ORIGINAL ARTICLE

A Comparative Analysis of Serious Injury and Illness Among Homeless and Housed Low Income Residents of New York City

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Background: Delivery of effective primary, secondary, and tertiary injury prevention in homeless populations is complex and could be greatly aided by an improved understanding of contributing factors.

Methods: Injury and health conditions were examined for hospitalized New York City homeless persons (n = 326,073) and low socioeconomic status (SES) housed residents (n = 1,202,622) using 2000 to 2002 New York statewide hospital discharge data (Statewide Program and Research Cooperative System). Age- and gender-adjusted odds ratios with 95% confidence intervals were calculated within age groups of 0.1 years to 9 years, 10 years to 19 years, 20 years to 64 years, and ≥65 years, with low SES housed as the comparison group.

Results: Comorbid conditions, injury, and injury mechanisms varied by age, gender, race or ethnicity, and housing status. Odds of unintentional injury in homeless versus low SES housed were higher in younger children aged 0 years to 9 years (1.34, 1.27–1.42), adults (1.13, 1.09–1.18), and elderly (1.25, 1.20–1.30). Falls were increased by 30% in children, 14% in adolescents or teenagers, and 47% in the elderly. More than one-quarter (26.9%) of fall hospitalizations in homeless children younger than 5 years were due to falls from furniture with more than threefold differences observed in both 3 year and 4 year olds ($p = 0.0001$). Several comorbid conditions with potential to complicate injury and postinjury care were increased in homeless including nutritional deficiencies, infections, alcohol and drug use, and mental disorders.

Conclusions: Although homelessness presents unique, highly complex social and health issues that tend to overshadow the need for and the value of injury prevention, this study highlights potentially fruitful areas for primary, secondary, and tertiary prevention.

Both homelessness and injury are universal issues in developed and developing urban societies. Nearly 1 in 14 Americans experience at least one bout of homelessness in their lifetime.[1] Adequate housing likely influences the prevalence of injury among individuals by either buffering or exacerbating the environmental conditions, which ultimately lead to adverse health outcomes and injuries.[2–4] Racial, ethnic, and socioeconomic disparities in injury are common.[5] Social and physical environments are the common factors that contribute differentially to injury risks in children, adults, and the elderly.[5–7] Although traumatic injury has been reported to be the most frequent indication for emergency room visits among homeless individuals both in the United States and abroad,[2,8–10] the relation between homelessness and injury has not been fully explored across the age span. In particular, persons with low socioeconomic status (SES) are known to have higher injury rates across a wide range of injury mechanisms,[11] and the majority of homeless individuals are low SES, raising the issue of how much of the apparent differential in injury risk is related to being homeless compared with low SES. Furthermore, some health conditions, such as mental illness and substance abuse, may contribute to the likelihood of becoming homeless, to increased injury risk, and to poorer outcomes once injured.

Although many studies have documented a range of health risks and conditions that are common in homeless populations,[12–15] the relation between homelessness, injury, and low SES has not been methodically investigated across the full range of injury mechanisms. Such comprehensive, systematic investigations of injury and injury mechanisms across the full age span of homeless populations could be useful in tailoring injury prevention activities, identifying issues with potential to complicate delivery of postinjury care, and monitoring the health impact of policy changes for this vulnerable population.

MATERIALS AND METHODS

Data Sources

The primary source of data for this study was the 2000 to 2002 Statewide Program and Research Cooperative System (SPARCS). SPARCS captures discharges from all acute care hospitals in New York State through a mandatory reporting

system that includes coding for external causes of injury.[16] SPARCS, maintained at the New York State Department of Health, is created through two primary forms: uniform billing forms and clinical data abstracting forms.[17] The 2000 to 2002 SPARCS databases contained a variable indicating residence status (i.e., H, homeless and F, foreign visitor) and up to 18 diagnosis codes per hospital discharge, including separate E-coded variables for "injury mechanism/cause" and "injury place." Other data variables provided through SPARCS included demographics (age, gender, and ethnicity), zip code of patient residence, patient disposition, length of stay, scheduled or unscheduled admission, type of admission (emergent, urgent, and elective), and primary and secondary payers.

Study Population

The study population consisted of low SES homeless (n = 326,073) and low SES housed persons (n = 1,202,622) who reported their place of residence to be New York City (NYC) and who were admitted to a hospital located in one of the city's five boroughs. Newborns aged 1 month or less were excluded from analyses of comorbid conditions and injury.

Variable Definitions

Classification of Demographic and Socioeconomic Variables

Race and ethnicity were categorized as (1) white, non-Hispanic; (2) black, non-Hispanic; (3) Hispanic, and (4) other or unknown. Low SES was defined for ages 0.1 years to 64 years as uninsured or Medicaid-insured and for ages 65 and older as uninsured, Medicare only, or Medicare plus Medicaid.

Classification of Injury and Injury-Related Mortality

Acute injury was defined as an unscheduled, urgent or emergent hospital admission with an injury-related DRG International Classification of Diseases—9th revision—Clinical Modification code.[18] Emergent patients were defined as those who "required immediate medical intervention as a result of severe, life-threatening or potentially disabling condition(s)," and urgent patients as those requiring "immediate attention for a physical or mental disorder generally resulting in admission to the first available and suitable accommodation."[16]

Source of hospital admission was categorized as follows: (1) referral from a private or clinic physician, (2) emergency department, or (3) transfer from another hospital or facility. This study does not include patients seen in the emergency department who were not admitted. It includes all patients who were admitted to the hospital regardless of length of stay.

