact information from provincial income assistance services for participants receiving this support. Participants provided aliases, nicknames or handles, as many participants were known on the street or by community agencies by these alternate names. Facebook was used to contact participants and was successful for the younger demographic in our sample. In this study we report the findings from the baseline and four subsequent follow-up interviews.

Table 1 Characteristics of homeless or vulnerably housed participants who had positive screening for DAST-10 and/or AUDIT at baseline ($n = 787$)

	Vancouver	Toronto	Ottawa	<i>P</i> -value ^a
<i>N</i> (screened positive at baseline)	307	218	262	
Clinically significant substance use (baseline), <i>n</i> (%)	174 (57)	114 (52)	149 (57)	0.53
Age in years (mean $\pm$ SD)	41 $\pm$ 9.7	42 $\pm$ 9	39 $\pm$ 11	0.02
Gender, <i>n</i> (%)				0.002
Male	192 (63)	156 (72)	199 (76)	
Female	115 (37)	62 (28)	63 (24)	
Ethnicity, <i>n</i> (%)				<0.0001
White	167 (56)	122 (57)	202 (78)	
Black/African–Canadian	8 (3)	29 (14)	8 (3)	
Indigenous	87 (29)	36 (17)	37 (14)	
Mixed ethnicity	25 (8)	16 (7)	10 (4)	
Other	10 (3)	11 (5)	3 (1)	
Ever diagnosed with a mental health problem, <i>n</i> (%)	169 (56)	93 (43)	166 (65)	<0.0001
Count of chronic health conditions median, <i>n</i> (%)				<0.0001
0	20 (7)	34 (16)	16 (6)	
1	57 (19)	47 (22)	54 (21)	
2	45 (15)	44 (20)	34 (13)	
≥ 3	185 (60)	93 (43)	158 (60)	
Housing status, <i>n</i> (%)				0.46
Vulnerably housed	154 (50)	101 (45)	119 (45)	
Homeless	157 (50)	125 (55)	143 (55)	
Marital status, <i>n</i> (%)				0.05
Single/never married	163 (53)	149 (66)	160 (61)	
Divorced/separated	79 (26)	47 (21)	59 (23)	
Widowed	13 (4)	5 (2)	4 (2)	
Married/common-law	30 (10)	15 (7)	16 (6)	
Partnered, not married	22 (7)	10 (4)	23 (9)	
Lifetime duration of homelessness (years), median (Q1–Q3)	4.0 (1.6–7.8)	4.0 (1.6–9.8)	2.8 (1.1–6.5)	0.02
Employed in past 12 months, <i>n</i> (%)	131 (42)	75 (34)	112 (43)	0.1
Incarcerated in past 12 months, <i>n</i> (%)	92 (30)	76 (35)	103 (39)	0.08
Has a primary care provider, <i>n</i> (%)	208 (68)	135 (62)	144 (55)	0.009
Highest level of education, <i>n</i> (%)				0.51
High school or less	220 (72)	148 (68)	188 (72)	
Some postsecondary education or higher	85 (28)	70 (32)	73 (28)	
Monthly income, (CDN dollars) median (Q1–Q3)	1125 (722–1994)	821 (516–1426)	900 (530–1362)	0.0005

^aAppropriate test as per data (Fisher's exact test, chi-squared test, Wilcoxon or ANOVA). *P*-value < 0.01 statistically significant.

Main explanatory variables

We used the 10-item Drug Abuse Screening Test (DAST-10)^{22,23} to screen for illicit drug use (positive screen ≥ 3) and defined clinically significant drug use as a DAST-10 score ≥ 6 , which would merit intensive clinical assessment.²⁴ The Alcohol Use Disorders Identification Test (AUDIT),²⁵ a 10-item questionnaire, was used to screen for alcohol use disorder (positive screen ≥ 8), and we defined clinically significant alcohol use as an AUDIT score of ≥ 20 .²⁶ These instruments have been validated in previous studies of vulnerable popu-

lations.^{24,27} Our primary explanatory variable was clinically significant substance use, which we defined as having an AUDIT score of ≥ 20 and/or a DAST-10 score ≥ 6 at each follow-up interview.

Outcome variables

We classified the housing history data based on methods adapted from Tsemberis *et al.*²¹ Each residence in a participant's housing history was classified into one of 25 types of residences, which were then classified into one of three

Fig. 1 Clinically significant substance use by city and follow-up among HHIT participants who screened positive on DAST-10 and/or AUDIT at baseline.

