ARTICLE | Article in Press

Accelerated aging and health in people experiencing homelessness in New Mexico: a latent class analysis

C Hicks · J Torres · C Phillips · A Madaras · S Doorley · J Anderson · J Hettema · J Knoefel · Kimberly Page on behalf of the PICKUP Study Group

Received: 27 May 2026 / Accepted: 23 September 2026
© The Author(s) 2026

Abstract

People experiencing homelessness (PEH) experience elevated rates of premature mortality and health conditions typically observed in housed individuals 15–20 years older, a phenomenon termed accelerated aging (AA). To investigate which groups of adult PEH are at risk of AA. Guided by the behavioral model for vulnerable populations, we assessed how factors, including physical health, healthcare access, environmental stressors, mental health, and substance use, cluster to create distinct profiles indicative of AA among PEH. Cross-sectional survey data were collected across 11 New Mexico counties (December 2023–March 2024) encompassing both urban and rural areas. A total of 505 people completed the survey and were included in this analysis. Eligibility was defined by the Homeless Emergency Assistance and Rapid Transitions to Housing Act. Latent class analysis (LCA) was conducted using 14 binary indicators spanning six domains: physical conditions, healthcare access, substance use disorders, life events, environmental stressors, and mental health, to identify distinct AA profiles. We examined associations between class membership and homelessness episode length via descriptive statistics, t tests, chi-square tests, and ANOVA. A 4-class solution provided optimal fit (BIC = 7353.16): 1) Healthcare-engaged, low medical complexity (13.7%); (2) Low medical complexity, moderate environmental stress (27.9%); (3) Psychosocial burden with multiple adversities (39.4%); and (4) High medical complexity and healthcare engagement (19.0%). Three classes (1, 3, and 4) comprised 70.5% of the sample and were designated accelerated-aging (AA) phenotypes. Homelessness episode length varied significantly by latent class (ANOVA $p = 0.023$) but not by binary AA status (Mann–Whitney U $p = 0.15$). AA represents premature development of age-related conditions and functional decline. The heterogeneous profiles underscore the need for tailored interventions addressing medical needs as well as structural barriers, trauma, and healthcare navigation. Age-based eligibility criteria for geriatric services may miss younger PEHs experiencing premature aging, particularly those with justice involvement or chronic unsheltered homelessness.

Keywords Homelessness · Accelerated aging · Latent class analysis · New Mexico

This Article in Press is shared early to give you faster access to new research. It is citable and carries a permanent DOI. The final edited version will replace it automatically.

C Hicks and J Torres are two authors contributed equally to the manuscript.

A list of authors and their affiliations appears at the end of the paper.

https://doi.org/10.1038/s41598-026-73446-2

Published online: 07 October 2026

Introduction

In January 2025, approximately 745,652 people experienced homelessness on a single night in the United States (US), a 3.4% decrease from the record high recorded in 2024[1,2]. Nearly one in five (143, 910, individuals) people experiencing homelessness (PEH) are aged 55 or older, and 6% (44,739) were over 64[1]. This substantial and growing population of older adults experiencing homelessness has been a public health concern for decades[3]. Although 2025 marked the first single-year decline in overall homelessness in nearly a decade, the longer-term trend has been one of marked growth – homelessness rose by more than 24% between 2007 and 2024 with disproportionate increases among older adults[4].

Older PEH patients exhibit disproportionately more age-related chronic health conditions, including hypertension, cardiovascular disease, diabetes, bone and joint diseases, respiratory illness, skin diseases, frailty, visual impairment, and functional decline, than both younger PEH patients and age-matched housed individuals[5–16]. Infectious diseases, including HIV and tuberculosis, are also more prevalent[17]. These conditions are exacerbated by limited opportunities for sanitary bathing and toileting, inadequate care and nutrition, and an increased risk of assault and victimization[16,18,19].

Accelerated aging refers to the premature onset of age-related multimorbidity, geriatric syndromes, and functional decline—conditions typically observed in housed adults 15–20 years older—together with elevated premature mortality[2–4]. A leading explanatory framework is "weathering," whereby chronic activation of physiological stress-response systems under cumulative social and environmental adversity increases allostatic load and hastens biological decline[5,6]. In people experiencing homelessness, this process is compounded by housing instability, victimization, food insecurity, inadequate sanitation, and disrupted healthcare, and it is increasingly recognized as a distinct clinical and public-health phenomenon[16,20–24]. We distinguish two levels of the construct: biological aging, indexed by biomarkers such as epigenetic clocks and allostatic-load measures, and the functional/phenotypic aging that those processes produce—the observable burden of chronic disease, healthcare need, trauma, and stress. Because our survey did not include biomarkers, this study characterizes accelerated aging at the phenotypic level, identifying how these observable manifestations cluster within individuals to form distinct aging profiles.

Emerging evidence suggests that housing instability operates as a cumulative stressor, with compounding life effects[25,26]. Individuals experiencing childhood homelessness may enter adulthood with already elevated biological aging markers[27]. Repeated cycles of homelessness may be more detrimental than single continuous episodes, as each transition disrupts healthcare continuity, medication access, social support, and daily routines. The weathering effects of housing instability and unsheltered status may interact with other forms of cumulative disadvantage, including racial discrimination, poverty, food insecurity, and environmental exposure, to accelerate aging processes through chronic activation of stress response systems[28–30]. The average mortality age among PEHs is between 50 and 65 years of age, making homelessness itself an independent risk factor for mortality[31].

Despite the growing recognition of accelerated aging among PEHs, detailed examinations of heterogeneous patterns and manifestations remain limited, particularly outside of major coastal cities. Because our survey captured health, social, and behavioral manifestations of aging rather than biological markers, accelerated aging is necessarily an unobserved construct in these data: it cannot be measured directly, only inferred from the pattern of its observable indicators. Latent class analysis (LCA), is a measurement model defined by these properties and thus is well suited for examining how multiple factors combine to create distinct accelerated aging pathways[32]. LCA treats the construct as unobserved, accepts categorial indicators directly, represents it as qualitative distinct types rather than continuous dimensions, and returns a graded posterior probability of membership rather than a fixed assignment. Thus, the LCA allows us to infer accelerated aging from the pattern of its observed indicators, and conceptualize this as arising from the clustering of chronic morbidity, functional and healthcare need, trauma, and cumulative environmental stress rather than from any single condition. And finally, we utilized Gelberg–Andersen's behavioral model for vulnerable populations[33] to guide indicator selection across six domains:

physical health conditions, healthcare access, substance use disorder, traumatic life events, environmental stressors, and mental health.

