US Mortality by Economic, Demographic, and Social Characteristics: The National Longitudinal Mortality Study

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ABSTRACT

Objectives. A large US sample was used to estimate the effects of race, employment status, income, education, occupation, marital status, and household size on mortality.

Methods. Approximately 530 000 persons 25 years of age or more were identified from selected Current Population Surveys between 1979 and 1985. These individuals were followed for mortality through use of the National Death Index for the years 1979 through 1989.

Results. Higher mortality was found in Blacks than in Whites less than 65 years of age; in persons not in the labor force, with lower incomes, with less education, and in service and other lower level occupations; and in persons not married and living alone. With occasional exceptions, in specific sex and age groups, these relationships were reduced but remained strong and statistically significant when each variable was adjusted for all of the other characteristics. The relationships were generally weaker in individuals 65 years of age or more.

Conclusions. Employment status, income, education, occupation, race, and marital status have substantial net associations with mortality. This study identified segments of the population in need of public health attention and demonstrated the importance of including these variables in morbidity and mortality studies. (*Am J Public Health.* 1995;85:949–956)

Introduction

Recent literature reviews have shown the continued and pervasive role that socioeconomic condition plays in morbidity and mortality.[1,2] Repeatedly, studies using any reasonable indicator of socioeconomic status (SES) have shown that poor individuals, those who are least educated, and workers with the least skills suffer, as Wilkinson noted, "a double injustice: life is short where its quality is poor."[3]

To describe the gross and net effects of different economic, demographic, and social characteristics on mortality, studies require large and diverse populations because the measures have a considerable degree of correlation. In this paper, gross effects refer to an association between a characteristic and mortality that is race and age adjusted and sex specific. Net effects refer to the residual association after additional adjustment for other covarying social and economic characteristics. In a large national sample of the US population of about 530 000 persons 25 years of age or more, selected economic, demographic, and social characteristics were measured, and mortality was determined for a maximum follow-up period of nearly 11 years. This study, the National Longitudinal Mortality Study, permits estimation of gross and net effects of employment status, income, education, occupation, race, marital status, and household size on mortality.

The characteristics chosen for analysis, although commonly used in research, were far from simple, single dimensional statements about a person's current status. An individual's current status is probably the result of a multitude of past circumstances and behavior and obviously influences future opportunities and behavior in pathways that are complex.[4] Aspects of economic status were characterized in this study by income, education, occupation, and employment status. At the simplest and most basic level, income is a measure of a person's financial resources; education is a measure of attained knowledge and economic potential; occupation is a measure of community status, skills, financial earnings, and specific occupational exposure; and employment status is a measure of present economic viability as well as an indirect measure of poor health. The demographic variables of age and sex clearly represent characteristics associated with mortality, and these variables must be considered. The characteristic of race, which "reflects the intersection of biological, cultural, socioeconomic, political and legal determinants, as well as racism,"[5] was evaluated in this study both as a covariate of other relationships and to assess whether there are net mortality differences by race. The characteristics of marital status and household size reflect both the number of persons who must use the economic resources available and the social factors related to living arrangements and to marriage, widowhood, separation, and divorce. The primary purposes of this report are to describe the gross and net effects of these complex variables on mortality and to discuss their public health relevance.

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Editor's Note. See related editorial by Blane (p 903) in this issue.

Methods

The National Longitudinal Mortality Study is a prospective study of mortality involving combined samples of the noninstitutionalized US population.[6,7] The samples are taken from selected Current Population Surveys, which are conducted by the Bureau of the Census.[8] The Current Population Surveys involve a complex probability sample of households that are surveyed monthly to obtain demographic, economic, and social information about the US population with particular emphasis on employment, unemployment, and other labor force characteristics. The surveys are used by the Bureau of Labor Statistics to prepare monthly estimates of the unemployment rate. Surveys are conducted by personal and telephone interviews, and response rates are close to 96%. The current analysis included nine Current Population Surveys in which persons were followed for mortality with the National Death Index. The surveys chosen were conducted in March 1979, April 1980, August 1980, December 1980, March 1981, March 1982, March 1983, March 1984, and March 1985.

