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ORIGINAL INVESTIGATION

# Risk Factors for Death in Homeless Adults in Boston

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**Background:** Homeless individuals experience high mortality rates. Males, whites, and substance abusers are more likely to die, but other high-risk characteristics are unknown.

**Objective:** To identify demographic and clinical factors associated with an increased risk of death in homeless individuals.

**Methods:** We conducted a case-control study of 338 adults who were seen by a health care program for the homeless in Boston, Mass, and who died in 1988 to 1993. Age-matched paired controls were selected from among individuals seen by the program who were alive at the end of 1993. Predictive data were obtained by blinded review of medical records. Odds ratios (ORs) for death were calculated using logistic regression analysis models.

**Results:** In a multivariate analysis, the strongest risk factors for death were acquired immunodeficiency syndrome (OR, 55.8), symptomatic human immunodeficiency virus infection (OR, 17.7), asymptomatic human immunodeficiency virus infection (OR, 4.1), renal disease (OR, 18.4), a history of cold-related injury (OR, 8.0), liver disease (OR, 3.8), and arrhythmia (OR, 3.3). A history of substance abuse involving injection drugs (OR, 1.6) or alcohol (OR, 1.5) also increased the risk of mortality. Nonfluency in English was associated with a decreased risk of death (OR, 0.4).

**Conclusions:** In a group of adults seen by a health care program for the homeless, specific medical illnesses were associated with the greatest risk of death. Substance abuse alone was less strongly associated with death. Interventions to reduce mortality among the homeless should focus on individuals with high-risk characteristics.

*Arch Intern Med. 1998;158:1454-1460*

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HOMELESSNESS IS a major social problem that affects at least half a million Americans.[1-3] Not surprisingly, homeless individuals are at greatly increased risk of death. Studies in Atlanta, Ga, and San Francisco, Calif, found that homeless people often died in their fifth decade, with accidents or homicides causing about half of all deaths.[4,5] The mortality rate among homeless men in Sweden was 4 times higher than expected.[6] In Philadelphia, Pa, the age-adjusted mortality rate in a cohort of homeless adults was 3.5 times that of the general population; mortality was particularly high among white men and substance abusers.[7] Homeless men in Boston, Mass, aged 18 to 24 years and 25 to 44 years were 5.9 and 3.0 times more likely to die, respectively, than their counterparts in the general population.[8]

The prevalence of conditions such as substance abuse, psychiatric disorders, and major medical illnesses among homeless individuals is high.[3,9-19] A systematic effort to identify the comorbid conditions that are associated with an increased risk of mortality in the homeless is important, because this information would assist efforts to prevent untimely deaths in this population. High-risk characteristics could be used as screening criteria by clinicians and social service agencies to focus attention on homeless individuals who are most likely to die in the near future. We conducted a case-control study of deaths in a cohort of homeless adults in Boston. Our main objective was to identify risk factors associated with death in this population.

## RESULTS

### SUBJECTS

A total of 17 292 patients had contact with BHCHP, of whom 606 died in Massachusetts in 1988 to 1993. No medical records could be obtained for 34 decedents; this

## SUBJECTS AND METHODS

### STUDY POPULATION AND CASE DEFINITION

The study population consisted of adults seen by the Boston Health Care for the Homeless Program (BHCHP) between July 1, 1988, and December 31, 1993. Patients were seen at more than 40 sites, including homeless shelters, drop-in centers, outpatient clinics, a recuperative residential facility for the homeless, and on the street. Case patients were identified by comparing the patient database with the Massachusetts death registry from 1988 to 1993. These methods have been described in a previous report.[8]

### SELECTION OF CONTROLS

Each case patient was paired with a control from the patient database who was born in the same year and who was alive at the end of 1993. Case patients and controls were matched for the month and year of first contact with the program, so that their potential periods of observation were equal. By selecting controls from a population of homeless patients, we sought to determine which factors other than homelessness per se were associated with death. Case patients and controls were not matched for sex because we wished to determine the effect of sex on risk of mortality.