Data on patient disposition from the hospital included the following: (1) died, (2) discharged home with self-care only, (3) discharged home with home care, (4) transferred to skilled nursing, intermediate care facility or hospice, (5) transferred to other hospital for tertiary aftercare, (6) transferred to other facility for inpatient care or referred for outpatient services (other transfer), (7) left against medical advice, or (8) other discharge. In-hospital mortality was defined as any death occurring after hospital admission and before hospital discharge.

Classification of Injury Mechanism(s)

Injury cause was indicated in 87.2% of admissions deemed to be injury related, and a valid code for place of injury was present in 42.5% of admissions. Injury was classified into intentional, unintentional, or indeterminate cause and by specific mechanism.[19] Motor vehicle crashes were further subcategorized as occupant- (E810–E819 [0.0, 0.1]) or pedestrian-related injuries (E810–E819 [0.7]) and other transportation-related injuries (E80.0–E807.9, E810.0–E810.2, E826.2–E826.9, E831, E833, E845.9). Other injury mechanisms included the following: falls (E880–E886, E888); fire and burn (E890 EE899, E924); drowning (E830, E832, E910); poisoning (E850–E869); suffocation (E911–E913); natural or environmental (E900–E909, E928.0–E.928.2); cut or pierced (E956.9, E986.0–E986.9); struck by or against (E916.0–E917.9); and firearms (E922, E955.0–E955.4, E965.0–E965.4, E985.0–E.985.4, E970).

Classification of Comorbid Disease(s) and Conditions

Variables used to measure the presence or occurrence of several associated medical conditions were derived using the International Classification of Diseases Clinical Modification 9th revision[19] diagnosis codes. Conditions examined included mental disorders; alcohol or drug dependency and substance abuse; infections, including pneumonia, tuberculosis, influenza, other respiratory, urinary tract, and upper respiratory infections; diabetes; cancer; ischemic heart disease; cerebrovascular disease; circulatory diseases; cirrhosis of the liver; renal disease or renal failure; nutritional deficiencies; and others.

Statistical Analyses

Because the lack of reliable denominators for the total number of homeless persons living in NYC prevented calculation of injury incidence and chronic disease prevalence, a population of low SES persons residing and receiving treatment in the same geographic region comprised the comparison group. Odds ratios with 95% confidence intervals are age- and gender-adjusted after stratification into broad age categories: children (age, 0.1–9 years); adolescents and teenagers (age, 10–19 years), adults (age, 20–64 years), and elderly (age, ≥65 years). The χ^2 test was used in univariate analyses of categorical variables with statistical significance defined as alpha ≤0.05. Data sets were processed using SAS 9.1.[20]

RESULTS

Study Population

The study population characteristics are shown by homeless versus and low SES housed residence in Table 1. In contrast to the observed racial or ethnic disparities, the gender distribution was remarkably similar between homeless and low SES housed persons, with women comprising the majority of hospitalizations in both groups (Table 1). The racial and

TABLE 1. Population Characteristics for All-Cause Hospitalizations in Homeless vs. Low Socioeconomic Status Housed Persons Hospitalized in New York City

|	Homeless	Low SES Housed	Total
N (%)	326,073 (100.0)	1,202,622 (100.0)	1,528,695 (100.0)
Age distribution (yr)*			
0.1 to 9	25,312 (7.8)	80,982 (6.7)	106,294 (7.0)
10 to 19	21,284 (6.5)	65,297 (5.4)	86,581 (5.7)
20 to 64	226,867 (69.6)	757,769 (63.0)	984,636 (64.4)
65 and older	52,610 (16.1)	298,574 (24.8)	351,184 (23.0)
Gender (% male)*	134,842 (41.4)	521,595 (43.4)	656,437 (42.9)
Race*			
White, non-Hispanic	32,673 (10.0)	257,632 (21.4)	290,305 (19.0)
Black, non-Hispanic	120,235 (36.9)	394,130 (32.8)	514,365 (33.6)
Hispanic	25,033 (7.7)	322,005 (26.8)	347,038 (22.7)
Other/unknown	148,132 (45.4)	228,855 (19.0)	376,987 (24.7)
Admission type*			
Emergent	310,784 (95.3)	875,416 (72.8)	1,186,200 (77.6)
Urgent	105 (0.0)	131,464 (10.9)	131,569 (8.6)
Elective	15,110 (4.6)	194,476 (16.2)	209,586 (13.7)
Admission source*			
Physician	49,174 (15.1)	333,418 (27.7)	382,592 (25.0)
Emergency department	265,907 (81.5)	792,052 (65.9)	1,057,959 (69.2)
Hospital transfer	10,881 (3.3)	53,718 (4.5)	64,599 (4.2)
Unknown	111 (0.0)	23,434 (1.9)	23,545 (1.5)
Discharge status*			
Died	5,752 (1.8)	32,846 (2.7)	38,598 (2.5)
Self-care	266,045 (81.6)	893,987 (74.3)	1,160,032 (75.9)
Home healthcare	7,170 (2.2)	71,584 (6.0)	78,754 (5.2)
Skilled nursing facility	9,205 (2.8)	88,774 (7.4)	97,979 (6.4)
Hospital transfer	6,622 (2.0)	19,954 (1.7)	26,576 (1.7)
Other transfer for services	0 (0.0)	2,297 (0.2)	2,297 (0.2)
Left against medical advice	31,279 (9.6)	93,180 (7.7)	124,459 (8.1)