This study examines accelerated aging among PEHs across New Mexico, with the goals of 1) characterizing demographic profiles, health status, and healthcare access patterns across age groups; 2) identifying latent classes of accelerated aging phenotypes; and 3) examining the relationships between class membership and homelessness episode length. By identifying distinct vulnerability profiles and temporal patterns, this work can inform the development of tailored interventions and age-inclusive policies that address the heterogeneous needs of people experiencing both homelessness and premature aging—a rapidly growing population that current service systems are poorly equipped to serve.

Methods

Study design

The PICKUP (Providing Inclusive and Comprehensive Care for Unhoused Populations) project[34] implemented a cross-sectional survey among people experiencing homelessness (PEH) in 11 counties in New Mexico, encompassing both urban and rural areas. The study was supported by an academic–community–civic partnership bringing together the UNM HSC, community-based health service organizations, and the New Mexico Department of Health. Data collection occurred between December 2023 and March 2024.

Participants

Individuals aged 18 + years who experienced homelessness as defined by the HEARTH Act were eligible: those lacking a fixed, regular, and adequate nighttime residence; those at imminent risk of losing housing within 14 days; or those fleeing domestic violence, dating violence, or stalking[35]. The participants were required to speak either English or Spanish and demonstrate the capacity to participate in the survey questionnaire. A brief screener was administered to potential participants to ensure eligibility.

Measures

The survey was developed from the California Statewide Study of People Experiencing Homelessness instrument[36] modified with partner input to reflect local service contexts and maintain 30–45 min administration time. The domains surveyed included demographics, housing trajectory, healthcare access and utilization, health insurance status, ability to obtain needed healthcare and medications, physical and mental health, substance use, economic factors, use of social services, violence and trauma exposure, criminal justice involvement, and food security.

Data collection

Trained personnel from partnering organizations and UNM HSC administered both the screener survey and the anonymous survey via REDCap on tablets with internet hot spots provided as needed. Recruitment methods across sites included real-time recruitment and interviewing (approaching people directly on the street, in shelters, or outreach centers), and flyers and sign-up sheets for scheduled survey days or planned events (e.g., health or job fairs). Surveys conducted by personnel from organizations serving unsheltered people were conducted in participant-convenient locations, including shelters, parks, agency sites, coffee shops, parking lots, street corners, churches, and community centers. The survey typically requires 30–45 min to administer. Some surveys were conducted in encampments by research assistants and trained medical students. All participants were provided

with $40 gift cards; many sites also offered additional resources such as clean clothes, food, and hygiene products as part of standard services.

Statistical analyses

Descriptive analyses

Frequencies, percentages, medians, and interquartile ranges (IQRs) characterized the sample. Chi-square tests and Kruskal–Wallis tests were used to compare groups across age, geographic location, and living situation.

Latent class analysis

Latent class analysis (LCA) is a person-centered, model-based method that identifies unobserved subgroups (classes) from patterns of observed categorical indicators and assigns each individual to the class for which they have the highest posterior probability of membership[7–9]. Unlike variable-centered approaches that estimate the independent effect of each risk factor, LCA characterizes how multiple risks co-occur within individuals. It is therefore well suited to accelerated aging, which we conceptualize as arising from the clustering of chronic morbidity, functional and healthcare need, trauma, and cumulative environmental stress rather than from any single condition. Accordingly, we selected 14 binary indicators as observable proxies for the domains through which accelerated aging manifests and accumulates; we did not measure biological-aging biomarkers, and the resulting classes represent phenotypic profiles of accelerated-aging risk. Models were estimated with the poLCA package (Version 1.6.0.1) in R (Version 4.4.2), and descriptive analyses were conducted in SAS 9.4 (SAS Institute, Cary, NC). Guided by the Gelberg–Andersen Behavioral Model for Vulnerable Populations, we selected 14 binary (high risk versus lower risk) indicators (Table 1) from the survey corresponding to predisposing, enabling, and need predictors: 1) health care access; 2) physical health conditions; 3) mental health; 4) substance use disorder; 5) traumatic life events; and 6) stressors and environmental pressures. Unconditional LCA models (2 to 6 classes) were estimated via maximum likelihood with 30 random starts and 20,000 iterations. The model selection criteria included the Bayesian information criterion (BIC; lower = better fit), relative entropy (> 0.60 = adequate separation), average posterior probability (AvePP; > 0.70 = clear classification), and theoretical interpretability. The participants were assigned to their most likely class on the basis of the maximum posterior probability.

Table 1 Survey items used for LCA analysis.

Domain	# of indicators	Indicators	Conceptual role
#1. Healthcare access	4	Primary care provider; regular place for care; health insurance; recent unmet healthcare needs	Enabling factors reflecting structural access to preventive care
#2. Physical health conditions	3	Chronic conditions; clinical/physical treatment receipt; medical device use	Direct markers of age-related morbidity
#3. Mental health	1	Mental health symptoms/conditions in the 6 months before homelessness	Need factor
#4. Substance use disorder	1	History of SUD treatment	Need factor and indicator of system engagement
#5. Traumatic life events	2	Lifetime incarceration; recent violence	Predisposing and need factors linked to chronic stress
#6. Stressors and environmental pressures	3	Unsheltered sleeping; employment barriers; work interference/barriers	Structural vulnerabilities associated with environmental and cumulative stress effects

Accelerated aging designation and associations with homelessness episode length

We designated a latent class as an accelerated-aging phenotype a priori when it exhibited elevated burden in one or more aging-relevant domains—chronic morbidity, functional and healthcare need, or cumulative psychosocial and environmental stress—at a median age substantially below the 65-year threshold conventionally used for geriatric-service eligibility. The remaining class, characterized by uniformly low burden and the youngest median age, served as the non–accelerated-aging reference. To summarize risk at the individual level, we derived a continuous accelerated-aging probability for each participant as the summed posterior probability of membership in the accelerated-aging classes, and we defined a binary accelerated-aging indicator using a threshold of 0.60. The continuous, class-based characterization is primary; the binary indicator is a secondary summary used only where a single grouping was analytically necessary (i.e., the episode-length comparisons below), and we note that dichotomization necessarily collapses meaningful between-class variation. We examined the relationships between latent class membership and current homelessness episode length via the following: 1) Mann–Whitney U tests comparing median episode length between binary AA groups; 2) one-way ANOVA assessing differences across episode length categories (0–3, 4–6, 7–12, 13–24, and > 24 months) with post hoc Tukey HSD tests; and 3) locally weighted scatterplot smoothing (LOESS) regression (span = 0.75) visualizing nonlinear relationships between continuous episode length and probabilistic AA scores[37]. Statistical significance was set at $p \leq 0.05$. Analyses were conducted via SAS 9.4 (SAS Institute, Cary, NC), the R packages poLCA and ggplot2.

