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Foreword

*Matilda White Riley and
T. Franklin Williams*

In some quarters of the health care community there is a growing feeling that too many books on the health aspects of "aging" are being published. While there is no argument in any quarter as to the growing importance of health care in an aging population, at the same time there is an unmistakable feeling that, in the search for solutions to the many and complex problems, a publishing overkill may actually be obscuring the real issues. It is as if some outside voice were telling us, "More books will not solve our problems."

Yet there is considerable evidence for the claim that too many current publications simply serve to heighten an awareness of such stereotypes as the following: the exploitative practices found in some nursing homes; the unfairness of legislation that requires older people to "spend down" before they become eligible for long-term benefits; the tendency of some medical practitioners to give up on older patients in order to devote more attention to younger patients where positive results can be documented; the increasing incidence of crime against the ill and home-bound elderly. To be sure, there is some truth in such stereotypes, and they demand real remedies; yet many publications serve only to elicit the "I didn't know that!" response or, worse still, a simple hand-wringing outrage at the unfairness of life for people in their later years.

By no stretch of the imagination does this volume contribute to such a dismal, if somewhat overdrawn, picture. It highlights the essence of diverse research activities on aging and health care at the National Institute on Aging as well as collaborative activities with the National Center for Health Services Research. Its several chapters aim to integrate current findings and to map directions for continuing research. Thus the volume is highly focused on the most urgent

Is there a role for prevention among the elderly?

Epidemiological evidence from the Alameda County Study

George A. Kaplan, Ph.D. and Mary N. Haan, Dr.P.H.

Striking changes are occurring in the age structure of the populations of most economically developed countries, and the United States is no exception (Rice and Feldman 1983; Siegal 1980). Although the population of the United States has undoubtedly been growing older for two centuries, until recently these developments have been relatively unnoticed. However, recent changes in the age structure of the population have been of such magnitude as to have been labeled variously as a "demographic revolution" (Myers 1981; Pifer and Bronte 1986) or the "graying of America." Between 1960 and 1985 the population aged 65 and over increased by 70.8 percent, compared to 26.2 percent for the younger population (National Center for Health Statistics 1987; Rice and Feldman 1983). In 1978, 73 percent of those 65 years of age could expect to reach age 75, compared to 61 per cent in 1940. Projections regarding future changes in the population age structure suggest that 17 percent of the population in 2020 will be age 65 or older (Siegal 1980; Siegal and Taeuber 1986).

These changes in age structure are even more striking when those over age 85 are considered. Those over 85 are, in fact, the fastest-growing segment of the population. Between 1960 and 1980 their numbers increased 164 percent, more than six times the rate of growth of the population as a whole (Rabin 1985). According to Brody et al. (1987), around the turn of the century almost half of the deaths in the United States will occur after age 80.

The reasons for these trends are generally attributable to the joint influence of changes in fertility of younger persons and the survival

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age. This has led some to assume that modifiable influences on health had already had their impact. According to this view, these survivors represent individuals for whom risk factors will no longer have any impact or will have a markedly reduced impact. Undoubtedly, those who survive to old age are different from those who do not, but the issue of how this selective pattern of survival relates to the impact of risk factors at old age is complex (Vaupel and Yashin 1985). As we shall see in what follows, there is considerable evidence that suggests that the health of older persons is influenced by behavioral, social, and socioeconomic factors.

The notion that longevity and health during the later years are related to behavior and the environment is not new. At the popular level, octogenarians or nonagenarians credit their good health to particular behaviors or features of their environment. In addition, there is growing appreciation of the large differences in levels of health and physical functioning that exist between individuals of the same age, differences which may be related to lifestyle and environment. From a prevention point of view, these differences may be more important than any age-related decrements in functioning. Indeed, the possibility has been raised that age-related decrements in some basic physiologic functions may reflect cohort differences in experience and behavior rather than inevitable declines with age (Riley and Bond 1983).

Finally, there is increasing recognition that health among older persons must be approached within a matrix that includes a variety of behavioral, social, and demographic forces, as well as the more traditional biomedical determinants. As Hess (1983:253) summarizes

Many outcomes commonly thought to be attributable to age are actually complex phenomena with multiple origins. The aging organism does not operate in a vacuum, but is engaged in a reciprocal interaction with a particular environment, and is itself the product of life-course experiences during a given slice of history.

