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Associations Between Different Types of Housing Insecurity and Future Emergency Department Use Among a Cohort of Emergency Department Patients

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Abstract

Housing insecurity can take multiple forms, such as unaffordability, crowding, forced moves, multiple moves, and homelessness. Existing research has linked homelessness to increased emergency department (ED) use, but gaps remain in understanding the relationship between different types of housing insecurity and ED use. In this study, we examined the association between different types of housing insecurity, including detailed measures of homelessness, and future ED use among a cohort of patients initially seen in an urban safety-net hospital ED in the United States between November 2016 and January 2018. We found that homelessness was associated with a higher mean number of ED visits in the year post-baseline. Other measures of housing insecurity (unaffordability, crowding, forced moves, and multiple moves) were not associated with greater ED use in the year post-baseline in multivariable models. We also found that only specific types of homelessness, primarily unsheltered homelessness, were associated with increased ED use.

Keywords

Homelessness; housing insecurity; emergency department use

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Background

Housing insecurity and health.

Multiple types of housing insecurity are associated with poor mental and physical health.[1] For example, people living in unaffordable housing have greater likelihoods of poor self-rated health, hypertension, and inability to afford needed health care.[2,3] Living in crowded conditions affects overall health and the spread of infectious disease.[4,5] Evictions are associated with greater odds of hospitalization for mental health[6] and reduced birthweight, shorter gestation, and increased infant mortality for those who were evicted while pregnant.[7] Youth experiencing an eviction have poorer health and mental health than youth who had not been evicted.[8,9]

Homelessness, the most severe manifestation of housing insecurity, is also associated with adverse health outcomes. People experiencing homelessness have higher rates of chronic medical conditions, such as diabetes, asthma, hypertension, mental illness, and substance use disorders, compared with housed individuals.[10–14] In a national survey, 44% of homeless individuals rated their health as poor or fair, compared with just 12% of the United States general population.[13] Several studies have estimated age-adjusted mortality rates among people experiencing homelessness compared to the general population. While specific estimates vary, all show much higher mortality among homeless populations. One recent study of homeless older adults in California estimated an age-standardized mortality rate 3.5 times higher than the general population.[15–18]

Housing insecurity and ED use.—The associations between homelessness and emergency department (ED) use are well documented,[19–23] and include greater odds of frequent ED use.[21,24,25] Reasons for ED visits among people experiencing homelessness include a high prevalence of health needs,[22,26–29] barriers to other forms of care,[19] and greater accessibility, acceptance, and agency associated with seeking care in the ED.[30] While EDs present a unique and valuable resource for providing low-barrier, rapid access to needed health care, policy makers, insurers, and healthy systems have expressed concerns about high rates of ED use.

Less is known about the relationships between non-homeless forms of housing insecurity and ED use,[31] despite evidence that ED patients have high rates of housing insecurity.[32] A small number of existing studies have found associations between unstable housing (defined in terms of inability to pay rent, the number of residential moves, forced moves, or doubling up) and increased acute care use, including diabetes-related ED use.[33–36] To our knowledge, however, no previous research has examined the associations between multiple manifestations of housing insecurity and ED use, such that different types of housing insecurity can be compared.

Gaps and framework.—There is no standardized definition of housing insecurity, and therefore it has been measured in a variety of ways spanning unaffordable housing, household crowding, frequent and/or forced moves (including evictions), and poor housing quality.[3,9,37,38] Despite often being studied as standalone concepts, a significant portion of renters in the United States experience simultaneous manifestations of housing insecurity of

varying degrees of severity.[38] Homelessness can be understood as the most severe form of housing insecurity and can also present in different ways, including sheltered or unsheltered, with each presenting unique challenges relating to health, such as navigating shelter rules (which may include curfews, bed access, and medication storage policies), seeking cover from the elements, and facing risks of victimization. As in the case of the broader concept of housing insecurity, clear and consistent definitions of homelessness are lacking in much research on homelessness and health outcomes.[39]

This study fills an important gap by examining associations between different types of housing insecurity, including different manifestations of homelessness, and prospective ED use. The included dimensions of housing insecurity draw on research that defines housing insecurity as a multidimensional concept with differential impacts on health.[38, 40, 41] To best isolate the role of housing insecurity on ED use, the analyses use Gelberg, Anderson, and Leake's Behavioral Model for Vulnerable Populations to identify individual-level characteristics that affect health services use and health status that might confound the relationship between housing insecurity and ED use.[42] While this study focuses primarily on individual-level housing insecurity and health-related characteristics, the authors acknowledge the role that structural factors play in producing both housing and health outcomes and inequities and discuss the results within this larger context.

Methods

Study design.