Ethics

The UNM HSC Human Research Protections Program Institutional Review Board approved this study with a waiver of written informed consent. The participants received an information sheet with all the required consent elements and provided verbal consent. Personnel and volunteers from each participating community agency received training in the ethical conduct of human research via Harvard Catalyst modules[38]. All research was performed in accordance with relevant guidelines/regulations and in accordance with the Declaration of Helsinki. The consent process emphasized voluntary participation, the right to withdraw, and confidentiality. Surveys were conducted in private spaces whenever possible via trauma-sensitive approaches. Staff were trained to respond with empathy and appropriate referrals for healthcare, mental health services, substance use treatment, housing assistance, and other social services.

Results

Sociodemographic characteristics

Of the 602 people screened, 578 (96%) were eligible, 548 (94.8%) consented to participate, 525 (95.8%) were administered surveys, and 505 (92.1%) had complete data for analyses and are used in these analyses (20 incomplete surveys were excluded). The median age was 43 years (IQR: 34–54), with 33.1% in the older age group (≥45 years). Table 2 shows the prevalence of selected demographic, socioeconomic and health related factors overall and by age grouped by tertile. The sample was predominantly male (65.3%), racially/ethnically diverse (33.9% Hispanic, 24.8% AI/AN, 21.4% White, 14.3% multiracial), and New Mexico-born (56.0%). About one-third (30.5%) had some post-secondary education. Most (72.3%) had been homeless for > 6 months, and 39.6% reported prior episodes. While 73.7% reported health insurance, only 42.4% had a regular healthcare source. Those in the middle age group (35–44 years) had the widest gap between health insurance coverage and having a place for regular healthcare (75.3% and 35.2%, respectively; $p < 0.001$).

Latent class identification

The BIC reached its minimum at the 4-class solution (BIC = 7353.2, Table 3) with excellent classification quality (entropy = 0.87, AvePP = 0.924), and only 0.8% of the cases showed ambiguous classification (near-tie probabilities across multiple classes). Four distinct profiles emerged (Table 4, Supplemental Fig. 1). In *Class 1, high health care engagement with low medical complexity* (13.7%, n = 69; median age 47 years [IQR: 39, 54]) was associated with chronic physical conditions (domain probability = 0.256) with high health care access (0.808), near universal primary care connections and moderately high mental health (0.565) and environmental stress probabilities (0.681). In *Class 2, low medical complexity and moderate environmental stress* (27.9%, n = 141; median age 36 years [IQR: 31, 46]) were associated with moderate environmental stressors (0.640) but minimal healthcare access (0.217), physical conditions (0.105), mental health burden (0.171), and trauma exposure (0.233). *Class 3: Psychosocial burden with multiple adversities* (39.4%, n = 199; median age 43 [IQR: 34, 54]), the largest class, presented with the highest environmental stress (0.797), substantial mental health burden (0.644), and elevated trauma exposure (0.577), including incarceration and violence, with moderate healthcare engagement (0.370) and minimal substance use treatment (0.045). In *Class 4, high medical complexity and healthcare engagement* (19.0%, n = 96; median age 52 [IQR: 40, 60]) was associated with the highest chronic condition probability (0.802), high healthcare access (0.794), and modest substance use treatment engagement (0.156).

Applying the a priori rule (Methods 2.5.3), Classes 1, 3, and 4 were designated accelerated-aging phenotypes and Class 2 served as the non–accelerated-aging reference; together the three accelerated-aging classes comprised 70.5% (n = 356) of the sample. Class 4 (high medical complexity) met the criterion through chronic-disease burden; Class 3 (psychosocial burden with multiple adversities) through cumulative trauma, mental-health, and environmental stress; and Class 1 through sustained functional and healthcare need despite a lower chronic-disease load—each at a median age (52, 43, and 47 years, respectively) well below 65. Class 2, the youngest (median 36 years) and lowest in burden across all domains, most closely approximated age-typical health. The classes differed significantly by age (Kruskal–Wallis $p < 0.001$), with Class 4 being the oldest (median: 52 years) and Class 2 the youngest (median: 36 years). Classes 1 and 3, both accelerated aging groups had intermediate median ages (47 and 43 years) yet exhibited substantial health complexity, trauma exposure, and healthcare challenges. Post hoc comparisons (Wilcoxon with Bonferroni correction) revealed 4 significant paired differences in median age: Class 1 vs Class 2 (47 vs. 36 years); Class 2 vs Class 3 (36 vs. 43 years); Class 2 vs Class 4 (36 vs. 52 years); and Class 3 vs Class 4 (43 vs. 52 years).

Accelerated aging and homelessness episode length

The median homelessness episode length was 18 months (IQR: 6, 44) overall. According to binary AA status, the AA group reported a median of 20 months (IQR: 6, 48) versus 16 months (IQR: 4, 38) for the non-AA group (Mann–Whitney U test: W = 24,397, $p = 0.15$). Prevalence of AA by episode length categorized by months (0–3, 4–6, 7–12, 13–24, and > 24 months is shown in Supplemental Table S1. Episode length varied significantly by latent class (ANOVA: $F(3, 501) = 3.22$, $p = 0.023$), although the effect size was small ($\eta^2 = 0.0225$), and post hoc tests revealed no significant pairwise differences. Class 3 had the longest median episodes (24 months, IQR: 10, 57), followed by Class 1 (16 months, IQR: 4, 37), Class 2 (14 months, IQR: 3, 38), and Class 4 (12 months, IQR: 5, 40). LOESS-smoothed curves (Fig. 1) revealed clear separation between the AA and non-AA groups throughout all episode durations, suggesting that AA risk is established at or before episode onset rather than accumulating progressively over time. The results were similar when the patients were stratified by first and recurring homeless episodes (Supplemental Figure S1).

https://doi.org/10.1038/s41598-026-73446-2

Table 2 Prevalence of selected demographic, socioeconomic, and health-related factors in people experiencing homelessness in New Mexico by age category.