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 using the methods found at <https://tsp.utoronto.ca/handle/1807/69938>. Participants were considered to have attained residential stability at each follow-up interview if they were housed and had been living in the same location for 6 months or more.

Statistical analysis

We included all participants who screened positive for drug and/or alcohol use by the DAST-10 and AUDIT criteria described above at baseline assessment. We excluded 12 self-identified transgender participants, who did not identify as male or female, and whose small number would not allow us to make predictions. Comparisons were made using the chi-squared test or Fisher's exact test (where appropriate) for categorical variables and one-way ANOVA for continuous variables. For missing data (i.e. participant did not know or refused to answer), the denominators were adjusted accordingly. We used a generalized logistic mixed effect regression model to examine the association between clinically significant substance use and residential stability where the clusters were the multiple observations collected per participant. We adjusted for the following potential confounding factors as fixed effects: city of recruitment, age, gender, self-identified racial/cultural group, highest level of education (completed high school or less versus postsecondary), number of chronic health conditions, lifetime duration of homelessness and having been diagnosed with a mental health problem. The following were entered as time-varying covariates: clinically

Fig. 2 Residential stability by city and follow-up among HHIT participants who screened positive on DAST-10 and/or AUDIT at baseline.

significant substance use (AUDIT score of ≥ 20 and/or a DAST-10 score ≥ 6 at each follow-up interview), median monthly income, employment, incarceration and having a PCP.

We examined selected interaction terms in the models to assess if the association of clinically significant substance use was modified by gender or having a PCP. Statistical significance was defined as having a P -value of <0.01 .

Results

At the baseline interview, 787/1178 (67%) HHIT participants screened positive for substance use (273 participants screened positive for both the DAST-10 and AUDIT, 349 screened positive for the DAST-10 alone, and 165 screened positive for the AUDIT alone). We achieved an average follow-up rate of $\sim 80\%$ over the 4-year period (supplementary figure). Table 1 compares the characteristics of the HHIT participants by city of recruitment. Participants from Toronto were more likely to be older, single or never married, to have a lower monthly income and a lower prevalence of having ≥ 3 chronic health conditions and less likely to have been employed or been diagnosed with a mental health problem compared to participants from Ottawa and Vancouver.

Figure 1 depicts the proportion of HHIT participants with clinically significant substance use at baseline and over the 4-year follow-up period stratified by recruitment city. In all cities the prevalence of clinically significant substance use declined over time: 57–42% in Vancouver; 52–33% in Toronto; and 57–37% in Ottawa. The proportion of participants who achieved residential stability increased over time in all three

Table 2 Distribution of HHIT participant characteristics among those achieving residential stability at each follow-up point*

<i>Residential stability Yes</i>	<i>FUP1 (n = 654) n = 291</i>	<i>FUP2 (n = 664) n = 362</i>	<i>FUP3 (n = 663) n = 359</i>	<i>FUP4 (n = 616) n = 335</i>
Clinically significant substance use ^b , n (%)	121 (42)	133 (37)	114 (32)	107 (32)
Age, mean $\pm$ SD (updated per follow-up)	44 (9)	44 (10)	45 (9)	47 (9)
Female, n (%)	105 (36)	132 (36)	133 (37)	120 (36)
Ethnicity				
White	173 (59)	216 (60)	234 (65)	209 (62)
Indigenous	75 (26)	82 (23)	71 (20)	73 (22)
Other	40 (14)	58 (16)	48 (13)	45 (13)
Ever diagnosed with a mental health problem, n (%)	165 (58)	202 (57)	210 (60)	184 (56)
At least three chronic health conditions, n (%)	190 (65)	214 (59)	217 (60)	197 (59)
Lifetime homeless duration, years, median (Q1–Q3)	3.1 (1.1, 7.2)	4 (1.4, 7.7)	3.6 (1.2, 7)	3.8 (1.2, 8.2)
Employed in the past 12 months ^a , n (%)	99 (34)	132 (37)	114 (32)	102 (31)
Incarceration in the past 12 months ^a , n (%)	64 (22)	48 (13)	34 (10)	33 (10)
Has a primary care provider ^a , n (%)	216 (74)	272 (75)	269 (75)	261 (78)
City, n (%)				
Toronto	81 (28)	110 (30)	99 (28)	93 (28)
Ottawa	83 (29)	102 (28)	110 (31)	107 (32)
Vancouver	127 (44)	150 (41)	150 (42)	135 (40)
Highest level of education, n (%)				
High school or less	198 (68)	246 (68)	249 (70)	230 (69)
Some postsecondary education or higher	92 (32)	115 (32)	107 (30)	103 (31)
Monthly income, (CDN dollars) median (Q1–Q3)	880 (568–1383)	900 (560–1450)	900 (563–1369)	900 (566–1358)

*Denominators vary across follow-up interview points.

