Excess Mortality Among Urban Residents: How Much, for Whom, and Why?

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ABSTRACT

Objectives. The goals of this study were to estimate prospective mortality risks of city residence, specify how these risks vary by population subgroup, and explore possible explanations.

Methods. Data were derived from a probability sample of 3617 adults in the coterminous United States and analyzed via cross-tabular and Cox proportional hazards methods.

Results. After adjustment for baseline sociodemographic and health variables, city residents had a mortality hazard rate ratio of 1.62 (95% confidence interval [CI]=1.21, 2.18) relative to rural/small-town residents; suburbanites had an intermediate but not significantly elevated hazard rate ratio. This urban mortality risk was significant among men (hazard rate ratio: 2.25), especially non-Black men, but not among women. Among Black men, and to some degree Black women, suburban residence carried the greatest risk. All risks were most evident for those younger than 65 years.

Conclusions. The mortality risk of city residence, at least among men, rivals that of major psychosocial risk factors such as race, low income, smoking, and social isolation and merits comparable attention in research and policy. (*Am J Public Health.* 2000;90:1898–1904)

The 20th century transformed the United States (and the world) from a predominantly rural–agrarian society to a heavily urban one. The economic and technologic advantages of urban life may be offset by losses in quality of life and health.[1–4] Available theory and research provide a surprisingly limited understanding of the health effects of living in cities. Urban residence may improve health through better access to medical care, sanitation, education, jobs, and income,[5] but it may also threaten health via greater exposure to environmental pollution, social stress, infections, violence, and accidents.

Research conducted in the 1970s and 1980s suggested a reduced risk of mortality among rural residents of the United States and the United Kingdom.[6–11] However, these studies had significant limitations: they relied on ecologic analyses, they were cross-sectional or retrospective rather than prospective, they included only limited portions of the national population, or they inadequately controlled for confounding variables (e.g., age, sex, race, socioeconomic status, and, especially, health), which could have produced, via selection mechanisms, a spurious association between place of residence and health.

More recent and rigorous cross-sectional demographic analyses have documented mortality hazards of living in selected urban areas, especially among poor men.[12–14] These studies, however, were neither national in scope nor prospective in design, and they did not control for potential confounders beyond age, sex, race, and, to some extent, socioeconomic or poverty status.

Recent prospective studies of older persons have addressed some limitations of earlier research. The National Longitudinal Mortality Study (1979–1985) showed that, after adjustment for age, sex, race/ethnicity, education, income, and marital status, rural residents aged 55 to 74 years experienced significantly lower mortality than residents of urban standard metropolitan statistical areas (SMSAs).[15] Mortality of rural residents in the National Longitudinal Study of Older Men (which included men 55 years or older) was significantly lower than that of both city and suburban residents of SMSAs, after adjustment for age, race, marital status, education, income, and whether health limited the kind or amount of work a respondent could do. Adjustment for retrospective reports of lifetime smoking and drinking behavior reduced the rural–urban mortality difference by about 30% and the rural–suburban difference by about 15%.[16]

Although the studies just described were prospective analyses of national samples, they still excluded significant portions of the population (persons younger than 55 years and, in the National Longitudinal Study, women), had limited or no controls for baseline health status, considered only all-cause mortality, and did not systematically test for variations in rural–urban mortality differences across major sociodemographic groups. Also, they either

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failed to test the explanatory effects of health behaviors or did so only through retrospective reports.

In the present article, we provide the first estimates, to our knowledge, of the prospective impact of urban residence on mortality in a national sample. Specifically, we (1) estimate prospective effects of urban, suburban, and rural residence on mortality over a 7.5-year period for adults 25 years or older in the coterminous United States, controlling for age, sex, race, marital and socioeconomic status, and multiple self-reported measures of baseline health; (2) specify how these effects vary by age, sex, race, marital status, socioeconomic position, and health; (3) determine whether excess mortality among urban residents is localized to specific urban areas or causes of death; and (4) assess the explanatory roles of health behaviors (smoking, drinking, relative weight, and physical activity) and employment.

