



# Geriatric Syndromes in Older Homeless Adults

Rebecca T. Brown, MD<sup>1,2</sup>, Dan K. Kiely, MPH, MA<sup>2</sup>, Monica Bharel, MD<sup>3,4,5</sup>, and Susan L. Mitchell, MD, MPH<sup>1,2</sup>

<sup>1</sup>Division of Gerontology of Beth Israel Deaconess Medical Center, Boston, MA, USA; <sup>2</sup>Hebrew SeniorLife Institute for Aging Research, Boston, MA, USA; <sup>3</sup>Boston Healthcare for the Homeless Program, Boston, MA, USA; <sup>4</sup>Department of Medicine of Boston Medical Center, Boston, MA, USA; <sup>5</sup>Department of Medicine of Massachusetts General Hospital, Boston, MA, USA.

**BACKGROUND:** The average age of the US homeless population is increasing. Little is known about the prevalence of geriatric syndromes in older homeless adults.

**OBJECTIVE:** To determine the prevalence of common geriatric syndromes in a sample of older homeless adults, and to compare these prevalences to those reported in the general older population.

**DESIGN:** Cross-sectional.

**PARTICIPANTS:** Two hundred and forty-seven homeless adults aged 50–69 recruited from eight homeless shelters in Boston, MA.

**MAIN MEASURES:** Interviews and examinations for geriatric syndromes, including functional impairment, cognitive impairment, frailty, depression, hearing impairment, visual impairment, and urinary incontinence. The prevalences of these syndromes in the homeless cohort were compared to those reported in three population-based cohorts.

**KEY RESULTS:** The mean age of the homeless cohort was 56.0 years, and 19.8% were women. Thirty percent of subjects reported difficulty performing at least one activity of daily living, and 53.2% fell in the prior year. Cognitive impairment, defined as a Mini-Mental State Examination score <24, was present in 24.3% of participants; impaired executive function, defined as a Trail Making Test Part B duration >1.5 standard deviations above population-based norms, was present in 28.3% of participants. Sixteen percent of subjects met criteria for frailty, and 39.8% had major depression, defined as a score  $\geq 10$  on the Patient Health Questionnaire 9. Self-reported hearing and visual impairment was present among 29.7% and 30.0% of subjects, respectively. Urinary incontinence was reported by 49.8% of subjects. After multivariate adjustment for demographic characteristics, homeless adults were more likely to have functional impairment, frailty, depression, visual impairment and urinary incontinence compared to three population-based cohorts of older persons.

**CONCLUSIONS:** Geriatric syndromes that are potentially amenable to treatment are common in older homeless adults, and are experienced at higher rates than in the general older population.

**KEY WORDS:** homeless persons; aged; geriatric syndromes.

J Gen Intern Med 27(1):16–22

DOI: 10.1007/s11606-011-1848-9

© Society of General Internal Medicine 2011

## INTRODUCTION

The average age of the US homeless population is increasing. One-third of homeless adults are currently aged  $\geq 50$ , increased from 11% in the 1990s.<sup>1</sup> Despite this trend, little is known about geriatric syndromes among the growing proportion of elderly homeless.

Limited earlier research suggests that homeless adults suffer premature mortality and age-related medical conditions compared to the general population. Homeless persons have age-adjusted mortality rates 3–4 times higher than domiciled adults,<sup>2</sup> and the proportion of homeless adults in their 50s with chronic diseases (e.g., hypertension) is similar to housed adults aged  $\geq 65$ .<sup>3,4</sup>

While the onset of chronic disease in homeless adults appears to be accelerated, the degree to which they experience geriatric syndromes (e.g., functional impairment, cognitive impairment, frailty, depression, hearing impairment, visual impairment, and urinary incontinence), has not been well-studied. Geriatric syndromes are associated with higher mortality,<sup>5</sup> disability,<sup>6</sup> and use of acute care services.<sup>7</sup> However, research advances over the past two decades demonstrate that these syndromes are preventable or amenable to relatively simple interventions.<sup>8</sup> While delivering standard treatments to homeless patients can be challenging, geriatric syndromes cannot be addressed if they remain undetected. Therefore, the goal of this study was to describe the prevalence of common geriatric syndromes in a sample of older homeless adults, and to compare these prevalences to those reported in three population-based cohorts.

## METHODS

### Sample

All emergency (N=6), transitional (N=5), and day shelters (N=5) in Boston serving  $\geq 50$  single adults daily were approached to participate. Permission to recruit subjects was obtained from

Received April 5, 2011

Revised June 28, 2011

Accepted August 11, 2011

Published online August 31, 2011

three emergency, three transitional, and two day shelters. To identify subjects within these shelters, systematic random sampling was used. A random number generator was used to select a starting position on bed lists or in meal lines. Every 3rd person was then sampled and assessed for eligibility. The number of subjects recruited was capped at each site based on the proportion of clients served monthly relative to the total number served monthly at all participant shelters. Enrollment was stratified to reflect the 4:1 ratio of men to women in the Boston homeless population.<sup>9</sup> Shelter clients were eligible if they were aged  $\geq 50$ , homeless,<sup>10</sup> able to communicate in English, and able to provide written informed consent. Individuals were excluded if they were delirious<sup>11</sup> or visibly intoxicated. Subjects received a \$5 pharmacy chain gift certificate. The Institutional Review Boards of Hebrew SeniorLife and Beth Israel Deaconess Medical Center in Boston approved the study's conduct.

