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Demography, Vol. 27, No. 1. (Feb., 1990), pp. 31-53.

Stable URL:
http://links.jstor.org/sici?sici=0070-3370%28199002%2927%3A1%3C31%3AOCAMOE%3E2.0.CO%3B2-4

Demography is currently published by Population Association of America.

Demography, Vol. 27, No. 1, February 1990

Occupational Careers and Mortality of Elderly Men

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This article presents findings from an analysis of occupational differentials in mortality among a cohort of males aged 55 years and older in the United States for the period 1966–1983. Using the National Longitudinal Survey of Mature Men, we construct event histories for 3,080 respondents who reach the exact age of 55. The dynamics that characterize socioeconomic differentials in mortality are analyzed by evaluating the differential effects of occupation over the career cycle. Maximum likelihood estimates of hazard-model parameters show that the mortality of current or last occupation differs substantially from that of longest occupation, controlling for education, income, health status, and other sociodemographic factors. In particular, the rate of mortality is reduced by the substantive complexity of the longest occupation while social skills and physical and environmental demands of the latest occupation lower mortality.

This article presents findings from an analysis of occupational differences in mortality among a cohort of men aged 55 years and older in the United States for the period 1966–1983. The social and technical divisions of labor that define the occupational structure give rise not only to differences in socioeconomic achievement and status but also to differences in health benefits and exposure to physically demanding or stressful working conditions—factors that operate as proximate determinants of mortality. We examine the influence of characteristics that depict the nature of work in the person's current or last occupation, net of other measures of socioeconomic status. We also differentiate the effects of current or last occupation from earlier occupational contexts to explicitly link older men's mortality experiences with the career cycle.

The most compelling reason for examining socioeconomic differences in mortality is the identification of more proximate socially structured causes of mortality. Previous research has identified two major dimensions underlying occupational differences in mortality—exposure and life-style. Life-style, as a by-product of social status, includes health behaviors, access to the health care system, and attitudes toward health care and health care providers. Researchers typically view occupation as the most accurate single indicator of social status and life-style. Yet occupations also define the environment in which persons are exposed to hazardous working conditions, environmental pollutants, emotional stresses, and other

risks. We investigate the relative importance of this latter source of differential mortality through direct measures of the amount and kind of exposures normally encountered in an occupation. Further, by defining life-style broadly in terms of racial, educational, income, and marital status differences in addition to occupation, we substantially broaden the examination of the effects of working conditions and life-style characteristics beyond those considered by past researchers.

Accurate characterization of the manner in which occupations influence mortality is crucial to any interpretation of the relative risks posed by different occupations. In particular, the high volume of movement, even among older men (Tolbert 1982), suggests that current occupational status alone cannot fully capture the influence of occupation. To show that mortality differs by current or even last occupation is no guarantee that the risks associated with that occupation are a direct *product* of its environment. Rather, they may obscure the effects of exposure or life style from earlier occupational contexts. For example, men in physically demanding and debilitating occupations may move to other less risky occupations before dying. To assess more adequately the influence of the occupational work environment, it is thus necessary to trace the effects of the occupational career rather than simply examining the effects of occupational status at a single time point. We address this problem by investigating the effect of older men's current or last (latest) occupation relative to their longest occupation at the age of 55. By measuring occupation over the career cycle, we are better able to capture the dynamic influence of a changing occupational context on mortality.

Background

This study extends previous research on socioeconomic differences in mortality (Kitagawa & Hauser 1973; Mare in press; Moriyama & Guralnick 1956; Mott & Haurin 1985) by distinguishing the effects of occupational exposure from the consistently observed negative relationship between socioeconomic status and mortality (e.g., Antonovsky 1967; Stockwell, Wicks, & Adamchak 1978). Further, in contrast to the more traditional synthetic cohort approach, we model mortality as a dynamic process by observing the experiences of a cohort of older men. Rather than discard information on retirees and older nonworking men, we make use of their completed work histories in charting the effects of occupational careers on mortality. We are able thus to expand on previous research by focusing on the mortality of older men as their careers unfold.

One of the earliest U.S. studies of occupational differences in mortality was that by Moriyama and Guralnick (1956), who observed very few differences between major (albeit heterogeneous) categories of nonlaborer occupations. When comparing across laborer and nonlaborer groups, however, substantially higher rates were noted for laborers. Kitagawa and Hauser (1973) continued this line of work by conducting the first comprehensive analysis of socioeconomic differences in mortality for the United States. Their analysis of the influence of latest occupation, education, and income showed substantial differences in mortality between educational and income groups. The inability of the data to support a multivariate analysis, however, made it impossible to identify explicitly the effects of occupation *net* of education and income. Instead, they explained occupational effects in terms of life-style differences, noting the consistent overlap of the occupational rankings with education and income.

The most compelling arguments in favor of a life-style interpretation for occupational differentials rely on the mortality experiences of wives (Daric 1951; Mare & Palloni 1988). If wives' mortality is strongly affected by their husbands' occupational status, then it seems reasonable to conclude that occupation is measuring life-style features shared by husbands and wives. In this case, occupation is simply a proxy for socioeconomic status. Whatever effect exposure has on mortality is assumed to be dominated by life-style factors. This view is echoed in other studies (e.g., Benjamin 1965; Fox & Adelstein 1978).

These findings notwithstanding, the growing body of research on cause-specific mortality within single occupations underscores the importance of attending to factors related to occupational risks (see issues of the *Journal of Occupational Medicine*). Occupations are not merely repositories of social and economic status. Kristofersen's (1986) report on mortality by occupation in Norway exemplifies this point, identifying substantial differences between occupations in violent deaths attributable to work-related accidents. Unfortunately, research on the hazards associated with specific occupations is often too narrow in focus to shed much light on the broader issues surrounding socioeconomic differences in mortality. Occupations may also have a feedback effect on life-style to the extent that health benefits and health promotion programs vary systematically by occupation (e.g., Alderman, Green, & Flynn 1980; Foreyt, Scott, & Gotto 1980; Schwartz 1980).

The difficulty in apportioning occupation-specific deaths to exposure versus life-style components stems, in part, from the way occupation is normally operationalized. Virtually all studies of occupational differences in mortality employ a single indicator of status. Mott and Haurin's (1985) analysis of socioeconomic differences in mortality, for example, although recognizing the importance of both exposure and life-style as antecedents of mortality, defines occupations only in terms of the Duncan socioeconomic indicator (SEI). To the extent that occupational risks operate along multiple dimensions, a single indicator of occupational status will misspecify these risks. Nevertheless, it is worth noting that they find a residual effect for SEI after controlling for education and income that disappears once health limitations and labor force status are taken into account (see also Mare & Palloni 1988). These results indicate that exposure to risks is a nontrivial component of occupational differences in mortality.

Career dynamics pose an additional problem for researchers trying to interpret occupational effects on mortality. With few exceptions (e.g., Mare in press), most studies rely on measures of occupation taken at a single point in time. This may be the usual occupation as reported on death certificates, or the latest occupation held at the time of a survey; either time point is incomplete by virtue of the fact that it is a point. When the effects of occupational exposure can be felt long after an individual has left the occupation, the timing of those effects should be explicitly modeled (Mare in press). Cross-sectional data are inadequate to analyze this type of problem.