Methods

Study Design

In 1986, the University of Michigan Survey Research Center conducted face-to-face interviews with a stratified, multistage sample of 3617 noninstitutionalized persons 25 years or older living in the coterminous United States, with persons 60 years and older and Blacks oversampled. Response rates were 70% for sample households and 68% for sample individuals (more than 1 person was sampled in some households).[17,18]

Deaths of sample respondents were ascertained through March 1994 from informants during follow-up surveys or mailings and through the National Death Index. To date, 95.8% (519 of 542) of all deaths have been verified with death certificates. Review of the remaining reported deaths (n=23) revealed strong evidence of death in all cases, with month and year of death derived from informant reports. Underlying causes of death (coded from death certificates via the National Death Index) were grouped into 5 categories: (1) tumors (*International Classification of Diseases, 9th Revision* [*ICD-9*][19] codes 140–239); (2) cardiovascular diseases (*ICD-9* codes 390–429); (3) infections (*ICD-9* codes 001–139); (4) external causes such as injury, suicide, or homicide (*ICD-9* codes E800–E999); and (5) all other (*ICD-9* codes 240–389 and 430–799).

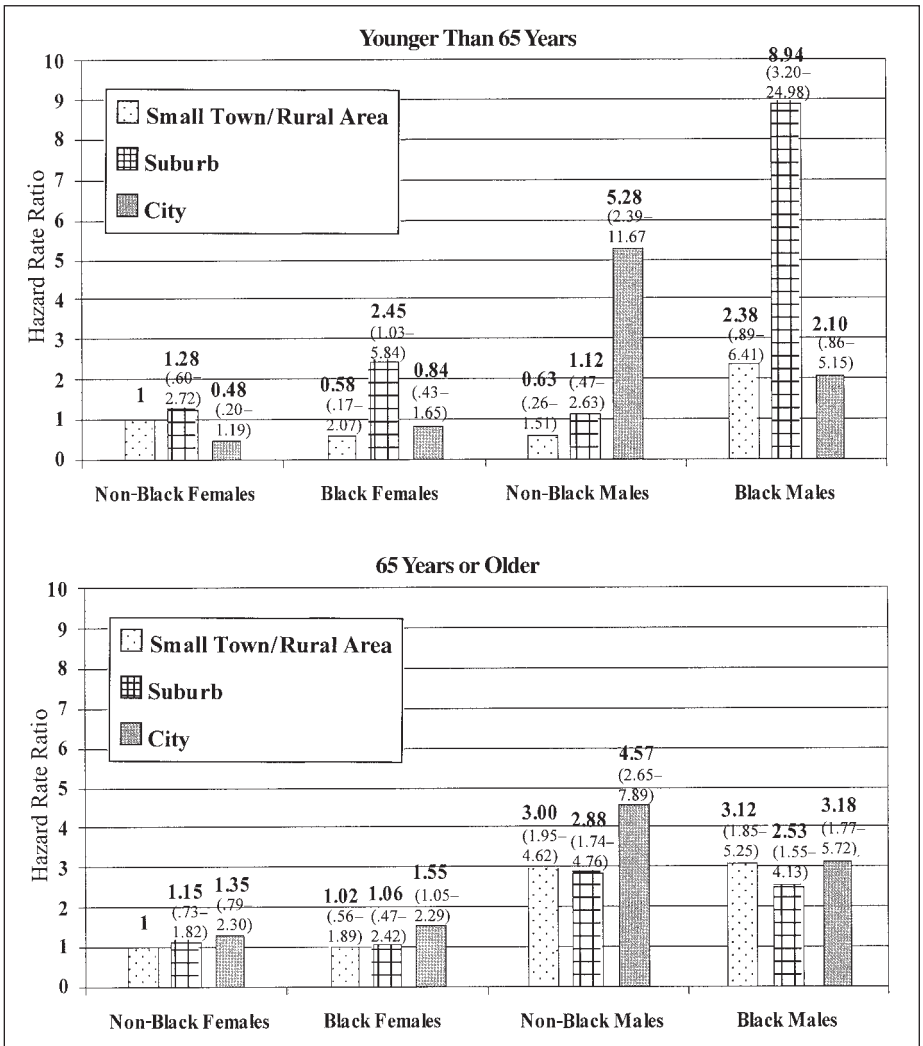
Measures

Place of residence. Respondents' 1986 addresses were classified into 3 US Bureau of the Census categories: (1) SMSA cities, (2) SMSA suburbs, and (3) adjacent/outlying areas (i.e., small cities or towns and rural areas, hereafter "small towns/rural areas").