We used data from ED-CARES (Emergency Department Patient Characteristics Associated with Risk for Future ED and Shelter Use), a prospective cohort study in which ED patients completed a baseline questionnaire containing information about housing status, among other characteristics. The patients were followed longitudinally using New York State administrative data from the Statewide Planning and Research Cooperative System (SPARCS), which is a comprehensive all-payer data-reporting system that collects deidentified patient-level data on hospital inpatient stays and outpatient visits, including emergency department visits, including admission and discharge dates and diagnoses.[43]

Setting and participants.—Study participants were recruited from an urban, public hospital ED in New York City (NYC). Research assistants followed a random sampling scheme to approach ED patients from November 2016 through January 2018. Adult patients (18 years old) were eligible if they spoke English or Spanish, were medically or psychiatrically stable as determined by the research staff or treating clinicians (e.g., not in severe pain, intubated, in psychological distress), lived in NYC, were not in prison/police custody, and could understand the informed consent process.

Data linkage.—Baseline questionnaires for ED-CARES participants were linked with the SPARCS database by the NYC Center for Innovation through Data Intelligence (CIDI). This center is an agency in the Office of the Mayor that performs cross-sector data analysis to inform NYC policies and programs. It conducted deterministic matching using participant names, social security numbers (SSN), dates of birth (DOB), and gender to link ED-CARES baseline survey data with the SPARCS database. SPARCS contains an Enhanced Unique

Personal Identifier (EUPI) to allow data matching. New York State Department of Health redacts EUPIs for HIV/AIDS-related records, so those were not available for matching. Of the 2,312 unduplicated participants in the ED-CARES study, 1,783 were successfully matched to SPARCS data (77%) and formed the analytic sample. A de-identified dataset was used for analysis.

Measures.—Baseline survey questionnaires were administered verbally by trained, bilingual (English/Spanish) research assistants, who recorded responses using REDCap electronic data capture software.[44] The questionnaire included questions on demographics, past hospital use, physical and emotional health, substance use, current and past housing insecurity, income, and food insecurity, among other metrics. It has been described in more detail previously.[45]

The primary outcome of interest was the number of ED visits in the year following the patient's baseline ED visit (at which the ED-CARES questionnaire was completed), as documented in SPARCS. The independent variables of interest were five dimensions of housing insecurity as measured by self-report in the ED-CARES baseline questionnaire and detailed in Box 1: homelessness (self-report of sheltered and unsheltered status from the prior night or anytime in the past year), unaffordable housing (owing rent arrears or not having paid the full rent in the past year), overcrowded housing (having more than two people per bedroom), forced moves (current or past-year formal or informal eviction), and multiple moves (living in three or more places in the past year). Participants could report more than one type of housing insecurity. To further examine the impact of different types of homelessness on ED use, the variables used to construct the broad homelessness measure were combined into nine mutually exclusive categories. All variable measures draw on previous research operationalizing housing insecurity to align concepts as closely as possible to commonly used measures, given the available data.[38] For the housing-insecure groups found to have a significant association with prospective ED use, we additionally examined ED visit diagnosis categories as grouped by the Healthcare Cost and Utilization Project's (HCUP) Clinical Classifications Software Refined (CCSR) for ICD-10-CM Diagnoses.[46] The HCUP CCSR classifies diagnosis codes across 21 body systems and encompasses 530 clinical categories.

Multivariable analyses included potentially confounding variables based on the Gelberg, Anderson, and Leake Behavioral Model for Vulnerable Populations.[42] These variables included predisposing factors: age, gender, race/ethnicity, employment status, education, criminal justice history, victimization history; enabling factors: insurance status and trouble meeting basic expenses; and need factors relating to multiple self-reported health measures, using previously validated or widely used questionnaires. Overall health status including physical and mental health was measured using the CDC Health-Related Quality of Life "Healthy Days Measure" HRQOL-4.[47] Patients were asked whether they had chronic medical conditions (such as asthma, diabetes, liver disease, high blood pressure, seizures, HIV or AIDS, heart disease, and cancer) or mental health problems (such as depression, anxiety, panic attacks, schizophrenia, or bipolar disorder) using questions modified from the At Home / Chez Soi study, a large study of people who were homeless and mentally ill in Canada.[48] We used previously validated single-question screening tests for unhealthy

alcohol use and drug use.[49, 50] Patients screening positive for unhealthy alcohol use completed the AUDIT screening instrument.[51] Patients screening positive for any drug use completed the DAST-10 screening instrument.[52]

Analytic methods.—We used multivariable negative binomial regression models to examine the association between the five broad categories of housing insecurity and the number of ED visits in the 12 months after the baseline ED visit. We also estimated negative binomial models to examine the association between more detailed experiences of homelessness and the number of ED visits. First, we examined the unadjusted relationships between the housing variables and the number of ED visits. Then, we examined the relationship between the housing variables and the number of ED visits, adjusting for all potential confounders. We used robust standard errors for all analyses. We also ruled out multicollinearity among covariates by examining variance inflation factors for all included variables; all had values below two. Lastly, we examined HCUP diagnosis categories for housing insecurity groups with significantly higher ED use post-baseline and reported the top five diagnoses from the last recorded ED visit in the 12-month post-baseline period. In all reported results, any cell value referencing a sample size of 10 or fewer participants was suppressed, per New York State Department of Health policy.