If no control matched for year of birth was found, controls born within ±2 years of the case patient were accepted; if no such controls were found, the case patient was eliminated from the analysis. If 2 or more potential controls were found, 1 was selected randomly. If no medical records could be obtained for a control patient, a replacement was selected randomly from the remaining candidates. To eliminate individuals who died outside of Massachusetts from the control group, controls were matched against the National Death Index for 1988 to 1993.[20] Controls who had died out of state were replaced in the same manner as controls without medical records.

### DATA COLLECTION

All patient data were obtained by retrospective review of medical records. Anticipating that homeless individuals often receive health care at multiple sites, medical records were sought at BHCHP and at Boston City Hospital, New England Medical Center, and Massachusetts General Hospital. These institutions were selected because they are located close to the largest homeless shelters in Boston and provide the majority of hospital-based care for patients seen by BHCHP. Medical records were reviewed by physicians who were blinded to the vital status of all patients and who did not review the chart of any patient they knew. Data were abstracted using standardized forms and explicit definitions for comorbidities. Chart review was restricted to records dated no more than 2 months after first contact to identify baseline conditions rather than conditions that developed during follow-up. The 2-month interval was chosen to allow for the reporting of any diagnostic testing initiated at the time of first contact.

Definitions of medical conditions were taken from the Charlson Comorbidity Index,[21] with the addition of certain conditions believed to be prevalent among homeless individuals (**Table 1**). Injuries and poisonings were categorized according to the *International Classification of Diseases, Ninth Revision, Clinical Modification*.[24] If more than 10 injuries or poisonings had occurred, only the 10 most recent events were recorded. Mental illnesses were grouped in 3 broad categories defined in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*[25]: schizophrenia or other psychotic disorder, mood disorder, and any other psychiatric disorder. Currently prescribed psychotropic medications and any history of a suicide attempt resulting in hospitalization were noted. Any history of or current substance abuse involving alcohol, opiates, cocaine, sedative-hypnotics, or injection drug use was recorded.

### STATISTICAL ANALYSIS

Matched-pairs logistic regression analysis models were used to estimate the odds ratio and 95% confidence interval associated with each potential risk factor. First, simple univariate models were constructed; factors that were associated with mortality at the $P \leq .05$ level were candidates for entry into the multivariate model. The multivariate model was built using a stepwise selection procedure with $P \leq .05$ required for both entry and retention. Demographic factors were added to the model if they were believed to be essential. Confounding factors were identified if their inclusion changed the β coefficient of any factor by more than 10%. All analyses were performed using SAS-PC statistical software (SAS Institute Inc, Cary, NC).

Attributable risk was calculated for each factor using the prevalence of the factor in control subjects to estimate the prevalence of the factor in the homeless population in general. The attributable risk estimates the proportion of all deaths that are attributable to a particular factor, assuming those factors that increase the risk of death are causally related to death.[26]

group did not differ significantly in age or sex from all other decedents. No suitable age-matched control could be identified for 14 older patients (average age, 69.4 years), all of whom were men. These 48 case patients were excluded from subsequent analyses. In the 558 case patients included in the study, the average age at first contact was 44.8 years (range, 19.4-80.5 years). Death occurred an average of 25.2 months after first contact.

Medical records were obtained for 85% of the 558 initially selected control patients. The remaining 15% were replaced by controls whose medical records were obtainable. Matching of the 558 control patients against the National Death Index revealed that 9 had died out of state; these patients were replaced with alternate controls.

The demographic characteristics of case patients and controls are shown in **Table 2**. Significantly fewer deaths occurred among women and individuals of Hispanic race. Nonfluency in English was associated with a more than 3-fold decrease in the risk of death.

### MEDICAL CONDITIONS

Certain medical conditions were associated with a greatly increased risk of death in univariate analyses (**Table 3**).