Analytical Models

The current study directly builds on these past studies in a number of important ways. First, we explicitly identify the underlying mortality hazard function by using a longitudinal data set, thus capturing the mortality experiences of a cohort of older men as they age. This approach overcomes limitations of cross-sectional studies, which perforce rely on synthetic cohort methods. Second, we expand the traditional notion of work to include both current (or last) occupation and the longest occupation at the age of 55. By considering both latest and longest occupation, we are better able to distinguish the effects of the current (or most recent) work environment from older workers' prior work experiences. Finally, we define occupation in terms of the nature of work but include additional measures of socioeconomic status. This allows us to investigate the effects of exposure to specific features of the occupation that may be confounded with incumbents' life-styles, as measured by their education, income, marital status, and race.

Mortality events can be characterized as rates or transition intensities that govern individuals' experiences; in traditional demographic analyses these correspond to central death rates. The instantaneous rate (or risk) of mortality at time t is called the hazard function and can be defined as

$$h[t|X(t)] = \lim_{\Delta t \downarrow 0} \Pr_i[t, t + \Delta t|X(t)]/\Delta t, \quad (1)$$

where Pr_j is the probability of dying in the interval $(t, t + \Delta t)$, given that the person has survived to time t and conditional on a set of random variables, $X(t)$, whose values may change over time. In the present study, $X(t)$ is a set of covariates that measure life-style and exposure dimensions of occupations as well as the sociodemographic characteristics of older men. We define the risk of mortality to follow the well-known exponential increase with age (Gompertz 1825); that is, the log of the risk of mortality is specified to be a linear function of age. Thus

$$h[t|X(t)] = \exp[\beta X(t) + \alpha t] \tag{2}$$

and

$$\ln(h[t|X(t)]) = \beta X(t) + \alpha t, \tag{3}$$

where β is a vector of parameters corresponding to the covariates in $X(t)$, which includes a constant, and α indicates the effect of age.

We estimate a series of models that cumulatively enhance our understanding of the mortality process and begin by posing the question: How do men's sociodemographic characteristics at the start of the process influence subsequent mortality? In essence, this can be construed as taking a cross-section of the population at a common point in the life course (in this instance, at the age of 55) and assessing the long-term ramifications of differences in men's characteristics.

In the basic model for this question, the risk of mortality is a function of age, race, marital status, period, education, family income, labor force status, and longest occupation. Covariates are measured at the start of the process, which is assumed to be the age of 55. We use longest occupation rather than latest occupation at that age to obtain the cumulative effects of occupational exposure by this stage in the career. It also provides us with a baseline measure of the effect of occupation on mortality. A set of dummy variables for occupation facilitate comparisons with previous research that defines occupation in a similar fashion.

Although this first step yields a rich description of older men's mortality experiences, men often change statuses over their lives (e.g., marital status, occupation), moving to statuses that incur different risks. Under these conditions, to constrain covariates artificially to be fixed from the age of 55 onward could lead to serious misspecification of the proximate effects of the covariates on the mortality process. Thus we allow variables such as occupation and marital status to be time-dependent and specify a model in which the risk of mortality is a function of latest occupation, education, income, and a set of demographic characteristics.

As we have argued previously, individuals' prior work experiences also may play an important role in influencing mortality. This is based on the supposition that many men in high-risk occupations will move to new jobs that lack these attributes. This may occur because the person's health no longer permits adequate performance on the job, it may reflect a "health investment strategy" in which the individual is seeking to maximize his future health (Wolfe 1985), or it may be entirely incidental to considerations of health. Just as longest occupation alone is inadequate as a measure of the current occupation's effect on mortality, latest occupation fails to detect earlier occupational experiences. We thus expand the model with time-dependent covariates to include characteristics of the longest job at the age of 55 as a measure of prior exposure that is missing from the latest occupation of mobile persons. Further, we replace the occupational dummy variables with covariates that measure the nature of work in the occupation (e.g., substantive complexity, physical and environmental demands). This allows evaluation of the relative contributions that specific features of the work context make to the mortality process.[1]

Data and Variables

Data

The mortality models are estimated with data drawn from two major sources: the National Longitudinal Survey of Mature Males (NLS) and the fourth edition of the *Dictionary of Occupational Titles* (DOT; see Miller, Treiman, Cain, & Roos 1980). The NLS is primarily designed to provide longitudinal information on the labor market behavior of older men for the 17-year period 1966–1983, but the survey also identifies death as a separate nonresponse category. These two basic attributes make the NLS a uniquely powerful data set to examine the linkages between mortality, characteristics of older men's careers, and life-style. Others have also made use of these features of the NLS to study adult mortality (Mare in press; Mare & Palloni 1988; Mott & Haurin 1985) but did not consider alternative measures of occupation as a means to better specify the effects of occupation.

The longitudinal quality of the NLS is used to develop a survival history and histories of time-dependent covariates for all respondents who survive to the exact age of 55 (i.e., 55 ± .5). The histories allow us to denote age-specific statuses in that the value of a given variable for any respondent (e.g., labor force status) can be arrayed beginning, on average, at 55 years of age and ending at the time at which the respondent left observation. This permits the identification of the age interval in which respondents experienced mortality and covariate values at the beginning of the interval.[2]

The original NLS sample consisted of 5,020 men, aged 45–59 in 1966. We excluded 1,415 of the older respondents because complete histories from the age of 55 on could not be obtained; 499 additional cases were lost either to attrition (295) or death (204) before reaching 55. Finally, 26 respondents were excluded because they were members of the armed services according to their longest or latest occupation. Sample weights from 1966 (standardized to avoid overly inflating the sample size) were applied to the remaining 3,080 respondents to obtain a representative sample as of 1966. Our final sample includes survival and covariate histories for 3,092 (or 3,080 unweighted) men who were exactly 55 years old at some time between 1966 and 1976, 576 of whom are known subsequently to have died.[3]

The histories are used to construct an analysis file of "exposure intervals." Each record in the file represents a 1-year age interval during which the values of all covariates are assumed to remain constant. Deaths, attrition, and labor force transitions are all assumed to have occurred in the middle of an interval. In all, 28,507 exposure intervals were created.

Measures capturing the nature of work in the occupation were obtained from the DOT and matched to NLS respondents according to their occupational codes. The DOT is the major source of information regarding the nature of jobs in the United States, providing measures on 46 characteristics that can be classified into eight components: training time, aptitudes, interests, physical demands, working conditions, industry, nature of work performed, and class of worker. In a prior study (Hayward & Grady 1986) four key factors summarizing these characteristics (i.e., substantive complexity, physical and environmental demands, social skill, and manipulative skill) were developed that are analogous to those reported in earlier studies (Miller et al. 1980). Information from the DOT was assigned to respondents based on their longest occupation at the age of 55 and their latest occupation. When respondents changed occupations, new information was assigned based on their new occupational code. In this manner, occupational histories were developed that described changes in the character of the work environment.

Due to design considerations of the NLS, there is a potential problem of left-hand censoring. Hazardous working conditions, for example, may have the greatest impact on mortality at younger ages, a possibility we cannot observe. If true, only the hardiest men in these risky occupations will have survived long enough to have been included in our sample.

Selectivity of this type will tend to bias downward the effect of occupational risks. Further, no covariates (notably income) corresponding to longest occupation are available to control for the effects of other early status dimensions. It is not clear how this limitation might affect the results, but it seems probable that the lack of controls will increase the apparent effect of occupational rank. If an occupation's rank correlates positively (negatively) with other occupational characteristics, then the effect of those characteristics will be biased upward (downward). A sense of the degree of bias can be had by noting that 204, or 4%, of the original respondents were eliminated from analysis because they died before reaching the age of 55. Although this is a sizable portion of the NLS sample, it should be noted that the mortality losses of young workers will be substantially smaller than this figure suggests. Nevertheless, the deaths are likely to fall disproportionately into the more hazardous occupations and among lower socioeconomic status individuals.