## Data Collection

Data were collected during a 40-minute in-person interview and physical examination conducted by one investigator (RTB), including demographics, health status, health services, homelessness, and geriatric syndromes. Demographics included age, gender, self-described race/ethnicity, marital status, education, and primary language. Health status data included self-reported general health, comorbidities, and alcohol and drug problems in the past 30 days, measured using the Addiction Severity Index composite score (range 0–1, higher scores indicate worse problems).<sup>12</sup> Cut-off scores established for homeless populations were used to dichotomize subjects as having alcohol ( $\geq 0.17$ ) or drug ( $\geq 0.10$ ) problems.<sup>10</sup> Binge-drinking was defined as consumption of  $\geq 5$  alcoholic beverages on  $\geq 1$  day in the past month.

Health services items included health insurance (yes/no) and insurance type. Subjects reported if they had a place where they usually obtained medical care. Subjects who identified a usual source of care were asked to specify type of care (outpatient clinic vs. emergency department (ED)). Health care utilization during the prior year was assessed, including clinic visits, ED visits, and hospitalizations. To characterize homelessness, subjects reported their age at first episode of homelessness, total years of lifetime homelessness, and number of months of homelessness during the past year.<sup>13</sup>

Geriatric syndromes included: functional impairment, cognitive impairment, frailty, depression, hearing impairment, visual impairment, and urinary incontinence. The modified Katz Activities of Daily Living Scale (ADL) rates ability to bathe, dress, transfer, toilet, and eat using three categories: no difficulty, a little or some difficulty, or a lot of difficulty or inability to perform.<sup>14</sup> The Brief Instrumental Functioning Scale rates ability to perform six instrumental activities of daily living (IADL) on a similar three category scale.<sup>15</sup> These scales were dichotomized: i. no difficulty performing any ADL (or IADL) and ii. difficulty performing  $\geq 1$  ADL (or IADL) independently. History of falls was assessed with a yes/no question, "Did you fall to the ground in the past year?"<sup>16</sup> Mobility was measured by self-reported difficulty walking and by self-reported balance problems.<sup>17</sup>

Cognition was measured using the MMSE<sup>18</sup> and the Trail Making Test Part B (TMT-B).<sup>19</sup> MMSE impairment was defined as a score  $< 24$ .<sup>20</sup> The TMT-B measures executive function, with

increasing time required to complete the task indicating worse function. TMT-B durations  $> 5$  minutes were truncated at 300 seconds. Impaired executive function was defined as TMT-B duration  $> 1.5$  standard deviations above population-based norms, or as stopping the task early.<sup>21</sup>

Frailty was defined using the Fried criteria, in which  $\geq 3$  of 5 characteristics were present: unintentional weight loss, exhaustion, low physical activity, slow walking speed, and weak handgrip.<sup>22</sup> Depression was assessed using the Patient Health Questionnaire 9 (PHQ-9), with major depression defined as a score of  $\geq 10$  (range 0–27, higher scores indicate more symptoms).<sup>23</sup> For comparison purposes, depression was examined as a single PHQ-9 item, feelings of depression  $> 7$  days in the prior 2 weeks. Hearing impairment was defined as difficulty hearing despite using a hearing aide, or as inability to identify  $\geq 50\%$  of whispered stimuli in either ear.<sup>24</sup> Visual impairment was defined as self-reported difficulty seeing despite wearing corrective lenses, or as best-corrected vision  $< 20/40$  on Snellen chart.<sup>25</sup> Urinary incontinence was assessed using the International Consultation on Incontinence Questionnaire (range 0–21; higher values indicate more symptoms and urinary incontinence is defined as a score  $\geq 1$ ).<sup>26</sup>

## Comparative Population-Based Measures

The characteristics of the homeless cohort were compared with three population-based cohorts: the Maintenance of Balance, Independent Living, Intellect, and Zest in the Elderly (MOBILIZE) of Boston Study (MBS),<sup>27</sup> the National Health and Nutrition Examination Survey (NHANES),<sup>28</sup> and the National Health Interview Survey (NHIS).<sup>29</sup> These cohorts were chosen because they measured geriatric syndromes comparable to those collected in this study. Although the MBS cohort was significantly older, we felt a priori that it would be informative to compare the prevalence of geriatric syndromes in the homeless to a relatively older cohort.