**Table 1. Definitions of Conditions**

| Condition | Definition |
|---|---|
| Nonfluency in English | Inability to communicate with health care providers in English without the use of an interpreter |
| Thromboembolic disease | Deep vein thrombosis diagnosed using ultrasonography or venography, or pulmonary embolism diagnosed using ventilation-perfusion scan or pulmonary angiography |
| Chronic venous insufficiency | Lower extremity edema attributed to venous insufficiency, with characteristic skin changes and/or stasis ulceration |
| Active tuberculosis | Definitive diagnosis based on positive cultures for *Mycobacterium tuberculosis*, or presumptive diagnosis followed by treatment with a course of multidrug therapy |
| Endocarditis | Definitive diagnosis of endocarditis by Duke[29] criteria |
| Human immunodeficiency virus (HIV) infection, asymptomatic | Clinical category A according to the Centers for Disease Control and Prevention (CDC)[31] 1993 revised classification system for HIV infection |
| HIV infection, symptomatic | Clinical category B according to the CDC 1993 revised classification system for HIV infection |
| HIV infection, acquired immunodeficiency syndrome | Clinical category C according to the CDC 1993 revised classification system for HIV infection |
| Pancreatitis | Clinical diagnosis of pancreatitis, based on at least 2 of the following: abdominal pain, elevated serum amylase and/or lipase level, radiographic evidence of pancreatitis |
| Seizures | Any seizure during lifetime |
| Chronic cognitive impairment | Mental retardation or dementia |
| Internal injury of the chest, abdomen, or pelvis | Traumatic pneumothorax or hemothorax, or injury to any intrathoracic, intra-abdominal, or pelvic organ |
| Open wound | Penetrating injuries or traumatic amputations, not involving internal injury as defined above |
| Minor injury | Nonpenetrating injuries such as superficial lacerations, abrasions, ecchymoses, and contusions |
| Poisoning or drug overdose | Toxic effects of drugs, medicinal substances, biological substances, or nonmedical substances (excluding acute alcohol intoxication or simple drunkenness) |

Human immunodeficiency virus (HIV) infection imparted a degree of risk that varied according to the clinical stage of the disease. A diagnosis of solid tumor with metastases was uniformly associated with death. The risk of mortality was increased more than 6-fold among individuals with thromboembolic disease, liver disease (defined as cirrhosis with or without clinical evidence of portal hypertension), or renal disease (defined as end-stage renal disease or a serum creatinine level of ≥177 mmol/L [≥2.0 mg/dL]). A high risk of mortality was observed in all individuals with elevated creatinine levels, and not only in those who were dependent on dialysis.

Cardiovascular conditions significantly associated with mortality included congestive heart failure and arrhythmias. The presence of pulmonary disease (primarily asthma and chronic obstructive pulmonary disease) increased the risk of death to a lesser degree. Other medical conditions that significantly increased the risk of death included a history of seizures, peptic ulcer disease, gastrointestinal bleeding from causes other than peptic ulcer disease, and pancreatitis.

**Table 2. Demographic Characteristics of 558 Homeless Adults Who Died and Their Matched Controls, and Odds Ratios for Death in Univariate Analyses**

| Variable | Case Patients, No. (%) | Controls, No. (%) | Odds Ratio (95% CI)* |
|---|---|---|---|
| Sex | | | |
| Male† | 478 (86) | 428 (77) | . . . |
| Female | 80 (14) | 130 (23) | 0.6 (0.4-0.8) |
| Race | | | |
| White† | 330 (59) | 296 (53) | . . . |
| Black | 169 (30) | 177 (32) | 0.8 (0.6-1.1) |
| Hispanic | 45 (8) | 66 (12) | 0.6 (0.4-0.9) |
| Other | 14 (3) | 19 (3) | 0.7 (0.3-1.4) |
| Veteran status | | | |
| Not a veteran† | 479 (86) | 505 (91) | . . . |
| Veteran | 79 (14) | 53 (10) | 1.7 (1.1-2.6) |
| English fluency‡ | | | |
| Fluent† | 544 (97) | 508 (91) | . . . |
| Nonfluent | 14 (3) | 50 (9) | 0.3 (0.2-0.5) |