Variables

Based on our conceptual framework contrasting exposure with life-style dimensions, we consider the effects of three major indicators of socioeconomic status: income, education, and occupation. Occupation is ordinarily used as the sole indicator of social status in mortality studies. Indeed, when information on education and income are available, researchers typically introduce them as controls for confounding factors, maintaining occupation as the single measure of socioeconomic status (Mott & Haurin 1985). In contrast, we interpret measures of race, marital status, family income, and educational attainment as additional indicators of life-style. Further, to specify better any residual effect of occupation once these others are taken into account, four distinct measures of occupational characteristics are introduced in place of the standard occupational titles or Duncan SEI.

Income is defined as total family income (both earned and unearned), allowing us to measure the "carrying capacity" of the person's household to provide for family members' health through the consumption of high-quality goods and services (Rosen & Taubman 1979; Wolfe 1983). Family income also represents the ability of family members to maintain the life-style of a particular social status. The number of good health habits, for example, increases with levels of income (Schoenborn 1986). Thus increases in family income should reduce mortality.

Education is defined in terms of completed years of schooling. Since general education occurs well before the age of 55, it also measures characteristics related to occupational attainment at earlier ages. Thus it serves as a control for unobservable selectivity into occupations, which may or may not be related to survival (Mare & Palloni 1988). In addition to determining access to various occupations, education also captures differences in tastes and preferences that influence health behaviors, such as smoking and exercise (Rosen & Taubman 1979; Schoenborn 1986), and awareness of health hazards (Fox, Brown, Koontz, & Kessel 1987). As in the case of family income, education should be negatively related to the mortality rate.

DOT variables are used to characterize the type and specialization of work tasks in the occupation. As noted above, we use multi-item scales developed in a prior study to improve reliability. These scales are interpreted as substantive complexity, physical and environmental demands, social skill, and manipulative skill. Inclusion of these factors enhances our ability to distinguish exposure from life-style effects, since the likelihood of their being confounded along four distinct work dimensions is smaller than with a single status measure such as SEI. Moreover, the four DOT factors do not actually measure social status. They are less likely, for this reason alone, to pick up the influence of unmeasured life-style effects.[4]

Substantive complexity reflects two key work features found to influence the risk of death from occupationally induced stress: routinization and autonomy (Schwartz 1980; Wolf

& Finestone 1986). Accordingly, increases in substantive complexity should lower mortality. Physical and environmental demands are defined in terms of specific physical requirements and hazards on the job; thus this factor reflects a work environment that is potentially detrimental to the health of the individual and should increase mortality. Social and manipulative skills represent distinct orientations to the nature of work and indirectly condition exposure to work-related hazards. Social skill refers to the ability to adapt to situations involving interaction with others on a routine basis. By contrast, manipulative skills emphasize working with objects such as tools and machinery. In a sense, these last two factors measure life-style differences or tastes, but these differences directly affect work role preferences. Exposure to health hazards is thus more likely in occupations with high manipulative skills than in those for which the demands are primarily people oriented.

We also consider the effects of the demographic factors race and marital status. Although race differences among mature men may be explained in terms of socioeconomic characteristics (Mott & Haurin 1985), race, like education, is a major determinant of occupational attainment. Its inclusion here controls for occupational selectivity effects in social background, which may be related to early occupational exposure to risks (Robinson 1987). Blacks are also expected to have higher mortality than nonblacks by virtue of well-known differences in life-style (Schoenborn 1986). Marital status measures aspects of life-style not captured in our other variables. For example, wives not only contribute to family income but also provide emotional support for their husbands and can assist them when they are ill (Verbrugge 1979). Unmarried people also smoke less and are more likely to quit smoking than married men (Dzegede, Hackworth, & Pike 1981). Married men should have lower mortality than unmarried men, regardless of whether the latter have ever been married (Kisker & Goldman 1988).

A period measure, survey year, is included to capture the declines in mortality rates among the older population during the observation period. Although not systematically examined, this decline is often attributed to changes in medical technology, access to Medicare, and cohort differences in physician utilization and wealth among the older population (Mott & Haurin 1985; Wolinsky, Mosely, & Coe 1986). Since respondents do not enter our analysis until they reach the age of 55, the survey year in which they enter will necessarily differ across individuals. The period measure controls for differences in mortality across birth cohorts and should be negatively related to the mortality rate.

Finally, we consider the consequences of two measures of health status on older men's mortality experiences: one indicating whether health limits the amount or kind of work and a trichotomous measure of labor force status contrasting disability status with retirement and being in the labor force. After the age of 65, disabled men are reclassified as retired, since Old Age Survivors, Disability and Hospital Insurance program distinctions between being disabled and being retired disappear and the two benefit programs essentially merge into one. Not surprisingly, previous research (Mott & Haurin 1985) established clear linkages between mortality and self-reported health status. In the present study, we provide additional insight into the role of these variables by considering whether socioeconomic characteristics, especially occupation, operate indirectly through health status. For example, occupations may influence mortality indirectly as a function of the substantial effects that they have on the timing of disability and retirement (Hayward, Hardy, & Grady 1989). Consequently, disabled men should experience higher mortality than men who are retired or in the labor force.

A table (available from the authors on request) of the percentage of deaths and exposure in each covariate category of the time-dependent and fixed covariates shows that based on the exposure distributions for occupation, latest occupation differs from longest occupation, evidencing a certain amount of mobility. Managerial as well as service and lower white-collar occupations all increase in numbers. Their growth is balanced by the exodus from

operative and farmer occupations. Add the distribution of deaths to these and an interesting pattern emerges when comparing longest to latest occupation. Farming occupations, whether owners or laborers, experience a marked improvement in survival, whereas clerical workers suffer a sharp increase in mortality.

Because these arrays only reflect shifts in the marginal distribution of workers, they understate the amount of mobility actually present. The cross-classification of person-years of exposure of longest occupation by current or last occupation is presented in Table 1. As in all mobility tables, the main diagonal and its adjacent cells dominate.[5] Nevertheless, the results shown here denote that older men moved a considerable amount during their later years. For example, the retention rates of longest occupation in panel A range from a high of about 65% for professionals and crafts to a low of 39% among laborers and service workers. Retention rates among the remaining occupations are approximately 50%. The inflow percentages in panel B indicate that managerial, clerical, and sales occupations are the prime white-collar recipients of movers and service occupations are the major blue-collar destinations.

Statistical Approach

We describe older men's mortality experiences by using life table techniques. The analysis is conducted in two steps. First, multivariate hazard models with fixed covariates are estimated to determine the net impact of longest occupation and other sociodemographic factors at the age of 55 on the risk of death. This allows us to ascertain the impact of characteristics, measured at the same point in the life course for all persons, on the mortality experiences of the cohort. Second, we use the parameter estimates from the multivariate models to construct occupation-specific life tables to facilitate comparisons of subgroup differences in mortality.

One limitation of our approach is that in constructing the life tables, covariates must be defined as categorical rather than continuous (Rodriguez, Hobcraft, McDonald, Menken, & Trussell 1984). For most of the covariates this was unproblematic. Age and year, for example, are coded into dummy variables representing single age and year categories. Years of education and income, however, were collapsed into somewhat arbitrary groups. Income was divided into quartiles, since we had no a priori rationale for imposing specific cutoffs and assumed that four categories were adequate to capture the influence of income without spreading the data too thin. Education was categorized on the basis of average years completed per degree—that is, less than high school (<12 years), high school and some college (12–15 years), and college degree (16 or more years). It was felt that differences between the college educated and those with a high school diploma (with perhaps a few years of college) warranted finer gradations than simply separating those who did not finish high school from those who did. Procedures used in calculating these life tables follow the techniques presented in Rodriguez et al. (1984) and are briefly described in an appendix (available from the authors).