^aTime-varying variables.

P-value < 0.01 statistically significant.

cities as shown in Figure 2: 19–57% in Vancouver; 22–53% in Toronto and 13–52% in Ottawa.

Table 2 shows the distribution of participant characteristics associated with residential stability at each follow-up period. The proportion of HHIT participants with clinically significant substance use who achieved residential stability declined from follow-up at year 1 to year 4 (42–32%). The unadjusted and adjusted odds ratios and 95% confidence intervals (95% CI) are presented in Table 3. Clinically significant substance use was negatively associated with achieving residential stability over the four-year follow-up period (Adjusted Odds Ratio [AOR] 0.7; 95% CI 0.57, 0.86). Other factors independently associated with residential stability were older age (AOR 1.02; 95% CI 1.01, 1.03), female gender (AOR 1.44; 95% CI 1.12, 1.86) and having a PCP (AOR 1.47; 95% CI 1.18, 1.84). A history of incarceration in the past 12 months was negatively associated with achieving residential stability over time (AOR 0.37; 95% CI 0.29, 0.47). The association of clinically significant substance use with residential stability was not modified by gender or having a PCP in the multivariate model (data not shown).

Discussion

Main findings

In this Canadian longitudinal cohort study, clinically significant substance use was independently and negatively associated with achieving residential stability. Certain factors were positively associated with residential stability. Being female, having older age and having a PCP were associated with higher odds of achieving housing stability, whereas incarceration in the last 12 months was negatively associated with residential stability.

What is already known on this topic

Clinically significant substance use has been shown to be negatively correlated to housing stability in other prospective studies in the USA, Europe and Australia.^{2–5,28} Among the Vancouver at home participants who were unable to maintain stable housing, interviewees identified ‘heavy substance use’ as the main driver behind this outcome.¹⁶ In the USA, data from the Department of Housing and Urban Development—Veterans Affairs Supported Housing initiative

Table 3 Multivariable logistic regression random effects model to estimate the independent effect of clinically significant substance use on residential stability over time^a

<i>Variables</i>	<i>Unadjusted odds ratio (95% CI)</i>	<i>Adjusted odds ratio* (95% CI)</i>	<i>Adjusted odds ratio (95% CI)</i>
Clinically significant substance use ^b	0.64 (0.53, 0.78)	0.73 (0.59, 0.89)	0.7 (0.57, 0.86)
Age	1.03 (1.02, 1.04)	1.02 (1.01, 1.03)	1.02 (1.01, 1.03)
Female	1.7 (1.35, 2.14)	1.49 (1.16, 1.91)	1.44 (1.12, 1.86)
Ethnicity			
White	REF	REF	REF
Other	0.87 (0.65, 1.19)	0.91 (0.67, 1.24)	0.86 (0.63, 1.18)
Indigenous	1.11 (0.85, 1.45)	1.09 (0.83, 1.44)	1.03 (0.78, 1.37)
Ever diagnosed with a mental health problem*	1.14 (0.91, 1.42)	1.11 (0.89, 1.4)	1.14 (0.9, 1.43)
At least three chronic health conditions	1.42 (1.14, 1.76)	1.25 (0.99, 1.57)	1.26 (0.99, 1.59)
Lifetime homeless duration	0.99 (0.98, 1.01)	0.99 (0.97, 1.01)	0.99 (0.97, 1)
Employed in the past 12 months ^b	0.83 (0.68, 1.01)	0.95 (0.77, 1.18)	0.94 (0.76, 1.17)
Incarceration in the past 12 months ^b	0.32 (0.26, 0.41)	0.37 (0.29, 0.47)	0.37 (0.29, 0.47)
Has a primary health provider ^b	1.76 (1.43, 2.16)	1.45 (1.16, 1.8)	1.47 (1.18, 1.84)
Time	1.14 (1.06, 1.23)	1.09 (1, 1.18)	1.08 (0.99, 1.17)
City			
Toronto	REF	REF	REF
Ottawa	0.76 (0.58, 1.00)	0.77 (0.57, 1.03)	0.75 (0.56, 1)
Vancouver	1.14 (0.88, 1.47)	1.01 (0.77, 1.33)	1.04 (0.79, 1.38)
Highest level of education			
High school or less	0.85 (0.67, 1.08)		0.94 (0.74, 1.2)
Some postsecondary education or higher	REF		REF
Monthly income (per thousand CDN dollars)	0.95 (0.90, 0.99)		0.98 (0.93, 1.02)

^aThe multivariable model used 93% of 2597 observations over the 4 years of follow-up due to missing data.