Characteristic	All: N = 505 Median age 43 yrs (IQR 34,54)		Tertile 1: Median Age ≤ 34 years (0–32.9%; n = 177)		Tertile 2: Median Age = 35–44 years (33.0–65.9%; n = 162)		Tertile 3: Median Age ≥ 45 years (66.0–100%; n = 166)	
	N	%	n	%	n	%	n	%
First time being homeless								
Yes	299	59.2%	109	61.6%	93	57.4%	97	58.4%
No	200	39.6%	64	36.2%	68	42.0%	68	41.0%
Episode of homeless in months								
Less than 6 months	126	25.0%	42	23.7%	43	26.5%	41	24.7%
Greater than 6 months	365	72.3%	130	73.4%	113	69.8%	122	73.5%
Gender								
Female	157	31.1%	60	33.9%	50	30.9%	47	28.3%
Male	330	65.3%	110	62.1%	106	65.4%	114	68.7%
Other (Trans-masculine, Trans-feminine, non-binary)	6	1.2%	1	0.6%	3	1.9%	2	1.2%
Race								
Black/ African-American	24	4.8%	10	5.6%	5	3.1%	9	5.4%
Asian	1	0.2%	0	0.0%	0	0.0%	1	0.6%
American Indian/Alaska Native	125	24.8%	46	26.0%	39	24.1%	40	24.1%
Latino/Latina/Latinx or Hispanic	171	33.9%	58	32.8%	61	37.7%	52	31.3%
White	108	21.4%	37	20.9%	38	23.5%	33	19.9%
Indigenous from Mexico/Central/South America	2	0.4%	0	0.0%	1	0.6%	1	0.6%
Mixed/Multiracial	72	14.3%	24	13.6%	18	11.1%	30	18.1%
Other	2	0.4%	2	1.1%	0	0.0%	0	0.0%
Education								
High school diploma/GED or less	183	36.2%	66	37.3%	60	37.0%	57	34.3%
Post-Secondary Education	154	30.5%	52	29.4%	46	28.4%	56	33.7%
Relationship status								
Single	368	72.9%	128	72.3%	126	77.8%	114	68.7%
Married	37	7.3%	13	7.3%	14	8.6%	10	6.0%
Divorced or separated	70	13.9%	25	14.1%	16	9.9%	29	17.5%
Widowed	18	3.6%	4	2.3%	3	1.9%	11	6.6%
Lives with a partner								
Yes	40	7.9%	14	7.9%	13	8.0%	13	7.8%
No	73	14.5%	23	13.0%	28	17.3%	22	13.3%
Military service								
Yes	25	5.0%	7	4.0%	11	6.8%	7	4.2%
No	465	92.1%	164	92.7%	146	90.1%	155	93.4%
Us born								
Yes	457	90.5%	154	87.0%	151	93.2%	152	91.6%
No	34	6.7%	17	9.6%	7	4.3%	10	6.0%
New Mexico born								
Yes	283	56.0%	86	48.6%	104	64.2%	93	56.0%
No	171	33.9%	67	37.9%	45	27.8%	59	35.5%
Friend and family member confidant								
Yes	300	59.4%	104	58.8%	99	61.1%	97	58.4%
No	190	37.6%	64	36.2%	61	37.7%	65	39.2%
Health insurance coverage								
Yes	372	73.7	127	71.8%	122	75.3%	123	74.1%

https://doi.org/10.1038/s41598-026-73446-2

Table 2 (continued)

Characteristic	All: N = 505 Median age 43 yrs (IQR 34,54)		Tertile 1: Median Age ≤ 34 years (0–32.9%; n = 177)		Tertile 2: Median Age = 35–44 years (33.0–65.9%; n = 162)		Tertile 3: Median Age ≥ 45 years (66.0–100%; n = 166)	
	N	%	n	%	n	%	n	%
No	96	19.0%	37	20.9%	29	17.9%	30	18.1%
Place for regular healthcare								
Yes	214	42.4%	82	46.3%	57	35.2%	75	45.2%
No	256	50.7%	82	46.3%	94	58.0%	80	48.2%

Table 3 Latent class analysis fit statistics.

Classes (k)	Log-Likelihood	AIC	BIC*
2	-3623.8	7305.7	7428.2
3	-3543.5	7175.0	7360.9
4	**-3493.0**	**7103.9**	**7353.2**
5	-3467.8	7083.5	7396.1
6	-3452.7	7083.4	7459.4

AIC indicated Akaike Information Criteria; BIC, Bayesian Information Criteria;

**Lower BIC indicates better fit. The 4-class model minimizes BIC while maintaining interpretability.*

Table 4 Average Conditional Probabilities* by Domain and Latent Class.

Domain	Class 1: Healthcare engaged	Class 2: Low medical complexity	Class 3: Multiple adversities	Class 4: High medical complexity
Access to healthcare	**0.808**	0.217	0.370	0.794
Traumatic/Adverse Life Events (e.g., incarceration, violence)	0.464	0.233	**0.577**	0.427
Mental Health	0.565	0.171	**0.644**	0.479
Chronic physical conditions	0.256	0.105	0.332	**0.802**
Substance use disorder treatment	0.000	0.000	0.045	**0.156**
Stress & environmental pressure	0.681	0.640	**0.797**	0.639

*Values represent average conditional probabilities across items within each domain (range: 0–1). Higher values indicate greater probability of endorsing risk indicators in that domain given class membership.