Sociodemographic/socioeconomic variables. Age was grouped into 3 categories (25–44, 45–64, ≥65 years), as were education (0–11, 12–15, ≥16 years) and income (<$10 000, $10 000–$29 999, ≥$30 000); sex, race (Black, non-Black), and marital status (married, not married) were dichotomized. More refined categories of age, education, and income produced results similar to those described here.

Self-reported health. Self-rated health was assessed in 5 categories: excellent, very good, good, fair, and poor. Life-threatening or debilitating chronic conditions were defined as major life-threatening (heart trouble, stroke, cancer, diabetes, lung disease) and debilitating (hypertension, arthritis, foot problems, broken bones, urinary incontinence) conditions experienced in the previous year. Functional status was evaluated on a 4-point scale: (1) confined to a bed or chair, (2) difficulty climbing stairs or walking several blocks, (3) difficulty doing heavy housework such as shoveling snow or washing walls, and (4) none of the above. These variables were all treated as categorical dummy variables, with life-threatening and debilitating chronic conditions truncated at 2 or more and 3 or more, respectively.

Health behaviors. Cigarette smoking was coded as never smoked, formerly smoked, and currently smokes. Alcohol consumption was



Note. Values are adjusted for education, income, marital status, and health.

FIGURE 1—Hazard rate ratios (and 95% confidence intervals) for all-cause mortality, by place of residence, race, and sex: persons younger than 65 vs older than 65 years, United States, 1986–1994.

TABLE 1—Distributions of Study Variables Within the City, Suburb, and Small Town/Rural Subsamples and the Total Sample: United States, 1986

	Cities (n = 881), Weighted %	Suburbs (n = 1701), Weighted %	Small Towns/Rural Areas (n = 1034), Weighted %	Total Sample (n = 3617)		
				Weighted %	Weighted n	Unweighted n
Age, y						
25–44	53.4	53.8	48.7	52.2	1890	1331
45–64	29.3	27.9	28.2	28.3	1024	1075
≥65	17.4	18.3	23.1	19.4	703	1211
Sex						
Male	45.3	48.1	47.0	47.1	1703	1358
Female	54.7	51.9	53.0	52.9	1914	2259
Race						
Non-Black	76.1	93.9	92.0	89.0	3220	2443
Black	23.9	6.1	8.0	11.0	397	1174
Education, y						
≥16	20.8	21.0	16.7	19.7	714	500
12–15	51.6	58.1	51.7	54.7	1978	1768
0–11	27.6	20.9	31.6	25.6	925	1349
Income, $						
≥30 000	36.1	46.8	33.2	40.3	1457	966
10 000–29 999	41.4	37.2	45.3	40.5	1466	1475
<10 000	22.5	16.1	21.5	19.2	694	1176
Marital status						
Not married	42.8	29.2	22.6	30.6	1108	1641
Married	57.2	70.8	77.4	69.4	2509	1976
No. of life-threatening chronic conditions						
0	85.1	86.6	84.3	85.6	3095	2870
1	12.1	10.5	11.2	11.1	401	576
≥2	2.8	2.9	4.5	3.3	121	171
No. of debilitating chronic conditions						
0	46.3	52.2	46.8	49.2	1779	1349
1	28.8	26.6	26.9	27.2	984	1010
2	15.4	15.2	17.4	15.9	574	751
≥3	9.5	6.1	8.9	7.7	280	507
Functional limitations						
None	82.3	86.9	83.1	84.7	3064	2777
Difficulty doing heavy work	7.6	6.0	7.3	6.8	244	348
Difficulty walking/climbing	5.8	4.3	6.7	5.3	193	302
Confined to bed/chair	4.3	2.8	3.0	3.2	116	190
Self-rated health						
Excellent	23.8	26.0	21.6	24.2	875	705
Very good	40.6	39.1	41.2	40.1	1449	1340
Good	17.4	21.9	21.2	20.6	744	788
Fair	13.2	9.9	13.2	11.6	421	587
Poor	5.1	3.2	2.8	3.5	128	197