Results

Of the 1,783 patients in the analytic sample, 917 (51%) reported some form of housing insecurity: 391 (22%) reported experiencing current or recent homelessness, 373 (21%) reported living in unaffordable housing, 201 (11%) reported living in crowded housing, 253 (14%) reported a recent forced move, and 241 (14%) reported three or more moves in the past year. Overall, there was a substantial amount of overlap among housing-insecure categories, particularly among homelessness, forced moves, and multiple moves. In total, 823 patients (49%) reported no housing insecurity. The mean number of ED visits post-baseline for the sample was six and the median was two. Post-baseline ED visit means and medians for each housing-insecure group are listed in Appendix Table 1.

Sociodemographic and health characteristics of the full sample are shown in Table 1. The mean age was 47; 43% of patients identified as women; 54% were Hispanic/Latinx; 24% were Black, non-Hispanic; 37% had less than a high school education; 26% had a lifetime history of incarceration; and 10% had experienced physical violence in the past year. Patients were primarily insured by Medicaid (47%, including dual Medicaid/Medicare) or were uninsured (24%). Most patients reported a chronic physical health diagnosis, including asthma, high blood pressure, or heart disease, among other conditions (75%) and 40% reported a mental health diagnosis. Sociodemographic and health characteristics varied by type of housing insecurity (Appendix Table 1). Patients experiencing homelessness reported the highest rates of physical and mental health diagnoses and the highest rates of incarceration history. They were also the most likely to be Black and to identify as men. Patients living in unaffordable housing had the highest rates of difficulty meeting basic expenses. Patients living in overcrowded housing were the youngest, the most likely to be women and Hispanic/Latinx, and the most likely to be uninsured. They were also the most likely to be working and to have less than a high school education. Patients reporting

multiple moves reported the highest rates of substance use. Sociodemographic and health characteristics by detailed homelessness status are presented in Appendix Table 2.

Controlling only for the five major insecure-housing conditions, patients reporting homelessness and multiple moves were the only housing-insecure groups who had a significantly higher average number of ED visits in the year post-baseline than their counterparts who reported no homelessness or multiple moves (p<.05, Table 2). After additionally adjusting for potentially confounding variables, only patients who reported homelessness had a statistically significantly higher number of ED visits in the year post-baseline. In analyses examining nine mutually exclusive and exhaustive combinations of homelessness categories (Table 3), only three sub-categories had significantly higher ED use in the year post-baseline than non-homeless patients: those who reported being unsheltered for the majority of nights in the past year and were also unsheltered the night before the interview; those whose only form of baseline homelessness was being unsheltered the previous night; and those who reported some drop-in center or shelter use in the past year, but not the majority of nights or the previous night. This last category includes a mixture of patients who spent the majority of nights in the past year in their own home, in someone else's home, or in an institution. Rates of institutionalization were higher for this group than for other homeless patient categories and the full sample. Notably, patients experiencing last night, or majority sheltered homelessness did not have a significantly higher mean number of ED visits in adjusted models than patients experiencing no homelessness.

Table 4 reports the top five most common ED visit diagnosis categories for the homeless categories with more frequent prospective ED use. Among all three categories combined, the most ascribed diagnosis was alcohol-related disorders. Other common diagnoses varied substantially among each group. For patients who were unsheltered for most of the previous year, disorders of the teeth and gingiva were particularly common. Of those who were unsheltered only the previous night, opioid-related disorders were the next most common diagnoses. Nonspecific chest pain was the second most common diagnosis among patients experiencing other types of homelessness.

Discussion

In this study we found that homelessness was the only housing insecurity category that had a relationship with increased ED use in the year following a baseline ED visit. Further, only certain types of homelessness were associated with increased ED use, predominantly unsheltered homelessness. Our findings are consistent with previous research demonstrating an association between homelessness and ED use but add more nuance than prior research in examining the relationship with different types of homelessness. Notably, homeless patients who were currently or consistently sheltered showed no difference in ED use from housed patients in multivariable models.

Many potential explanations arise when attempting to explain the relationship between unsheltered homelessness and ED use. Existing research points to lower rates of accessing primary and preventive care for unsheltered adults, including dental care,[14, 53] which may increase the need for ED-based care. In our study, unsheltered patients experienced a

wide range of conditions that brought them into the ED, including those that may be intricately related to the challenges of living on the streets (where options for bedding down are scarce and access to hygiene resources may be limited), such as trauma- and other stressor-related disorders, disorders of the teeth and gingiva, and pain. We also observed that unsheltered patients had a high prevalence of ED visits with a primary diagnosis of alcohol-related disorders, which may be related to the documented bidirectional relationship between homelessness and alcohol use,[54, 55] as well as to the practical reality that people experiencing unsheltered homelessness are often in places that are visible to the public, where their alcohol use may prompt ambulance transports to the ED for public intoxication.[54] More research is needed to better understand ED use among patients who do not report clear or consistent patterns of homelessness, but high rates of prior-year institutionalization may be one driving factor.