Employment status was determined by a highly structured interview that began with the following question: "What was [name] doing most of last week?" Next, probing questions were asked regarding the person's employment-related activities. Persons were classified as employed (working during the past week), unemployed (seeking work during the past 4 weeks), houseworkers (managing the care of their own home and/or children), retired and other (retired, performing volunteer work, discouraged from seeking work), or unable to work (long-term physical or mental illness or disability).

Occupation was ascertained by two questions: "What kind of work was [name] doing?" and "What were [name]'s most important activities or duties at this job?" This information was used to code occupation by means of the 1970 Bureau of the Census Index of Industries and Occupations; three-digit codes for specific occupations were produced. Occupations were grouped into the following six categories: managerial and professional; technical, sales, and administrative; service; farming, forestry, and fishing; precision production, craft, and repair; and operators, fabricators, and laborers. Analyses in this paper that involve occupation exclude persons 65 years of age or older since few were employed, and they also exclude those less than 65 years of age who did not have an occupation recorded at the time of the survey, primarily because they were not in the labor force.

The interviewer ascertained family income by asking, "Which category on this card represents the total combined income of all members of this family during the past 12 months?" For the Current Population Surveys conducted in March of the various sample years, a more detailed questionnaire was used; people were asked to specify actual amounts of income from each source, and these amounts were combined to represent total family income. Income was adjusted to 1980 dollars by means of the consumer price index. Education was determined by the following questions: "What is the highest grade or year of regular school [name] has ever attended?" and "Did [name] complete that grade?" For marital status, the interviewer asked, "Is [name] now married, widowed, divorced, separated, or has [name] never been married?" For household size, a roster of household members was completed by the interviewer and the number of members of the household counted. Persons in institutions are not included in these surveys.

The samples in the National Longitudinal Mortality Study were matched to the National Death Index to determine deaths occurring in the years 1979 through 1989. The National Death Index, a computer file of all deaths in the United States since 1979, is maintained and operated by the National Center for Health Statistics.[9] The index has been shown to be an effective and accurate means of ascertaining deaths when personal identifiers are used.[10–12] The mortality rates for the National Longitudinal Mortality Study are lower than those of the entire US population, which is to be expected since the study consists of samples from the noninstitutionalized population and identification of deaths from the National Death Index results in some missed deaths.

The Cox proportional hazards model[13] was used to estimate the relative risk of mortality in terms of various social and economic variables for men and women separately and for the age groups 25 through 44, 45 through 64, and 65+ years. For each variable, the assumption of the proportionality of the hazard was not seriously violated in any sex or age group. The first model used age, race, and each variable singly as independent variables. The second model used age, race, the specific variable of interest, and all four of the other variables, with the exception of occupation. Occupation was included in a separate model because of the reduced sample size and because the older age group was not analyzed. Thus, estimates of relative risk were adjusted first for age and race and then for age, race, and the other variables. In the model, age was categorized in 5-year groups and represented by indicator variables. Race was categorized as White, Black, and all other races combined (Asian, Pacific Islander, Aleut, Eskimo, and Native American); indicator variables were used here as well. Hispanic status was not identified in these analyses. The statistical significance ($P < .01$) of the relative risk for each category of a variable, relative to a specified reference category, is provided. Likelihood ratio statistics, which are distributed as chi-square values, are also provided; these statistics indicated whether the addition of a certain variable as a whole to the model produced a statistically significant result. The race characteristic was evaluated in a model including age and in another model including both age and the other characteristics. A likelihood ratio test ($P < .01$) indicated no significant interaction of the relationship of income, education, marital status, and household size by race with mortality. A small interaction between race and employment status resulted in different magnitudes of the relationships for some employment status categories in Blacks and Whites, although the patterns of mortality by category of employment status remained similar.