The hazard equations are then reestimated to allow for time-dependent covariates. For this analysis, income and education are treated as continuous variables, as are age and survey year. The purpose at this stage is to evaluate the consequences of men's *latest* occupational status for mortality. We reintroduce information on the respondent's longest occupation at the age of 55 to identify more fully the implications of occupational careers for mortality. Finally, additional information on occupational effects is brought to bear by substituting occupational characteristics for titles.

Because the analysis is based on a file of exposure intervals, we estimate discrete-time hazard models. Under the assumption that the data are generated by a continuous-time proportional hazard model, the actual differences in our models and those generated within a continuous-time framework are likely to be small. In addition, the discrete-time approach makes it easy to incorporate time-dependent covariates whose values follow step functions

Table 1. Occupational Mobility of Longest Occupation by Latest Occupation

Latest	Longest 1	2	3	4	5	6	7	8	9	10
A. Movement From Longest to Latest Occupation[a]										
1. Professional	.645	.088	.067	.070	.020	.015	.018	.057	.000	.020
2. Manager	.160	.522	.142	.279	.107	.064	.042	.075	.013	.074
3. Clerical	.053	.041	.485	.022	.024	.035	.041	.072	.013	.031
4. Sales	.029	.127	.036	.494	.015	.014	.003	.006	.000	.030
5. Crafts	.055	.103	.109	.050	.654	.180	.134	.091	.154	.089
6. Operatives	.024	.058	.077	.040	.095	.515	.228	.099	.127	.135
7. Laborers	.002	.014	.028	.009	.030	.086	.390	.084	.074	.058
8. Service	.011	.032	.049	.030	.033	.070	.120	.489	.070	.045
9. Farm Laborer	.001	.002	.000	.000	.006	.008	.007	.002	.518	.046
10. Farmer	.019	.013	.008	.005	.016	.012	.015	.024	.031	.471
B. Movement Into Latest From Longest Occupation[b]										
1. Professional	.676	.112	.035	.034	.051	.033	.010	.028	.000	.022
2. Manager	.105	.418	.046	.083	.172	.086	.014	.023	.002	.051
3. Clerical	.094	.088	.417	.018	.102	.125	.037	.059	.004	.057
4. Sales	.055	.294	.034	.426	.069	.054	.003	.005	.000	.060
5. Crafts	.022	.051	.022	.009	.650	.151	.028	.017	.012	.038
6. Operatives	.014	.040	.021	.010	.131	.598	.066	.026	.014	.080
7. Laborers	.003	.029	.022	.007	.120	.294	.335	.065	.023	.101
8. Service	.017	.059	.036	.021	.122	.218	.094	.343	.020	.071
9. Farm Laborer	.004	.013	.000	.000	.084	.089	.020	.006	.524	.260
10. Farmer	.031	.026	.006	.003	.062	.040	.013	.018	.010	.791

[a]Columns sum across rows to equal 1.000.
[b]Rows sum down columns to equal 1.000.

over time. The hazard models are estimated using a log-linear approach. This prevents the hazard rate from being less than zero and allows us to estimate a linear model of the dependency of the rate on a set of covariates. We assume that the hazard rate within each age interval is constant and introduce age as a covariate to obtain the age-dependency of the mortality rate. In those models in which age is categorical, the baseline hazard function is piece-wise exponential in form. When age is specified as continuous (and its effect linear), we approximate a Gompertz function.

Results

Population Subgroup Differences in Mortality

Population subgroup differences in men's mortality experiences are assessed by sequentially introducing measures for (1) period, race, and marital status, (2) education, occupation, and income, and (3) labor force status. With the exception of period, covariates are fixed at the age of 55. This decomposition, shown in Table 2, summarizes the long-term mortal implications of status from a cross-section of the population at a common point in the life course. Although the time-dependent effect of these variables on mortality may differ, the "fixed" covariates model accurately reflects the cohort's experiences conditional on their characteristics at age 55.[6]

Each additional variable improves the fit of the model significantly ($p < .05$) but also reduces the effect of some previously entered variables. For example, although race and education exercise independent influences on mortality, both effects diminish substantially after the introduction of longest occupation and income. In this instance, the lower life-chances of older blacks or poorly educated men can be attributed to their limited access to high-income occupations.

Those occupational effects observed in model 5 are, in turn, partly accounted for by differences in income, and the effects of income are explained by differences in labor force status. Not all occupational differences, however, are accounted for by the addition of education and income; for example, mortality rates for professionals and service workers still differ significantly from one another in model 7. The pattern of occupational differences in mortality net of other status characteristics suggests that the better prospects of high-status occupations are only partially explained by higher earnings and educational attainment.

With regard to the remaining covariates, the effect of marital status is significant in all of the models, although it appears that some of the influence of marriage operates through family income and labor force status, perhaps by enabling married men to work longer and enjoy higher standards of living than single men. Similarly, period differences, which exhibit the known decline in mortality rates over the period of 1966–1983, are not all attributable to the included variables. Age also operates independently of socioeconomic status. Thus secular improvements in longevity notwithstanding, the mortality of older men still appears to depend strongly on aging.

The parameter estimates from the hazard models imply substantial differences in life expectancy across occupations. To illustrate these differences, Figure 1 presents life expectancy estimates at the age of 55 and Figure 2 graphs survival rates of selected occupations. The estimates are standardized for the other covariates in the model, facilitating comparisons between occupations free from the influence of other personal characteristics. Life expectancy at 55 ranges from a low of 18.3 years for service workers to a high of 22.7 years for professionals, a difference of about 4.5 years. The survival plots in Figure 2 show clearly the implications of occupational differences in mortality as men age. The curve for professionals is much flatter than that for service workers and farm laborers. Factors associated with status such as responsibility or authority and routinization may be operating to discriminate between occupations in addition to income or education, an issue we consider below with occupational measures of work content.

Career Patterns in Older Men's Mortality

To evaluate the proximate effects of latest occupation, as well as other sociodemographic factors, the models are reestimated with time-dependent covariates. This approach portrays more accurately the proximate effects of socioeconomic status by ensuring that exposure and death are assigned to current rather than prior status. In addition, we analyze occupational differences both in terms of categories and DOT characteristics associated with the respondent's three-digit occupation.[7] The categorical variables are useful in that they denote mortality differences across major occupational groups and facilitate comparisons with previous studies. The DOT characteristics provide unique insights into how the nature of work accounts for categorical differences in mortality. In combination, the two sets of models provide more information on occupational effects than either could alone.

Table 3 shows the results when latest occupation is analyzed without controls for longest occupation. As in the case of the fixed covariates, the effect of race is explained by occupation and education, the effect of education is explained by occupation and income, but occupational differences cannot be explained fully by any status measures. Thus rather substantial occupational differences in mortality remain even after controlling for socioeconomic status. Moreover, the pattern of the estimates indicates that those occupations with the highest mortality (clerical, operatives, services, and laborers) are also the lowest in status, with two major exceptions. Farmers and farm laborers now have the lowest rates of mortality.

The DOT factors listed in Table 4 identify how characteristics describing the nature of work may account for this pattern. In model 2, the effects of occupation are derived largely from occupational differences in substantive complexity; occupations low in substantive complexity have higher mortality rates—a finding consistent with Mott and Haurin's arguments. Once other status characteristics are introduced (particularly income), however, the effect of occupation reduces to the physical and environmental demands imposed on workers by their occupation. Somewhat surprisingly, the parameter estimate indicates that the mortality rate *decreases* as physical and environmental demands *increase*. This result, however, is consistent with the previously observed categorical differences, in which farmers and farm laborers exhibited very low mortality rates and clerical workers were among the highest risk occupations.