**Odds ratios are calculated as the risk of death among subjects in the demographic category in question, compared with subjects in the reference category. CI indicates confidence interval; ellipses, not applicable.*
*†Reference category.*
*‡See Table 1 for definition.*

## PSYCHIATRIC CONDITIONS AND SUBSTANCE ABUSE

Psychiatric conditions and substance abuse histories are shown in **Table 4**. Among psychiatric conditions, the only significant predictor of death was a history of a suicide attempt. The risk of dying was about twice as high among individuals with a history of abusing alcohol or cocaine. Death was more than 3 times more likely in individuals with a history of opiate abuse or injection drug use.

## INJURIES AND POISONINGS

A history of injury or poisoning severe enough to require medical attention was commonly found (**Table 5**). A previous cold-related injury (frostbite, hypothermia, or immersion foot) was associated with an almost 7-fold increase in the risk of death. Death was also more likely to occur in individuals who had previously suffered a fracture or dislocation. A history of poisoning or drug overdose, typically involving opiates or multiple drugs, increased the risk of death almost 3-fold. The external cause of previous injuries was not strongly associated with mortality. The risk of death increased as the number of previous injuries and poisonings increased; death was 1.7 times more likely in individuals who had suffered 4 or more events compared with those who had not.

**Table 3. Medical Conditions in Case Patients and Controls, and Odds Ratios for Death in Univariate Analyses***

| Variable† | Case Patients, No. (%) | Controls, No. (%) | Odds Ratio (95% CI) |
|---|---|---|---|
| Cardiovascular conditions | | | |
| Hypertension | 116 (21) | 106 (19) | 1.1 (0.8-1.5) |
| Angina | 16 (3) | 18 (3) | 0.9 (0.4-1.8) |
| Myocardial infarction | 23 (4) | 16 (3) | 1.4 (0.8-2.7) |
| Congestive heart failure | 20 (4) | 7 (1) | 3.2 (1.3-7.9) |
| Arrhythmia | 26 (5) | 6 (1) | 5.0 (1.9-13.1) |
| Valvular heart disease | 9 (2) | 6 (1) | 1.5 (0.5-4.2) |
| Peripheral vascular disease | 11 (2) | 5 (1) | 2.2 (0.8-6.3) |
| Thromboembolic disease | 20 (4) | 3 (1) | 6.7 (2.0-22.4) |
| Chronic venous insufficiency | 29 (5) | 25 (5) | 1.2 (0.7-2.1) |
| Pulmonary disease | 110 (20) | 79 (14) | 1.5 (1.1-2.1) |
| Infectious diseases | | | |
| Positive tuberculin skin test | 94 (17) | 90 (16) | 1.1 (0.8-1.5) |
| Active tuberculosis | 21 (4) | 11 (2) | 2.1 (1.0-4.7) |
| Endocarditis | 15 (3) | 7 (1) | 2.1 (0.9-5.3) |
| HIV infection, asymptomatic | 20 (4) | 9 (2) | 2.2 (1.0-4.9) |
| HIV infection, symptomatic | 44 (8) | 6 (1) | 7.3 (3.1-17.2) |
| AIDS | 65 (12) | 5 (1) | 21.0 (6.6-66.9) |
| Gastrointestinal conditions | | | |
| Peptic ulcer disease | 62 (11) | 32 (6) | 2.2 (1.4-3.4) |
| Gastrointestinal bleeding | 23 (4) | 7 (1) | 3.3 (1.4-7.7) |
| Pancreatitis | 42 (8) | 17 (3) | 2.5 (1.4-4.3) |
| Liver disease | 31 (6) | 5 (1) | 6.2 (2.4-15.9) |
| Neurologic conditions | | | |
| Seizures | 133 (24) | 71 (13) | 2.2 (1.6-3.0) |
| Chronic cognitive impairment | 19 (3) | 13 (2) | 1.5 (0.7-3.0) |
| Cerebrovascular disease | 10 (2) | 10 (2) | 1.0 (0.4-2.4) |
| Cancers | | | |
| Solid tumors without metastases | 20 (4) | 17 (3) | 1.2 (0.6-2.5) |
| Solid tumors with metastases | 15 (3) | 0 (0) | . . .‡ |
| Diabetes mellitus | 36 (6) | 25 (4) | 1.4 (0.9-2.4) |
| Renal disease | 13 (2) | 2 (0.4) | 6.5 (1.5-28.8) |
| Rheumatologic disease | 5 (1) | 2 (0.4) | 2.5 (0.5-12.9) |