In what follows, we will refer to some of the epidemiologic evidence that supports a role for prevention in older populations, concentrating on behavioral, social, and socioeconomic factors in their relationship to mortality from all causes and functional ability. Although there is not space to review it, a growing amount of evidence also suggests that many traditional physiologic risk factors are also associated with increased risk in the elderly. Thus, there is evidence that hypertension and isolated systolic hypertension, elevated blood lipids, glucose

of older persons. Improvements in survival accompanied by declining fertility and aging of the baby-boom cohorts will lead to an increase in the numbers and proportions of older persons for quite some time. Projections based on births that have already occurred indicate that these trends will continue for at least the next sixty to seventy years.

Given that the prevalence and incidence of most chronic diseases and disabilities increase with age, the aging of the population is likely to have a substantial impact on the need for medical services, long-term care, and social services. Of the 11 percent of the gross national product spent on health in 1984, one-third of the expenditures for personal health care were for older persons (Davis 1986). Clearly, the substantial increases in the number of older persons in the population and the continuation of these trends for almost a century represent a potential medical, social, and economic challenge to society of unprecedented proportions.

Meeting this challenge will undoubtedly require a substantial commitment of resources. However, the question as to what type of resources these will be is, as yet, unanswered. Even those authors such as Fries (1983) who postulate that we are witnessing a period of increasing good health among older persons, with a smaller and smaller proportion of the later years being spent in ill states, foresee a need for substantially increased health care services for the next four to five decades. Others are less optimistic (Manton 1982; Manton and Soldo 1985; Myers and Manton 1984; Schneider and Brody 1983), projecting potentially alarming increases in the need for health care and social services.

Leaving aside the issue of the need for traditional health care resources for the elderly, what other resources might be important in meeting the challenge of an aging society? From a public health perspective, preventive activities stand out as an important tool. If it is possible to prevent the development of debilitating chronic disease, to delay its onset, or to reduce the disability associated with it, then such activities could go far toward meeting at least some of the challenges associated with an aging population. In what follows, we will examine some of the epidemiologic evidence which suggests that such an approach may indeed have a significant impact on the health of older persons.

DISEASE PREVENTION IN OLDER PERSONS

Approaches to health promotion and disease prevention among older persons have often been limited by the observation that older individuals constitute a special group by virtue of having survived to old

intolerance, and other factors are associated with increased risk of poor health (Kannel and Gordon 1980; Kannel and Vokonas 1986; Khaw et al. 1984; Smith 1983).

Although this chapter will refer to information derived from a variety of sources, we will focus primarily on the experiences gained in a 22-year-old study of residents of Alameda County, a typical urban county of approximately one million people, located in northern California. The Alameda County Study is one of several prospective, community-based studies of chronic disease that laid the groundwork for preventive approaches. However, the Alameda County Study is virtually unique in that it did not place any age limits on participation. This wide age range, coupled with a broad examination of behavioral, social, and psychological factors, makes it a unique resource for examining the role of prevention in the elderly.