The MBS cohort included community-dwelling adults aged  $\geq 65$ . The following variables were obtained: demographics; health status (rating of general health, comorbidities, binge-drinking); health services (outpatient visit, hospitalization); geriatric syndromes (functional status (impairment in  $\geq 1$  ADLs,<sup>14</sup> impairment in  $\geq 1$  IADLs,<sup>30</sup> fall in the prior year, difficulty walking); cognition (MMSE, TMT-B); frailty<sup>22</sup>; depression (feelings of depression most or all of the time during the past week)<sup>31</sup>; hearing impairment (self-report); visual impairment (acuity  $< 20/40$ ); urinary incontinence (self-report)).

The following variables were obtained from NHANES (aged 50–69): demographics; health status (rating of general health; comorbidities; binge-drinking); health services (health insurance; usual source of health care; prior year hospitalization); and geriatric syndromes (difficulty walking; depression (PHQ-9); hearing impairment (self-report); visual impairment (self report; acuity  $< 20/40$ ); urinary incontinence (self-report)).

Finally, the following items were derived from NHIS (aged 50–69): demographics; health status (rating of general health; comorbidities; binge-drinking); health services (health insurance; usual source of care; outpatient visit, ED visit or hospitalization); and geriatric syndromes (functional status

(difficulty walking, balance problem); hearing impairment; visual impairment (all syndromes self-report)).

## Statistical Analyses

Descriptive statistics were used to present subject characteristics in the homeless and population-based cohorts, using means and standard deviations for continuous variables and counts and frequencies for categorical variables. For NHIS and NHANES, provided sample weights were used to obtain estimates for the US population.

Comparisons were made between the characteristics of the homeless and MBS cohorts, using two-sample t-tests or Wilcoxon tests for continuous measures and two-sample chi-square tests for categorical measures. Because the NHANES and NHIS data were population estimates derived using sample weights, one-sample tests were used to compare the homeless sample to the NHANES and NHIS populations. Variance for the NHANES and NHIS subpopulations aged 50–69 were calculated using the full data files and provided masked-variance units.

To compare the prevalence of geriatric syndromes (outcomes) in the homeless and population-based cohorts (main independent variable), linear and logistic multivariate modeling was used for continuous and dichotomous outcomes, respectively. The models were adjusted for demographics: age, gender, race/ethnicity (non-Hispanic White vs. other), marital status (married vs. not married), education (<high school vs.  $\geq$  high school), and primary language (English vs. other). Age was analyzed in quartiles in the logistic regression models and in continuous form in the linear models. Binge-drinking and comorbidities that were associated with the geriatric syndromes in bivariate analyses ( $p < 0.10$ ) were included in the final multivariate models.

All analyses were conducted using SAS version 9.2 (SAS Institute, Cary, North Carolina).

## RESULTS

### Sample

A total of 472 shelter clients were screened for eligibility, of whom 387 (82.0%) were eligible. Reasons for ineligibility included: not homeless, 44 (51.8%); unable to communicate in English, 27 (31.8%); unable to provide informed consent, five (5.9%); and visible intoxication, nine (10.6%). Among the 387 eligible individuals, 250 (64.6%) subjects were recruited. Eligible clients who declined participation did not differ significantly from those recruited by observed race/ethnicity, but were older (mean age 59.5 years,  $p = 0.002$ ) and more likely to be men (89.8%,  $p = 0.02$ ). Only three eligible subjects were aged  $\geq 70$ . To ease comparison with the population-based cohorts, these three subjects were excluded from analyses, with the remaining 247 subjects comprising the final sample.

### Subject Characteristics

Characteristics of the 247 homeless subjects are presented in Table 1. Mean age was 56.0 (SD, 4.8) years, 19.8% were female,

39.7% were White, 26.1% had not completed high school, and 87.0% identified English as their primary language. Comorbid conditions were common, including hypertension (59.0%), arthritis (44.9%), and depression (59.6%). A third of subjects reported binge-drinking in the prior month.

The majority of subjects had health insurance (94.7%), most commonly Medicaid (87.9%). During the prior year, most subjects had received ambulatory care (87.3%) or care in an ED (69.7%); 43.3% were hospitalized overnight.

The subjects' mean age at first episode of homelessness was 42.3 (SD, 13.0) years. Mean years of lifetime homelessness was 7.7 (SD, 8.4) years, and 62.8% of subjects had been homeless for  $\geq 1$  year.

## Geriatric Syndromes

In the category of functional status, 30.0% of subjects reported difficulty performing  $\geq 1$  ADL, and 57.1% reported difficulty performing  $\geq 1$  IADL (Table 2). More than half of subjects fell in the prior year (53.2%). Mean MMSE score was 26.3 (SD, 3.1), and 24.3% of subjects had cognitive impairment defined by MMSE score  $< 24$ . Mean TMT-B duration was 130.4 (SD, 67.3) seconds, and 28.3% of subjects had cognitive impairment defined by TMT-B duration. Sixteen percent of subjects met frailty criteria, and 39.8% had major depression defined by PHQ-9 score. Hearing difficulty was reported by 29.7% of subjects, and 21.0% had best-corrected vision  $< 20/40$ . Urinary incontinence was reported by 49.8% of subjects.