* $p < 0.0001$.
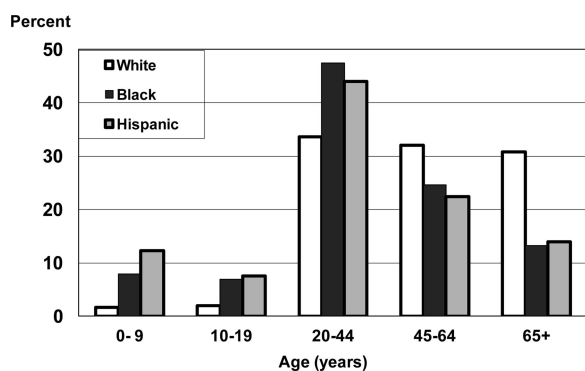
Figure 1. Racial and ethnic distribution of homeless persons hospitalized in New York City by age group (0.1–9 years, 10–19 years, 20–44 years, 45–64 years, and ≥65 years) for white, non-Hispanics; black, non-Hispanics; and Hispanics.

ethnic distribution is shown by age for the NYC homeless population (Fig. 1). The hospitalized homeless population is remarkable for its racial distribution across age groups in which whites are concentrated in the adult and elderly age ranges, with <2% of homeless whites falling into the 0.1-year to 9-year age group.

Population Admission Source and Discharge Disposition

The admission source and discharge disposition for homeless patients differed significantly from low SES housed patients. Homeless persons were more often admitted into the hospital through the emergency department rather than by physician or clinic referral, were more likely to leave against medical advice, and were less likely to be discharged to home health care or a skilled nursing facility than low SES housed persons (Table 1).

Injury-Related Diagnoses Among Homeless Persons

Approximately 9.4% (n = 30,711) of all hospitalizations (n = 326,073) in the homeless population were for injury (Table 2). This varied across age groups with injury-related hospitalizations comprising a larger percentage of all hospitalizations in the elderly (12.9%) and in the adolescents and teenagers (11.3%) than for adults (8.4%) or children (9.2%). Compared with low SES housed patients, unintentional injury among the homeless was 13% higher in children, 6% higher in adults, and 63% higher in elderly adults (Table 3). The frequency and odds of unintentional injury varied significantly by injury mechanism. Intentional injury (assaults and suicides) accounted for 17.1% of

TABLE 2. Distribution of Injury-Related Diagnoses for Hospitalization of Homeless Children, Adults, and the Elderly

Diagnoses	Children (0.1–9 yr, n = 25,312)	Adolescents/Teenagers (10–19 yr, n = 21,284)	Adults (20–64 yr, n = 226,867)	Elderly (≥65 yr, n = 52,610)	Total Homeless (n = 326,073)
Injury, all	2,335 (9.2)*	2,412 (11.3)*	19,155 (8.4)*	6,809 (12.9)†	30,711 (9.4)
Injury, unintentional	1,885 (7.5)‡	1,517 (7.13)§	9,761 (4.3)	3,731 (7.1)*	16,894 (5.2)
Transportation					
Bicycle	27 (0.1)	67 (0.3)*	90 (0.0)*	NR	NR
Motor vehicle	44 (0.2)*	90 (0.4)*	364 (0.2)*	51 (0.1)	549 (0.2)
Occupant	NR (0.0)*	23 (0.1)*	102 (0.0)*	16 (0.0)	NR (0.0)
Other transportation	NR (0.0)	27 (0.1)	128 (0.1)*	NR (0.0)	167 (0.0)
Pedestrian	42 (0.2)‡	34 (0.2)*	131 (0.1)*	33 (0.1)	240 (0.0)
Burns, all	303 (1.2)*	45 (0.2)	254 (0.1)*	92 (0.2)*	694 (0.2)
Fire and flame	25 (0.1)	19 (0.1)	122 (0.1)	48 (0.1)*	214 (0.0)
Liquid and vapor	204 (0.8)†	21 (0.1)	73 (0.0)*	31 (0.1)§	329 (0.1)
Cut/pierce	58 (0.2)	96 (0.5)	377 (0.2)*	17 (0.0)	548 (0.2)
Drowning	NR (0.0)	NR (0.0)	NR (0.0)	NR (0.0)*	13 (0.0)
Environmental	104 (0.4)	53 (0.3)	261 (0.1)	78 (0.2)*	496 (0.2)
Heat	NR (0.0)	NR (0.0)	28 (0.0)	29 (0.1)	61 (0.0)
Cold	NR (0.0)	NR (0.0)	120 (0.1)*	29 (0.1)*	152 (0.0)
Falls	693 (2.7)*	408 (1.9)	2,711 (1.2)	2,257 (4.3)*	6,069 (1.9)
From buildings	13 (0.1)	NR (0.1)	64 (0.0)	NR (0.0)	92 (0.0)
From furniture	186 (0.7)‡	NR (0.1)	105 (0.1)*	210 (0.4)*	NR (0.2)
From height	82 (0.3)*	56 (0.3)†	291 (0.1)	99 (0.2)‡	528 (0.2)
From stairs or steps	83 (0.3)§	41 (0.2)	362 (0.2)	152 (0.3)*	638 (0.2)
From same level*	152 (0.6)	204 (1.0)	1,153 (0.5)	1,131 (2.2)	2,640 (0.8)
Collision, shoving	15 (0.1)	26 (0.1)	15 (0.0)*	NR (0.0)	NR (0.0)
Slipping, tripping*	137 (0.5)	178 (0.8)	1,138 (0.5)	1,120 (2.2)	2,573 (0.8)
Poisoning					
From medication	87 (0.3)	79 (0.4)	1,700 (0.8)*	208 (0.4)*	2,074 (0.6)
From other substances	196 (0.8)‡	186 (0.9)§	1,647 (0.7)*	224 (0.4)*	2,253 (0.7)
Struck by or against	100 (0.4)†	105 (0.5)	204 (0.1)§	31 (0.1)†	440 (0.1)
Suffocation	18 (0.1)	NR (0.0)	24 (0.0)	18 (0.0)	NR (0.0)
Firearm, all	NR (0.0)	150 (0.7)	465 (0.2)	NR (0.0)†	623 (0.2)
Injury, intentional					
Assault	66 (0.3)	673 (3.2)	2,823 (1.2)‡	83 (0.2)*	3,645 (1.1)
Late effects of injury	22 (0.1)	35 (0.2)	442 (0.2)†	188 (0.4)*	687 (0.2)