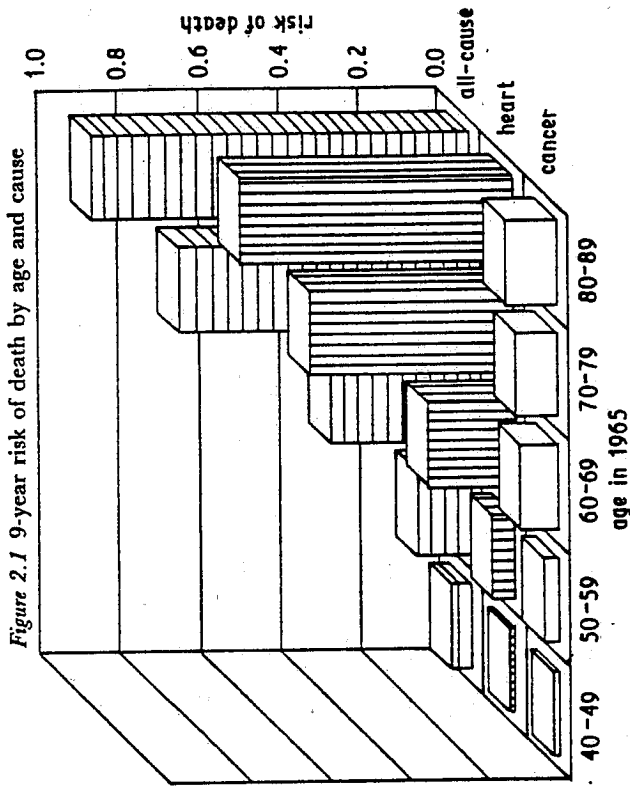
THE ALAMEDA COUNTY STUDY

Research design

In 1965 the Human Population Laboratory, an epidemiologic research unit within the state of California's Department of Health Services, initiated a long-term, community-based study of adult residents of Alameda County (Berkman and Breslow 1983; Hochstim 1970). One of the major purposes of the study was to examine the interrelationships of physical, mental, and social dimensions of health. The study design involved an initial survey of almost 7,000 people. Because all adult respondents in the sampling frame were eligible to participate in the study regardless of age, there were respondents as old as 94 years. In 1974 and in 1983, respondents were reinterviewed. Mortality and cancer incidence information, based on over 120,000 person-years of follow-up, has been routinely collected via computerized linkage to vital statistics and cancer registry files.

Mortality and disability risk with aging

It is instructive to examine the overall association between age and risk of death in this group. Advancing age is associated with increasing risk for many, but certainly not all, conditions. Figure 2.1 shows the relationship between age and nine-year risk of death from all causes, cardiovascular causes, and cancer for males and females. Those who



Source: Alameda County Study.

were 70 to 79 years of age in 1965 compared to those 40 to 49 had fourteen times the nine-year risk of death from all causes. For cardiovascular deaths and cancer deaths, the increased risk is 37- and 7.4-fold, respectively. Age is also related to the proportion of persons who report problems in dressing, feeding themselves, or moving about or in getting outdoors/climbing stairs. The prevalence of such problems in 1965 for those who were 70 to 79 is 6.1 and 9.1 times higher compared to those who were 40 to 49 years old, for the two types of disability, respectively (Figure 2.2).

For all of these outcomes, there is a substantial increase in risk with age. It is this relationship that we seek to understand when asking if prevention efforts might be efficacious in older populations. If wide variations in risk of these outcomes are observed for individuals of the same age, and if these variations are related to features of the individual's behavior or environment, then there is the possibility that preventive efforts aimed at these features will alter the association between increasing age and increased risk of poor health.

age and nine-year risk of death in two cohorts in the Alameda County Study chosen to be representative of this large county in 1965 and 1974 ($n = 6,928$ and $3,119$, respectively). As can be seen, the relationship between age and nine-year risk of death is considerably different in the two cohorts. In fact, the magnitude of the age-related decline in mortality risk in the later cohort, compared to the earlier, increases significantly with age (Haan et al., in preparation).