## Comparison with Population-Based Cohorts

Homeless subjects were significantly more likely to be younger, men, non-White, and not married compared to all three population-based cohorts ( $p < 0.001$ , Table 1). Homeless subjects were less likely to report good, very good or excellent health than the comparison cohorts ( $p < 0.001$ ). Comorbidities were more common in the homeless cohort as compared to NHANES and NHIS, with the exception of cancer and congestive heart failure (NHANES) and stroke and diabetes (NHIS). Cancer and coronary artery disease were more common in MBS than in the homeless cohort, but the prevalences of other comorbidities were similar. Rates of binge drinking were higher in the homeless than in all three population-based cohorts ( $p < 0.001$ ).

A larger proportion of homeless subjects reported having health insurance compared to NHANES ( $p < 0.001$ ) and NHIS ( $p = 0.01$ ), predominantly Medicaid, though more homeless subjects lacked a usual source of care or used the ED for care ( $p < 0.001$ ). Homeless subjects reported fewer outpatient visits in the prior year compared to MBS subjects ( $p < 0.001$ ), but had rates similar to NHIS. Homeless subjects more often reported visiting the ED ( $p < 0.001$ ) and being hospitalized ( $p < 0.001$ ) in the prior year compared to the population-based cohorts.

After multivariate adjustment, homeless subjects had higher rates of ADL and IADL impairment compared with MBS subjects ( $p = 0.004$ , Table 2). Falls in the prior year did not differ between the homeless and MBS cohorts, but were more common in the homeless compared to NHIS ( $p < 0.001$ ). Difficulty walking was more common among homeless subjects compared to the

Table 1. Baseline Characteristics of Homeless Subjects (n=247) and Comparisons with Population-Based Cohorts

Characteristic	Homeless (n=247)	MBS (n=765)	P value*	NHANES (n=2533)	P value†	NHIS (n=6584)	P value‡
<b>Demographics</b>							
Age, years mean (SD)	56.0 (4.8)	78.1 (5.4)	< 0.001	57.6 (7.5)	< 0.001	58.6 (6.2)	< 0.001
Age, range	50-69	65-97	N/A	50-69	N/A	50-69	N/A
Women, n (%)	49 (19.8)	489 (63.9)	< 0.001	1312 (51.8)	< 0.001	3574 (54.3)	< 0.001
<b>Race/ethnicity, n (%)</b>							
African-American	99 (40.1)	122 (16.0)		274 (10.8)		742 (11.3)	
White	98 (39.7)	585 (76.6)	< 0.001	1811 (71.5)	< 0.001	5098 (77.4)	< 0.001
Multiracial/Other	24 (9.7)	41 (5.4)		172 (6.8)		261 (4.0)	
Latino	26 (10.5)	16 (2.1)		276 (10.9)		483 (7.3)	
Married or partnered, n (%)	15 (6.1)	325 (42.7)	< 0.001	1315 (65.1)	< 0.001	3720 (56.7)	< 0.001
< High school education, n (%)	64 (26.1)	85 (11.1)	< 0.001	374 (18.5)	0.002	903 (13.8)	< 0.001
Primary language English, n (%)	214 (87.0)	N/A	N/A	2377 (93.9)	< 0.001	6382 (96.9)	< 0.001
<b>Health status</b>							
<b>Self-reported health, n (%)</b>							
Good, very good, excellent	146 (59.1)	651 (85.1)	< 0.001	1669 (82.3)	< 0.001	5253 (79.9)	< 0.001
<b>Comorbid conditions, n (%)</b>							
Stroke	17 (6.9)	76 (10.0)	0.15	76 (3.8)	0.01	287 (4.4)	0.05
Cancer	14 (5.8)	188 (24.7)	< 0.001	158 (7.8)	0.24	823 (12.5)	0.002
Diabetes mellitus	40 (16.4)	141 (18.7)	0.42	275 (11.0)	0.007	973 (14.8)	0.48
Coronary artery disease	32 (13.1)	199 (26.8)	< 0.001	124 (6.1)	< 0.001	595 (9.0)	0.03
Congestive heart failure	11 (4.5)	39 (5.2)	0.67	58 (2.9)	0.14	N/A	N/A
Hypertension	144 (59.0)	470 (62.2)	0.38	803 (37.5)	< 0.001	3058 (46.5)	< 0.001
Asthma or COPD	79 (32.2)	123 (16.3)	< 0.001	464 (18.6)	< 0.001	1137 (17.3)	< 0.001
Arthritis	110 (44.9)	346 (48.7)	0.31	709 (35.1)	0.001	2537 (38.6)	0.04
Depression	146 (59.6)	135 (17.7)	< 0.001	N/A	N/A	2244 (34.4)	< 0.001
<b>Alcohol problems, n (%)</b>							
Addiction severity index $\geq 17$	45 (18.7)	N/A	N/A	N/A	N/A	N/A	N/A
$\geq 1$ binge drinking episodes	73 (30.0)	5 (0.7)	< 0.001	165 (6.5)	< 0.001	182 (2.8)	< 0.001
<b>Drug problems, n (%)</b>							
Addiction severity index $\geq 10$	41 (16.8)	N/A	N/A	N/A	N/A	N/A	N/A
<b>Health services</b>							
<b>Insurance, n (%)</b>							
Private	231 (94.7)	N/A	N/A	2143 (84.7)	< 0.001	5901 (89.8)	0.01
Medicare	4 (1.7) <sup>§</sup>			1680 (66.3)	< 0.001	4403 (67.0)	< 0.001
Medicaid	46 (19.9)			361 (14.2)	0.01	1516 (23.1)	0.25
Military	203 (87.9)			173 (6.8)	< 0.001	433 (6.6)	< 0.001
	33 (14.3)			98 (3.8)	< 0.001	339 (5.2)	< 0.001
<b>Usual source of care, n (%)</b>							
Clinic	170 (70.8)	N/A	N/A	2243 (88.6)	< 0.001	5859 (90.8)	< 0.001
None or emergency department	70 (29.2)	N/A	N/A	290 (11.4)	< 0.001	597 (9.2)	< 0.001
<b>Utilization, prior year, n (%)</b>							
$\geq 1$ clinic visit	213 (87.3)	744 (97.3)	< 0.001	N/A	N/A	5655 (87.8)	0.45
$\geq 1$ emergency department visit	170 (69.7)	N/A	N/A	N/A	N/A	1233 (19.1)	< 0.001
$\geq 1$ in-patient hospital admission	106 (43.3)	167 (21.9)	< 0.001	258 (10.2)	< 0.001	711 (10.8)	< 0.001
<b>Homelessness</b>							
Age at first episode of homelessness, years mean (SD)	42.3 (13.0)	N/A	N/A	N/A	N/A	N/A	N/A
Lifetime years homelessness, years mean (SD)	7.7 (8.4)	N/A	N/A	N/A	N/A	N/A	N/A
Months homelessness, prior year, months mean (SD)	9.6 (3.8)	N/A	N/A	N/A	N/A	N/A	N/A
Homeless $\geq 1$ year, n (%)	155 (62.8)	N/A	N/A	N/A	N/A	N/A	N/A