The demands of an older worker's latest occupation may reflect more the physical requirements of effective workers than the level of risk to which workers are exposed. In other words, men who are unable to cope with the physical and environmental demands of their job may subsequently choose less demanding employment or exit the labor force. Disability, as an alternative to switching occupations, is not available to all workers. Because the income from disablity often will be less than that obtained through continued employment, workers unable to accept a reduction in their established living standards will choose to remain in the work force in some capacity. The likely occupational choices of these men are probably limited to undemanding occupations related to their previous line of work (operatives and laborers) or unrelated low skill occupations (such as some clerical or service occupations). The high disability rates of clerical and service occupations relative to others (Hayward et al. 1989) support our contention that less healthy workers probably seek undemanding work before accepting disability.

Alternatively, it may well be the case that those in the poorest health experience death prior to the age of 55—the point at which we begin the process. Good health may be a prerequisite for older incumbents of physically demanding jobs, resulting in the low mortality rates of these occupations. Unfortunately, this form of frailty cannot be addressed with these data. We observe that characteristics of the occupation influence mortality in a manner consistent with a frailty type of process.

From our perspective it is especially important to consider occupational status and work content over the career when assessing the total impact of occupation on mortality. The

Table 2. Sociodemographic Differences in Mortality Among a Cohort of Older Men: Covariates Fixed at Age 55

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
Variable	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE
Constant	−3.307	.447	−2.912	.459	−2.135	.531	−2.445	.561	−2.975	.590	−2.863	.591	−2.876	.591
Age														
55	−.996	.475	−.975	.475	−1.604	.528	−1.589	.529	−1.562	.529	−1.482	.530	−1.629	.531
56	−.610	.467	−.589	.467	−1.009	.511	−.995	.512	−.968	.512	−.896	.513	−1.046	.514
57	−1.034	.478	−1.013	.478	−1.383	.519	−1.369	.519	−1.346	.519	−1.280	.520	−1.422	.521
58	−.665	.469	−.645	.470	−.926	.507	−.917	.507	−.896	.508	−.836	.508	−.970	.509
59	−.602	.469	−.582	.469	−.849	.504	−.845	.504	−.826	.505	−.771	.505	−.900	.506
60	−.351	.465	−.330	.465	−.597	.498	−.595	.498	−.578	.498	−.530	.498	−.650	.499
61	−.455	.469	−.433	.469	−.670	.497	−.668	.497	−.653	.498	−.608	.498	−.724	.498
62	−.601	.476	−.580	.477	−.790	.503	−.792	.504	−.780	.504	−.737	.504	−.845	.504
63	−.430	.476	−.408	.476	−.571	.501	−.576	.501	−.566	.501	−.527	.501	−.619	.501
64	−.308	.478	−.288	.478	−.443	.503	−.451	.503	−.445	.504	−.410	.504	−.490	.504
65	.110	.472	.170	.472	−.004	.495	−.018	.495	−.015	.495	.012	.495	−.061	.496
66	−.066	.483	−.049	.483	−.187	.506	−.204	.506	−.201	.506	−.181	.506	−.207	.506
67	−.047	.492	−.032	.491	−.190	.511	−.210	.511	−.203	.511	−.189	.511	−.214	.511
68	−.109	.512	−.088	.512	−.192	.527	−.217	.527	−.211	.527	−.207	.527	−.231	.527
69	−.398	.586	−.388	.586	−.463	.597	−.484	.597	−.476	.597	−.483	.597	−.494	.597
70	ref	—	ref	—	ref	—	ref	—	ref	—	ref	—	ref	—
Race														
Black			ref	—	ref	—	ref	—	ref	—	ref	—	ref	—
Nonblack			−.462	.127	−.419	.127	−.371	.128	−.282	.133	−.207	.135	−.243	.135
Marital status														
Single					ref	—	ref	—	ref	—	ref	—	ref	—
Married					−.406	.115	−.397	.115	−.385	.116	−.306	.118	−.230	.120
Year														
1966					1.044	.416	1.049	.416	1.035	.417	1.003	.417	1.056	.417
1967					.133	.373	.125	.373	.118	.373	.084	.374	.123	.374
1968					.542	.284	.526	.284	.518	.284	.490	.284	.514	.285
1969					−.082	.299	−.092	.300	−.102	.300	−.121	.300	−.098	.300
1970					−.407	.302	−.412	.302	−.417	.302	−.430	.302	−.392	.302
1971					−.136	.253	−.138	.253	−.143	.253	−.149	.253	−.139	.253

1972			ref	—	ref	—	ref	—	ref	—	ref	—
1973			.009	.224	.014	.224	.017	.224	.024	.224	.022	.224
1974			−.161	.225	−.154	.225	−.149	.225	−.138	.225	−.147	.225
1975			−.170	.221	−.160	.221	−.155	.221	−.139	.222	−.157	.222
1976			−.375	.229	−.362	.229	−.351	.229	−.334	.230	−.363	.230
1977			−.482	.234	−.468	.234	−.455	.235	−.433	.235	−.469	.235
1978			−.149	.222	−.132	.222	−.118	.222	−.093	.222	−.141	.223
1979			−.278	.229	−.257	.229	−.237	.229	−.205	.229	−.251	.229
1980			−.303	.236	−.279	.236	−.260	.237	−.222	.237	−.274	.237
1981			−.461	.252	−.435	.252	−.413	.253	−.366	.253	−.431	.254
Education (years)												
Less than 12					.301	.180	.166	.187	.087	.190	.076	.191
12–15					ref	—	ref	—	ref	—	ref	—
16 or more					−.152	.245	.056	.255	.043	.255	.014	.255
Longest occupation												
Professionals							ref	—	ref	—	ref	—
Managers							.378	.226	.357	.226	.328	.227
Clerical							.405	.279	.415	.280	.377	.280
Sales							.455	.281	.449	.282	.472	.282
Crafts							.508	.219	.484	.220	.466	.220
Operatives							.658	.220	.615	.222	.568	.222
Laborers							.646	.265	.556	.267	.556	.267
Farmers							.486	.242	.377	.246	.338	.245
Service							.935	.251	.890	.253	.838	.253
Farm laborers							.812	.319	.650	.324	.647	.323
Family income (quartile)												
First									ref	—	ref	—
Second									−.194	.114	−.082	.116
Third									−.338	.124	−.226	.127
Fourth									−.347	.137	−.223	.139
Labor force status												
In the labor force											ref	—
Disabled											.974	.163
Retired											.360	.196
X^2	6,296.54	6,284.74	6,248.98		6,239.29		6,220.97		6,211.46		6,180.73	

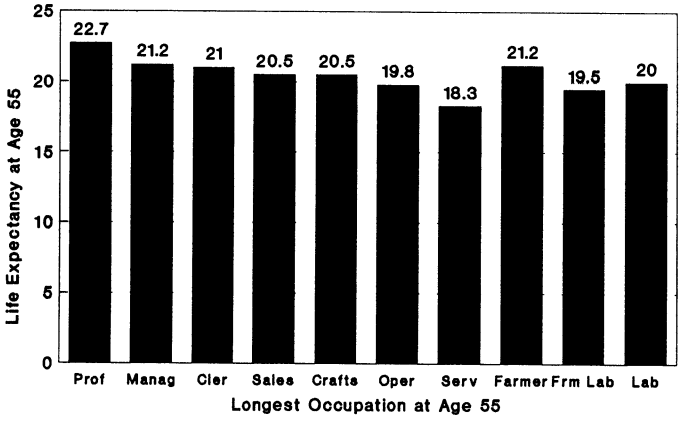

Figure 1. Male Life Expectancy by Longest Occupation at the Age of 55

results shown in Table 2, concerning longest occupation, suggest that there indeed may be an important exposure component involved in occupational mortality differences not necessarily related to life-style. The significant *negative* effect on mortality of the physical and environmental demands of latest occupation further reinforces this impression. Nevertheless, changes in occupation over the career may obscure the true effect of either the latest or longest occupation on mortality, a possibility we incorporate in the models with measures of both. The contrast between longest and latest occupations provides an indirect means to examine our supposition that, when possible, older workers pursue work options perceived to enhance their survival.