Results

There were 530 507 men and women 25 years of age or more in the National Longitudinal Mortality Study with known values for the variables (except occupation); 54 304 of these individuals died during the follow-up period from 1979 through 1989 (Table 1). The distribution of race categories is shown in Table 1 (the distributions of the other characteristics are available from the authors).

Blacks less than 65 years of age had significantly higher age-adjusted mortality rates than Whites in the same age group; also, Blacks in the 25- to 44-year group showed more than twice the rates of Whites, and those in the 45- to 64-year group showed 1.5-fold higher rates (Table

2). After adjustment for the other characteristics, the excess risk among Blacks was reduced but still significantly higher than that of Whites. In the 65+ age group, the multivariable adjusted mortality rates of Blacks were similar to, or even slightly lower than, those of Whites. The only statistically significant relationship for the "other" race category involved the older age group, which showed lower mortality than Whites.

Employment status, after adjustment for age and race, showed categories with large relative risks for death (Table 2). The highest relative risk, for each sex and age group, involved those persons classified as unable to work; mortality rates ranged from 3.08 to 11.25 times higher than the rates for those who were employed. The next highest categories included retired persons (or those not working for other reasons) and houseworkers. The few men classified as houseworkers had higher relative risks than those who were retired; female houseworkers had lower relative risks than retired persons. Unemployed men less than 65 years old showed mortality risks higher than the risks of those who were working. Although unemployed women more than 45 years of age had lower mortality rates than the employed women in the same age group, this difference was not statistically significant. In the 25- through 44-year age group, retired women had smaller relative risks than men, and women unable to work had larger risks. This pattern of mortality was generally the same when adjustment was made for the other variables, although the relative risks were usually smaller after adjustment. We concluded that the following categories were associated with increased mortality independent of the other characteristics in these models: the unable to work, retired/other, and houseworker categories for both sexes and the three age groups and the unemployed category for men less than 65 years of age.

Mortality declined strongly and steadily with increasing income for men and women less than 65 years of age (Table 2). After adjustment for age and race, men 25 through 44 years old and 45 through 64 years old with family incomes of $50 000 or more had mortality rates that were approximately 30% of the rates of those with incomes of $5000 or less. Adjustment for the other variables raised the relative risk in the high income group from 0.3 to nearly 0.7, indicating that part of the decreased mortality was accounted for by the associations of income with employment, education, marital status, and household size. However, even after adjustment, there was a significant relationship, both in magnitude and by statistical tests, between increasing income and lower mortality in each age and sex group, with similar relationships for women and for men. (It is important to note that income was classified as combined family income rather than individual income.)

Higher education level was associated with lower mortality in men and women, with the strongest relationships in persons less than 65 years of age and much weaker associations in the older age group (Table 2). For those less than 65 years of age, there were twofold to threefold differences between the education categories with the highest and the lowest risks. After adjustment for the other variables, the ratio of the highest to the lowest risk decreased to between 1.5 and 2. The multivariate adjustment altered the relative risks for high education to a much lower extent than the multivariate adjustment altered the higher levels of income (Table 2).

The widowed, divorced, separated, and never married categories all involved higher mortality rates than the married category after adjustment for age and race (Table 2). The relative risks were largest for the younger age groups and smallest for the older age groups. Adjustment for the other variables reduced each relative risk.

Men and women less than 65 years of age who were members of a household with two or more residents had a lower mortality rate than those who lived alone (Table 2). For women 65 years of age or more, those who lived alone had lower mortality; for men in the same age group, living alone appeared to convey slightly higher mortality. After adjustment for the other variables, including marital status (which was closely associated with household size), a significant relationship held for women 65 years of age or more (living alone was associated with a decreased risk) and women 25 through 44 years old (living alone was associated with an increased risk).

Table 3 shows the relationships between six categories of occupation and mortality. The sample size was reduced for the occupation analyses since 22% of the sample was not in the labor force. Relative to the professional group, the service occupation group had significantly higher mortality. For men, the professional group showed the lowest relative mortality in comparison with the other occupation groups after adjustment for age and race. When adjustment was made for the other social and economic variables, the farming group had a relative mortality lower than that of professionals, although the difference was statistically significant only for the 45- through 64-year age group. In men, the addition of the other social and economic variables reduced each occupation effect considerably. The relative risks for the income, education, employment status, marital status, and household size categories changed by 4% or less when occupation categories were added as covariates.