The absence of a relationship between sheltered homelessness and ED use may reflect on multiple factors. Research has shown that the primary driver of homelessness is a lack of affordable housing, rather than mental illness, substance use, or other health issues[56, 57] and in New York City, most people experiencing homelessness are sheltered, due to a legal right to shelter. Individuals who remain unsheltered may thus have more complex health and social needs that are not well met in the existing shelter system. Some of these are reflected in the confounding variables included in our models (including higher rates of lifetime incarceration, mental health diagnoses, and substance use), but other unmeasured confounders may influence both the decision or ability to enter shelter as well as ED use. Individuals in shelter may also have better access and linkages to health care services through referrals from shelter staff or onsite medical care, although these are not universally present across all shelters.

It is important to note that individual-level factors are not the only, nor are they necessarily the primary, factors at play in ED use among housing-insecure populations. Swope and Hernandez outline a conceptual model that illustrates how structural inequities shape housing circumstances, and how housing conditions interact with one another and other structural factors to produce health inequities.[40] Structural inequality and historic and contemporary exclusionary housing policies and practices that have spanned generations (including for example, exclusionary zoning, redlining, predatory lending, forced removal from native lands, and racist residential covenants) affect how housing resources are distributed and thus who is susceptible to housing insecurity.[58–61] We could not directly measure these structural forces and complex interactions in this study. Nonetheless, it is important to consider upstream interventions for improving health and health care among housing-insecure individuals.

To that end, this research adds additional evidence to the case for creating and strengthening policies and interventions that prevent and alleviate homelessness, and unsheltered homelessness in particular. One well-studied intervention is Housing First, an evidence-based policy that provides housing to homeless individuals (primarily those who are chronically homeless and with mental health and/or substance use needs) without preconditions for treatment or services. Existing research reliably shows that Housing

First improves housing retention and stability among formerly homeless individuals.[62, 63] Additionally, the provision of high-quality shelter that meets the needs of people experiencing homelessness may help prevent increased ED use in some cases, although our results do not allow us to ascertain whether the provision of shelter itself is protective against ED use, or if there are other unmeasured confounders at play that influence both the decision to enter shelter and future ED use. More research examining models of shelter that may be beneficial to the health of people experiencing homelessness is warranted, specifically models of shelter designed to meet the needs of unsheltered individuals with complex health and social needs. Other housing interventions that address homelessness and housing insecurity more broadly should also be considered. Policies that have been proposed at the national level include establishing a housing stabilization fund for households facing eviction, increasing access to legal assistance for tenants, strengthening and enforcing renter protections, building and preserving housing for people experiencing homelessness (including permanent supportive housing), and establishing a universal housing voucher program.[64]

On the health services side, this study could inform improvements to care for ED patients through attention to housing status, such as by adding housing navigator or social work resources in EDs to allow for assessments of patient housing status and referrals to appropriate resources at the time of an ED visit. This study highlights that attention should be paid to the type of housing insecurity experienced by patients when considering social needs screening tools and social need assistance linkages.[65] Additionally, low-barrier preventive care, such as that provided by street medicine teams, could work to treat some conditions before a need to present to the ED.[66] Notably, the majority of homeless patients, including those that were unsheltered, were insured by Medicaid, highlighting an opportunity to expand on recent investments by Medicaid to address health-related social needs, including programs to provide housing and related-services.[67]

Last, better coordination between health care and housing/homelessness systems could help researchers and policymakers better understand the myriad relationships between housing insecurity and health. For instance, better state, local, and federal data-tracking on evictions, forced moves, homelessness, and other measures of housing insecurity in combination with linked administrative data (including health records and insurance billing records) would be particularly useful for future research aiming to examine how different forms of housing insecurity may affect different health metrics beyond ED use.

Limitations.

Because the housing insecurity and homelessness variables used in this study were based on self-report from the baseline ED visit, we were unable to assess how changes in homelessness and housing insecurity affected ED use over time or to make causal inferences from the results. Future research focusing on housing as a social determinant of health should approach housing insecurity not as a static descriptor, but as a circumstance that can and does change over time. A longitudinal analysis of housing insecurity as it relates to health services use would allow for better understanding of the short, medium, and long-term effects of housing insecurity as well as the impacts of different lengths of exposure

to housing insecurity. Such a study would be logistically challenging and expensive to conduct, thus our unique methodology linking survey and administrative data, although with limitations, does add to the body of knowledge about ED use among the unstably housed and homeless in NYC. Relatedly, 23% of the ED-CARES sample did not match with the SPARCS database. Because we used deterministic matching, reasons for mismatch are likely related to errors in recording identifying information either in the ED-CARES survey or in the medical record, as well as data suppression.

Second, this research was conducted among ED patients from one safety-net hospital in New York City and may not be generalizable to other populations or locations, given that health care access, housing insecurity, and other health and social vulnerabilities vary greatly across geographic areas in the United States, and also given the unique homeless services environment in New York City. However, our findings are consistent with a wealth of research showing associations between homelessness and ED use.