Table 5 presents the independent effects of both longest and latest occupation, where occupation is defined categorically and the effects are net of the remaining sociodemographic factors. The pattern depicted by these estimates clearly indicates that longest and latest occupations have strikingly different effects on mortality. For example, in terms of longest occupation, professionals decidedly have the lowest risk of death but only an average rate in terms of latest occupation. Still more dramatic differences separate the rates for farmers, farm laborers, and clerical workers. In terms of longest occupation, clericals have the second

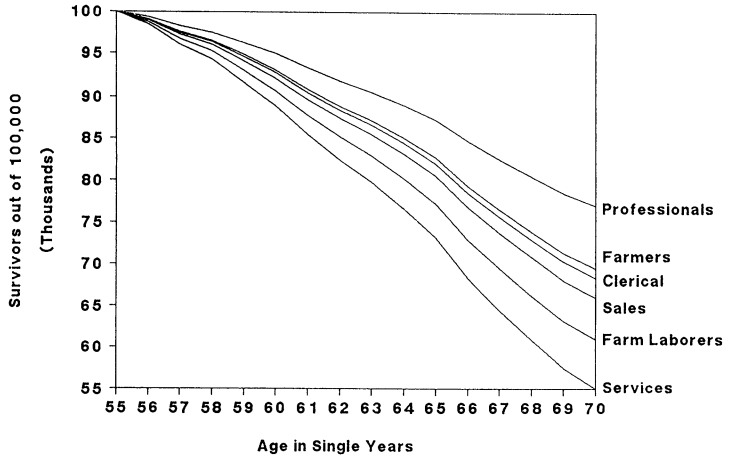

Figure 2. Survivorship of Selected Longest Occupations at the Age of 55

Table 3. Sociodemographic Differences in Mortality Among a Cohort of Older Men: Time-Dependent Hazard-Model Estimates With Current or Last Occupation Categories

	Model 1		Model 2		Model 3		Model 4	
Variable	B	SE	B	SE	B	SE	B	SE
Constant	−6.162	.823	−6.695	.854	−5.914	.863	−5.278	.969
Age	.087	.016	.085	.016	.073	.016	.076	.017
Race[a]	−.249	.136	−.164	.137	−.119	.139	−.179	.137
Marital status[b]	.481	.105	.466	.106	.371	.107	.276	.107
Year	−.032	.016	−.031	.016	−.027	.016	−.041	.016
Education (years)	−.035	.012	−.025	.014	−.008	.014	.011	.014
Current or last occupation								
Professionals			ref	—	ref	—	ref	—
Managers			.210	.212	.188	.212	.125	.213
Clerical			.591	.236	.510	.236	.441	.237
Sales			.266	.263	.232	.263	.186	.263
Crafts			.225	.206	.121	.206	.118	.209
Operatives			.488	.210	.379	.210	.330	.211
Laborers			.539	.243	.382	.245	.270	.245
Farmers			.042	.267	−.144	.269	−.219	.270
Service			.665	.229	.524	.230	.475	.230
Farm Laborers			.004	.381	−.168	.381	−.201	.381
Family income					−1.6E-5	3.1E-6	−7.4E-6	3.1E-6
Labor force status								
In the labor force							ref	—
Disabled							1.280	.124
Retired							.142	.117
Health status[c]							−.585	.094
X^2	6,334.68		6,312.19		6,285.16		6,108.28	

[a] 1 = nonblack; 0 = black.
[b] 1 = married; 0 = single.
[c] Does health limit amount or type of work? 1 = yes; 2 = no.

lowest mortality rate but suffer the *highest* rate with regard to latest occupations. Similarly, farmers and farm laborers have high rates of death for longest occupation but the lowest rates of mortality for latest occupation.

The dramatic differences in mortality between longest and latest occupations are also present in the effects of the DOT factors shown in Table 6. Comparing these results with those shown previously in Table 4 demonstrates the importance of separating the estimates for latest occupation from prior occupational history. For example, we observed previously that when longest occupation is omitted from the model, the substantive complexity of a man's latest occupation had a significant impact on mortality (model 2, Table 4). However, the estimates shown in model 1 of Table 6 reveal this to be, in part, a reflection of prior occupational status. Net of longest occupation, the substantive complexity of the latest occupation has no significant impact on mortality. In fact, the direct effect of latest occupation is felt only through physical working conditions and social skill requirements, both of which are associated with lower mortality. The effect of physical demands in the latest occupation appears to account for the relatively low rates of mortality observed among farmers and farm laborers. Similarly, the influence of social skill requirements likely reflects the low mortality rates found among sales workers and managers.

In contrast, longest occupation influences mortality primarily via substantive com-

Table 4. Sociodemographic Differences in Mortality Among a Cohort of Older Men: Time-Dependent Hazard-Model Estimates With Current or Last Occupation's DOT Characteristics

Variable	Model 1		Model 2		Model 3		Model 4	
	B	SE	B	SE	B	SE	B	SE
Constant	−6.162	.823	−6.320	.830	−5.594	.836	−4.766	.990
Age	.087	.016	.086	.016	.073	.016	.076	.017
Race[a]	−.249	.136	−.205	.136	−.167	.137	−.231	.136
Marital status[b]	.481	.105	.474	.105	.379	.106	.287	.107
Year	−.032	.016	−.032	.016	−.028	.016	−.041	.016
Education (years)	−.035	.012	−.029	.014	−.012	.014	.007	.014
Current or last occupation								
Physical demands			−.077	.052	−.117	.052	−.127	.052
Substantive complexity			−.137	.060	−.010	.060	−.071	.059
Social skills			−.081	.062	−.071	.062	−.077	.061
Manipulative skills			−.003	.056	−.001	.056	.039	.056
Family income					−1.6E-5	3.1E-6	−8.1E-6	3.1E-6
Labor force status								
In the labor force							ref	—
Disabled							1.284	.123
Retired							.153	.116
Health status[c]							−.589	.094
X^2	6,334.68		6,322.38		6,293.72		6,115.42	

[a] 1 = nonblack; 0 = black.
[b] 1 = married; 0 = single.
[c] Does health limit amount or type of work? 1 = yes; 2 = no.

plexity. The parameter estimates indicate that men whose longest occupation ranks low in substantive complexity experience higher rates of mortality. Thus when comparing this effect with those noted previously for latest occupation, we observe that the consequences of occupational features for mortality vary substantially over the career cycle. Unfortunately, it is impossible to gauge the contribution that previous social status characteristics have had on what appear to be strong career effects. It may be that much of what we here attribute to occupation, for example, may be due to differences in income. Although this possibility cannot be dismissed, it is unlikely that income entirely explains the pattern of results observed for occupation. The fact that latest occupation continued to exert an influence on mortality after controlling for income suggests that longest occupation would also have an independent effect. Thus what we present as the effect of longest occupation is probably only partially an effect of the social status coincident with longest occupation.