coded as follows: nondrinker (0 drinks in the past month), moderate drinker (1–89 drinks in the past month), and heavy drinker (≥90 drinks in the past month). Body mass index (self-reported weight in kilograms divided by the square of height in meters) was assessed as normal, high, or low, in accordance with the methods of Berkman and Breslow.[20] A physical activity index was used to average how often the respondent reported engaging in active sports or exercise, doing garden or yard work, and taking walks; scores were divided into quintiles.

Employment/occupation. The sample was classified, via standard census questions and coding, as (1) white-collar (professional/technical, managerial, clerical, and sales workers), (2) blue-collar (foremen/craftsmen, operatives, laborers, and service workers), (3) unemployed or disabled, (4) retired, or (5) keeping house.

Statistical Analyses

Cases were weighted to adjust for differential selection probabilities and response rates. Descriptive statistics and cross tabulations were obtained through SAS (SAS Institute Inc, Cary, NC). Cox proportional hazard models were used to estimate relative hazards of mortality by place of residence and confounding or explanatory variables through Taylor series linearization procedures in SUDAAN (Research Triangle Institute, Research Triangle Park, NC) to account for stratified multistage sampling.

Results

Descriptive Findings

Of the weighted sample, 24% lived in cities, 47% lived in suburbs, and 29% lived in small towns/rural areas (Table 1). The sample was somewhat older in small towns/rural areas, slightly more female in cities, and substantially more Black in cities. Also, suburban residents were somewhat better educated, had higher incomes, and were slightly healthier; respondents were much more likely to be unmarried as one moved from small towns/rural areas to suburbs to cities.

Mortality increased sharply with increasing age and with decreasing education, income, or health status (Table 2). Men, Blacks, those

not married, and those living in cities manifested somewhat higher mortality.

Place of Residence Effects

Because the data in Table 2 are not adjusted for age or other potential confounders, proper estimation of the predictive association of place of residence with mortality required multivariate analysis (Table 3). The mortality hazard rate ratio of city residents between 1986 and 1994 was 1.62 (95% confidence interval [CI] = 1.21, 2.18) times greater than that of residents of small towns/rural areas after adjustment for 1986 levels of all sociodemographic, socioeconomic, and health predictors. Suburban residents also had a higher mortality hazard than small-town/rural residents, but this difference was not statistically significant. Thus, city residents had significantly higher mortality risks not explainable in terms of their sociodemographic, socioeconomic, or health status at baseline.

Variations in Risk

Is the mortality risk of urban residence the same for all people? We examined this question by adding to the model of Table 3 multiplicative interactions between place of residence and each of the other predictors shown in the table. There was no evidence of significant ($P \leq .05$) differences in the effects of place of residence by age, marital status, education, income, or any of the health variables. Race and place of residence interacted significantly ($P \leq .05$) in a complex way; the elevated risk of city residence was greatest for non-Blacks, while suburban residence involved a greater mortality risk for Blacks. Sex and place of residence also interacted significantly ($P \leq .01$), with the mortality hazard of city residence being significant only for men (2.25 [95% CI = 1.55, 3.28], vs 1.09 among women).

Observing this strong sex difference in the effects of city residence, we repeated other interaction tests within the sexes. Among women, there were no significant interactions, that is, no place-of-residence differences in mortality for any racial, age, socioeconomic, marital, or health subgroup. Men also manifested no significant interactions of place of residence with marital status, education, income, or health. The interaction between race and residence in the total sample was replicated among men ($P \leq .01$); the mortality hazard of urban residence was greater among non-Black men, while suburban residence involved a higher hazard rate ratio among Black men. There was also a significant ($P \leq .05$) interaction with age, with the male mortality risks associated with urban or suburban residence most manifest among those younger than 65 years.