BEHAVIORAL, SOCIAL, AND SOCIOECONOMIC FACTORS AND MORTALITY

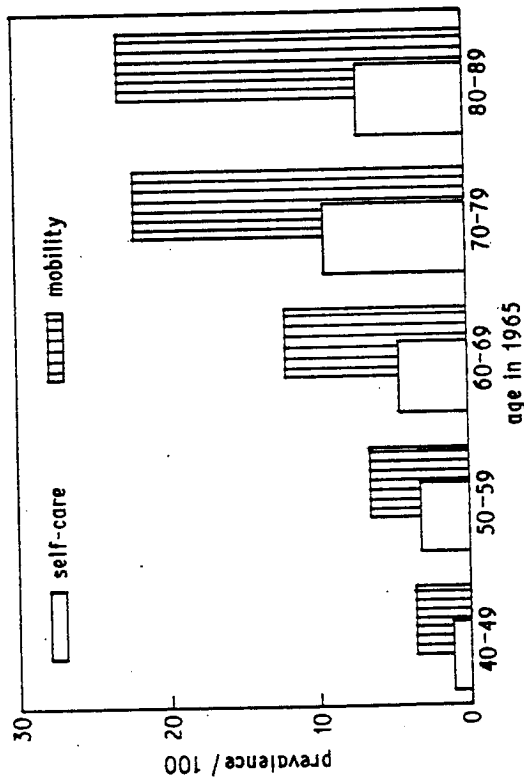
Behavioral factors

Smoking

By far the most important behavioral factor related to health in middle-age is that of smoking (Califano 1979; Pooling Project Research Group 1978). The impact of smoking on the 17-year mortality risk from all causes was examined for those 60 to 94 years old in the Alameda County Study (Kaplan, Seeman, Cohen et al. 1987). Although the overall mortality rates are high (80 percent for those over 70 years old in 1965) there was still substantial variation associated with smoking status. Current smokers in this age group had 1.47 times the mortality risk of those who had never smoked. Current smokers were at 1.23 times the risk of death as past smokers. Although the elevated risk associated with smoking declined somewhat with increasing age and with adjustment for other behavioral risk factors (Table 2.1), when the sample was restricted to those over 70 years of age, 21 percent of whom were over 80 years old, current smokers were still at higher risk than nonsmokers.

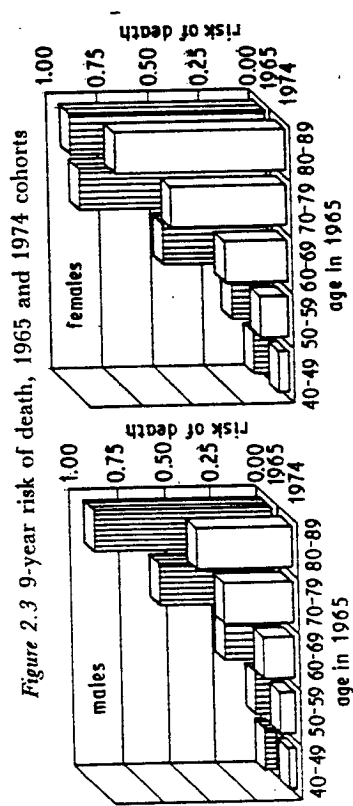
Because the Alameda County Study reinterviewed 1965 respondents in 1974, it was possible to examine changes in smoking status in older persons and the impact of changes in smoking status on mortality after 1974 (Haan et al. 1986). Table 2.2 shows the results of these analyses for 1974-1983 of deaths in respondents who were at least 50 years old in 1965 (≥ 59 in 1974). There is a clear impact of changes in smoking status on subsequent mortality risk. Even when there is statistical adjustment for a number of factors, including the presence of chronic conditions and symptoms at baseline, those who have quit smoking

Figure 2.2 Self-care and mobility problems of non-institutionalized adults Alameda County, CA



Source: Alameda County Study.

The substantial changes, over the last few decades, in mortality rates at older ages provide compelling evidence that the relationship between advancing age and increasing risk is not fixed. For example, death rates for those over 85 years declined 28 percent between 1950 and 1980 (Rabin 1985). Figure 2.3 compares the relationship between



Source: Alameda County Study.

Table 2.2 Association between smoking change (1965-1974) and nine-year (1974-1983) all-cause mortality in those over 50 years old in 1965, Alameda County Study

Smoking status	Relative hazard	95% Confidence interval
Never (n = 399)	1.00	—
Quit before 1965 (n = 158)	1.06	0.79-1.42
Quit 1965-1974 (n = 129)	1.33	0.98-1.82
Current (n = 177)	1.76	1.35-2.31

Source: Haan, Kaplan, Cohen and Knudsen (1986)

have lower risk than continuing smokers. Continuing smokers have 1.76 times the risk of respondents who never smoked. Those who quit before 1965 did not differ from those who never smoked, and those who quit between 1965 and 1974 had a risk level that was intermediate between those who never smoked and those who quit earlier. Similar analyses were carried out for the respondents who reported no chronic conditions or symptoms in 1965, for example, those who were exceptionally healthy at base line. In these analyses it was possible to take into account the appearance of new chronic conditions and symptoms in 1974 and their impact on subsequent mortality. Similar results were obtained. Continuing smokers were at 1.92 times the risk of those who had never smoked, and quitters were at somewhat elevated, but non-significant, risk compared to those who had never smoked.

These results are consistent with a growing number of epidemiologic studies that argue for the importance of smoking and changes in smoking status in the health of older persons (Barrett-Connor et al. 1984; Hammond and Garfinkel 1969; Jajich et al. 1984; Khaw et al. 1984; Pooling Project Research Group 1978). Although there are some conflicting reports (Branch and Jette 1984; Kannel and Gordon 1980), the bulk of the evidence is consistent enough to stress the importance of the smoking and health association even in the sixth and seventh decades of life. Furthermore, the Haan et al. (1986) results suggest that interventions directed at smoking in older persons may result in decreased risk of death.