*Odds ratios are calculated as the risk of death among subjects with the condition in question, compared with subjects without it. CI indicates confidence interval; HIV, human immunodeficiency virus; and AIDS, acquired immunodeficiency syndrome.

†See Table 1 for definitions of medical conditions not described in the Charlson Comorbidity Index.

‡Odds ratio is undefined.

**Table 4. Psychiatric History and Substance Abuse in Case Patients and Controls, and Odds Ratios for Death in Univariate Analyses**

| Variable | Case Patients, No. (%) | Controls, No. (%) | Odds Ratio (95% CI) |
|---|---|---|---|
| Psychiatric history | | | |
| Schizophrenia or other psychotic disorder | 48 (9) | 67 (12) | 0.7 (0.5-1.0) |
| Mood disorder | 81 (15) | 81 (15) | 1.0 (0.7-1.4) |
| Any other psychiatric diagnosis | 55 (10) | 52 (9) | 1.1 (0.7-1.6) |
| Previous suicide attempt | 47 (8) | 22 (4) | 2.3 (1.4-4.0) |
| Psychotropic medications† | | | |
| Antipsychotics | 27 (5) | 42 (8) | 0.6 (0.4-1.0) |
| Antidepressants | 17 (3) | 13 (2) | 1.3 (0.6-2.7) |
| Antimanics | 6 (1) | 8 (1) | 0.8 (0.3-2.2) |
| Anxiolytics | 21 (4) | 23 (4) | 0.9 (0.5-1.7) |
| Any psychotropic medication | 57 (10) | 68 (12) | 0.8 (0.6-1.2) |
| Substance abuse history‡ | | | |
| Alcohol | 426 (89) | 339 (79) | 2.3 (1.7-3.0) |
| Opiates | 141 (25) | 62 (11) | 3.1 (2.1-4.4) |
| Cocaine | 139 (25) | 89 (16) | 1.9 (1.4-2.6) |
| Sedatives or hypnotics | 33 (6) | 18 (3) | 1.9 (1.1-3.5) |
| Injection drug use | 206 (37) | 98 (18) | 3.2 (2.3-4.4) |

*Odds ratios are calculated as the risk of death among subjects with the condition in question compared with subjects without it. CI indicates confidence interval.

†Refers to psychotropic medications that were currently prescribed for the subject at the time of first contact.

‡Refers to a history of current substance abuse.

## RESULTS OF MULTIVARIATE ANALYSES

The results of multivariate analyses are shown in **Table 6**. The strongest predictor of death was the clinical diagnosis of the acquired immunodeficiency syndrome, which was associated with an odds ratio of 55.8 and an attributable risk of 0.35. Symptomatic and asymptomatic HIV infection also significantly increased the risk of mortality. Other medical diagnoses associated with death were renal disease, liver disease, arrhythmia, and seizures. A history of solid tumor with metastases could not be included in the final model, because the odds ratio was undefined. Substance abuse was not as strongly associated with death as were medical diagnoses; the risk of death was increased less than 2-fold in the presence of a history of injection drug use or alcoholism.

A history of either cold-related injury or fracture was a significant risk factor; psychiatric conditions, however, did not meet criteria for inclusion. The trend toward decreased risk of death among women ($P = .08$) and Hispanics ($P = .08$) did not reach statistical significance; sex and race were nonetheless included in the model because of their clinical relevance. Nonfluency in English was associated with a significantly decreased risk of death.