NR, Not reported due to small numbers or the ability to use total to deduce small cell size.
* $p < 0.0001$.
† $p < 0.01$.
‡ $p < 0.001$.
§ $p < 0.05$.
Values are expressed as n (%).
Statistical significance for comparison with low SES housed.

all injury-related hospitalizations, and odds were significantly increased in all age groups beginning with ages 10 and higher.

Falls

Falls accounted for 19.8% of all cause injury hospitalizations in the homeless group and were disproportionately higher in children (29.7%) and the elderly (33.1%) than in other age groups. Compared with similarly aged low SES housed patients, the odds of hospitalization for fall-related injuries were increased significantly for three of the four age groups examined (Tables 2 and 3). Falls were increased by 30% in children, 14% in adolescents/teenagers, and 47% in the elderly (Table 3). More than one-quarter (26.9%) of fall hospitalizations in homeless children younger than 5 years were due to falls from furniture.

Falls from furniture were similar in infants ($p = 0.85$) and insignificantly increased in 1 year olds ($p = 0.10$) and 2 year olds ($p = 0.22$). However, more than threefold differences were observed for both homeless 3 year olds ($p = 0.0001$) and 4 year olds ($p = 0.0001$).

Motor Vehicle, Transportation, and Pedestrian

All homeless age groups showed either significantly decreased (children, adolescents or teenagers, and adults) or a tendency (elderly) toward decreased odds of hospitalization because of transportation-related injuries (Table 3). Low SES children, adolescents or teenagers, and adults had odds that were more than twice that of homeless children for motor vehicle injury. Pedestrian injuries were similarly lower in

TABLE 3. Age- and Gender-Adjusted Odds Ratios With 95% Confidence Intervals for Select Injury and Poisoning for Homeless Compared With Low-SES Housed Children, Adults, and the Elderly

Diagnoses	Children (0.1–9 yr)	Adolescents or Teenagers (10–19 yr)	Adults (20–64 yr)	Elderly (≥65 yr)
Injury, unintentional	1.13 (1.07–1.20)	0.99 (0.93–1.05)	1.06 (1.03–1.08)	1.63 (1.57–1.70)
Transportation				
Motor vehicle	0.47 (0.34–0.64)	0.44 (0.35–0.55)	0.43 (0.38–0.48)	0.76 (0.57–1.02)
Pedestrian	0.58 (0.41–0.80)	0.33 (0.24–0.48)	0.47 (0.39–0.57)	0.80 (0.55–1.15)
Burns, all	0.77 (0.68–0.87)	0.87 (0.63–1.21)	0.77 (0.67–0.88)	2.34 (1.83–2.99)
Fire and flame	0.83 (0.54–1.28)	1.37 (0.82–2.28)	1.08 (0.89–1.31)	3.14 (2.20–4.46)
Liquid and vapor	0.78 (0.67–0.91)	0.84 (0.52–1.36)	0.53 (0.42–0.68)	1.71 (1.14–2.56)
Environmental	1.25 (1.00–1.57)	1.06 (0.77–1.44)	1.15 (1.00–1.32)	1.93 (1.49–2.49)
Heat	3.29 (0.66–16.34)	0.41 (0.05–3.29)	0.86 (0.57–1.30)	1.63 (1.08–2.46)
Cold	2.15 (0.48–9.62)	*	2.97 (2.33–3.79)	2.98 (1.90–4.68)
Falls	1.30 (1.19–1.42)	1.14 (1.02–1.28)	1.03 (0.98–1.07)	1.47 (1.40–1.54)
Medical or surgical mishaps	0.45 (0.40–0.51)	0.46 (0.40–0.53)	0.70 (0.68–0.72)	0.65 (0.62–0.68)
Struck by or against	1.55 (1.22–1.97)	1.21 (0.97–1.52)	0.87 (0.75–1.01)	1.96 (1.30–2.94)
Suffocation	0.69 (0.42–1.16)	0.64 (0.14–2.93)	1.00 (0.63–1.57)	1.17 (0.71–1.95)
Poisoning	1.18 (0.97–1.42)	1.26 (0.99–1.60)	1.47 (1.38–1.56)	3.01 (2.54–3.55)
From medication	1.18 (0.93–1.52)	0.93 (0.72–1.19)	1.24 (1.17–1.31)	2.73 (2.31–3.23)
From other substances	1.37 (1.16–1.62)	1.25 (1.05–1.48)	1.34 (1.26–1.42)	2.74 (2.33–3.22)
Injury, intentional				
Assault	1.02 (0.78–1.35)	1.20 (1.09–1.32)	1.14 (1.09–1.19)	3.15 (2.40–4.15)
Suicide	1.15 (0.31–4.27)	0.96 (0.83–1.12)	1.19 (1.11–1.26)	2.25 (1.60–3.19)
Late effects of injury	1.49 (0.90–2.47)	1.19 (0.81–1.75)	1.22 (1.10–1.36)	3.15 (2.63–3.77)