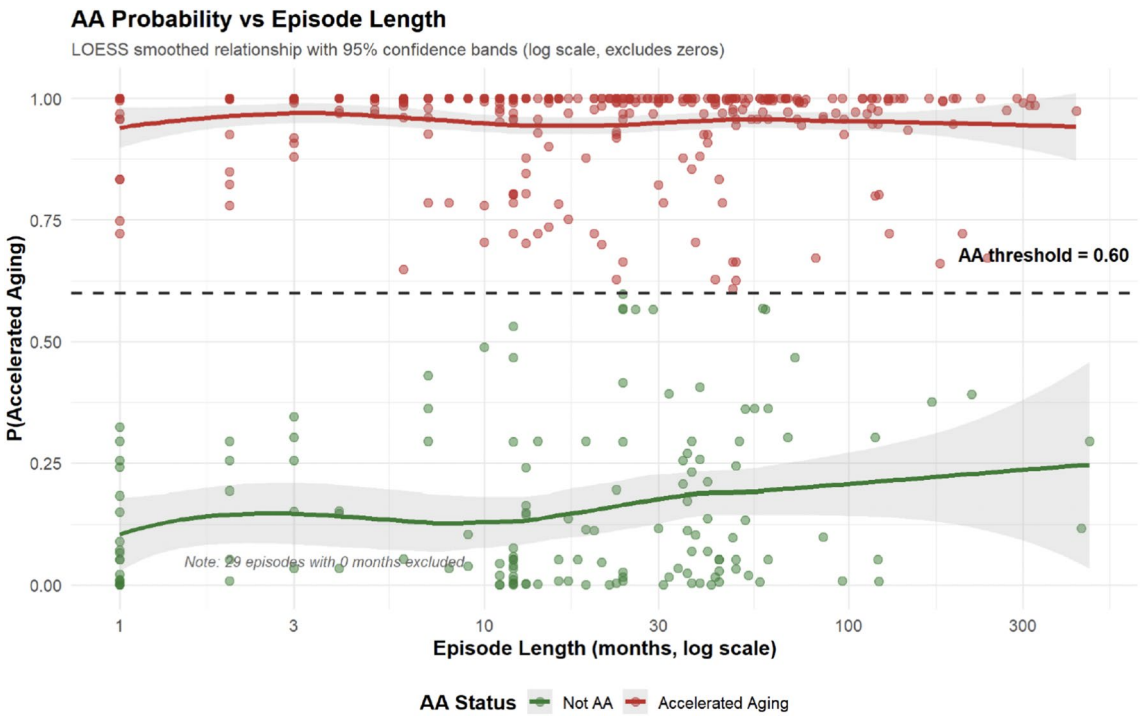


Fig. 1 Temporal Stability of Accelerated Aging Probability Across Homelessness Episode Duration shown with LOESS-smoothed curves*. LOESS-smoothed curves display probabilistic AA scores as a function of current episode length (log scale), stratified by binary AA classification status (red = AA; green = non-AA). Horizontal dashed line indicates the AA classification threshold (0.60). Individual data points (jittered for visibility) show the bimodal distribution of AA probabilities. Episodes with 0 months duration (n = 29) were excluded from visualization.

Discussion

This study identified four distinct latent classes among PEHs in New Mexico, three of which (70.5%) exhibited accelerated aging, with significant heterogeneity in physical health, healthcare access, mental health, substance use, trauma exposure, and environmental stressors. Critically, while episode length varied significantly across latent classes, accelerated aging probability remained within groups across episode durations, suggesting that vulnerability profiles are mostly established at or before homelessness onset rather than accumulating progressively with time spent homeless.

Pathways leading to accelerated aging

Class 4 (*High Medical Complexity and Healthcare Engagement*) represents traditional accelerated aging: high chronic disease burden with sustained healthcare engagement (0.794). These individuals (median age 52 years) present with geriatric health profiles with successful care connections, likely reflecting their condition severity and navigation ability. Interventions, such as addiction medicine and medication management, should maintain and optimize existing healthcare connections while addressing gaps. Housing should prioritize accessibility, healthcare proximity, and onsite nursing support through permanent supportive housing models[39].

Class 3 (*psychosocial burden with multiple adversities),* the largest class, exemplifies the "weathering" pathway[28]. The highest level of environmental stress (0.797), substantial mental health burden (0.644), and elevated trauma, including incarceration (0.577), embody cumulative psychosocial stressors that impact biological aging. Low healthcare engagement (0.370) and minimal substance use treatment (0.045) reveal profound system disconnection despite moderate insurance coverage, reflecting barriers beyond coverage: transportation, documentation requirements, stigma, trauma responses and competing survival needs[40–43]. Interventions must be trauma-informed, recognizing that institutional violence experiences create barriers to engagement[44]. Peer support specialists with lived experience can bridge people in this class to formal services. Street medicine and criminal justice diversion programs interrupting homelessness–jail cycling offer critical opportunities to intercede for those who are outside the traditional healthcare system[43,45–47]. For this group, housing stability may necessitate health improvement, supporting "housing first" approaches without sobriety or treatment compliance requirements[40].

Class 1 (*high healthcare engagement with low medical complexity)* presents a paradox: sustained healthcare utilization despite relatively few chronic conditions. This may reflect the fact that individuals are maintaining prior care relationships or can manage functional limitations not captured by our chronic disease indicators. Moderate mental health (0.565) and environmental stress (0.681) suggest situational crises, indicating intervention windows before the trajectory decreases. Priorities include maintaining care continuity through housing transitions, medical respite connections, addressing emerging functional limitations, and intensive rapid rehousing to minimize homelessness duration.

Class 2 (*low medical complexity, moderate environmental stress*) approximates stably housed individuals experiencing temporary economic/situational housing disruption. Minimal healthcare access despite moderate environmental stress may reflect good baseline health or early-stage instability not yet disrupting care. This group may benefit from one-time financial assistance preventing shelter entry, short-term rental assistance with case management, employment services, and minimal health care intervention maintenance rather than restoring health[48,49]. Early intervention before environmental stressors are translated into chronic conditions is critical.

Age distribution differences confirmed that health profiles represent development of premature age-related conditions rather than normative aging. Classes 1 and 3 (median ages 47 and 43 years) exhibited substantial health complexity despite being younger than Class 4 (52 years), supporting accelerated aging. The young median age of Class 2 patients (36 years) may partially explain the lower burden, although minimal healthcare engagement despite stress could point to either good health or unmet care barriers.

Temporal patterns and implications

LOESS smoothing revealed marked early differentiation and subsequent stability (Fig. 1). AA individuals maintained consistently high probabilities (≈0.95) across all episode durations, whereas non-AA individuals maintained low probabilities with modest increases (from 0.15 to 0.25), showing clear separation throughout with minimal convergence. LOESS-smoothed curves showed clear separation between the accelerated-aging and non–accelerated-aging groups across all episode durations, with little convergence over time (Fig. 1). Because these data are cross-sectional, they cannot establish temporal ordering; however, the pattern is consistent with health vulnerabilities that predate or coincide with the onset of homelessness rather than accumulating progressively with time spent homeless, aligning with research documenting that pathways into homelessness involve preexisting conditions, disability, prior trauma, and cumulative socioeconomic disadvantage[50–52]. This interpretation is provisional and would require longitudinal data to confirm.