^bTime-varying variables.

Bold values indicate *P*-value < 0.01 as statistically significant.

(HUD–VASH) also demonstrated substance use disorder as a risk factor for shorter duration of stable housing.²⁹ Other Canadian studies have also corroborated the finding that being female is positively associated with residential stability.³⁰ Possible explanations for this finding include specific housing programs for women, e.g. those for victims of domestic abuse, leading to more housing opportunities.

Older age was also associated with residential stability. Cognitive function has been linked to residential stability in the US setting, with poorer cognition leading to worse housing outcomes.³¹ Older homeless populations have been defined as ≥50 years, due in part to the higher rates of early mortality compared to the general population.³² The HOPE HOME evaluated cognitive impairment in a group of homeless adults ≥50 years (mean age 58 years) and found that they had a prevalence of cognitive impairment 3–4 times higher than the general population aged ≥70 years.³³ As the mean age of our study's participants achieving residential stability was 47 years by follow-up year 4, we can postulate that age-associated

cognitive decline is not yet a major factor and that older participants may have more executive or life skills than younger participants.

We found that incarceration in the last 12 months was negatively associated with residential stability. Incarceration has been shown to be a risk factor for homelessness among US veterans,³⁴ but analyses of the HUD–VASH data did not find an association between incarceration and increased unstable housing.³⁵ The HUD–VASH program offers housing rental assistance combined with case management and clinical services for homeless veterans, with greater emphasis on serving specific subpopulations including chronically homeless adults and those with mental illness and addiction disorders.²⁹ As this finding differed greatly from the existing literature, the authors concluded that the HUD–VASH program was a successful model for prevention of housing exits based on incarceration history.³⁵ A number of studies have demonstrated a relationship between incarceration and homelessness.^{36,37} Difficult childhood trauma³⁸ and

experiencing incarceration as a youth³⁰ were associated with transitioning to homelessness as an adult. The success of the HUD–VASH program points to the need for additional supports to help persons who are homeless or vulnerably housed in their transition out of prison.

What this study adds

Having a PCP was positively associated with achieving residential stability. Although studies have shown an association between having a PCP and decreasing unmet health care needs,³⁹ none have demonstrated a link to residential stability. Possible explanations include having the PCP act as a broker and advocate for the participant by liaising with housing resources as well as social and support workers or those individuals with PCPs have greater financial resources or higher level of functioning.

Although our observational prospective cohort study did not offer any intervention to participants, overall clinically significant substance use declined over the 4-year follow-up period. These results are similar to those described by Somers *et al.*, where a significant and equal reduction in substance use was observed among both intervention and treatment as usual participants of the Vancouver at home study.¹⁷ In contrast, the HUD–VASH program demonstrated lower substance use in the intervention group when compared to the two control groups.⁴⁰ These findings suggest the possibility that effective community programs may already exist, which could be scaled up or adapted into other interventions for maximal effect.

Strengths of our study include sampling from three Canadian cities of differing sizes, the large cohort of participants from homeless or vulnerably housed populations, the length and completion of follow-up and the use of time-varying covariates. Our cohort's demographics are similar to those of current Canadian homeless populations,¹ making our study's findings relevant to future projects.

Limitations of this study

Our study had some limitations. As with any questionnaire, social desirability bias may have led to underreporting substance use, leading to lower prevalence levels. Additionally, participants were excluded at the time of recruitment if they were unable to provide informed consent due to the effects of substance use, potentially restricting the number of participants with clinically significant substance use. Given the observational design of this study, we cannot infer a direct causal relationship between substance use and homelessness. We are also unable to determine whether our participants were engaged with or enrolled in other studies or programs with interventions for substance use or other health problems.

In conclusion, clinically significant substance use among homeless or vulnerably housed persons was associated with a reduced likelihood of residential stability, whereas female gender and having a PCP increased the likelihood of residential stability over time. Further research is needed to determine whether better access and integration of addiction treatment programs into supportive housing initiatives can improve residential stability in this population and improve both housing and health outcomes.