Third, because our study is observational in nature, it is subject to unmeasured confounding, meaning that there may be other factors that influence both homelessness and ED use, which may explain some of the observed relationships, but which we are not able to identify.

Last, we note that sampling from an ED, as we did in the current study, will by its nature result in "oversampling" individuals with more frequent ED use compared with the general population and likely explains the relatively high rates of next-year ED use observed in this study even for patients without reported housing insecurity.[68] Patients who were acutely medically or psychiatrically unstable were excluded from the study, which may have also affected results related to future ED use. Finally, the presence of outliers with very high ED use affected the mean estimates considerably, as seen in the difference between the bivariate measures of mean and median ED use. Therefore, specific estimates of the mean number of ED visits should be interpreted with caution.

Conclusions.

In this study we found that, among measures of housing insecurity, only certain types of homelessness, primarily unsheltered homelessness, were significantly associated with a greater number of future ED visits. This study therefore contributes to the literature, which to date has primarily examined the intersection of ED use with more broadly defined housing insecurity and homelessness. By examining detailed housing experiences among ED patients, our study presents a more nuanced picture of ED use among people experiencing homelessness and discusses implications for future research and housing- and health-related policies.

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Appendix Table 1:

ED, Sociodemographic, and Health Characteristics of Full ED Patient Sample, By Housing Insecurity Category

	Values are percentages, unless otherwise specified					
	No reported housing insecurity (n=823)	Homeless-ness (n=391)	Un-affordable housing (n=373)	Over-crowded housing (n=201)	Recent forced move (n=253)	Multiple moves (n=241)
ED Visits						
One year post-baseline, mean (SD)	3 (8)	13 (30)	5 (13)	4 (16)	8 (19)	11 (33)
One year post-baseline, median (IQR)	2 (3)	4 (9)	2 (5)	2 (3)	3 (7)	4 (8)
Predisposing Factors						
Age, mean (SD)	48 (17)	48 (14)	45 (14)	40 (14)	45 (16)	44 (15)
Gender: woman[1]	50	18	43	55	36	27
Race/Ethnicity						
Hispanic/Latinx	59	35	52	73	43	31
Non-Hispanic Black	18	41	27	11	32	37
Non-Hispanic White	13	16	13	6	13	20
Other	9	8	8	9	12	12
Employment Status						
Working	51	20	46	59	35	34
Unemployed	17	37	26	25	33	35
Unable to work	16	35	20	--	23	33
Retired	17	8	8	--	10	7
Educational Attainment						
Less than HS education	35	37	37	39	35	29
High school graduate/GED	24	33	27	27	25	28
Some college or higher	40	30	36	34	40	42
Lifetime history of jail/prison	16	55	29	12	36	45
Victimization						
Experienced physical violence in past 12 months	5	26	12	--	18	29
Experienced sexual violence in past 12 months	--	3	--	--	--	5
Enabling Factors						
Insurance						

	Values are percentages, unless otherwise specified					
	No reported housing insecurity (n=823)	Homeless-ness (n=391)	Un-affordable housing (n=373)	Over-crowded housing (n=201)	Recent forced move (n=253)	Multiple moves (n=241)
Uninsured	25	12	29	35	17	17
Medicaid	28	59	42	34	48	54
Medicare	9	7	5	--	7	5
Dual Medicaid/ Medicare	12	8	7	--	10	5
Other/private	26	13	18	22	17	19
Trouble meeting basic expenses	21	66	76	37	69	65
Need Factors						
# days in past 30 where physical health not good, mean (SD)	8 (11)	12 (12)	10 (11)	9 (11)	11 (11)	11 (12)
Physical health diagnosis[2]	73	82	77	66	80	79
# days in past 30 where mental health not good, mean (SD)	5 (10)	12 (13)	9 (12)	7 (11)	11 (13)	12 (13)
Mental health diagnosis[3]	32	63	46	21	51	60
Any substance use[4]	33	64	46	32	55	68
AUDIT score, mean (SD)[5]	2 (6)	9 (13)	5 (9)	3 (7)	7 (11)	9 (12)
DAST-10 score, mean (SD)[6]	0.4 (1)	2 (3)	1 (3)	0.4 (1)	2 (3)	3 (3)

Note: n values below 10 are suppressed.

[1.] This sample did not have anyone that reported any identity other than man or woman.

[2.] Physical health conditions were self-reported and include: asthma; chronic bronchitis, COPD, or emphysema; diabetes; migraine headaches; liver disease including hepatitis or cirrhosis; high blood pressure; heart attack; stroke; seizures; HIV or AIDS; kidney problems; heart disease; and cancer.

[3.] Mental health conditions were self-reported and include: depression, anxiety, panic attacks, schizophrenia, bipolar disorder, PTSD, borderline personality, other mental health disorder.

[4.] "Any substance use" includes any drug use in the past year inclusive of marijuana use and/or any alcohol use more than 4(women)/5(men) drinks per day at least once in the year

[5.] AUDIT is a 10-question screening instrument that helps identify unhealth alcohol use. The range of possible AUDIT scores is 0 to 40. A score of 1 to 7 suggests low-risk consumption; scores from 8 to 14 suggest hazardous or harmful alcohol consumption; and scores of 15 or more indicates the likelihood of alcohol dependence (moderate-severe alcohol use disorder).