Identifying and addressing upstream vulnerabilities can contribute to identifying and addressing premature aging conditions. Among those with prior homelessness episodes (39.6%), the current episode length likely substantially underestimates the cumulative lifetime exposure. The contrast between temporal stability within groups and episode length differences across classes suggests that vulnerability profiles present distinct trajectories where health and housing share common upstream determinants. In Class 3's trauma and incarceration pathways, criminal justice involvement simultaneously drives health decline and housing instability[53,54]. Class 4 medical complexity may reflect disability-related barriers to employment and housing, which precipitate homelessness.

Policy implications

In this sample, 70.5% of participants were classified with accelerated-aging phenotypes despite median ages well below 65, illustrating how age-based eligibility thresholds for geriatric services may not align with functional need in this population. Although our non-probabilistic sample precludes population-level estimates, the finding suggests that phenotypic or needs-based screening at service entry—assessing chronic disease, functional limitation, mental health, trauma, healthcare engagement, substance use, and violence or incarceration exposure—could help identify individuals who may benefit from comprehensive geriatric assessment, intensive case management, and tailored intervention regardless of chronological age. We offer these as considerations for service design rather than definitive policy prescriptions.

Comparison with existing literature

Our findings confirm the high prevalence of chronic conditions, mental health challenges, trauma, and healthcare barriers[5–15]. The accelerated aging prevalence (67.8%) aligns with estimates showing that middle-aged homeless adults exhibit health profiles comparable to those of housed individuals 10–20 years older[21,55]. The insurance-access disconnect (73.7% coverage, 42.4% regular care) echoes Medicaid expansion challenges[41,42]. However, we make novel contributions: latent class analysis identified person-centered profiles representing distinct pathways rather than variable-centered individual risk factors; diverse urban–rural New Mexico settings extend evidence beyond coastal cities; and LOESS temporal analysis revealed that accelerated aging risk is established at episode onset rather than accumulating progressively, critically informing intervention timing.

Strengths and limitations

The strengths of this study include its sample size and geographic diversity, an academic-community-civic partnership that contributes to cultural appropriateness[56], person-centered LCA with excellent classification quality, and strong AI/AN (24.8%) and Hispanic (33.9%) representation. Several limitations warrant emphasis. First, accelerated aging was operationalized through self-reported health and social indicators rather than biomarkers of

biological aging (e.g., epigenetic or allostatic-load measures); our classes therefore represent phenotypic proxies for accelerated aging rather than direct measurements of it. Second, participants were recruited through a non-probabilistic convenience sample across partnering sites, and the descriptive statistics characterize the analytic sample only—they are unweighted, are subject to sampling error and potential selection bias, and should not be generalized as population prevalences for people experiencing homelessness in New Mexico. The cross-sectional design precludes causal inference[57], and current-episode-only measurement may have resulted in underestimation of cumulative exposure.

Future directions

Priorities include longitudinal studies tracking health trajectories with biomarkers identifying critical intervention periods; validated measures of cumulative lifetime exposure capturing literal homelessness, institutional settings, and marginal housing; intervention trials testing whether targeting services to specific vulnerability profiles improves outcomes; mechanistic studies examining how exposures such as incarceration accelerate aging; mixed methods and participatory research engaging people with lived experience; and structural research examining why individuals with serious conditions become homeless rather than receiving disability support, and how criminalization policies contribute to health healthcare disconnection. Addressing accelerated aging ultimately requires addressing the structural conditions that create and sustain homelessness.

Conclusion

Accelerated aging among PEHs in New Mexico manifests through multiple distinct pathways. While medical complexity characterizes one phenotype, most follow pathways of cumulative psychosocial trauma and systemic barriers. Accelerated aging risk is largely established at homelessness onset, emphasizing upstream prevention and early intervention. Age-based eligibility criteria systematically exclude younger adults experiencing premature aging. Effective responses require differentiated intervention strategies tailored to specific vulnerability profiles. The profound heterogeneity documented underscores that multiple pathways require multiple targeted responses.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1038/s41598-026-73446-2.

Acknowledgements Acknowledgments: The PICKUP study group includes: Kimberly Page, Christina Phillips, Annemarie Madaras, Jess Anderson, John Torres, Alejandro Aragon, Andres Reyes, Tristin Garcia, Evangelina Moralez-Norris, Ben Chase, Abigail Unruh, Fletcher Herring, Lina Tarhuni, Sara Doorley, Lindsay Fox, Carrie Hicks, Nolan Debring, Morgan Stein, Lauren Anderson, Emily Zwierzchowski, Meggie Woods, Eytan Libedinsky, and Jenna Norton.

Author contributions CH, JT, and KP contributed to conceptualization, original draft writing, formal analyses , validation, review, and editing. JT, JA, SD, JH, JK contributed to study methodology, investigation, review and editing. KP, CP, AM, and SD contributed to funding acquisition, investigation, methodology, resources, visualization, original draft writing, reviewing, and editing. PICKUP Study Group: conceptualization, investigation, methodology, project administration, operations, reviewing and editing. The PICKUP study was a collaboration that involved academic, community health and service organizations, the NM Department of Health, and the Office of the Governor of New Mexico. We wish to acknowledge the following community partners whose participation was invaluable in reaching participants and data collection: Alianza of New Mexico, Roswell, Chavez County, NM; Interfaith Community Shelter, Santa Fe, Santa Fe County, NM; Four Corners Detox Recovery & Santa Fe Recovery Center; Gallup, McKinley County, NM; San Juan County Partnership, Farmington, San Juan County, NM; Rio Arriba County Health and Human Services, Española, Rio Arriba County, NM; Counseling Center, Inc.; Alamogordo, Otero County, NM; Los Alamos County Social Services, Los Alamos County, NM; Luna County Health House & La Casa Inc., Deming, Luna County and Las Cruces, Doña Ana County, NM; H2 Academic Solutions, Belen, Valencia County, NM; Amador Health Center, Las Cruces, Doña Ana County, NM; Gateway Shelter, Westside Emergency Shelter, and Albuquerque Opportunity Center, Albuquerque, Bernalillo County, NM. We also acknowledge the es-

sential support from the New Mexico Department of Health for funding community partners to provide mobile services for people experiencing homelessness and key support from Joshua Swatek, Tracy Gordon, Vivian Heye, Rachel Simon Stark, Jamie Davis, and Andrew Gans. Finally, we are grateful to Amy Whitfield from the Office of the Governor of New Mexico for contributing to study planning and implementation.