* = <0.001 (<0.001–>1,000).

homeless children, adolescents or teenagers, and adults compared with similarly aged low SES housed persons.

Burns

Although homeless children younger than 10 years were at a significantly decreased risk of burn compared with low SES housed children, they contributed disproportionately to total burn injury in the homeless sample (Tables 2 and 3); they comprised 7.7% of the homeless population but accounted for 43.7% (303 of 694) of all burn hospitalizations among the homeless. The majority of these burns were caused by hot liquids and vapor, where this age group accounted for 62.0% (204 of 329) of all burns in that category. Although they contributed a smaller portion of total homeless burn injury, elderly homeless were more than twice as likely as low SES housed elderly to be hospitalized for burn injury. Unlike the younger age group of children who were more likely to be burned by liquids and vapors (66.8%) than fire or flame (8.3%), elderly were more likely to be burned seriously from fire or flames (52.2%) than liquids and vapors (35.9%).

Environmental, Cold-, and Heat-Related Injury

Approximately 500 homeless persons were hospitalized with a diagnosis for environmentally related injury associated with heat or cold exposure. Although this injury mechanism was rare in persons younger than 19 years, homeless adults and elderly were three times more likely than low SES housed to be hospitalized for cold-related injury (Table 3). Elderly were 63% more likely to be hospitalized for heat-related injury, although both heat- and cold-related

hospitalizations comprised a small portion (1.1%) of elderly injury-related admissions.

Poisoning

Among homeless persons, poisoning contributed significantly to injury-related hospitalizations with poisoning from medications present in 6.8% and poisoning from other substances in 7.3% of all injury-related hospitalizations (Table 2). All homeless age groups demonstrated increased odds of hospitalization because of the unintentional poisoning from nonmedicinal substances with children and the elderly showing the greatest relative increases (Table 3). Odds of poisoning from medication were increased significantly for homeless adults and elderly (Table 3).

Intentional Injury

Assault- and Violence-Related Injury

Nearly 12% (3,645) of all homeless hospitalizations were due to injury associated with assault. Compared with low SES housed, all groups aged ≥10 years experienced significantly increased odds of assault-related hospitalization. Hospitalizations for assault were more than threefold higher in homeless compared with low SES housed elderly (Table 3). Assaults were 20% higher in adolescents or teenagers and 14% higher in adults.

Self-Inflicted Injury

More than 5% of all injury-related hospitalizations in homeless were related to self-inflicted injury. The majority of

the nearly 1,600 self-inflicted injury hospitalizations occurred in adolescents or teenagers (n = 240) or adults (n = 1,305) with fewer suicides in elderly (n = 46). However, both adults and elderly showed a significantly increased odds of self-harm compared with low SES housed (Table 3). Although numbers were small, suicide hospitalization among elderly homeless were double that of low SES housed.

Late Effects of Injury

Late Effects

Most of the 687 admissions of homeless with a diagnosis of late effects of injury occurred in adults (n = 442) and the elderly (n = 188) who were significantly more likely than similarly aged low SES housed adults to be hospitalized with this diagnosis (Table 3). Odds were particularly increased in homeless elderly persons, who were more than three times more likely to be hospitalized for late effects than their low SES housed counterparts.

Comorbid Conditions

Several comorbid conditions with potential to complicate injury and postinjury care were found to be increased in the homeless sample compared with low SES housed persons (Table 4). The most common of these were nutritional deficiencies, infections, alcohol and drug use, and mental disorders.

Infection

Except for adolescents or teenagers, all age groups demonstrated increased odds of infection in one or more categories (Table 4). Homeless children were 30% more likely to have urinary tract infections and 25% more likely to have upper respiratory infections. In general, homeless persons were less likely to receive an influenza diagnosis at hospitalization. Homeless adults and elderly had significantly increased odds of hospitalization because of tuberculosis, with homeless adults being 50% and elderly 118% more likely to have tuberculosis than those in the low SES housed comparison group.

Psychiatric, Alcohol, and Substance Abuse Diagnoses

All age groups among the homeless population experienced an increased age- and gender-adjusted odds of either mental illness or alcohol or drug dependency, but no single group was increased across all three categories (Table 4). Mental illness diagnoses were significantly increased in all nonelderly age groups. Except for the youngest age group, all homeless age groups had increased odds of hospitalization because of nondependent drug use (Table 4). Homeless adolescents and teenagers had higher odds of hospitalization because of drug dependency but not to alcohol dependency, although both were increased in the homeless elderly. Alcohol and drug dependency were infrequent admitting diagnoses, but increase in importance when principal and all diagnoses established during the hospital stay were considered.