This complex pattern of mortality by place of residence is depicted in Figure 1, which shows, within each of 2 age groups, adjusted hazard rate ratios by race, sex, and residence. Each entry shows the hazard rate ratio (and associated 95% confidence interval) of mortality for each group relative to the group exhibiting, in general, the lowest mortality (younger, non-Black women in small towns/rural areas), after adjustment for all the variables included in Table 3.

Differences across places of residence were more modest among those older than 65 years; city residents were generally at higher risk, but differences were not significant within race–sex subgroups. Women younger than 65 years also manifested nonsignificant differences by place of residence, except for a significantly elevated risk ratio (2.45; 95% CI = 1.03, 5.84) among Black female suburban residents. Among men younger than 65 years, however, the excess mortality hazards of non-Black residents of cities (5.28; 95% CI = 2.39, 11.67) and Black residents of suburbs (8.94; 95% CI = 3.20, 24.98) were large and significant (but involved wide confidence intervals).

Potential Explanations

A full analysis of potential explanations for these differences in mortality risk by place of residence is beyond the scope of this article. However, we explored several explanatory issues: (1) Are the effects due to particular

TABLE 2—Weighted Percentages and Numbers of Deaths Across Study Variables: United States, 1986–1994

	Deaths, Weighted %	Weighted No. of Deaths (Rounded)	Unweighted No. of Deaths
Residence			
Small town/rural area	9.8	101	170
Suburb	8.7	148	181
City	12.0	106	191
Age, y			
25–44	1.9	35	35
45–64	8.2	84	107
≥65	33.5	236	400
Sex			
Male	12.1	205	253
Female	7.8	150	289
Race			
Non-Black	9.5	307	337
Black	12.2	48	205
Education, y			
≥16	4.4	31	34
12–15	7.1	140	175
0–11	19.9	184	333
Income, $			
≥30 000	2.9	42	43
10 000–29 999	11.1	163	191
<10 000	21.6	150	308
Marital status			
Not married	13.9	154	319
Married	8.0	201	223
No. of life-threatening chronic conditions			
0	7.0	216	297
1	23.0	92	163
≥2	39.0	47	82
No. of debilitating chronic conditions			
0	4.2	74	90
1	11.4	112	162
2	17.1	98	152
≥3	25.1	70	138
Functional limitations			
None	5.9	182	254
Difficulty doing heavy work	26.6	65	97
Difficulty walking/climbing	32.1	62	105
Confined to bed/chair	40.3	47	86
Self-rated health			
Excellent	3.0	26	41
Very good	6.7	98	149
Good	12.1	90	116
Fair	19.0	80	144
Poor	47.8	61	92

TABLE 3—Cox Proportional Hazard Rate Ratios Predicting All-Cause Mortality From Place of Residence and Possible Confounding Compositional Variables (n = 3617): United States, 1986–1994

	Hazard Rate Ratio (95% Confidence Interval)
Residence	
Small town/rural area	1.00
Suburb	1.15 (0.87, 1.53)
City	1.62** (1.21, 2.18)
Age, y	
25–44	1.00
45–64	3.36*** (1.75, 6.43)
≥65	11.96*** (6.43, 22.25)
Sex	
Male	1.00
Female	0.41*** (0.30, 0.55)
Race	
Non-Black	1.00
Black	1.16 (0.88, 1.51)
Education, y	
≥16	1.00
12–15	1.04 (0.68, 1.58)
0–11	1.00 (0.66, 1.52)
Income, $	
≥30 000	1.00
10 000–29 999	2.31** (1.43, 3.76)
<10 000	2.65*** (1.67, 4.21)
Marital status	
Not married	1.00
Married	0.81 (0.61, 1.07)
No. of life-threatening chronic conditions	
0	1.00
1	1.36* (1.06, 1.74)
≥2	1.68** (1.15, 2.44)
No. of debilitating chronic conditions	
0	1.00
1	1.00 (0.64, 1.57)
2	0.95 (0.60, 1.51)
≥3	0.78 (0.51, 1.21)
Functional limitations	
None	1.00
Difficulty doing heavy work	1.83** (1.25, 2.66)
Difficulty walking/climbing	1.95** (1.33, 2.86)
Confined to bed/chair	2.31** (1.42, 3.74)
Self-rated health	
Excellent	1.00
Very good	1.49 (0.98, 2.29)
Good	1.64 (0.93, 2.88)
Fair	1.59 (0.93, 2.70)
Poor	3.11** (1.54, 6.31)