## COMMENT

This study elucidates the risk factors for death in a group of homeless adults in Boston. Our results agree with previous findings that male sex, white race, and a history of substance abuse increase the risk of death in homeless individuals.[7] These criteria, however, are of limited use in identifying a high-risk subgroup because such a large proportion of the homeless population in the United States meets this profile. More than three quarters of the homeless are men, about half are white, and a large number abuse alcohol or cocaine.[3] Our study shows that a small subgroup of homeless individuals at extremely high risk of death can be identified by the presence of medical conditions such as HIV infection, renal disease, liver disease, and arrhythmias. These comorbidities are associated with a much greater risk of death than substance abuse alone.

**Table 5. Injury and Poisoning Histories in Case Patients and Controls, and Odds Ratios for Death in Univariate Analyses***

| Variable | Case Patients, No. (%) | Controls, No. (%) | Odds Ratio (95% CI) |
|---|---|---|---|
| Type of injury | | | |
| Fracture | 163 (29) | 117 (21) | 1.6 (1.2-2.2) |
| Dislocation | 11 (2) | 2 (0.4) | 5.5 (1.2-24.8) |
| Major head injuries | | | |
| Concussion | 31 (6) | 23 (4) | 1.4 (0.8-2.3) |
| Cerebral contusion | 4 (1) | 5 (1) | 0.8 (0.2-3.0) |
| Subdural hematoma | 11 (2) | 6 (1) | 1.8 (0.7-5.0) |
| Intracerebral hemorrhage | 4 (1) | 3 (1) | 1.3 (0.3-6.0) |
| Any major head injury | 47 (4) | 34 (3) | 1.4 (0.9-2.2) |
| Internal injury of the chest, abdomen, or pelvis† | 30 (5) | 26 (5) | 1.2 (0.7-2.0) |
| Open wound† | 33 (6) | 27 (5) | 1.2 (0.7-2.1) |
| Frostbite, hypothermia, or immersion foot | 21 (4) | 4 (1) | 6.7 (2.0-22.4) |
| Poisoning or drug overdose† | 31 (6) | 12 (2) | 2.8 (1.4-5.6) |
| Burns | 25 (4) | 26 (5) | 1.0 (0.6-1.7) |
| Minor injury† | 204 (37) | 186 (33) | 1.2 (0.9-1.5) |
| External cause of injury | | | |
| Assault | | | |
| Without knife or gun | 175 (31) | 143 (26) | 1.3 (1.0-1.7) |
| With knife | 43 (8) | 46 (8) | 0.9 (0.6-1.4) |
| With gun | 17 (3) | 14 (3) | 1.2 (0.6-2.5) |
| Any assault | 204 (37) | 169 (30) | 1.3 (1.0-1.7) |
| Motor vehicle crash | 42 (8) | 42 (8) | 1.0 (0.6-1.6) |
| Pedestrian-motor vehicle crash | 26 (5) | 24 (4) | 1.1 (0.6-1.9) |
| Accident (not involving motor vehicle) | 145 (26) | 107 (19) | 1.5 (1.1-2.0) |
| No. of injuries and poisonings | | | |
| ≤3‡ | 471 (84) | 506 (91) | ... |
| ≥4 | 87 (16) | 52 (9) | 1.7 (1.2-2.5) |

**Odds ratios are calculated as the risk of death among subjects with the condition in question, compared with subjects without it. CI indicates confidence interval; ellipses, not applicable.*

*†See Table 1 for definitions.*

*‡Reference category.*

Despite these findings, substance abuse remains an important risk factor for death for 2 reasons. First, conditions that moderately increase risk of death will be linked to a large number of deaths if the condition is common. Although the odds ratio associated with alcoholism was only 1.5, the high prevalence of alcoholism in the homeless population led to a large attributable risk. By this measure, more than a quarter of deaths in this cohort were attributable to alcohol abuse.