Abbreviations: MBS, MOBILIZE Boston Study; NHANES, National Health and Nutrition Examination Survey; NHIS, National Health Interview Survey; COPD, chronic obstructive pulmonary disease

\*Compares prevalence of or mean value of characteristics in homeless cohort to MBS cohort

†Compares prevalence of or mean value of characteristics in homeless cohort to NHANES cohort

‡Compares prevalence of or mean value of characteristics in homeless cohort to NHIS cohort

§Proportions for type of insurance add to >100%, as some subjects had more than one type of insurance

population-based cohorts. After multivariate adjustment, the only cognitive measure that was significantly worse in the homeless compared to MBS was continuous MMSE score ( $p < 0.001$ ). Cognitive impairment defined by MMSE score  $< 24$  did not differ between the cohorts. Rates of frailty were higher in the homeless than the MBS cohort ( $p < 0.001$ ). Major depression defined by PHQ-9 score was more frequent in the homeless than in NHANES ( $p < 0.001$ ), as were feelings of depression in the homeless vs. MBS ( $p = 0.02$ ) and NHANES ( $p < 0.001$ ). Self-reported hearing impairment did not differ between the homeless and comparison cohorts. Visual acuity  $< 20/40$  was more common in the homeless than in

the comparison cohorts. A greater proportion of homeless subjects had urinary incontinence vs. MBS or NHANES ( $p < 0.001$ ).

## DISCUSSION

As the first study to rigorously characterize the presence of geriatric syndromes in older homeless adults, this report increases our understanding of age-related syndromes in this

Table 2. Prevalence of Geriatric Syndromes among Homeless Subjects (n=247) and Population-Based Cohorts