TABLE 1—Population Size, Number of Deaths, and Distribution of Race: National Longitudinal Mortality Study, 1979 through 1989 Follow-Up

Sex and Age, y	Population at Risk, No.	No. of Deaths	Distribution by Race, %		
			White	Black	Other
Men					
25–44	123 326	2 366	88.8	8.1	3.2
45–64	83 177	9 734	89.7	7.8	2.5
65+	40 808	17 281	90.2	7.8	2.0
Women					
25–44	133 560	1 366	86.1	10.3	3.6
45–64	92 250	6 313	88.1	9.4	2.5
65+	57 386	17 244	90.4	8.1	1.4

Note. As a result of rounding, percentages may not add to 100.

Discussion

These data from the National Longitudinal Mortality Study show the strong gross and net effects of employment status, income, education, occupation, and marital status on mortality rates in men and women under 65 years of age. In men and women more than 65 years old,

TABLE 2—Adjusted Relative Risks of Death by Selected Categories: National Longitudinal Mortality Study, 1979 through 1989 Follow-Up

	Men						Women					
	25–44-Year Group (n = 123 326)		45–64-Year Group (n = 83 177)		65+ Group (n = 40 808)		25–44-Year Group (n = 133 560)		45–64-Year Group (n = 92 250)		65+ Group (n = 57 386)	
	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR
Race												
White[a]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Black	2.07*	1.36*	1.68*	1.28*	1.00	0.92*	2.15*	1.69*	1.72*	1.35*	1.11*	1.00
All other	0.95	0.87	0.95	0.92	0.70*	0.70*	1.20	1.21	0.89	0.90	0.71*	0.66*
Likelihood ratio statistic (2 *df*)	137*	27*	239*	55*	35*	40*	107*	45*	204*	58*	37*	32*
Employment status												
Employed[a]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Unemployed	2.06*	1.60*	1.36*	1.16*	1.10	1.03	1.25	1.09	0.93	0.85	0.93	0.90
Houseworker	5.48*	3.38*	2.94*	2.16*	1.43*	1.31*	1.41*	1.36*	1.57*	1.59*	1.47*	1.47*
Retired	4.23*	2.90*	2.04*	1.74*	1.51*	1.45*	2.32*	2.08*	2.17*	2.01*	1.80*	1.78*
Unable to work	6.20*	4.16*	3.96*	3.17*	3.16*	2.97*	11.25*	8.21*	5.34*	4.46*	3.08*	2.98*
Likelihood ratio statistic (4 *df*)	592*	296*	1728*	1010*	875*	753*	200*	149*	827*	690*	709*	644*
Income (1980 dollars)												
<$5000[a]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
$5000–$9999	0.76*	1.00	0.84*	0.96	0.94*	0.98	0.63*	0.74*	0.77*	0.95	0.99	1.00
$10 000–$14 999	0.60*	0.97	0.65*	0.88*	0.84*	0.90*	0.52*	0.68*	0.67*	0.92	0.94*	0.94
$15 000–$19 999	0.44*	0.80	0.54*	0.80*	0.78*	0.86*	0.47*	0.65*	0.58*	0.84*	0.95	0.94
$20 000–$24 999	0.35*	0.70*	0.47*	0.75*	0.75*	0.84*	0.42*	0.60*	0.52*	0.78*	0.92	0.89*
$25 000–$49 999	0.34*	0.76*	0.41*	0.71*	0.73*	0.84*	0.39*	0.60*	0.47*	0.75*	0.96	0.91*
$50 000+	0.27*	0.67*	0.32*	0.63*	0.66*	0.84*	0.38*	0.62*	0.43*	0.69*	0.93	0.90
Likelihood ratio statistic (6 *df*)	311*	36*	981*	115*	212*	53*	110*	23*	385*	49*	13	18*
Education, y												
0–4	1.55*	0.76	1.16*	0.81*	1.07	0.94	1.46	0.80	1.35*	0.95	1.07	0.99
5–7	1.38*	1.01	1.38*	1.07	1.12*	1.03	1.00	0.79	1.50*	1.21*	1.10*	1.05
8	1.41*	1.08	1.22*	1.03	1.15*	1.09*	1.63*	1.31	1.36*	1.17*	1.09*	1.07*
9–11	1.38*	1.17	1.21*	1.07	1.11*	1.06	1.51*	1.32*	1.29*	1.14*	1.06	1.05
12[a]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13–15	0.92	0.94	0.91*	0.96	0.97	0.99	0.85	0.86	1.01	1.05	0.96	0.97
16	0.59*	0.65*	0.70*	0.80*	0.90*	0.96	0.70*	0.71*	0.85	0.94	0.97	0.99
17+	0.48*	0.54*	0.60*	0.72*	0.76*	0.85*	0.64*	0.64*	0.81*	0.94	0.82*	0.83*
Likelihood ratio statistic (7 *df*)	221*	95*	413*	103*	156*	56*	88*	49*	173*	36*	56*	32*