Funding This study was funded by the New Mexico Department of Health through the Master Services Agreement with the University of New Mexico. Additional funding from the NIH NIA New Mexico Alzheimer's Disease Research Center (P30AG086404) supported authors KP, JA, JT, and JK. The opinions expressed in this article are the author's own and do not reflect the view of the National Institutes of Health.

Data availability Data are publicly available at Figshare.com [https://figshare.com/articles/dataset/PICKUP_Study_Data_Providing_Inclusive_and_Comprehensive_Care_for_Unhoused_Populations/29383379].

Declarations

Ethics The UNM HSC IRB granted Exempt classification with a waiver of written informed consent. The participants were provided with detailed information, including all the elements of informed consent.

Disclosures Dr. Page discloses that she has received support from Gilead Sciences for speaking and travel not related to this project. She and all the other authors have no other financial or nonfinancial interests to disclose.

Open Access This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

References

1. HUD Releases 2025 Annual Homelessness Assessment Report to congress. https://www.hud.gov/news/hud-no-26-037.
2. U.S. Office of Housing and Urban Development. The 2024 Annual Homelessness Assessment Report (AHAR) to Congress: PART 1: point-in-time estimates of homlessness December 2024. https://www.huduser.gov/portal/sites/default/files/pdf/2024-AHAR-Part-1.pdf (2024).
3. Hahn, J. A., Kushel, M. B., Bangsberg, D. R., Riley, E. & Moss, A. R. Brief report: The aging of the homeless population: Fourteen-year trends in San Francisco. *J. Gen. Intern. Med.***21**, 775–778 (2006).
4. Byrne, T. et al. Persistence of a birth cohort effect in the US among the adult homeless population. *JAMA Netw. Open***7**, e2452163 (2024).
5. Brown, R. T., Kimes, R. V., Guzman, D. & Kushel, M. Health care access and utilization in older versus younger homeless adults. *J. Health Care Poor Underserved***21**, 1060–1070 (2010).
6. Brown, R. T. & Steinman, M. A. Characteristics of emergency department visits by older versus younger homeless adults in the United States. *Am. J. Public Health***103**, 1046–1051 (2013).
7. DeMallie, D. A., North, C. S. & Smith, E. M. Psychiatric disorders among the homeless: a comparison of older and younger groups. *Gerontologist***37**, 61–66 (1997).
8. Garibaldi, B., Conde-Martel, A. & O'Toole, T. P. Self-reported comorbidities, perceived needs, and sources for usual care for older and younger homeless adults. *J. Gen. Intern. Med.***20**, 726–730 (2005).
9. Gelberg, L., Linn, L. S. & Mayer-Oakes, S. A. Differences in health status between older and younger homeless adults. *J. Am. Geriatr. Soc.***38**, 1220–1229 (1990).
10. Hategan, A., Tisi, D., Abdurrahman, M. & Bourgeois, J. A. Geriatric homelessness: Association with emergency department utilization. *Can. Geriatr. J.***19**, 189–194 (2016).
11. Kellogg, F. R. & Horn, A. The elderly homeless: A study comparing older and younger homeless persons, with three case histories. *Care Manag. J.***13**, 238–245 (2012).

12. Crane, M. & Warnes, A. M. Homelessness among older people and service responses. *Rev. Clin. Gerontol.***20**, 354–363 (2010).
13. Reynolds, K. A. et al. Aging and homelessness in a Canadian context. *Can. J. Commun. Ment. Health***35**, 1–13 (2016).
14. Brown, R. T., Kiely, D. K., Bharel, M. & Mitchell, S. L. Factors associated with geriatric syndromes in older homeless adults. *J. Health Care Poor Underserved***24**, 456–468 (2013).
15. Brown, R. T. et al. Trajectories of functional impairment in homeless older adults: Results from the HOPE HOME study. *PLoS ONE***14**, e0221020 (2019).
16. Brown, R. T., Kiely, D. K., Bharel, M. & Mitchell, S. L. Geriatric syndromes in older homeless adults. *J. Gen. Intern. Med.***27**, 16–22 (2012).
17. Waddell, C. J. et al. Infectious diseases among people experiencing homelessness: A systematic review of the literature in the United States and Canada, 2003-2022. *Public Health Rep.*https://doi.org/10.1177/00333549241228525 (2024).
18. Moffa, M. et al. A systematic scoping review of environmental health conditions and hygiene behaviors in homeless shelters. *Int. J. Hyg. Environ. Health***222**, 335–346 (2019).
19. Leibler, J. H. et al. Homelessness, personal hygiene, and MRSA nasal colonization among persons who inject drugs. *J. Urban Health***96**, 734–740 (2019).
20. Henwood, B. F. et al. Geriatric conditions among formerly homeless older adults living in permanent supportive housing. *J. Gen. Intern. Med.***34**, 802–803 (2019).
21. Brown, R. T. et al. Geriatric conditions in a population-based sample of older homeless adults. *Gerontologist***57**, 757–766 (2017).
22. Mantell, R. et al. Accelerated aging in people experiencing homelessness: A rapid review of frailty prevalence and determinants. *Front. Public Health***11**, 1086215 (2023).
23. Suh, K., Beck, J., Katzman, W. & Allen, D. D. Homelessness and rates of physical dysfunctions characteristic of premature geriatric syndromes: Systematic review and meta-analysis. *Physiother. Theory Pract.***38**, 858–867 (2022).
24. Gordon, S. J., Baker, N., Marin, T. S. & Steffens, M. Health status of people who are and are not experiencing homelessness: Opportunities for improvement. *Int. J. Environ. Res. Public Health*https://doi.org/10.3390/ijerph21101313 (2024).
25. Shinn, M., Greer, A. L., Bainbridge, J., Kwon, J. & Zuiderveen, S. Efficient targeting of homelessness prevention services for families. *Am. J. Public Health***103**(Suppl 2), S324–S330 (2013).
26. Culhane, D. P., Metraux, S. & Byrne, T. A prevention-centered approach to homelessness assistance: A paradigm shift?. *Hous. Policy Debate***21**, 295–315 (2011).
27. Chung, E. K. et al. Screening for social determinants of health among children and families living in poverty: A guide for clinicians. *Curr. Probl. Pediatr. Adolesc. Health Care***46**, 135–153 (2016).
28. Geronimus, A. T., Hicken, M., Keene, D. & Bound, J. 'Weathering' and age patterns of allostatic load scores among blacks and whites in the United States. *Am. J. Public Health***96**, 826–833 (2006).
29. McEwen, B. S. & Stellar, E. Stress and the individual. Mechanisms leading to disease. *Arch. Intern. Med.***153**, 2093–2101 (1993).
30. Ra, C. K. et al. Unsheltered homeless and unstably housed adults have higher levels of stress and more health risk factors than sheltered homeless adults. *J. Soc. Distress Homelessness***32**, 42–50 (2023).
31. Morrison, D. S. Homelessness as an independent risk factor for mortality: Results from a retrospective cohort study. *Int. J. Epidemiol.***38**, 877–883 (2009).
32. Weller, B. E., Bowen, N. K. & Faubert, S. J. Latent class analysis: A guide to best practice. *J. Black Psychol.***46**, 287–311 (2020).
33. Gelberg, L., Andersen, R. M. & Leake, B. D. The behavioral model for vulnerable populations: Application to medical care use and outcomes for homeless people. *Health Serv. Res.***34**, 1273–1302 (2000).
34. Page, K., Phillips, C. E. & Madaras, A. PICKUP: Survey of people experiencing homelessness in New Mexico, summary report. (2024).
35. Homeless emergency assistance and rapid transition to housing act. https://www.hudexchange.info/homelessness-assistance/hearth-act/.
36. Kushel, M. & Moore, T. Towards a new understanding: The California Statewide Study of People Experiencing Homelessness. (2023).
37. Jacoby, W. G. Loess. *Electoral Stud.***19**, 577–613 (2000).
38. Calzo, J. P. et al. Engaging institutional review boards in developing a brief, community-responsive human subjects training for community partners. *Prog. Community Health Partner. Res. Educ. Action***10**, 471–477 (2016).
39. Henwood, B. F., Cabassa, L. J., Craig, C. M. & Padgett, D. K. Permanent supportive housing: Addressing homelessness and health disparities?. *Am. J. Public Health***103**(Suppl 2), S188–S192 (2013).
40. Tsemberis, S., Gulcur, L. & Nakae, M. Housing first, consumer choice, and harm reduction for homeless individuals with a dual diagnosis. *Am. J. Public Health***94**, 651–656 (2004).
41. Baggett, T. P., O'Connell, J. J., Singer, D. E. & Rigotti, N. A. The unmet health care needs of homeless adults: a national study. *Am. J. Public Health***100**, 1326–1333 (2010).