[6.] DAST-10 is a 10-item screening instrument to assess drug abuse. DAST-10 scores of 1–2 indicate a low level of problems related to drug abuse, 3–5 indicate a moderate level, 6–8 indicate a substantial level, and 9–10 indicate a severe level.

Appendix Table 2:

ED, Sociodemographic, and Health Characteristics of Full ED Patient Sample, By Homelessness Sub-Category

	Values are percentages, unless otherwise specified					
	No homeless-ness (n=1381)	Sheltered last night (n=175)	Sheltered majority of nights (n=154)	Un-sheltered last night (n=91)	Un-sheltered majority of nights (n=77)	Other (n=66)[1]
ED Visits						
One year post-baseline, mean (SD)	4 (14)	8 (15)	11 (24)	19 (39)	20 (44)	17 (37)
One year post-baseline, median (IQR)	2 (4)	3 (6)	4 (7)	7 (12)	6 (12)	4 (14)
Predisposing Factors						
Age, mean (SD)	46 (17)	50 (13)	49 (14)	47 (12)	49 (13)	48 (16)
Gender: woman[2]	50	19	23	12	14	21
Race/Ethnicity						
Hispanic/Latinx	59	32	32	37	35	38
Non-Hispanic Black	19	47	49	30	38	32
Non-Hispanic White	12	12	--	--	--	--
Other	9	9	--	--	--	--
Employment Status						
Working	51	20	19	--	--	30
Unemployed	19	35	34	49	49	29
Unable to work	17	35	34	36	40	--
Retired	13	10	12	--	--	--
Educational Attainment						
Less than HS education	36	45	44	26	35	30
High school graduate/GED	24	32	31	36	35	29
Some college or higher	40	23	26	37	30	41
Lifetime history of jail/prison	17	49	51	69	62	52
Victimization						
Experienced physical violence in past 12 months	6	20	24	40	30	24
Experienced sexual violence in past 12 months	1	--	--	--	--	--
Enabling Factors						
Insurance						
Uninsured	28	13	9	16	23	--
Medicaid	31	60	58	62	58	55
Medicare	7	6	--	--	--	--

	Values are percentages, unless otherwise specified					
	No homeless-ness (n=1381)	Sheltered last night (n=175)	Sheltered majority of nights (n=154)	Un-sheltered last night (n=91)	Un-sheltered majority of nights (n=77)	Other (n=66)[1]
Dual Medicaid/Medicare	10	7	--	--	--	17
Other/private	24	14	17	--	--	--
Trouble meeting basic expenses	34	66	62	65	68	59
Need Factors						
# days in past 30 where physical health not good, mean (SD)	9 (11)	11 (11)	11 (12)	13 (12)	15 (12)	11 (12)
Physical health diagnosis[3]	74	82	86	81	75	88
# days in past 30 where mental health not good, mean (SD)	6 (10)	10 (13)	10 (13)	15 (13)	14 (14)	12 (13)
Mental health diagnosis[4]	34	55	62	73	70	70
Any substance use[5]	35	55	53	81	75	70
AUDIT score, mean (SD)[6]	3 (6)	6 (10)	6 (11)	16 (14)	14 (15)	9 (11)
DAST-10 score, mean (SD)[7]	0.5 (1)	2 (3)	2 (3)	4 (4)	4 (4)	3 (3)

Note: n values below 10 are suppressed.

[1] Other homeless refers to participants who reported some drop-in center or shelter use, but not the majority of nights in the past year or the previous night

[2] This sample did not have anyone that reported any identity other than man or woman.

[3] Physical health conditions were self-reported and include: asthma; chronic bronchitis, COPD, or emphysema; diabetes; migraine headaches; liver disease including hepatitis or cirrhosis; high blood pressure; heart attack; stroke; seizures; HIV or AIDS; kidney problems; heart disease; and cancer.

[4] Mental health conditions were self-reported and include: depression, anxiety, panic attacks, schizophrenia, bipolar disorder, PTSD, borderline personality, other mental health disorder.

[5] "Any substance use" includes any drug use in the past year inclusive of marijuana use and/or any alcohol use more than 4(women)/5(men) drinks per day at least once in the year

[6] AUDIT is a 10-question screening instrument that helps identify unhealth alcohol use. The range of possible AUDIT scores is 0 to 40. A score of 1 to 7 suggests low-risk consumption; scores from 8 to 14 suggest hazardous or harmful alcohol consumption; and scores of 15 or more indicates the likelihood of alcohol dependence (moderate-severe alcohol use disorder).

[7] DAST-10 is a 10-item screening instrument to assess drug abuse. DAST-10 scores of 1–2 indicate a low level of problems related to drug abuse, 3–5 indicate a moderate level, 6–8 indicate a substantial level, and 9–10 indicate a severe level.