(Continued)

TABLE 2—*Continued*

	Men						Women					
	25–44-Year Group (n = 123 326)		45–64-Year Group (n = 83 177)		65+ Group (n = 40 808)		25–44-Year Group (n = 133 560)		45–64-Year Group (n = 92 250)		65+ Group (n = 57 386)	
	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR
Marital status												
Married[a]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Widowed	2.94*	2.18*	1.77*	1.45*	1.11*	1.06	1.84*	1.32	1.54*	1.42*	1.14*	1.15*
Divorced	2.10*	1.65*	1.71*	1.40*	1.23*	1.14*	1.24*	1.00	1.40*	1.37*	1.23*	1.26*
Separated	2.15*	1.63*	1.45*	1.17	1.25*	1.18	1.45*	1.02	1.66*	1.45*	1.26*	1.27*
Never married	2.26*	1.72*	1.61*	1.24*	1.11*	1.05	1.60*	1.26	1.38*	1.31*	1.15*	1.18*
Likelihood ratio statistic (4 *df*)	312*	92*	389*	79*	54*	12	44*	8	224*	88*	65*	48*
Household size												
1[a]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	0.87	1.13	0.70*	1.01	0.89*	0.98	0.86	0.91	0.77*	1.04	0.97	1.07*
3	0.71*	0.99	0.64*	0.98	0.89*	0.99	0.76	0.79	0.68*	0.95	1.12*	1.16*
4	0.54*	0.89	0.62*	1.00	0.96	1.06	0.71*	0.77	0.66*	0.92	1.11	1.12
5	0.60*	0.95	0.59*	0.95	0.91	1.04	0.61*	0.64*	0.72*	0.99	1.14	1.14
6	0.64*	0.97	0.62*	0.99	0.90	1.01	0.67*	0.67	0.68*	0.90	1.27*	1.31*
7+	0.69*	0.94	0.56*	0.86	0.92	1.02	0.59*	0.57*	0.64*	0.82	1.26*	1.26*
Likelihood ratio statistic (6 *df*)	105*	14	195*	8	34*	4	26*	23*	104*	16	57*	33*

Note. Age-adjusted RR indicates relative risks adjusted for age and race, except for the race category, which was adjusted only for age. Multivariate-adjusted RR indicates relative risks adjusted for multiple variables (age, race, employment status, income, education, marital status, and household size), except for the variable specific to that section.

[a]Reference group.

*$P < .01$.

