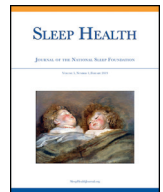




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Longitudinal effects of permanent supportive housing on insomnia for homeless adults

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ABSTRACT

Objectives: To examine the longitudinal change in insomnia as adults transition from homelessness to permanent supportive housing (PSH) and whether additional factors may moderate this relationship.

Methods: Standardized interviews were conducted with 331 homeless participants in Los Angeles prior to moving into PSH. Outcomes were measured 3, 6, and 12 months after move-in. Insomnia was assessed using the Sleep Condition Indicator, which is a 2-item validated short-form inventory that is intended to be used in clinical settings as a brief screening instrument for insomnia. Mixed-effects models were used to examine insomnia across all 4 measurement points and to test for interactions between time and covariates.

Results: Participants were on average approximately 55 years old and had spent an average of 5.6 years homeless in their lifetime, with approximately 70% identifying as male. Sixty-two percent of the sample screened positive for insomnia disorder at baseline. There was a significantly reduced likelihood of insomnia at each measurement period compared to baseline, but no differences were found between 3, 6, and 12 months. Mental health symptoms, physical health comorbidities, tobacco consumption, and female gender were associated with an increased likelihood of insomnia.

Conclusion: Findings indicate a significant decrease in insomnia after moving into PSH, regardless of time spent homeless.

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Introduction

Homelessness—both sheltered and unsheltered—is associated with poor sleep quality and insufficient duration.^{1–3} *Insomnia*, which refers to dissatisfaction with sleep quantity or quality,⁴ can both contribute to and be a consequence of disproportionately high rates of disease found among adults experiencing homelessness, including obesity, hypertension, cancer, and depression; it can also contribute to early mortality that is well documented in this population.^{4–6} Permanent supportive housing (PSH) using a housing-first approach is regarded as an evidence-based intervention to end homelessness by providing low-barrier affordable housing paired with flexible health and social services.⁷ Although PSH has been credited with a decline in the number of chronically homeless adults in the United States since 2007,⁸ a recent consensus study report from the National Academies of Sciences, Engineering, and Medicine concluded that current evidence that PSH improves health in

general—and sleep in particular—is lacking.⁹ The primary objective of the current study was to examine longitudinal change in insomnia as adults transition from homelessness to PSH and whether additional factors may moderate the relationship between housing and insomnia for persons who have experienced homelessness. Specifically, we hypothesized that screening positive for insomnia would be mitigated upon entry to PSH and that the relationship between housing status and insomnia would be moderated by mental health symptoms, physical health conditions (eg, hypertension), and alcohol and tobacco consumption, all of which are experienced at disproportionately high rates among homeless and recently housed adults.^{6,10}

Participants and methods

As part of a larger study of HIV risk behavior, standardized interviews were conducted with 421 homeless participants prior to moving into PSH between August 2014 and January 2016.¹¹ Participants were recruited from 26 PSH organizations in Los Angeles via agency referrals and direct outreach during known move-in events (eg, when a new building opened and all or most residents attended an

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orientation to sign paperwork and receive keys). People were eligible for participation if they were at least 39 years old, were currently homeless, spoke English or Spanish, were moving into PSH within 20 miles of downtown Los Angeles, and had no minor children moving into PSH with them. Given that the larger study focused on HIV risk behavior outcomes, the nonparenting restriction and minimum age of 39 (thereby turning 40 during the course of the study) were chosen to reduce variability in HIV risk behavior owing to differing developmental stages within the life course. Outcomes were measured again at 3, 6, and 12 months after move-in. All participants provided informed consent, and this study was approved by the institutional review board from the University of Southern California.

For this study, we included 331 adults who moved into PSH between baseline and 3-month interviews, had no self-reported history of sleep apnea, and reported male or female gender. The average time between baseline interview and PSH move-in was 25.3 days (SD = 27.3; range = 0-134; median = 15). Insomnia was assessed using the Sleep Condition Indicator, which is a 2-item validated short-form inventory that is intended to be used in clinical settings as a brief screening instrument of insomnia ($\alpha = .84$).¹² Responses to the number of nights with problematic sleep (ie, "In the past month, on average, how many nights a week have you had problems with your sleep?") were coded such that 0 = greater than 4 nights, 1 = 4 nights, 2 = 3 nights, 3 = 2 nights, and 4 = less than 2 nights. The extent to which sleep bothered participants (ie, "Thinking about the past month, to what extent has poor sleep troubled you in general?") was coded 0-4 corresponding to Likert-style responses (ie, "much," "very much," "somewhat," "a little," "not at all"). The 2 items were summed such that lower scores indicate worse sleep and transformed to age-sex reference categories suggestive of clinical insomnia.¹³