42. Gelberg, L., Gallagher, T. C., Andersen, R. M. & Koegel, P. Competing priorities as a barrier to medical care among homeless adults in Los Angeles. *Am. J. Public Health***87**, 217–220 (1997).
43. Testa, A. et al. Links of previous incarceration with geriatric syndromes and chronic health conditions among older adults in the United States. *J. Gerontol. A Biol. Sci. Med. Sci.*https://doi.org/10.1093/gerona/glae084 (2024).
44. Hopper, E. K., Bassuk, E. L. & Olivet, J. Shelter from the storm: Trauma-informed care in homelessness services settings. *Open Health Serv. Policy J.***3**, 80–100 (2010).
45. Lim, S. et al. Impact of a New York City supportive housing program on Medicaid expenditure patterns among people with serious mental illness and chronic homelessness. *BMC Health Serv. Res.***18**, 15 (2018).
46. Witte, L. et al. Health professions education and training programs in health care for homeless individuals: A scoping review: A scoping review. *Acad. Med.*https://doi.org/10.1093/acamed/wvag009 (2026).
47. Kogan, A. C. et al. Access to basic needs and healthcare by people experiencing unsheltered homelessness. *J. Prim. Care Community Health***16**, 21501319251356768 (2025).
48. Nelson, R. E. et al. Association of temporary financial assistance with housing stability among US veterans in the Supportive Services for Veteran Families program. *JAMA Netw. Open***4**, e2037047 (2021).
49. O'Connell, M., Sint, K. & Rosenheck, R. How do housing subsidies improve quality of life among homeless adults? A mediation analysis. *Am. J. Community Psychol.***61**, 433–444 (2018).
50. Fargo, J. D., Munley, E. A., Byrne, T. H., Montgomery, A. E. & Culhane, D. P. Community-level characteristics associated with variation in rates of homelessness among families and single adults. *Am. J. Public Health***103**(Suppl 2), S340–S347 (2013).
51. Nilsson, S. F. et al. The bidirectional association between psychiatric disorders and sheltered homelessness. *Psychol. Med.***54**, 742–752 (2024).
52. Giano, Z. et al. Forty years of research on predictors of homelessness. *Communit. Ment. Health J.***56**, 692–709 (2020).
53. King, C. & Huang, X. Neighbourhood violence and housing instability: An exploratory study of low-income women. *Hous. Stud.***39**, 651–670 (2024).
54. Bryan, B. Housing instability following felony conviction and incarceration: Disentangling being marked from being locked up. *J. Quant. Criminol.***39**, 833–874 (2023).
55. Gutman, S. A. et al. Home safety fall and accident risk among prematurely aging, formerly homeless adults. *Am. J. Occup. Ther.***72**, 7204195030p1-7204195030p9 (2018).
56. Schoonveld, M., Hammond, A., Li, V., Mosites, E. & Clarke, K. E. N. Improving data on homelessness and health: Partnering with community-based organizations. *BMC Public Health***25**, 2918 (2025).
57. Gelberg, L. & Linn, L. S. Assessing the physical health of homeless adults. *JAMA***262**, 1973–1979 (1989).

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Authors and Affiliations

C Hicks[1] · J Torres[2] · C Phillips[2] · A Madaras[2] · S Doorley[2] · J Anderson[2] · J Hettema[2] · J Knoefel[2,3] · Kimberly Page[2,4] on behalf of the PICKUP Study Group

✉ Kimberly Page
Pagek@salud.unm.edu

[1] School of Medicine, University of New Mexico Health Sciences Center, Albuquerque, NM, US

[2] Department of Internal Medicine, School of Medicine, University of New Mexico Health Sciences Center, Albuquerque, NM, US

[3] Department of Neurology, School of Medicine, University of New Mexico Health Sciences Center, Albuquerque, NM, US

[4] Division of Epidemiology, Biostatistics, and Preventive Medicine, University of New Mexico Health Sciences Center, MSC 10 5550, 1, 87131 Albuquerque, NM, US

[5] School of Medicine, University of New Mexico Health Sciences Center, Albuquerque, NM, USA