TABLE 3—Adjusted Relative Risks of Death, by Categories of Occupation: National Longitudinal Mortality Study, 1979 through 1989 Follow-Up

	Men				Women			
	25–44-Year Group (n = 119 383)		45–64-Year Group (n = 70 031)		25–44-Year Group (n = 95 796)		45–64-Year Group (n = 51 141)	
Occupation	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR	Age-Adjusted RR	Multivariate-Adjusted RR
Professional[a]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Technical	1.48*	1.20	1.28*	1.13*	1.15	1.01	1.05	0.98
Service	1.89*	1.20	1.57*	1.17*	1.75*	1.42*	1.26*	1.08
Farming	1.27	0.81	1.11	0.82*	1.64	1.39	0.81	0.74
Production	1.46*	1.04	1.25*	1.01	0.67	0.57	0.88	0.80
Operators	1.72*	1.10	1.37*	1.05	1.46*	1.22	1.03	0.90
Likelihood ratio statistic (5 *df*)	95*	16*	127*	42*	39*	19*	23*	13

Note. Age-adjusted RR indicates relative risks adjusted for age and race. Multivariate-adjusted RR indicates relative risks adjusted for multiple variables (age, race, employment status, income, education, marital status, and household size).
[a]Reference group.
*$P < .01$.

these variables were related to mortality, although the magnitude of effect was much smaller than in the younger age groups, consistent with the results of other studies.[14] The estimates of these gross and net effects were possible in the National Longitudinal Mortality Study because of the large size of the population.

Employment status showed the largest likelihood ratio statistics and the largest relative risks after multivariate adjustment. Those who were unable to work had a very high relative risk; it must be noted, however, that only a small portion of the population was included in this category (less than 3% overall for persons less than 65 years of age). The employment status relationship was probably due to both economic and health factors. Persons in the unable to work category, by definition, had health conditions that limited their ability to work, and they also suffered the economic and social implications of not being employed. People were assigned to the unable to work category if they had a long-term illness or disability that prohibited them from working in the previous 6 months; however, those with a short-term illness could have been assigned to either the houseworker or the retired/other category, depending on their response. A recent report of the British Regional Heart Study showed elevated mortality in those who became unemployed and in those who retired for reasons other than illness, even after adjustment for social class, risk factors, and existing illness.[15] The National Longitudinal Mortality Study results direct attention to the nonworking population as an area for public health concern. Those who are not working may not have health insurance and may not be eligible for medical benefit programs, and thus they may be lacking both adequate treatment and prevention.[16,17] In addition, prevention and public health programs that reach people through the workplace will probably miss this population. The elevated risks in the unemployed, retired, and houseworker populations suggest, but do not prove, that working in itself may be beneficial. A recent commentary suggested that changing the social structure, particularly for older persons, by "providing incentives for sustained functioning" through increased employment opportunities is certainly feasible and desirable.[18]

Income and education have been a dominant and somewhat competitive duo in assessments of the relationship between SES and mortality.[19–21] The National Longitudinal Mortality Study demonstrates that they are separately related to mortality. Taken alone, the differences in income appeared to describe greater differences in mortality relative to education. However, income was more strongly associated with the other variables than was education, so multivariate adjustment reduced the income effects more than the education effects. The reduction in mortality ratios for the education groups appeared greatest in those with more than a high school education. There are important differences between income and education.[20] Income is a more current and variable characteristic, while education is nearly always fixed by 25 years of age. Income describes a realized attainment, and education indicates the potential for attainment. Income represents purchasing power and education is a measure of intellectual accomplishment, although not necessarily a measure of intellectual potential. In the National Longitudinal Mortality Study, income is assessed as combined family income and thus does not reflect an individual's earnings, except for those residing in single-person households. Education, on the other hand, is a characteristic of the individual. The pathways through which income and education affect mortality are complex but are likely to be linked to purchasing power for health services, healthy habits and behaviors, and the knowledge and empowerment that comes with education. Since we observed no major differences in these relationships between men and women, these pathways appeared to influence mortality similarly in men and women. The National Longitudinal Mortality Study results strongly confirm the often-repeated finding that poor individuals and those who are least educated are in the greatest need of health services, including components of both prevention and treatment.