Each interview also assessed for self-reported alcohol and tobacco consumption (ie, never, monthly, weekly, or daily use during the past 3 months) with an adapted item from the National Institute on Drug Abuse quick screener.¹⁴ Severity of mental health symptoms was measured with the Modified Colorado Symptom Index ($\alpha = .91$; higher scores indicate the presence of more mental health disorder symptoms).¹⁵ Health conditions were assessed by asking, "Has a doctor or other health professional ever told you that you had any of the following conditions?" with response options taken from the National Health Interview Survey.¹⁶

A mixed-effects model was used to test a positive screening of insomnia as the outcome and time (at baseline, 3 months, 6 months, and 12 months) as the predictor. The model adjusted for age, sex, education, race, years of homelessness, alcohol and tobacco consumption, and number of mental and physical health comorbidities at baseline. Multiple imputation was used to assign values to 5.1% (n = 68) of data available; analyses were conducted with 1324 observations across 4 time points. Additional mixed-effects models tested for interactions between time and each covariate (eg, age, sex).

Results

Table 1 provides descriptive statistics for subject-level variables and repeated measures at baseline, 3 months, 6 months, and 12 months. At baseline, participants were on average approximately 55 years old (range: 39-82 years old) and had spent an average of 5.6 years homeless in their lifetime (range: 0-44 years homeless), with approximately 70% identifying as male and 30% identifying as female. Approximately 20% of participants were white and 80% reported a nonwhite racial/ethnic identity. More than 50% of the sample had some college education and 27% had high school degrees, whereas 18% had never completed high school. Of 298 participants that reported results from an HIV test, 9.4% (n = 28) indicated positive HIV status at baseline. Participants reported approximately 3 physical health conditions (range: 0-9 conditions) and 3 mental

Table 1
Descriptive statistics of homeless adults placed in PSH

	M or n	SD or %
Subject-level variables (n = 331)		
Age at baseline	54.81	7.35
Gender		
Female	96	29.0
Male	235	71.0
Race		
White	72	21.8
Nonwhite minority	259	78.3
Education		
No high school degree or equivalent	61	18.4
High school degree or equivalent	89	26.9
At least some college	181	54.7
Years spent homeless ^a	5.64	6.64
HIV positive	28	9.4
Chronic physical health conditions	3.14	1.72
Chronic mental health conditions	2.92	2.17
Observation-level variables (n = 1324)		
Mental health symptom score ^{b,c}		
Baseline	21.59	12.89
3 mo	18.28	12.15
6 mo	18.61	13.53
12 mo	17.48	13.35
3-mo alcohol recall (weekly use or >)		
Baseline	110	33.2
3 mo	110	33.2
6 mo	108	32.6
12 mo	110	33.2
3-mo tobacco recall (weekly use or >)		
Baseline	187	56.5
3 mo	180	54.4
6 mo	178	53.8
12 mo	174	52.6
Sleep score category (positive screening for insomnia) ^d		
Baseline	204	61.6
3 mo	157	47.4
6 mo	149	45.0
12 mo	142	42.9

^a Three individuals did not report years homeless.

^b Fifty-six missing observations for missing mental health symptom scores.

^c Modified Colorado Symptom Index.⁸

^d Sleep Condition Indicator,⁶⁻⁷ coded as positive vs negative screening for insomnia.

health conditions (range: 0-7 conditions) on average, with an average mental health symptom score of 19.03 (SD = 13.06) across all measurement periods (range: 0-54). Compared to baseline, there was a significant reduction in mental health symptom score at each subsequent time point (*t* values = -3.24, -2.91, -3.99, respectively; *P* values < .01). The most common chronic physical health diagnoses at baseline were hypertension (52%), arthritis (41%), respiratory conditions (29%), and diabetes (24%). Throughout the study, typically consuming alcohol weekly or more than weekly over the past 3 months was reported 33% of the time (n = 438), and weekly or more than weekly tobacco use over the past 3 months was reported 54% of the time (n = 719). There were no significant changes in alcohol or tobacco use over time (*P* values > .05).