Geriatric syndrome	Homeless (n=247)	MBS (n=765)	P value*	NHANES (n=2533)	P value†	NHIS (n=6584)	P value‡
Functional status, n (%)							
ADL impairment	74 (30.0)	173 (22.6)	0.004	N/A	N/A	N/A	N/A
IADL impairment	140 (57.1)	309 (40.4)	< 0.001	N/A	N/A	N/A	N/A
Fall in prior year, n (%)	131 (53.2)	285 (37.5)	0.50	N/A	N/A	850 (13.6)	< 0.001
Mobility impairment, n (%)							
Difficulty walking, self-report	102 (41.3)	219 (28.9)	0.002	164 (8.1)	< 0.001	649 (9.9)	< 0.001
Difficulty with balance, self-report	90 (36.6)	N/A	N/A	N/A	N/A	915 (14.5)	< 0.001
Cognition							
MMSE score, mean (SD)	26.3 (3.1)	27.1 (2.7)	< 0.001	N/A	N/A	N/A	N/A
MMSE impaired, <sup>§</sup> n (%)	60 (24.3)	92 (12.0)	0.12	N/A	N/A	N/A	N/A
TMT-B score, mean (SD)	130.4 (67.3)	143.6 (78.6)	0.05	N/A	N/A	N/A	N/A
TMT-B impaired, <sup>  </sup> n (%)	67 (28.3)	92 (12.0)	0.56	N/A	N/A	N/A	N/A
Frailty, n (%)	40 (16.4)	76 (10.0)	0.002	N/A	N/A	N/A	N/A
Depression, n (%)							
PHQ-9 ≥ 10	98 (39.8)	N/A	N/A	161 (8.8) <sup>¶</sup>	< 0.001	N/A	N/A
Depressed feelings ≥ 7 days	95 (38.6)	25 (3.3)	0.02	125 (6.9)	< 0.001	N/A	N/A
Hearing impairment, n (%)							
Self-report	73 (29.7)	410 (53.7)	0.23	631 (25.3)	0.22	1404 (21.3)	0.17
Whispered voice test	63 (25.6)	N/A	N/A	N/A	N/A	N/A	N/A
Visual impairment, n (%)							
Self-report	74 (30.0)	N/A	N/A	470 (19.0)	0.14	933 (14.2)	< 0.001
Acuity <20/40 (Snellen)	44 (21.0)	97 (13.8)	< 0.001	345 (17.2)	0.008	N/A	N/A
Urinary incontinence, n (%)							
Self-report	122 (49.8)	314 (41.1)	< 0.001	661 (36.9)	< 0.001	N/A	N/A
ICIQ score, mean (SD)	4.5 (5.7)	N/A	N/A	N/A	N/A	N/A	N/A

Abbreviations: MBS, MOBILIZE Boston Study; NHANES, National Health and Nutrition Examination Survey; NHIS, National Health Interview Survey; ADL, Activities of Daily Living; IADL, Instrumental Activities of Daily Living; MMSE, Mini-Mental State Examination; TMT-B, Trail Making Test Part B; PHQ-9, Patient Health Questionnaire 9; ICIQ, International Consultation on Incontinence Questionnaire

\*Compares prevalence of or mean value of geriatric syndromes in homeless cohort to MBS cohort. Both homeless and MBS values are adjusted for age, gender, race/ethnicity, marital status, education, and binge-drinking and comorbidities associated with the geriatric syndromes in bivariate analyses (p<0.10)

†Compares prevalence of geriatric syndromes in homeless cohort to NHANES cohort. Both homeless and NHANES values are adjusted for age, gender, race/ethnicity, marital status, education, primary language, and binge-drinking and comorbidities associated with the geriatric syndromes in bivariate analyses (p<0.10)

‡Compares prevalence of geriatric syndromes in homeless cohort to NHIS cohort. Both homeless and NHIS values are adjusted for age, gender, race/ethnicity, marital status, education, primary language, and binge-drinking and comorbidities associated with the geriatric syndromes in bivariate analyses (p<0.10)

§Impairment defined as MMSE score < 24

||Impairment defined as TMT-B duration >1.5 standard deviations above population-based norms

¶Includes participants in the NHANES Mobile Examination Component

population. Our findings demonstrate that older homeless adults commonly experience geriatric syndromes that may be amenable to intervention. Even after multivariate adjustment, syndromes including functional and mobility impairment, frailty, depression, visual impairment and urinary incontinence were significantly more common in the homeless compared to population-based cohorts.

Our cohort was similar to large representative cohorts of homeless adults, with respect to gender, race/ethnicity, marital<sup>32</sup> and health status.<sup>33</sup> The cohort differs from other homeless cohorts in several respects. In comparison to homeless adults aged ≥50 in one study of self-reported comorbidities, subjects in our cohort reported higher comorbidity rates, including hypertension (59.0% vs. 43.2%) and arthritis (44.9% vs. 27.0%).<sup>3</sup> Subjects also reported higher insurance rates than other studies. In a nationally-representative homeless cohort, 56.6% of adult subjects were insured<sup>32</sup>; homeless adults aged ≥50 have reported similar insurance rates.<sup>3</sup> As in other studies, the majority of subjects in our study had Medicaid.<sup>34</sup> The high insurance rate in our cohort reflects both Massachusetts' history of insuring the homeless population and recent health care reform, which provides subsidized insurance for residents earning ≤300% of the federal poverty level.

Health insurance is associated with better ambulatory care access and fewer barriers to obtaining care in both homeless and housed adults.<sup>35</sup> Consistent with this finding, our cohort had high rates of ambulatory care. However, our cohort also had more ED visits and hospitalizations relative to the comparison cohorts, suggesting that in older homeless adults, high insurance rates may still be associated with high rates of acute care utilization.

This study corroborates research reporting high rates of geriatric syndromes in homeless adults, but extends earlier work by providing a more comprehensive assessment of these syndromes and by comparison with population-based cohorts. Prior studies of older homeless adults have reported high rates of functional impairment,<sup>4</sup> cognitive impairment,<sup>36</sup> depression,<sup>37</sup> hearing<sup>4</sup> and visual impairment.<sup>38</sup> A recent systematic review of cognitive impairment in homeless adults found that 0-21% (weighted mean, 4.2%) of subjects scored <24 on the MMSE.<sup>36</sup> While the proportion of subjects in our cohort scoring <24 (24.4%) is higher than the upper range of reviewed studies, the review included adults aged ≥18, while our subjects were aged ≥50.