Note. The –2 log-likelihood (model χ^2) was 728.94 ($P < .001$).
*$P \leq .05$; **$P \leq .01$; ***$P < .001$.

urban areas or types thereof? (2) Do they vary by causes of death? and (3) Can they be explained by differential patterns of health behavior or employment?

Effects across types of urban areas. Examination of crude mortality rates across all 70 primary sampling units in our sample revealed no tendency for the excess mortality in cities to be concentrated in a subset of urban areas defined by size, region, age, or any other recognizable feature. The number of primary sampling units did not allow detailed multivariate analyses; however, statistical analyses showed no differences between SMSAs above vs below 2 million in population, and region of residence did not affect mortality or the relation of urban residence to mortality.

Causes of death. The model in Table 3 was reestimated for each of 6 broad causes of death: (1) infections (n = 12), (2) tumors (n = 131), (3) cardiovascular diseases (n = 160), (4) external causes (n = 23), (5) other known causes (n = 168), and (6) unknown causes (n = 48). Given the small numbers of deaths from some causes, we interpreted the results cautiously. For the total sample, as well as for men, the number of deaths due to infections and tumors was significantly greater in cities than in small towns/rural areas (total sample hazard rate ratios: 12.31 [95% CI = 1.27, 118.98] and 2.65 [95% CI = 1.47, 4.79] for infections and tumors, respectively). The numbers of deaths from other known and unknown causes were also greater in cities, although not significantly so, and the numbers of deaths from cardiovascular diseases and external causes were nonsignificantly lower in cities than in small towns/rural areas (others have reported significantly greater cardiovascular mortality rates in cities, however[14]).

Among women, there were no significantly increased mortality risks of city residence for any cause of death. Thus, the increased mortality risk for men living in cities was evident across the causes accounting for the majority of deaths, although factors relevant to infections and tumors may contribute especially to excess male mortality in cities.

Health behaviors. City residents manifested a slightly riskier profile of health behaviors, being more likely than small-town/rural residents to smoke (31% vs 30% for suburban residents and 30% for small-town/rural residents), drink heavily (4.5% vs 5.1% and 2.9%), be underweight (5.4% vs 5.1% and 5.0%) (but not overweight [15.2% vs 13.1% and 19.0%]), and be in the lowest physical activity quintile (28% vs 17% and 22%). Adding these variables to the equation in Table 3 reduced the hazard rate ratio for city residence by 10% to 15% in the total sample and in the most affected subgroups (men overall, and especially non-Black men), reductions less than those seen in previous retrospective studies.[16]

Health behaviors might also exacerbate the deleterious effects of urban residence. Mortality effects of place of residence did not vary significantly by physical activity or body mass index. However, both smoking (current or ever) and drinking (any amount of) alcohol significantly exacerbated the impact of city residence both in the total sample and in men. In the total sample, the hazard rate ratios for city residence were 2.15 and 2.48 among smokers and drinkers but only 0.98 and 1.23 among never smokers and nondrinkers, respectively. Comparable hazards among men were 2.63 and 3.44 vs 1.05 and 1.27.

Smoking and drinking combined additively in modifying the effect of place of residence, especially among individuals younger than 65 years. The place-of-residence effects among those younger than 65 years shown in Figure 1 were largely absent among persons who neither drank nor had ever smoked, accentuated among those who drank and had ever smoked, and intermediate among those who either drank or had ever smoked. Those older than 65 years showed little systematic variation in mortality by place of residence within the same categories of smoking and drinking (data not shown).