Occupation is likely to influence mortality through specific occupational exposures (e.g., chemical, accidents, stress), through high-risk behaviors adopted by coworkers (e.g., smoking), through its association with income and education, and through its own value as a measure of social position or class. The broad general categories of occupation used in

this report were inadequate for use as a measure of occupational exposure, and more detailed occupational analyses will be conducted. The current analysis showed considerable reduction in the gross relative risks for occupation categories after adjustment for income, education, and the other variables, suggesting that the net association, perhaps representing the effect of social status per se of each occupation group, is very weak. The magnitudes of the relative risks in the occupation groups of the National Longitudinal Mortality Study are weaker than those found in British studies, which have involved longer average follow-ups.[22,23] This suggests that occupation is a less satisfactory measure of social class in the United States, that these occupational groups are measured differently, or that health selection may reduce gradients in the National Longitudinal Mortality Study.

The excess mortality of those in the unmarried categories was due only in part to the associated economic variables. The relative risks were greatest in the younger age groups and decreased in the older groups. The relative risks associated with not having been married were similar to those associated with marriage relationships that had ceased through death, divorce, or separation. In the 25- to 44-year age group, the increases in risks for those in the unmarried categories were smaller in women than in men and were not significantly increased in women after adjustment for the other factors. This suggests that, for women in the younger age group, much of the increased risk was due to economic circumstances. In this follow-up period, there were very few acquired immunodeficiency syndrome (AIDS) deaths, and thus such deaths would not contribute to the findings seen in the National Longitudinal Mortality Study. Household size was closely related to marital status and imparted little or no additional information, except for the reversal of the association in women more than 65 years of age. In this group, it appeared that living alone was an indicator of healthy status. A study conducted in England that examined morbidity in elderly persons living alone concluded that those living alone did not have higher levels of morbidity, and these individuals reported a higher satisfaction with their life than people living with others.[24] The National Longitudinal Mortality Study results for those less than 65 years of age are similar to the findings of a multicountry study of mortality by marital status.[25] Across the countries studied, married persons consistently had the lowest mortality, and the relative increase in mortality for unmarried men was higher than that for unmarried women.[25] These data suggest that issues regarding bereavement and separation and their relation to disease and death in women and men are important for future research.

Some of the relationships described in this paper may have been biased if categories of the social and economic characteristics contained persons with existing poor health. Certainly, part of the characterization of employment status describes, by definition, those who are unable to work as a result of ill health. Men not of the usual retirement age who stated that they were retired or occupied with housework may not have been working because of existing illness. In addition, there is the potential effect of lower economic attainment resulting from ill health throughout a person's life. That is, perhaps some aspect of ill health has prevented a person from reaching his or her education or income potential. The effect of prior health status was thought to be of most importance early in the follow-up period, and analyses conducted by Fox et al.[23] indicate that much, although probably not all, of the influence of health selection had worn off after 5 years of follow-up. Also, in a review of relevant studies, Wilkinson[3] concluded that health selection's "contribution to observed class differentials in health is probably always small in relation to the overall size of the mortality differentials." Future analyses of the National Longitudinal Mortality Study will investigate the relation of the length of mortality follow-up to mortality gradients.

In summary, within each race group, segments of American society can be clearly identified as having a substantially higher risk of death than others, and these segments are largely identified as being poorer, less educated, employed in occupations that are service oriented, and not in the labor force. Also, when adjustment was made for these factors, Blacks who were less than 65 years old continued to have higher mortality than Whites. The magnitude of the relative risk for these factors was substantial, particularly in comparison with established risk factors such as cigarette smoking (the relative risk of death for cigarette smokers vs nonsmokers is less than 2).[26] In addition to the usual goals of targeted disease prevention and health promotion, solutions to public health problems will require redress of the fundamental causes of economic deprivation and further research regarding the pathways through which these economic conditions are related to disease and death. □

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The 1995 Conference of the Canadian Society for Epidemiology and Biostatistics will be held from August 16 through 19, 1995, at the Hotel Newfoundland in St John's, Newfoundland. The program will include a symposium on surveillance and risk assessment. Panel discussions will address funding, access to data, and associated ethical issues. They also hope to address the role of epidemiology and biostatistics in health reform.

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