It should be pointed out that decreases in the association between a risk factor and a health outcome with increasing age do not necessarily mean that the risk factor is becoming less important. If the outcome is increasingly common with advancing age, then the absolute impact of preventive efforts may increase even though the association between

Table 2.1 Association between behavioral risk factors and 17-year mortality by age, Alameda County Study

Relative hazard (RH) ^a	Age 38-49 (n = 1,822)		Age 50-59 (n = 1,075)		Age 60-69 (n = 713)		Age 70+ (n = 564)	
	RH	95% CI ^b	RH	95% CI ^b	RH	95% CI ^b	RH	95% CI ^b
Risk factor at baseline (1965)	1.77	1.21, 2.61	1.81	1.33, 2.47	1.46	1.10, 1.94	1.43	1.08, 1.89
Smoking	1.24	0.73, 2.08	1.06	0.69, 1.61	1.57	1.16, 2.13	1.01	0.76, 1.33
Current/never	1.48	1.08, 2.02	1.27	0.97, 1.66	1.38	1.09, 1.75	1.37	1.09, 1.72
Physical activity	1.66	1.17, 2.35	1.32	0.97, 1.79	1.02	0.77, 1.35	1.32	1.05, 1.67
Low/high								
Relative weight								
Moderate/else								

Source: Kaplan, Sceman, Cohen et al. (1987).
^aRelative hazard from Cox proportional hazards regression analysis, with all seven risk factors included and with adjustment for age and self-reported health status at baseline.
^bConfidence interval.

the risk factor and the outcome is weaker. To put it more simply, even though the association between smoking and coronary mortality may decrease with age, the total number of coronary deaths prevented through the smoking cessation may be greatest at the older ages.

Physical activity

Numerous epidemiologic studies also indicate that physical inactivity is associated with poor health, but few studies have examined this association in older people (Paffenberger et al. 1984; LaPorte et al. 1984). Table 2.1 shows the association between physical activity and death from all causes during seventeen years for respondents in the Alameda County Study (Kaplan et al. 1987). The physical activity score was based on the frequency and presumed strenuousness of reported leisure-time participation in active sports, taking long walks, swimming, physical exercise, gardening, and hunting and fishing. For convenience of presentation, those engaging in little or no leisure-time physical activity are compared to those engaging in more than a little. For those over 70 years of age, physical inactivity is associated with 1.37 times higher risk of death over the next 17 years. As can be seen, the risks associated with sedentary levels of activity change very little with increased age, even when there is adjustment for age, sex, baseline health problems, and other risk factors such as smoking.

Using analyses similar to those described above for changes in smoking, the association between changes in physical activity and subsequent mortality was also examined (Haan et al. 1986). In these analyses, measures of physical activity and changes in physical activity were calculated by combining the frequency of participation (often, sometimes, or never) in sports, swimming or walking, and exercise. Participation in these activities was weighted by 2, 1, or 0, depending on whether they were engaged in often, sometimes, or never. Change was measured as the difference in 1965 and 1974 values. Changes in physical activity level were significantly associated with subsequent risk of death in this group of those over 50 years old. Those who increased their levels of physical activity between 1965 and 1974 showed decreased risk of death, compared with those who stayed the same or those who decreased their levels. Those who increased one unit on the scale had 0.84 times the risk of those who stayed the same, even when the analyses were restricted to those who were healthy at baseline and adjustment was made for incident chronic conditions during the follow-up period, alcohol consumption, smoking changes, weight changes, and body mass

index. Thus, in those 59 years old or more in 1974, increases in physical activity over the preceding nine years (1965-1974) are associated with decreases in subsequent mortality risk, and decreases in physical activity are associated with increases in risk. Furthermore, this pattern of results does not seem to be due to health problems that might motivate decreases in physical activity or other possible confounders.