Acknowledgements

We would like to acknowledge the following individuals from our community partner organizations: Street Health—Laura Cowan, Erika Khandor and Stephanie Gee; PHS Community Services Society—Liz Evans and Clare Hacksel; and 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 HHiT study participants for their contribution to these data.

Supplementary data

Supplementary data are available at the *Journal of Public Health* online.

Funding

This work 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 (Ottawa, Ontario).

Conflict of interest

The authors declare that they have no competing interests. The authors alone are responsible for the content and writing of this paper. 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.

References

- 1 Gaetz S, Gulliver T, Richter T. *The State of Homelessness in Canada: 2014*. Toronto: The Homeless Hub Press, 2014.
- 2 McVicar D, Moschion J, van Ours JC. From substance use to homelessness or vice versa? *Soc Sci Med*. 2015;136-137:89–98.

- 3 Tsai J, Kaspro WJ, Rosenheck RA. Alcohol and drug use disorders among homeless veterans: prevalence and association with supported housing outcomes. *Addict Behav* 2014;**39**(2):455–60.
- 4 Zerger S. Housing: a fundamental component of drug policy. *Int J Drug Policy* 2012;**23**(2):91–3.
- 5 Edens EL, Kaspro W, Tsai J *et al.* Association of substance use and VA service-connected disability benefits with risk of homelessness among veterans. *Am J Addict* 2011;**20**(5):412–9.
- 6 Johnson G, Chamberlain C. Homelessness and substance abuse: which comes first? *Aust Social Work* 2008;**61**(4):342–56.
- 7 Orwin RG, Scott CK, Arieira C. Transitions through homelessness and factors that predict them: three-year treatment outcomes. *J Subst Abuse Treat* 2005;**28**(Suppl 1):S23–39.
- 8 Stergiopoulos V, Hwang SW, Gozdzik A *et al.* Effect of scattered-site housing using rent supplements and intensive case management on housing stability among homeless adults with mental illness: a randomized trial. *JAMA* 2015;**313**(9):905–15.
- 9 Roy E, Robert M, Vaillancourt E *et al.* Residential trajectory and HIV high-risk behaviors among Montreal street youth—a reciprocal relationship. *J Urban Health* 2011;**88**(4):767–78.
- 10 Roy E, Robert M, Fournier L *et al.* Residential trajectories of street youth—the Montreal cohort study. *J Urban Health* 2014;**91**(5):1019–31.
- 11 Hwang SW. Homelessness and health. *CMAJ* 2001;**164**(2):229–33.
- 12 Fazel S, Geddes JR, Kushel M. The health of homeless people in high-income countries: descriptive epidemiology, health consequences, and clinical and policy recommendations. *Lancet* 2014;**384**(9953):1529–40.
- 13 Beijer U, Andreasson S, Agren G *et al.* Mortality and causes of death among homeless women and men in Stockholm. *Scand J Public Health* 2011;**39**(2):121–7.
- 14 Goering PN, Velchuizen S, Watson A. *et al.* National At Home/Chez Soi Final Report Calgary, AB: Mental Health Commission of Canada, 2014. Available from: <http://www.mentalhealthcommission.ca>.
- 15 Aubry T, Nelson G, Tsemberis S. Housing first for people with severe mental illness who are homeless: a review of the research and findings from the at Home-chez Soi demonstration project. *Can J Psychiatry* 2015;**60**(11):467–74.
- 16 Patterson ML, Currie L, Rezanoff S *et al.* Exiting homelessness: perceived changes, barriers, and facilitators among formerly homeless adults with mental disorders. *Psychiatr Rehabil J* 2015;**38**(1):81–7.
- 17 Somers JM, Moniruzzaman A, Palepu A. Changes in daily substance use among people experiencing homelessness and mental illness: 24-month outcomes following randomization to housing first or usual care. *Addiction* 2015;**110**(10):1605–14.
- 18 Hwang SW, Aubry T, Palepu A *et al.* The health and housing in transition study: a longitudinal study of the health of homeless and vulnerably housed adults in three Canadian cities. *Int J Public Health* 2011;**56**(6):609–23.
- 19 Ardilly P, Le Blanc D. Sampling and weighting a survey of homeless persons: a French example. *Survey Methodol* 2001;**27**(1):109–18.