Sixty-two percent of the sample screened positive for insomnia at baseline. At 3 months post move-in, 24% fell below and 10% rose above the threshold for insomnia compared to baseline, resulting in 47% of participants screening positive for insomnia. At 6 months, 14% fell below and 12% rose above the threshold for insomnia compared to 3 months, resulting in 45% of participants screening positive for insomnia. At 12 months, 15% fell below and 13% rose above the threshold for insomnia compared to 6 months, resulting in 43% of participants screening positive for insomnia. Throughout the study, 22% of the sample consistently screened positive for insomnia. After adjusting for all covariates, models revealed a significantly reduced likelihood of screening positive for insomnia at each measurement period compared

Table 2

Results of mixed-effects logistic regression testing change in positive screening for insomnia^a over time among homeless adults after placement in PSH.

	OR	95% CI	P
Interview			
Baseline	Ref.		
3 mo	0.51	0.34-0.78	.002
6 mo	0.43	0.28-0.65	<.001
12 mo	0.41	0.27-0.63	<.001
Age	0.98	0.95-1.02	.288
Gender			
Female	Ref.		
Male	0.50	0.29-0.87	.015
Race			
White	Ref.		
Nonwhite minority	0.68	0.38-1.21	.187
Education			
No high school degree or equivalent	Ref.		
High school degree or equivalent	0.93	0.45-1.93	.842
At least some college	1.14	0.59-2.19	.705
Years of homelessness ^b	0.99	0.96-1.03	.757
Mental health symptom score ^{c,d}	1.09	1.07-1.11	<.001
Chronic physical health conditions	1.19	1.02-1.37	.022
Chronic mental health conditions	1.00	0.88-1.15	.951
3-mo alcohol recall			
Less than weekly	Ref.		
Weekly or more	1.41	0.93-2.12	.101
3-mo tobacco recall			
Less than weekly	Ref.		
Weekly or more	2.12	1.36-3.29	.001

Subject level, n = 331; observation level, n = 1324. Model was estimated using 10 multiple imputations, largest fraction of missing information = .054, and average relative variance increase = .0073.

^a Insomnia measured with Sleep Condition Indicator,⁶⁻⁷ coded as positive vs negative screening for insomnia.

^b Imputed 12 observations.

^c Imputed 56 observations.

^d Modified Colorado Symptom Index.⁸

to baseline (Table 2; $P < .01$). Sidak-adjusted pairwise comparisons revealed no differences in rates of insomnia between 3, 6, and 12 months (Fig. 1). Mental health symptoms, physical health comorbidities, 3-month tobacco consumption, and female gender were associated with an insomnia (Table 2, $P < .05$). No statistically significant interactions emerged between time and covariates ($P > .05$).

Discussion

This is one of few studies that have examined the prevalence of sleep problems among adults experiencing homelessness¹⁻³ and

the first study to examine the impact of PSH on insomnia. Previous studies of adults living in shelters in the United States found that less than half (47.2%) reported sleeping the recommended 7-9 hours a night² and that poor sleep quality, short sleep duration, and excessive daytime sleepiness were prevalent at rates almost double of those reported in the general population.^{2,3} A study by Leger and colleagues in France similarly found that people experiencing homelessness report sleeping less and are more likely to report insomnia and daytime fatigue than persons in the general population. This study also found that unsheltered adults experiencing homelessness report higher rates of insomnia (45.0%) than those in shelter settings.¹ The findings from the current study indicate high rates of insomnia with 62% of the sample screening positive for insomnia while experiencing homelessness. However, there was a significant reduction in rates of insomnia after moving into PSH, regardless of a person's lifetime years of experiencing homelessness. Despite this significant improvement in sleep after moving into PSH, many respondents reported persistent insomnia after housing, with more than 42% screening positive for insomnia at any given time point after being housed, which compares to an overall age-adjusted prevalence for insomnia in the past year of approximately 19% in a population-based sample of adults in the United States.¹⁷ Such high rates may reflect the high disease burden experienced by this population, aspects of their new sleeping environment in PSH, and/or individual health behaviors and habits.^{4,18} Although we did not find support for our moderating hypothesis that factors such as mental health would improve as sleep improved, an assessment of insomnia among this sample was associated with mental health symptoms, physical health comorbidities, and tobacco consumption, which is consistent with previous literature.¹⁹⁻²¹ This suggests that efforts to improve health and reduce tobacco use within PSH may have the added benefit of reducing high rates of insomnia.