One additional finding in regard to the other covariates is worth noting. Specifically, there is no effect of retirement per se on mortality. High mortality risks among those not in the labor force are concentrated among the disabled—a small fraction of the total population.

Discussion

Researchers often analyze socioeconomic differences in mortality in terms of occupational differences. In this article we have sought to enhance our understanding of the basis for occupational mortality differences in two ways. First, we explicitly acknowledged that these differences could arise from differences in both exposure and life-style. Consequently, occupational characteristics were analyzed in conjunction with other independent measures of socioeconomic status. We found that occupational differences could not be fully explained

Table 5. Sociodemographic Differences in Mortality Among a Cohort of Older Men: Longest Versus Latest Occupational Categories (X^2 = 6,096.92)

Variable	B	SE
Constant	−5.591	.980
Age	.078	.017
Race[a]	−.186	.139
Marital status[b]	.286	.108
Year	−.042	.017
Longest occupation		
Professionals	ref	—
Managers	.368	.243
Clerical	.223	.297
Sales	.657	.311
Crafts	.549	.240
Operatives	.555	.242
Laborers	.523	.287
Farmers	.502	.276
Service	.689	.274
Farm laborers	.897	.359
Latest occupation		
Professionals	ref	—
Managers	−.091	.237
Clerical	.293	.265
Sales	−.117	.299
Crafts	−.181	.241
Operatives	.038	.242
Laborers	−.024	.273
Farmers	−.480	.315
Service	.128	.263
Farm laborers	−.658	.428
Family income	−6.9E-6	3.1E-6
Labor force status		
In the labor force	ref	—
Disabled	1.293	.124
Retired	.155	.117
Health status[c]	−.583	.094

[a] 1 = nonblack; 0 = black.
[b] 2 = married; 0 = single.
[c] Does health limit amount or type or work? 1 = yes; 0 = no.

in terms of other traditional measures of status. Second, we portrayed mortality as an outcome of the labor force career, allowing labor force status and occupational incumbency over the career cycle to alter men's life chances. Independent effects of men's longest and latest occupations were estimated and compared. We discovered that mortality responded readily to these aspects of older men's careers.

It is worth noting that our results in no way contradict the findings of past researchers. Indeed, they go some distance in furthering our understanding of those earlier findings. As we noted at the outset, others have also analyzed the NLS data and obtained largely the same results. We take this as a strong indication of the validity of both approaches, even though we have been able to incorporate additional pieces of information. Nevertheless, there is one significant difference between this study and those that have preceded it. Although most previous research has made use of either longest (often reported as the person's usual)

Table 6. Sociodemographic Differences in Mortality Among a Cohort of Older Men: The Effects of Longest and Latest Occupational DOT Characteristics

Variable	Model 1		Model 2	
	B	SE	B	SE
Constant	−6.371	.832	−5.011	.946
Age	.087	.016	.078	.017
Race[a]	−.214	.138	−.230	.137
Marital status[b]	.475	.105	.287	.107
Year	−.033	.016	−.043	.016
Education (years)	−.024	.015	−.012	.015
Longest occupation				
Physical demands	.106	.058	.086	.058
Substantive complexity	−.112	.070	−.135	.068
Social skills	.119	.068	.100	.067
Manipulative skills	.075	.064	.074	.063
Current or last occupation				
Physical demands	−.128	.060	−.165	.060
Substantive complexity	−.083	.069	−.070	.068
Social skills	−.141	.071	−.133	.071
Manipulative skills	−.038	.065	.001	.064
Family income			−7.5E-6	3.1E-6
Labor force status				
In the labor force			ref	—
Disabled			1.300	.124
Retired			.148	.116
Health status[c]			−.587	.094

Note: For Model 1, X^2 = 6,315.50; for Model 2, X^2 = 6,108.68.
[a] 1 = nonblack; 0 = black.
[b] 1 = married; 0 = single.
[c] Does health limit the amount or type of work? 1 = yes; 0 = no.

occupation or latest occupation, none has examined both simultaneously. We have analyzed them in isolation and as separate points along a single career line. As a consequence, we have shown that the effect of occupation qua occupation is perhaps stronger than earlier believed. The position that occupation is simply a proxy for social status needs to be reexamined in light of these findings.

The exposure of men to physically taxing or environmentally unsafe working conditions earlier in the career does shorten their lives, but models 1 and 2 in Table 6 indicate that the low income of workers who faced these conditions may be a better explanation of their mortality experiences. This interpretation may be somewhat misleading, however, because it ignores the possibility that men may change occupations just as their accumulated exposure begins to weigh on their health. In fact, if demanding occupations require healthy individuals, then the mortality of those occupations can appear to be lower than other undemanding occupations. This is, in fact, precisely what we have observed in our data. In other words, the mortality associated with these men's *latest* occupation decreases as their physical and environmental demands increase. This may be a product of several factors: men in the poorest health may have already died (i.e., frailty); men in poor health are unlikely to select themselves into these jobs; and finally, incumbents in poor health may transfer to less demanding jobs. In this latter case, the impact of exposure is not felt immediately by the occupations responsible for placing workers at risk but rather by those occupations that serve as destinations for mobile workers.

This can be illustrated readily by simulating men's mortality experiences according to combinations of longest and latest occupations. Table 7 presents the risks associated with these combinations based on the parameter estimates for the linear additive model in Table 5 (see Mare in press, for a similar example). The risks shown are simply those associated with longest and latest occupation, net of the other covariates in the model. Perhaps most striking, the drop in the risk of death in farm laborer occupations from longest to latest reflects the movement of the frailest incumbents into other occupations. That is, the risk of death for those who leave the farm laborer occupation compared with those who remain appears to be generally higher. In addition, the high rate of death among clericals in terms of latest occupation is shown to be a product of the influx of less healthy men from other occupations. Almost without exception, those men entering clerical jobs have higher rates of death than incumbents. Finally, the results show that lifelong incumbents of service occupations have generally higher rates than either those who exit or those who enter service jobs, thus accounting for the relatively high rate of death for service positions in terms of both latest and longest occupation.

To be sure, men change occupations for reasons other than health. The promise of greater prestige and earnings may be stronger inducements to change than considerations of survival. On the other hand, controlling for income and health status increases the negative effect of the latest occupation's physical demands on mortality. Regardless of the reasons behind these men's occupational shifts and their effects on mortality, our results suggest that research on occupational mortality can benefit by analyzing occupations within the broader context of the career. The fact that careers develop in response to a number of concerns, many of which are linked to health, argues in favor of a dynamic approach to the study of occupational mortality.

An important implication of this analysis for other studies is that occupational differentials in mortality are likely to be obscured whenever the effects of prior history are confounded with current experiences. Ignoring prior occupational exposure will result in understatements of the effect of hazardous working conditions, insofar as these effects develop insidiously over time. Indeed, this may account for the common observation that occupation effects on mortality rarely survive once other status characteristics have been controlled. In other words, effects peculiar to risks encountered on the job may be low among new entrants, resulting in stronger apparent effects for social status characteristics than for current occupational characteristics. Our control for longest occupation has enabled us to separate some of the effects of low exposure from low risk. The importance of this separation is apparent in the effects of physical demands on mortality between longest and latest occupation.

It bears repeating at this point that our results are based on the experiences of men as they near the close of their working lives. Had we also been able to include work histories of younger men, the differences between longest and latest occupation might well have been stronger still. To the extent that frail workers are more likely to die at earlier ages when exposed to hazardous working conditions, the effect of the longest occupation's physical demands will be understated.