Employment/occupation. Working outside the home may increase one's exposure to physical, chemical, biological, and psychosocial hazards in both the workplace and the broader environment. Although men in cities and suburbs had the highest rates of employment outside the home, adjustment for employment status and broad occupational type (i.e., blue- vs white-collar) had little effect on the mortality risks evident in Table 3 and Figure 1. Also, employment/occupation did not modify the effect of urban residence, except for greater mortality risks of urban and suburban residence among the disabled and unemployed.

Discussion

Our analyses provide the strongest evidence to date that (1) city residents in the United States have a significant prospective excess mortality risk and (2) this risk is not attributable to differences between city residents and others in terms of age, race, sex, education, income, marital status, or health. Consistent with the findings of previous studies, the mortality risk of city residence may be present only for men and attenuated among older persons.[13–16] Among respondents younger than 65 years in our sample, non-Black men were at greatest risk in cities, and Black men—and, to a lesser degree, Black women—were at greatest risk in suburbs. The modest sample size and small numbers of deaths by race and residence subgroup lead us to view this novel racial difference cautiously. The excess mortality risk among men residing in cities rivals that of other major psychosocial risk factors for mortality, including race, low income, cigarette smoking, and social isolation, and merits the same effort to understand and alleviate it as has been directed at these other risk factors.

Achieving such understanding will not be easy. The mortality risk of city residence appears not to be limited to particular urban areas or types thereof and extends broadly across causes of death, being perhaps most significant for infections and tumors. Elevated levels of tumor deaths suggest the influence of physical, chemical, and biological exposures in urban areas, perhaps potentiated by immunosuppressive effects of the ambient psychosocial stresses of urban life. Neither employment/occupation nor differences in major health behaviors across places of residence contributed substantially in our data to explaining the excess mortality risk of men living in central cities. However, smoking and drinking did exacerbate the mortality risk of city residence. Further research is required to replicate and explain these effects. Smoking and drinking may exacerbate environmental exposure or be associated, especially among younger men, with more risky lifestyles and even illegal activities not measured in our study (or in most studies).

Living in cities also involves potentially stressful noise levels, sensory stimulation and overload, interpersonal relations and conflict, and vigilance against hazards ranging from crime to accidents. These elements may be present in homes, neighborhoods, or work environments or in the spaces people traverse between such locations.[1–4] City residents may also have fewer adaptive resources for dealing with such stresses, particularly social relations and supports.[21] Future research should explore the contribution of these psychosocial factors to increased mortality risks among male residents of cities, as well as the reasons why women do not appear to experience the same increased risk.[13,16]

Our data suggest, paradoxically, that suburban residence may expose Blacks to mortality risks as great as or greater than those involved with living in cities. Recent research indicates that the majority of Blacks live in suburbs that are no better (or that are even worse) socioeconomically than the central city of their SMSA.[22] Even among Blacks living in more affluent or racially integrated suburbs, stress linked to race and racism may add to or compound other ambient stresses of life in urban areas. Among Blacks, exposure to discrimination is related positively to education but negatively to health.[23,24] Studies of racial minorities have shown that the mental health of a group is enhanced by higher concentrations of that group.[25–27] These are important areas for future research.

Future studies must be more carefully designed to investigate the impact of place of residence on health. In particular, we need (1) larger samples to allow more refined analyses by cause of death and by population subgroups, (2) more careful assessment of both psychosocial and physical–chemical–biological risk factors in individuals' lives and the broader environments in which they live and work, and (3) more extensive and careful assessment of change over time in both where people live and work (owing to their geographic mobility) and the contexts in which they live and work (owing to changes in these contexts). Lacking such change data, we find that the impact of city residence weakens with length of follow-up, perhaps leading to underestimation of the total effect. □

Contributors

J. S. House led the overall study and writing of the paper. J. M. Lepkowski provided statistical direction for the overall study and all analyses and contributed to the writing of the paper. D. R. Williams contributed to the conceptualization of the study and analyses and to the writing of the paper. R. P. Mero conducted all analyses and contributed to preparation of the tables and to the writing of the paper. P. M. Lantz, S. A. Robert, and J. Chen contributed to the design and execution of the analyses and to the writing of the paper.

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