List of Abbreviations:

ED	Emergency Department
ED-CARES	Emergency Department Patient Characteristics Associated with Risk for Future ED and Shelter Use
SPARCS	Statewide Planning and Research Cooperative System

NYC	New York City
CIDI	Center for Innovation through Data Intelligence
SSN	Social Security Number
DOB	Date of Birth
EUPI	Enhanced Unique Personal Identifier
HCUP	Healthcare Cost and Utilization Project
CCSR	Clinical Classifications Software Refined
ICD-10-CM	International Classification of Diseases, Tenth Revision, Clinical Modification
CDC	Centers for Disease Control and Prevention
HRQOL-4	Health-Related Quality of Life "Healthy Days Measure"
AUDIT	Alcohol Use Disorders Identification Test
DAST-10	Drug Abuse Screening Test

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Box 1:

Housing Insecurity and Homelessness Dimensions

Dimension	Measurement
Homelessness	Spent last night in a homeless shelter/transitional housing _or_ Spent last night outside _or_ Spent majority of nights in past year in shelter/transitional housing _or_ Spent majority of nights in past year outside _or_ Any reported shelter or drop-in center[1] use in past year
Unaffordable housing	Currently owes rent arrears _or_ Has not paid full rent in past year
Crowded housing	Lives in own house or someone else's house _and_ There are more than 2 people per bedroom
Forced moves	Asked to leave current place _or_ Evicted in past year _or_ Currently being evicted _or_ Asked to leave family/friends place in past year
Multiple moves	Lived in 3 or more places in the past year

[1.] Drop-in centers in New York City provide services to unsheltered homeless individuals.

Housing, ED, Sociodemographic, and Health Characteristics of Full ED Patient Sample

	Full linked sample n=1783
Housing Insecurity [1]	
Homelessness, n (%)	391 (22)
Unaffordable housing, n (%)	373 (21)
Overcrowded housing, n (%)	201 (11)
Recent forced move, n (%)	253 (14)
Multiple moves, n (%)	241 (14)
No housing insecurity, n (%)	823 (49)
ED visits	
One year post-baseline, mean (SD)	6 (19)
One year post-baseline, median (IQR)	2 (5)
Predisposing Factors	
Age, mean (SD)	47 (16)
Gender: woman, n (%) [2]	772 (43)
Race/Ethnicity, n (%)	
Hispanic/Latinx	955 (54)
Non-Hispanic Black	429 (24)
Non-Hispanic White	228 (13)
Other	160 (9)
Employment Status, n (%)	
Working	787 (44)
Unemployed	406 (23)
Unable to work	373 (21)
Retired	217 (12)
Educational Attainment, n (%)	
Less than HS education	651 (37)
High school graduate/GED	461 (26)
Some college or higher	669 (38)
Lifetime history of jail/prison, n (%)	458 (26)

	Full linked sample n=1783
Victimization, n (%)	
Experienced physical violence in past 12 months	186 (10)
Experienced sexual violence in past 12 months	27 (2)
Enabling Factors	
Insurance, n (%)	
Uninsured	435 (24)
Medicaid	672 (38)
Medicare	133 (7)
Dual Medicaid/Medicare	165 (9)
Other/private	376 (21)
Trouble meeting basic expenses, n (%)	739 (41)
Need Factors	
# days in past 30 where physical health not good, mean (SD)	10 (11)
Physical health diagnosis, n (%) [3]	1345 (75)
# days in past 30 where mental health not good, mean (SD)	8 (11)
Mental health diagnosis, n (%) [4]	712 (40)
Any substance use, n (%) [5]	735 (41)
AUDIT Score, mean (SD) [6]	4 (9)
DAST-10 Score, mean (SD) [7]	1 (2)

[1] Housing insecurity categories are not mutually exclusive.

[2] This sample did not have anyone that reported any identity other than man or woman.

[3] Physical health conditions were self-reported and include: asthma; chronic bronchitis, COPD, or emphysema; diabetes; migraine headaches; liver disease including hepatitis or cirrhosis; high blood pressure; heart attack; stroke; seizures; HIV or AIDS; kidney problems; heart disease; and cancer.

[4] Mental health conditions were self-reported and include: depression, anxiety, panic attacks, schizophrenia, bipolar disorder, PTSD, borderline personality, other mental health disorder.

[5] "Any substance use" includes any drug use in the past year inclusive of marijuana use and/or any alcohol use more than 4(women)/5(men) drinks per day at least once in the year

[6] AUDIT is a 10-question screening instrument that helps identify unhealth alcohol use. The range of possible AUDIT scores is 0 to 40. A score of 1 to 7 suggests low-risk consumption; scores from 8 to 14 suggest hazardous or harmful alcohol consumption; and scores of 15 or more indicates the likelihood of alcohol dependence (moderate-severe alcohol use disorder).

[7] DAST-10 is a 10-item screening instrument to assess drug abuse. DAST-10 scores of 1–2 indicate a low level of problems related to drug abuse. DAST-10 scores of 1–2 indicate a low level of problems related to drug abuse, 3–5 indicate a moderate level, 6–8 indicate a substantial level, and 9–10 indicate a severe level.