Substantive complexity, a characteristic that tends to separate routine and repetitive tasks from those that offer outlets for creative and abstract work, is relevant only to mortality differentials in the longest occupation. Social skill requirements, on the other hand, characterize variations in mortality associated only with the latest occupation and represent the importance of job-related interpersonal contacts. These two dimensions each capture an aspect of occupations related to mortality at different points in the career. They may reflect different types of stress encountered at work, the consequences of which depend on one's position in the career cycle and its connection to other life-course events. The deaths of relations and friends, for instance, may increase the importance of satisfactory associations at work or aggravate stresses further. They may also be related to aspects of life-style that are not picked up by differences in education and income.

Table 7. Simulation of Effects of Occupational Mobility on the Risk of Mortality

Latest occupation	Longest occupation									
	1	2	3	4	5	6	7	8	9	10
1. Professional	.0037	.0054	.0047	.0072	.0065	.0065	.0063	.0074	.0092	.0062
2. Manager	.0034	.0049	.0043	.0066	.0059	.0059	.0057	.0068	.0084	.0056
3. Clerical	.0050	.0072	.0063	.0096	.0087	.0087	.0084	.0100	.0123	.0083
4. Sales	.0033	.0048	.0041	.0064	.0057	.0058	.0056	.0066	.0081	.0055
5. Crafts	.0031	.0045	.0039	.0060	.0054	.0054	.0053	.0062	.0076	.0051
6. Operatives	.0039	.0056	.0048	.0075	.0067	.0068	.0065	.0077	.0095	.0064
7. Laborers	.0036	.0053	.0046	.0070	.0063	.0063	.0061	.0073	.0089	.0060
8. Service	.0042	.0061	.0053	.0082	.0074	.0074	.0072	.0085	.0104	.0070
9. Farm laborer	.0019	.0028	.0024	.0037	.0033	.0034	.0033	.0038	.0047	.0032
10. Farmer	.0023	.0033	.0029	.0045	.0040	.0040	.0039	.0046	.0057	.0038

Note: $h = \exp[\beta_0 + \beta_1 \text{ (longest occupation)} + \beta_2 \text{ (latest occupation)}]$, net of age, race, marital status, year, family income, labor force status, and health status.

Overall, our efforts to incorporate features of men's careers in an analysis of mortality differentials have provided new information regarding the role of occupations. We can no longer dismiss broad occupational differences in mortality as artifacts of social status. To be sure, education and income do account for a portion of these differences, as other investigators have discovered. However, sizable mortality differences between occupations emerge that cannot be reduced to education, income, or health effects once prior experiences are separated from current experiences. Although we have just begun to examine the ramifications of the occupational career, it seems certain that workers do not fully escape the consequences of past occupational exposure. Further, it is likely that occupational mortality differentials respond to major changes in other areas of life not normally associated with the career. Whether or not exposure operates through a frailty mechanism or is mediated by these other processes is beyond the scope of this analysis. Nevertheless, our results have clearly established the place for this issue on a mortality research agenda.

Notes

[1] Mare's (in press) analysis of mortality was also concerned with the consequences of socioeconomic careers. He indexed career using first occupation after schooling and occupation at maturity. Occupations were defined categorically. The present study expands on Mare's work in a number of important ways. First, we introduce (albeit crudely) the notion of duration in a job by including longest occupation. Second, we directly assess the effects of the most proximate occupation prior to death. Third, we assess how occupational features of both longest and latest occupations "explain" categorical differences in mortality. Finally, we introduce a more exhaustive set of personal characteristics as covariates. Despite these refinements, however, our results parallel those of Mare, demonstrating the importance of careers in examining socioeconomic differences in mortality.

[2] Between 1966 and 1971, interviews were conducted approximately one year apart, allowing us to identify accurately the age interval in which mortality events and changes in covariate status occur. Subsequent to this period, however, interviews were sometimes conducted two years apart. Specific instances of this are 1971–1973, 1973–1975, 1976–1978, 1978–1980, and 1981–1983. In this situation, mortality transitions are randomly allocated to one of the two age intervals. Although this tends to increase the estimated standard errors (Tuma & Hannan 1984, pp. 145–151), random assignment of dates does not bias coefficient estimates unless deaths occur significantly more frequently in one interval than another. There is no reason to believe this is the case in the NLS data. Previous researchers, using quite different techniques, showed that the NLS data agree well with national mortality rates (Mare & Palloni 1988; Mott & Haurin 1985). Covariate histories are defined as step functions in which covariate values are determined at the time of observation. Thus in the case of a 2-year observation interval, the covariate value at the beginning of the interval is assigned to each of the age intervals.

[3] Prior to weighting, missing data for variables included in the analysis were imputed using a "hot deck" procedure. This involved creating a matrix cross-classifying broad categories of education, age, race, labor force status, and survey year. Variable means were calculated for each group of persons defined by this cross-classification and stored as an array in the corresponding cells of the matrix. Each case was then read, and for each survey year, its cell in the imputation matrix was determined. A case's valid values replaced those previously stored and missing values were replaced by those held in the matrix. This procedure has the desirable property of maintaining the means and variances within each cell of the matrix for all variables. Matrix dimensions were chosen to reflect major sample characteristics for which there were no missing data. The cutpoints for each dimension were calculated to ensure that a sufficient number of cases would match the characteristics of each cell, causing values held in the matrix to be frequently replaced.

[4] To be sure, there will still be some life-style influences contained in our measures of occupational characteristics. Likewise, income includes some of the effect of education not captured by years of schooling. As it is virtually impossible to obtain perfect indicators, our position has been to measure as closely as possible the concepts of interest. Thus we have not chosen a measure of occupation (like SEI) known to be highly correlated with education and income, our other measures of life-style differences. By choosing measures that tap a wide variety of life-style and exposure dimensions, we

are able to gauge the independent effects of each better than studies that rely on a few redundant measures of a single dimension.

[5] Neither a model of independence nor one of quasi-independence fits these data. This is not surprising given the short observation period. Moreover, occupational mobility is far from a random event. Whether or not these moves were motivated by health concerns or some other factor is impossible to determine from these data.

[6] In this and the following tables, we present estimated standard errors rather than t values. These standard errors are provided for the readers' information, although they may be somewhat misleading if interpreted carelessly. Under some conditions these estimates will be too high, resulting in acceptance of the null hypothesis of no significant effect when, in fact, the effect differs significantly from zero (e.g., see Cox & Oakes 1984; Hauck & Donner 1977). We prefer not to use Wald statistics to test the significance of coefficients. Instead we employ likelihood-ratio tests that exhibit better large-sample properties.

[7] We have maintained the detail provided by the older workers' three-digit occupations in assigning values of the occupational characteristics, thus overcoming limitations imposed by our admittedly heterogeneous occupational groupings. Because the DOT characteristics are measured as continuous variables, their effects can be interpreted directly rather than in comparison with a reference category. Age, period, years of schooling, and family income are also measured as continuous variables in the time-dependent models. Employing categorical variables aids in detecting non-(log) linear relationships, but our results so far suggest that a single parameter adequately captures each of the main effects. Moreover, we avoid the measurement errors from misclassifying individuals by groups.

Acknowledgments

This work was partially supported by National Institute on Aging Grant AG04915. The views and opinions expressed herein do not necessarily reflect those of the National Institute on Aging or Battelle Memorial Institute. Address correspondence to David E. Moore, Human Affairs Research Centers, Battelle Memorial Institute, 4000 N.E. 41st Street, Seattle, WA 98105.

[*Received March 1988. Revised June 1989.*]

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