The prevalence of most geriatric syndromes was significantly higher compared to the population-based cohorts. Even when compared to MBS, with an average age >20 years older, the

homeless cohort had a higher prevalence of most geriatric syndromes. While differences between the cohorts including demographics, alcohol use, and comorbidities might be hypothesized to account for the higher prevalence of syndromes, differences in prevalences persisted after adjustment for these factors, with the exception of selected measures of cognitive impairment, falls in MBS, and self-reported visual impairment in NHANES. Higher rates of drug use among the homeless cohort may explain some of the observed differences in rates of syndromes. Because measurement of drug use differed between the cohorts, we did not adjust for this variable.

The study has several limitations. Inter-rater reliability was not tested for RTB's measurements. However, RTB was trained in administration of cognitive measures by the Hebrew SeniorLife Clinical Studies Manager. All other instruments were administered according to published guidelines, using a written script to ensure consistent administration. While the questionnaire data are based on self-report, homeless adults' self-reports are as accurate as the general population.<sup>39</sup> Limited power may account for our inability to detect a significant difference between the cohorts in prevalence of cognitive impairment defined by MMSE <24. Recruitment of subjects was limited to shelters, and therefore does not capture individuals who do not access these organizations. This could either overestimate geriatric syndromes (if more functional individuals do not access shelters) or underestimate (if frailer individuals are unable to seek shelter). However, <6% of single homeless adults in Boston stay on the street during the winter.<sup>9</sup> Finally, because we only included Massachusetts shelters, the findings may not be generalizable to other areas. However, the subjects' demographic characteristics are similar to a nationally representative homeless sample.<sup>32</sup>

The average age of the homeless population is expected to continue to increase.<sup>1</sup> Our study shows that older homeless adults have higher rates of most geriatric syndromes compared to the general population. Many geriatric syndromes are potentially amenable to intervention, and, if addressed proactively, may reduce adverse outcomes and acute care utilization. While delivering health care services to homeless elders is challenging, screening and standard treatment for geriatric syndromes is warranted for homeless adults aged  $\geq 50$  who access health care.

**Acknowledgements:** We thank the data management team (Margaret Bryan, Ellen Gornstein, Diane Engorn); Michele Shaffer, PhD, for statistical consultation; the staff at participating shelters; and the subjects who generously gave their time to this study. This work was supported by the Hartford Foundation, NIH-NIA T32 AG023480, and the HRCA/Harvard Research Nursing Home Program Project, funded by NIH-NIA AG004390. Dr. Mitchell was supported by NIH-NIA K24 AG033640.

**Conflicts of Interest:** None disclosed.

**Corresponding Author:** Rebecca T. Brown, MD; Hebrew SeniorLife Institute for Aging Research, 1200 Centre Street, Boston, MA 02131, USA (e-mail: rebeccabrown@hsl.harvard.edu).

## REFERENCES

- Hahn JA, Kushel MB, Bangsberg DR, Riley E, Moss AR. BRIEF REPORT: the aging of the homeless population: fourteen-year trends in San Francisco. *J Gen Intern Med.* 2006;21(7):775-8.