Second, conditions such as liver disease, seizures, cold-related injuries, and fractures may in fact be surrogate markers for severity of substance abuse. For example, a history of cold-related injury greatly increased the risk of death, but only 4 individuals actually died of hypothermia.[8] A history of frostbite or hypothermia may in fact identify a group of patients with severe substance abuse who demonstrate a high level of self-neglect and risk-taking behavior. These characteristics may predispose individuals to death from a variety of causes. Substance abuse is likely a major contributing factor to deaths because of injuries and drug overdoses; in this cohort, 13% of all deaths were accidental, 4% were caused by homicide, and 2% were caused by suicide.[8]

Clinical interventions to prevent deaths among the homeless may be most successful when focused on high-risk subgroups such as individuals with HIV infection. Acquired immunodeficiency syndrome was the leading cause of death in our cohort, accounting for 18% of all deaths.[8] Since newer treatments for HIV infection can reduce morbidity and prolong life,[27] ensuring that HIV-infected homeless individuals have access to appropriate medical care is of greater importance than ever before.[28] At a social policy level, efforts should be redoubled to prevent HIV infection among homeless individuals who engage in high-risk behaviors. In our study, 75% of those who died of acquired immunodeficiency syndrome had a history of injection drug use. Methadone maintenance treatment[29-31] and needle-exchange programs[32,33] are effective methods of reducing HIV infection in injection drug users and should be expanded.

Homeless individuals with conditions such as renal disease, liver disease, arrhythmias, and seizures have a markedly increased risk of death. Primary care providers who are experienced in working with homeless patients should orchestrate clinical care for these individuals. Intensive efforts to engage patients, encourage adherence to therapy, and trace patients who are lost to follow-up may be most effectively coordinated through multidisciplinary teams of physicians, nurses, and social workers.[34] Treatment of coexisting substance abuse should also be emphasized.

The 3-fold decrease in risk of death associated with nonfluency in English is an interesting and unexpected finding. This correlation cannot be explained completely on the basis of confounding by Hispanic race, since it remains significant even in a multivariate model that includes race as a predictive factor. Nonfluency in English may identify a subgroup of individuals who have become homeless because of purely economic reasons and who therefore suffer from a lower burden of disease than do other homeless people. In other words, individuals who are fluent in English may be less likely to become homeless unless, in addition to being poor, they have comorbid conditions that predispose them to both homelessness and death.

We found a trend toward a decreased risk of death among individuals diagnosed as having schizophrenia or other psychotic disorders. In Massachusetts, individuals with these conditions are eligible for long-term psychiatric case-management services that are coordinated with general medical care. We hypothesize that the paradoxically beneficial effect of schizophrenia may be the result of the structured medical and social services that are provided to these chronically disabled patients. Therefore, at a health policy level, expanding the availability of these types of supportive services might reduce deaths among homeless individuals.

Certain limitations of this study should be noted. Only deaths that occurred in Massachusetts were identified; risk factors in individuals who migrated out of state and then died were not examined. We studied individuals who had contact with a health care program for the homeless, and thus our findings may not be generaliz-