Chronic Disease and Medical or Surgical Misadventures

All homeless age groups were less likely to have received a diagnosis of cancer, renal disease, or ischemic

TABLE 4. Age- and Gender-Adjusted Odds Ratios With 95% Confidence Intervals for Select Medical Conditions for Homeless Compared With Low-SES Housed Children, Adults, and the Elderly

Diagnoses	Children (0.1–9 yr)	Adolescents and Teenagers (10–19 yr)	Adults (20–64 yr)	Elderly (65 yr and Older)
Infections, all	1.08 (1.04–1.12)	0.96 (0.91–1.02)	1.01 (1.00–1.02)	0.87 (0.85–0.90)
Tuberculosis	1.41 (0.98–2.04)	0.99 (0.69–1.44)	1.50 (1.41–1.58)	2.18 (1.89–2.52)
Pneumonia	0.98 (0.94–1.02)	0.80 (0.73–0.88)	0.95 (0.93–0.97)	0.86 (0.86–0.91)
Urinary tract infection	1.30 (1.26–1.35)	0.94 (0.86–1.02)	0.98 (0.95–1.01)	0.89 (0.87–0.92)
Upper respiratory infection	1.25 (1.19–1.31)	1.03 (0.93–1.14)	1.12 (1.07–1.16)	1.61 (1.51–1.71)
Influenza	0.32 (0.22–0.48)	0.75 (0.36–1.55)	0.64 (0.45–0.91)	0.43 (0.21–0.88)
Mental disorders	1.21 (1.13–1.29)	1.30 (1.25–1.35)	1.16 (1.15–1.17)	1.02 (1.00–1.04)
Dementia, all causes	0.20 (0.03–1.46)	0.52 (0.06–4.32)	1.15 (1.07–1.23)	1.00 (0.96–1.03)
Substance abuse	1.29 (0.50–3.32)	1.40 (1.30–1.50)	1.12 (1.10–1.13)	1.68 (1.58–1.78)
Alcohol dependency syndrome	*	0.82 (0.69–0.97)	0.90 (0.89–0.92)	1.64 (1.54–1.75)
Drug dependency	0.93 (0.26–3.38)	1.25 (1.13–1.40)	0.98 (0.96–0.99)	1.43 (1.27–1.62)
Nondependent drug use	2.02 (0.48–8.44)	1.56 (1.43–1.71)	1.59 (1.57–1.62)	1.76 (1.64–1.88)
Cancer	0.06 (0.04–0.08)	0.12 (0.09–0.15)	0.90 (0.88–0.92)	0.85 (0.82–0.88)
Cerebrovascular disease	0.58 (0.42–0.81)	0.48 (0.35–0.66)	0.89 (0.86–0.92)	1.01 (0.98–1.03)
Circulatory	0.55 (0.50–0.61)	0.61 (0.56–0.67)	0.90 (0.89–0.91)	1.06 (1.03–1.08)
Ischemic heart disease	0.98 (0.27–3.56)	0.26 (0.08–0.85)	0.79 (0.77–0.80)	0.84 (0.83–0.86)
Renal disease	0.62 (0.47–0.83)	0.25 (0.19–0.32)	0.73 (0.69–0.77)	0.83 (0.80–0.87)
Renal failure	0.31 (0.20–0.48)	0.26 (0.19–0.36)	0.82 (0.79–0.85)	0.84 (0.81–0.87)
Cirrhosis of the liver	*	0.57 (0.31–1.05)	1.04 (1.00–1.08)	0.83 (0.77–0.91)
Diabetes	1.21 (0.98–1.48)	0.88 (0.79–0.97)	0.99 (0.98–1.01)	1.05 (1.03–1.07)
Nutritional deficiencies	0.52 (0.39–0.70)	0.27 (0.17–0.41)	0.97 (0.92–1.03)	0.79 (0.74–0.84)

* = <0.001 (<0.001–>1,000).

heart disease (Table 4). All nonelderly age groups had lower odds of cerebrovascular disease and circulatory disease. Only the elderly had significantly increased odds of circulatory disease and diabetes, although children younger than 10 years showed a tendency toward more diabetes. All groups showed significantly decreased diagnoses related to surgical and medical misadventures (Table 3).

DISCUSSION

In this study, we found that homelessness was associated with increased age- and gender-adjusted injury risk for some, but not all injury mechanisms compared with low SES housed populations. Patterns of injury in homeless versus low SES housed differ by intent and across injury mechanisms. These findings suggest additional routes through which a host of factors, including homelessness, contribute to disparities in some injury mechanisms, particularly in younger-aged vulnerable subpopulations.