Table 2:

Incidence Rate Ratios and Mean Number of ED Visits in the Year Post-Baseline, by Housing Insecurity Category

	Unadjusted[1]				Adjusted[2]			
	IRR	Confidence interval of IRR	Estimated mean where effect=Y	Estimated mean where effect=N	IRR	Confidence interval of IRR	Estimated mean where effect=Y	Estimated mean where effect=N
Homelessness	3.14	2.57 – 3.84	13.96	4.44	1.75	1.18 – 2.59	12.03	6.88
Unaffordable housing	1.15	0.95 – 1.41	8.46	7.33	0.97	0.78 – 1.20	8.94	9.26
Overcrowded housing	1.02	0.80 – 1.31	7.96	7.78	1.03	0.80 – 1.33	9.25	8.94
Forced moves	0.88	0.69 – 1.11	7.38	8.39	1.00	0.76 – 1.30	9.08	9.11
Multiple moves	1.60	1.27 – 2.03	9.97	6.22	1.15	0.68 – 1.95	9.77	8.47

[1] Unadjusted models include the five housing insecurity variables only.

[2] Adjusted models include all covariates identified by the Behavioral Model for Vulnerable Populations, as listed in Table 2.

Table 3:

Mean Number of ED Visits in the Year Post-Baseline, by Homelessness Sub-Category

Homelessness combinations[1]							Unadjusted				Adjusted			
SLN	SMN	ULN	UMN	Other	None	n	Estimated mean	Confidence interval	IRR compared to no homelessness	Confidence interval of IRR	Estimated mean	Confidence interval	IRR compared to no homelessness	Confidence interval of IRR
x	x					102	9.49	6.94 – 12.97	2.58	1.87 – 3.57	7.99	4.32 – 14.78	1.30	0.90 – 1.89
x						64	5.72	3.83 – 8.53	1.56	1.03 – 2.34	6.20	3.33 – 11.53	1.01	0.69 – 1.49
	x					41	14.56	8.92 – 23.76	3.96	2.41 – 6.52	11.06	5.14 – 23.78	1.80	0.95 – 3.43
x			x			--	11.11	3.89 – 31.73	3.02	1.06 – 8.67	10.94	2.94 – 40.69	1.78	0.52 – 6.11
		x	x			50	23.12	14.87 – 35.94	6.29	4.01 – 9.87	16.20	8.48 – 30.95	2.64	1.52 – 4.59
		x				30	14.87	8.39 – 26.35	4.05	2.27 – 7.22	15.61	7.21 – 33.78	2.54	1.38 – 4.71
			x			18	14.44	6.90 – 30.25	3.93	1.87 – 8.28	10.33	3.86 – 27.63	1.68	0.80 – 3.53
	x	x				--	13.64	5.29 – 35.12	3.71	1.44 – 9.60	10.39	4.48 – 24.12	1.69	0.84 – 3.41
				x		66	17.23	11.72 – 25.32	4.69	3.16 – 6.96	19.41	10.10 – 37.31	3.16	1.69 – 5.91
					x	1381	3.67	3.37 – 4.01			6.13			

[1]. Combinations of homeless conditions indicated by "x" are exhaustive and mutually exclusive. SLN=sheltered last night, SMN=sheltered majority of nights, ULN=unsheltered last night, UMN=unsheltered majority of nights, Other=some drop-in center or shelter use, but not majority or last night, None=no homelessness. N values below 10 are suppressed.

Table 4:

Top ED Diagnosis Categories for Homeless Sub-Categories with Significantly Higher ED visits Post-Baseline

	Unsheltered last night and majority of nights n=50	Unsheltered last night but not majority of nights n=30	Other homeless, not last night, not majority nights n=66	Total n=146
	Alcohol-related disorders	Alcohol-related disorders	Alcohol-related disorders	Alcohol-related disorders
	Disorders of the teeth and gingiva	Opioid-related disorders	Nonspecific chest pain	Musculoskeletal pain, not low back pain
	Musculoskeletal pain, not low back pain	Abdominal pain and other digestive/ abdomen signs and symptoms	Sprains and strains	Nonspecific chest pain
	Nonspecific chest pain	Trauma- and other stressor-related disorders	Musculoskeletal pain, not low back pain	Abdominal pain and other digestive/ abdomen signs and symptoms
	Skin and subcutaneous tissue infections		Abdominal pain and other digestive/ abdomen signs and symptoms	Disorders of the teeth and gingiva
Top categories as a percent of all diagnoses	*48*	*60*	*36*	*32*

Notes: Categories are author's analysis using the Healthcare Cost and Utilization Project (HCUP) Clinical Classifications Software Refined (CCSR) for ICD-10-CM Diagnoses and are reported in order of frequency. Individual category percentages are not reported because of small n values. Categories are from the last recorded visit to the ED. The top five categories are reported. Where there are fewer than five diagnoses listed, it is because of the remaining categories were evenly split.