Findings from this study suggest that just as there has been a push for PSH providers to become "trauma informed" to meet the needs of this population, there is a need for programs to become "sleep informed" by screening for sleep problems and promoting sleep hygiene. There is also a need to test existing evidence-based treatments for insomnia (eg, Cognitive Behavioral Therapy for Insomnia)²² with populations that have experienced homelessness. Given that PSH serves as a locus of psychosocial and health services, PSH provides unique opportunities to conduct sleep assessments and interventions that account for sleep environment (eg, light, noise, bedding), sleep practices (eg, bedtime routines, technology use), and underlying health and lifestyle issues,^{4,18} yet more research is needed.

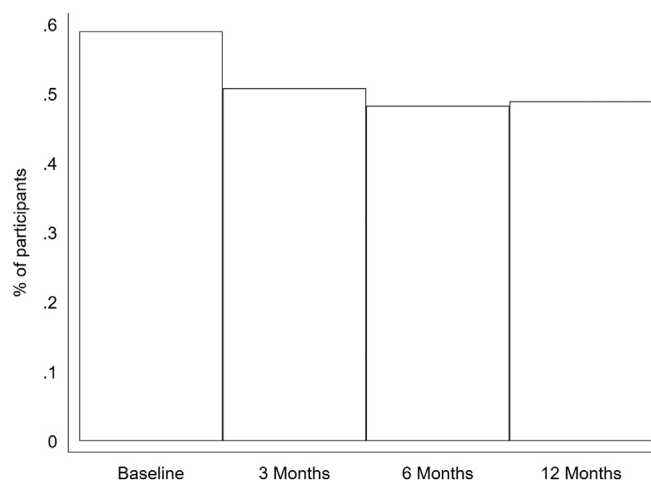


Fig. 1. Predicted marginal proportion of participants who screened positive for insomnia over 12 months.

The study is limited primarily by its quasi-experimental single-group design, although the longitudinal nature of the design and results indicate that the effect of PSH on rates of insomnia persisted over time. We also used a valid and reliable instrument that uses self-report to assess for insomnia disorder, yet more work is needed to assess its predictive validity with respect to independent clinical evaluations of insomnia.¹³ Additionally, it is not clear the extent to which our sample is representative of the overall population experiencing homelessness and whether the variance in our sample for mental health issues, alcohol use, and tobacco use is representative of all individuals moving into PSH. Items to measure substance use in this study only captured episodes of use, but the quantity consumed or the type of a specific substance (ie, cigarettes vs other nicotine products) was not recorded. We cannot determine how many cigarettes were smoked per week or how many drinks were consumed during each drinking event. Furthermore, risk behaviors may be underreported as evidenced by the higher rates of tobacco use found in other recent studies of homeless adult populations.^{23,24} Although clearly our findings are not generalizable to individuals younger than 39, participants in this study represent 52.6% of all individuals aged 39 or older who were entered into the Los Angeles County Homeless Management Information System (HMIS) in the same zip codes and PSH types (without dependent children) during the same time period based on data provided by the Los Angeles Homeless Services Authority. The mean age of people placed in PSH during the same time as our study was 47.7 (SD = 13.0) years, with 74.3% of those placed being older than 39 years. Although age, race, and ethnicity were similar across HMIS and study data, our sample was 29.0% female, whereas HMIS had a higher proportion (33.4%) of women.²⁵ Although this study begins to address the lack of evidence about the impact of PSH on sleep cited by the National Academies of Sciences, Engineering, and Medicine,⁹ additional sleep research using objective (eg, accelerometry) and subjective (eg, daily diary) tools is needed²⁶ to further understand the contextual and behavioral factors that influence sleep problems in PSH.

Conclusion

This study suggests that the provision of housing significantly reduces insomnia for people experiencing homelessness. This underscores the value of PSH not only to end homelessness but to improve sleep—a fundamental need that is not often explicitly addressed in homelessness research and policy. These findings also suggest that improvements in sleep are rapid and sustained over the first year that persons live in PSH. However, despite the improvements observed after moving into housing, rates of insomnia among tenants persisted at more than double the general population prevalence of insomnia.¹⁷ From a sleep health perspective, this implies that interventions to reduce insomnia among PSH tenants are needed as much or more than in the general population. This will likely become more apparent because PSH has been adopted by governments in the United States, Canada, Europe, and Australia as a leading approach to address homelessness. Overall, efforts to address insomnia among adults who have experienced long-term homelessness may help reduce health disparities and premature mortality that has been well-documented in this vulnerable population.^{27,28}

Conflict of interest

The authors have no other conflicts of interest to declare.

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