There were significant racial and ethnic differences in the age distribution of the homeless population. Salit et al.[15] found that homeless patients in a public hospital in NYC were more likely to be male, black, and middle-aged. With the exception of gender, we found this to be true of our study population. Among hospitalizations of low SES housed elderly individuals, ~40% are white, although they comprise only 19% of NYC's general population. Although whites make up slightly more of the 20-year- to 44-year-old general population of NYC than blacks, homeless and low SES housed patients within this age group were disproportionately black. The hospitalized homeless infants and children are predominately minority that highlights the need for increased awareness of homelessness issues by child injury prevention programs. All children, but not all adolescents or teenagers, resided in a sheltered situation, which seems to offer a protective effect for some injuries to which poor children are vulnerable.[5,6,21]

Several comorbid conditions were present in the homeless that either predispose the homeless to injury or complicate the treatment of and recovery from injury. Our findings are in general agreement with other reports on homeless health that note that, in comparison with the general population, homeless persons have significantly higher rates of mental illness, substance abuse, alcoholic psychoses, pulmonary tuberculosis, diabetes, and several non–life-threatening conditions related to lack of stable domicile, such as skin disorders.[13,14,22–24] Other studies have shown high rates of hospitalization and utilization of emergency department services for nonurgent and nonemergent conditions because their medical needs are not otherwise met.[23] Surprisingly, despite this, medical and surgical misadventures were recorded less frequently for the homeless than for low SES housed NYC residents. We hypothesize that the slightly lower odds of hospitalization for chronic medical conditions and possibly the lower surgical misadventures observed herein may be partially explained by lower access to diagnostic testing and lower utilization of surgical procedures in homeless patients. Further study into factors associated with injury in the homeless population—with an accompanying subgroup analysis—is warranted. Nonetheless, given the findings herein, the urban homeless population may benefit from targeted age-appropriate injury prevention interventions in the areas of environmental hazards and burn, fall, poison, and violence prevention in addition to increasing access the availability of stable housing, primary medical care, and specialty services such as mental health, substance abuse treatment, and victim services.

For instance, we found that homelessness was associated with an increased risk of hospitalization from unintentional poisonings among young children. Generally, these poisonings occur while homeless families reside in shelters or temporary public housing as a result of ingesting nonmedicinal substances. With the availability of low-cost and effective preventative measures, reducing unintentional poisonings through educational interventions and environmental modifications could be particularly successful in the homeless population.

Homeless persons across the age span were more likely to be hospitalized because of fall-related injury than low SES housed persons. Another potentially fruitful area was the finding that toddlers aged 3 and 4 years were at increased risk of hospitalization because of falls from furniture compared with similarly aged low SES housed. This suggests the need to examine whether there is a safety gap in sheltered toddler sleep facilities, as they move from the crib or baby bed. Although it must be noted that we had data only on those hospitalized and not on deaths before hospitalization, we did not find an increased risk of drowning or suffocation of young sheltered children.

Intentional injury, from both assault and suicide, was particularly increased in the homeless. The findings of this study are similar to other studies showing homeless persons to be particularly vulnerable to violence-related injury. Homeless persons are reported to have higher rates of alcohol abuse, intravenous drug use, and heavy tobacco usage.[9,14] There are reports that substance dependence and mental illness are associated with injury and victimization in both homeless men and women.[24] We found that elderly homeless persons tended to have similar odds of mental disorders and dementia as low SES housed elderly, but increased odds of both alcohol and drug dependence. In addition to increased vulnerability to assaults, we also found an increased odd of self-inflicted injury among adult and elderly homeless persons. The reasons for this are not clear. There are reports of high rates of posttraumatic stress disorder in the homeless because of their high risk of exposure to traumatic events.[13]

Homeless adults and elderly persons had increased odds of hospitalization because of late effects of injury than similarly aged housed individuals. It is unclear whether this represents delayed health seeking behavior, lack of sanitary environments for self-care postinjury, lack of access to regular care and preventive services, nutritional deficiencies, complicating comorbid illnesses, or a combination of these factors. The

homeless population is not well integrated into a primary care system.[12] Physicians report delaying discharge of homeless patients—particularly those who undergo surgery—out of concern for lack of clean environments, personal care skill, resources, and ability to adhere to follow-up care instructions. Discharge planners face issues related to the patients' ability to adhere to postsurgical instructions, including wound care, which may be compromised in the unsheltered or in group living arrangements.[15] Environmental factors, such as the increased risk for cold-related injury, are of particular concern, because a history of this type of injury is a well-documented risk factor for death in homeless persons living in inner cities.[3]

Our study found lower mortality among hospitalized homeless patients, whereas previous cohort studies of total mortality in this population have shown age-adjusted mortality rates that were as high as 3.6 times the nonhomeless populations.[25] Much of this mortality is out-of-hospital mortality, and our study did not examine out-of-hospital deaths. It is also possible that this finding is impacted by "social" admissions and disproportionate admissions for conditions that could otherwise be treated in outpatient settings (particularly conditions that may worsen with street living or spread to other shelter residents). In addition, our comparison population is low SES housed individuals who are known to have both higher mortality rates than similarly aged higher income individuals and limited access to the hospital for non–life-threatening conditions.

This study had notable limitations. Calculation of injury incidence and disease prevalence for the study and comparison populations is hampered by unreliable denominators for the homeless population. Calculation of odds of injury is age- and gender-adjusted but not race-adjusted. To the extent that there are racial disparities in both the homeless and low SES housed populations, this could have influenced our findings of injury risk in homeless populations. We did not have data on whether individuals were sheltered or unsheltered in cases of intentional injury or assault. NYC has a well-developed system of private, faith-based and publicly funded homeless shelters whose average daily shelter census reported at 33,687 in 2005.[21] Identification and counting of the unsheltered population is challenging as ~30% of homeless adults have been estimated to live outside of the shelter system.[12] An estimated 3,755 individuals continue to live unsheltered.[21] Of this population, 57% live on city streets and in parks, with a majority (28%) living in the borough of Manhattan. An estimated 43% of the population lives in subway cars, terminals, or subway stations. Although we used the closest socioeconomic equivalent that we could identify as the comparison population, our determination of low SES relied on insurance status and primary and secondary payers, rather than on patients' levels of income, wealth, or education. Future work should include injury risk scoring and injury severity analysis comparisons across the population groups.