**Table 6. Risk Factors Associated With Death in Homeless Adults in Multivariate Analyses***

| Variable† | Case Patients, No. (%) | Controls, No. (%) | Odds Ratio (95% CI) | Attributable Risk‡ |
|---|---|---|---|---|
| HIV infection, AIDS | 65 (12) | 5 (1) | 55.8 (14.4-216.9) | 0.35 |
| HIV infection, symptomatic | 44 (8) | 6 (1) | 17.7 (5.3-58.8) | 0.14 |
| HIV infection, asymptomatic | 20 (4) | 9 (2) | 4.1 (1.5-11.6) | 0.06 |
| Renal disease | 13 (2) | 2 (0.4) | 18.4 (2.1-161.5) | 0.07 |
| Frostbite, hypothermia, or immersion foot | 21 (4) | 4 (1) | 8.0 (1.7-38.6) | 0.07 |
| Liver disease§ | 31 (6) | 5 (1) | 3.8 (1.2-11.5) | 0.03 |
| Arrhythmia | 26 (5) | 6 (1) | 3.3 (1.1-9.4) | 0.02 |
| Seizures§ | 133 (24) | 71 (13) | 1.7 (1.1-2.6) | 0.06 |
| Fracture | 163 (29) | 117 (21) | 1.6 (1.1-2.3) | 0.11 |
| Injection drug use§ | 206 (37) | 98 (18) | 1.6 (1.1-2.3) | 0.10 |
| Alcohol dependence or abuse | 426 (89) | 339 (79) | 1.5 (1.1-2.3) | 0.28 |
| Nonfluency in English | 14 (3) | 50 (9) | 0.4 (0.2-0.8) | ... |
| Female‖ | 80 (14) | 130 (23) | 0.7 (0.5-1.1) | ... |
| Black¶ | 169 (30) | 177 (32) | 0.9 (0.6-1.2) | ... |
| Hispanic¶ | 45 (8) | 66 (12) | 0.6 (0.3-1.1) | ... |
| Other race¶ | 14 (3) | 19 (3) | 0.7 (0.3-1.5) | ... |

*Odds ratios are calculated as the risk of death among subjects with the characteristic in question, compared with subjects without it, unless otherwise specified. CI indicates confidence interval; HIV, human immunodeficiency virus; AIDS, acquired immunodeficiency syndrome; and ellipses, not applicable.

†See Table 1 for definitions.

‡Attributable risk is an estimate of the proportion of all deaths that are attributable to a particular risk factor, assuming that factors that increase risk are causally related to death.

§Positive confounding existed between the following pairs of factors: liver disease and gastrointestinal bleeding, liver disease and pancreatitis, seizures and pancreatitis, and injection drug use and previous suicide attempt. If these confounding factors were added to the multivariate model, the odds ratio (95% CI) for liver disease became 2.9 (1.0-9.0), for seizures 1.5 (1.0-2.4), and for injection drug use 1.5 (1.0-2.3).

‖Reference category is male.

¶Reference category is white.

able to homeless people who do not seek health care at all. Previous investigators[35] have found that homeless people who seek health care tend to have higher levels of morbidity than non–care seekers. While all the individuals in our study were homeless at the time of first contact, data are not available on which individuals subsequently obtained temporary or permanent housing. Thus, our analysis did not take the subsequent duration of homelessness into account.

Characteristics of case patients and controls were obtained by retrospective chart review. This method may underestimate the prevalence of comorbidities in homeless individuals who have not undergone a comprehensive health evaluation.[36] Thus, the association between certain risk factors and death may have been overestimated if case patients tended to receive more medical scrutiny than controls prior to entry into the study. On the other hand, 15% of initial controls were replaced because they had no medical records. This process preferentially selected controls with more contact with the health care system and may have weakened true associations between risk factors and death.

In conclusion, our study identifies the characteristics of homeless individuals at extremely high risk of death. Clinicians who see homeless individuals should be alert to the need for aggressive intervention and close medical follow-up in patients with these risk factors. To prevent many of these deaths, however, changes must occur at the level of social policy rather than at the level of individual clinical intervention. These changes include wider availability of supportive services and stable low-income housing, improved access to health care, and the expansion of methadone maintenance treatment and needle-exchange programs. Efforts to prevent deaths among the homeless must address the complex medical, psychiatric, substance abuse, and socioeconomic problems of this vulnerable population. Studies are needed to rigorously evaluate the effectiveness of these efforts.

*Accepted for publication November 13, 1997.*

*This study was supported in part by a grant from the Department of Medicine, Boston Medical Center, Boston, Mass. Dr Hwang is a recipient of a Health Services Research Fellowship from the Agency for Health Care Policy and Research, Rockville, Md.*

*We thank Alice Knowles of JSI Incorporated for invaluable data management services and Charlene Zion of the Massachusetts Registry of Vital Records and Statistics for providing death registry data (Boston).*

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*Printed and Published in the United States of America*