- Hibbs JR, Benner L, Klugman L, et al. Mortality in a cohort of homeless adults in Philadelphia. *N Engl J Med.* 1994;331(5):304-9.
- Garibaldi B, Conde-Martel A, O'Toole TP. Self-reported comorbidities, perceived needs, and sources for usual care for older and younger homeless adults. *J Gen Intern Med.* 2005;20(8):726-30.
- Gelberg L, Linn LS, Mayer-Oakes SA. Differences in health status between older and younger homeless adults. *J Am Geriatr Soc.* 1990;38(11):1220-9.
- Tschanz JT, Corcoran C, Skoog I, et al. Dementia: the leading predictor of death in a defined elderly population: the cache county study. *Neurology.* 2004;62(7):1156-62.
- Tinetti ME, Liu WL, Claus EB. Predictors and prognosis of inability to get up after falls among elderly persons. *JAMA.* 1993;269(1):65-70.
- Mor V, Wilcox V, Rakowski W, Hiris J. Functional transitions among the elderly: patterns, predictors, and related hospital use. *Am J Public Health.* 1994;84(8):1274-80.
- Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev.* 2009;2:CD007146.
- Quirk M, Greene J, Owens C. Homelessness in the City of Boston, Winter 2008-2009: Annual census report. Available at: [www.cityofboston.gov/Images\\_Documents/homeless2008\\_-\\_2009\\_tcm3-1764.pdf](http://www.cityofboston.gov/Images_Documents/homeless2008_-_2009_tcm3-1764.pdf). Accessed July 7, 2011.
- Burt MR, Aron LY, Douglas T, Valente J, Lee E, Iwen B. Homelessness: Programs and the People they Serve. Washington, DC: Urban Institute; 1999.
- Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegel AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med.* 1990;113(12):941-8.
- McLellan AT, Kushner H, Metzger D, et al. The fifth edition of the addiction severity index. *J Subst Abuse Treat.* 1992;9(3):199-213.
- Hwang SW, Colantonio A, Chiu S, et al. The effect of traumatic brain injury on the health of homeless people. *CMAJ.* 2008;179(8):779-84.
- Katz S, Downs TD, Cash HR, Grotz RC. Progress in development of the Index of ADL. *Gerontologist.* 1970;10(1):20-30.
- Sullivan G, Dumenci L, Burnam A, Koegel P. Validation of the brief instrumental functioning scale in a homeless population. *Psychiatr Serv.* 2001;52(8):1097-1099.
- Cummings SR, Nevitt MC, Kidd S. Forgetting falls. The limited accuracy of recall of falls in the elderly. *J Am Geriatr Soc.* 1988;36(7):613-6.
- Tinetti ME. Clinical practice. Preventing falls in elderly persons. *N Engl J Med.* 2003;348(1):42-9.
- Folstein MF, Folstein SE, McHugh PR. Mini-Mental State. A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res.* 1975;12(3):189-98.
- Reitan RM. The validity of the trail-making test as an indicator of organic brain disease. *Percept Mot Skills.* 1958;8:271-6.
- Crum RM, Anthony JC, Bassett SS, Folstein MF. Population-based norms for the Mini-Mental State Examination by age and educational level. *JAMA.* 1993;269(18):2386-91.
- Heaton RK, Miller W, Taylor MJ, Grant I. Revised comprehensive norms for an expanded Halstead-Reitan battery: demographically adjusted neuropsychological norms for African American and Caucasian adults. Lutz, Florida: Psychological Assessment Resources; 2004.
- Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci.* 2001;56(3):M146-56.
- Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* 2001;16(9):606-13.
- Bagai A, Thavendiranathan P, Detsky AS. Does this patient have hearing impairment? *JAMA.* 2006;295(4):416-28.
- Calonge N, Petitti DB, DeWitt TG, et al. US Preventive Services Task Force. Screening for impaired visual acuity in older adults: US Preventive Services Task Force recommendation statement. *Ann Intern Med.* 2009;151(1):37-43.W10.
- Avery K, Donovan J, Peters TJ, Shaw C, Gotoh M, Abrams P. ICIQ: a brief and robust measure for evaluating the symptoms and impact of urinary incontinence. *Neurourol Urodyn.* 2004;23(4):322-30.
- Leveille SG, Kiel DP, Jones RN, et al. The MOBILIZE Boston Study: design and methods of a prospective cohort study of novel risk factors for falls in an older population. *BMC Geriatr.* 2008;8:16.
- Centers for Disease Control and Prevention. National Health and Nutrition Examination Survey, 2007-2008. Available at: [www.cdc.gov/nchs/nhanes/nhanes2007-2008/nhanes07\\_08.htm](http://www.cdc.gov/nchs/nhanes/nhanes2007-2008/nhanes07_08.htm). Accessed July 7, 2011.

29. Centers for Disease Control and Prevention. National Health Interview Survey questionnaires, datasets and related documentation, 1997 to the present. Available at: [www.cdc.gov/nchs/nhis/quest\\_data\\_related\\_1997\\_forward.htm](http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm). Accessed July 7, 2011.
30. **Lawton MP, Brody EM.** Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist*. 1969;9(3):179–86.
31. **Radloff LS.** The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas*. 1977;1(3):385–401.
32. **Kushel MB, Vittinghoff E, Haas JS.** Factors associated with the health care utilization of homeless persons. *JAMA*. 2001;285(2):200–6.
33. **White MC, Tulsy JP, Dawson C, Zolopa AR, Moss AR.** Association between time homeless and perceived health status among the homeless in San Francisco. *J Community Health*. 1997;22(4):271–82.
34. **Kushel MB, Perry S, Bangsberg D, Clark R, Moss AR.** Emergency department use among the homeless and marginally housed: results from a community-based study. *Am J Public Health*. 2002;92(5):778–84.
35. **Ayanian JZ, Weissman JS, Schneider EC, et al.** Unmet health needs of uninsured adults in the United States. *JAMA*. 2000;284(16):2061–9.
36. **Burra TA, Stergiopoulos V, Rourke SB.** A systematic review of cognitive deficits in homeless adults: implications for service delivery. *Can J Psychiatry*. 2009;54(2):123–33.
37. **Cohen CI, Teresi J, Holmes D.** The mental health of old homeless men. *J Am Geriatr Soc*. 1988;36(6):492–501.
38. **Pitz S, Kramann C, Krummenauer F, Pitz A, Trabert G, Pfeiffer N.** Is homelessness a risk factor for eye disease? Results of a German screening study. *Ophthalmologica*. 2005;219(6):345–9.
39. **Gelberg L, Siecke N.** Accuracy of homeless adults' self-reports. *Med Care*. 1997;35(3):287–90.