In summary, homelessness presents unique, highly complex social and health issues that tend to overshadow the recognized value of injury prevention in this heterogeneous population. Increased hospitalization because of both unintentional and intentional injury mechanisms suggests that existing injury prevention techniques deemed effective in more stably housed populations is in need of reexamination and possible tailoring for shelter populations. These findings provide information that could be used to improve screening, injury and violence prevention, delivery of care, and postinjury care.

REFERENCES

1. Herman DB, Manuel J. Populations at special health risk: the homeless. In: Heggenhougen K, Quah S, eds *International Encyclopedia of Public Health*. San Diego, CA: Academic Press; 2008:261–268.
2. Bonnie RJ, Fulco CE, Liverman CT, et al. *Reducing The Burden of Injury: Advancing Prevention and Treatment*. Washington, DC: National Academy Press; 1999: xiv, 319.
3. Hwang SW, Lebow JM, Bierer MF, O'Connell JJ, Orav EJ, Brennan TA. Risk factors for death in homeless adults in Boston. *Arch Intern Med*. 1998;158:1454–1460.
4. Trevena LJ, Nutbeam D, Simpson JM. Asking the right questions of disadvantaged and homeless communities: the role of housing, patterns of illness and reporting behaviours in the measurement of health status. *Aust N Z J Public Health*. 2001;25:298–304.
5. Pressley JC, Barlow B, Kendig T, Paneth-Pollak R. Twenty year trends in fatal injuries to very young children: the persistence of racial disparities. *Pediatrics*. 2007;119:e875–e884.
6. Pressley JC, Barlow B, Durkin M, Jacko SA, Dominguez DR, Johnson L. A national program for injury prevention in children and adolescents: the injury free coalition for kids. *J Urban Health*. 2005;82:389–402.
7. Laursen B, Nielsen JW. Influence of sociodemographic factors on the risk of unintentional childhood home injuries. *Eur J Public Health*. 2008;18:366–370.
8. Pearson DA, Bruggman AR, Haukoos JS. Out-of-hospital and emergency department utilization by adult homeless patients. *Ann Emerg Med*. 2007;50:646–652.
9. Padgett DK, Struening EL. Influence of substance abuse and mental disorders on emergency room use by homeless adults. *Hosp Community Psychiatry*. 1991;42:834–838.
10. Beijer U, Andreasson S. Physical diseases among homeless people: gender differences and comparisons with the general population. *Scand J Public Health*. 2009;37:93–100.
11. Cubbin C, LeClere FB, Smith GS. Socioeconomic status and injury mortality: individual and neighbourhood determinants. *J Epidemiol Community Health*. 2000;54:517–524.
12. D'Amore J, Hung O, Chiang W, Goldfrank L. The epidemiology of the homeless population and its impact on an urban emergency department. *Acad Emerg Med*. 2001;8:1051–1055.
13. 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;20:726–730.
14. Raoult D, Foucault C, Brouqui P. Infections in the homeless. *Lancet Infect Dis*. 2001;1:77–84.
15. Salit SA, Kuhn EM, Hartz AJ, Vu JM, Mosso AL. Hospitalization costs associated with homelessness in New York City.[see comment] *N Engl J Med*. 1998;338:1734–1740.
16. New York State Department of Health. *SPARCS Annual Report Series*. NYSDOH: Albany, NY; 1981.
17. Bijur PE, Wilt S, Kurzon M, Hayes R, Goodman A. The epidemiology and causes of injuries resulting in hospitalization in New York City: 1990–1992. *Bull N Y Acad Med*. 1997;74:31–50.
18. Recommended framework for presenting injury mortality data. *MMWR Recomm Rep*. 1997;46:1–30.
19. World Health Organization. *International Classification of Diseases 9th Revision (ICD-9-CM)*. 8th ed, Vol 1 and 2. McGraw-Hill: World Health Organization; 1999.

20. SAS Institute. SAS/STAT 9.1 Users Guide. Cary, NC: SAS Institute; 2008.
21. NYC Department of Homeless Services. Historic data [cited 2007 July 5] and Street outreach: HOPE 200. Available at: http://www.nyc.gov/html/dhs/downloads/pdf/histdata.pdf and http://www.nyc.gov/html/dhs/downloads/pdf/success_strategies.pdf. Accessed July 5, 2007.
22. Ferenchick GS. The medical problems of homeless clinic patients: a comparative study. *J Gen Int Med.* 1992;7:294–297.
23. 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;92:778–784.
24. Padgett DK, Struening EL. Victimization and traumatic injuries among the homeless: associations with alcohol, drug, and mental problems. *Am J Orthopsychiatry.* 1992;62:525–534.
25. Hibbs JR, Benner L, Klugman, et al. Mortality in a cohort of homeless adults in Philadelphia. *N Engl J Med.* 1994;331:304–309.