- 20 Statistics Canada. Canadian Community Health Survey: Annual Component. 2012. <http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=135927>. (23 January 2020, date last accessed).
- 21 Tsemberis S, McHugo G, Williams V *et al.* and residential stability: the residential time-line follow-back inventory. *J Commun Psychol* 2007;**35**(1):29–42.
- 22 French MT, Roebuck MC, McGeary KA *et al.* Using the drug abuse screening test (DAST-10) to analyze health services utilization and cost for substance users in a community-based setting. *Subst Use Misuse* 2001;**36**(6–7):927–46.
- 23 Yudko E, Lozhkina O, Fouts A. A comprehensive review of the psychometric properties of the drug abuse screening test. *J Subst Abuse Treat* 2007;**32**(2):189–98.
- 24 Maisto SA, Carey MP, Carey KB *et al.* Use of the AUDIT and the DAST-10 to identify alcohol and drug use disorders among adults with a severe and persistent mental illness. *Psychol Assess* 2000;**12**(2):186–92.
- 25 Barbor TF, de la Fuente JR, Saunders J *et al.* *AUDIT: the alcohol use disorders identification test: guidelines for use in primary health care*. Geneva, Switzerland: World Health Organization, 1992.
- 26 Donovan DM, Kivlahan DR, Doyle SR *et al.* Concurrent validity of the alcohol use disorders identification test (AUDIT) and AUDIT zones in defining levels of severity among out-patients with alcohol dependence in the COMBINE study. *Addiction* 2006;**101**(12):1696–704.
- 27 Winn JL, Shealy SE, Kropp GJ *et al.* Housing assistance and case management: improving access to substance use disorder treatment for homeless veterans. *Psychol Serv* 2013;**10**(2):233–40.
- 28 Van Straaten B, Rodenburg G, Van der Laan J *et al.* Substance use among Dutch homeless people, a follow-up study: prevalence, pattern and housing status. *Eur J Public Health* 2016;**26**(1):111–6.
- 29 O'Connell MJ, Kaspro W, Rosenheck RA. Rates and risk factors for homelessness after successful housing in a sample of formerly homeless veterans. *Psychiatr Serv* 2008;**59**(3):268–75.
- 30 Cheng T, Wood E, Feng C *et al.* Transitions into and out of homelessness among street-involved youth in a Canadian setting. *Health Place* 2013;**23**:122–7.
- 31 Gabrielian S, Burns AV, Nanda N *et al.* Factors associated with premature exits from supported housing. *Psychiatr Serv* 2015;**67**(1):86–93.
- 32 Grenier A, Barken R, Sussman T *et al.* A literature review of homelessness and aging: suggestions for a policy and practice-relevant research agenda. *Can J Aging = La revue canadienne du vieillissement* 2016;**35**(1):28–41.
- 33 Hurstak EE, Johnson JK, Tieu L *et al.* Factors associated with cognitive impairment in a cohort of older homeless adults: Results from the HOPE HOME study. *Drug Alcohol Dependence* 2017;**178**:562–70.
- 34 Argintaru N, Chambers C, Gogosis E *et al.* A cross-sectional observational study of unmet health needs among homeless and vulnerably housed adults in three Canadian cities. *BMC Public Health* 2013;**13**(1):577.

- 35 Tsai J, Rosenheck RA. Risk factors for homelessness among US veterans. *Epidemiol Rev* 2015;**37**:177–95.
- 36 Tejani N, Rosenheck R, Tsai J *et al*. Incarceration histories of homeless veterans and progression through a national supported housing program. *Commun Ment Health J* 2014;**50**(5): 514–9.
- 37 Kushel MB, Hahn JA, Evans JL *et al*. Revolving doors: imprisonment among the homeless and marginally housed population. *Am J Public Health* 2005;**95**(10):1747–52.
- 38 McNiel DE, Binder RL, Robinson JC. Incarceration associated with homelessness, mental disorder, and co-occurring substance abuse. *Psychiatr Serv* 2005;**56**(7):840–6.
- 39 Saddichha S, Fliers JM, Frankish J *et al*. Homeless and incarcerated: an epidemiological study from Canada. *Int J Soc Psychiatry* 2014;**60**(8):795–800.
- 40 Cheng AL, Lin H, KasproW W *et al*. Impact of supported housing on clinical outcomes: analysis of a randomized trial using multiple imputation technique. *J Nerv Ment Dis* 2007;**195**(1):83–8.