Weight

Extremes of body mass, represented by high ratios of weight to height², have also been associated with increased risk in a number of studies of younger and middle-aged individuals (Berkman and Breslow 1983; National Institutes of Health 1985). Respondents in the 1965 Alameda County Study were classified with respect to the body mass index, compared with actuarial reports of desirable weight for height. In previous analyses for younger individuals in the Alameda County Study, being 10 percent or more underweight or 30 percent or more overweight was associated with increased risk of death. When the mortality experience of older respondents was examined, similar findings were obtained (Kaplan, Seeman, Cohen et al. 1987). For respondents 60 years old or older, those who were more than 10 percent underweight or 30 percent overweight had 1.20 times the risk of death over the next 17 years when compared with those of moderate weight. When the effects of age, sex, race, baseline physical health, and other behavioral risk factors were taken into account, these results still held. For those 70 years of age or older, the effect was still strong (Table 2.1).

Changes in weight were also associated with increased risk, although not in the direction that one might expect from the current emphasis on weight reduction (Haan et al. 1986). In these analyses, weight loss between 1965 and 1974 was associated with significantly increased risk in the subsequent follow-up period. Even when the analyses were restricted to those who were in good health at baseline, and there was statistical adjustment for incident chronic conditions presenting between 1965 and 1974, baseline body mass index and body mass index squared, alcohol consumption, and changes in smoking and physical activity between 1965 and 1974, there was still increased risk associated with weight loss. For those who were 59 years old or more, a nine-year weight loss of 14 pounds was associated with 1.56 times (95 percent confidence interval = 1.23-1.98) the risk of death during the follow-up period compared with those who had no weight change. Thus, both extremes of weight and substantial weight loss appear to be important

predictors of subsequent survival, even in those who have reached the age of 70 years or more.

Social factors

There is a growing body of evidence that indicates that aspects of social functioning related to social support and social network participation are related to health (Cohen and Syme 1985). In particular, a number of epidemiologic studies have indicated that the extent of social participation an individual reports is a strong predictor of subsequent mortality (Broadhead et al. 1983). Most but not all (Blazer 1982; Zuckerman et al. 1984) of these studies have restricted their attention to young and middle-aged individuals. For example, previous analyses of Alameda County Study respondents who were 30 to 69 years of age at baseline (Berkman and Syme 1979) indicated that those who reported low levels of social network participation were at considerably increased risk of death during the next nine years.

These analyses were extended to older respondents and expanded (Seeman et al. 1987) using the Alameda County Study data. Several measures of social connections were utilized in addition to the Social Network Index used by Berkman and Syme (1979). For those 60 years of age and older, there was a strong association between the Social Network Index and risk of death over the next 17 years. Respondents who were classified in the lowest of four groups on this index were at 1.56 times the risk of death compared with those classified in the most connected group, even when there was adjustment for age, sex, race, and baseline health status. Social isolation, coded as fewer than five contacts per month with close friends and relatives, was also associated with increased risk, as was membership in a church group. Marital status and membership in non-church groups were only marginally associated with mortality risk. When the results were examined for different age groups, measures of social connections continued to be predictive even for the oldest group, although in some cases the risks declined somewhat (Table 2.3).

In order to further examine the contribution of social connections to health among older persons, the association between changes in social connection between 1965 and 1974 and mortality from 1974 was assessed (Kaplan 1986). As in the previous analyses of change, attention was restricted to those who were 59 years or older in 1974. In these analyses, changes in the number of close friends, number of

Table 2.3 Association between social risk factors and 17-year mortality by age

Risk factor (1965)	Age 38-49 (n = 1,822)		Age 50-59 (n = 1,075)		Age 60-69 (n = 713)		Age 70+ (n = 564)	
	RH	95% CI ^b	RH	95% CI ^b	RH	95% CI ^b	RH	95% CI ^b
Model 1: Marital status (1965) Not married/married	1.70	1.20-2.40	1.40	1.03-1.91	0.98	0.76-1.27	1.15	0.92-1.42
Social isolation (contacts with close friends and/or relatives isolated/not isolated)	1.16	0.84-1.59	1.04	0.76-1.42	1.32	1.02-1.70	1.27	1.02-1.59
Membership in church group No/yes	1.65	1.15-2.37	1.06	0.80-1.40	1.36	1.05-1.76	1.26	1.03-1.55
Memberships in other groups No/yes	1.14	0.83-1.57	1.04	0.77-1.40	0.89	0.71-1.12	1.14	0.94-1.39
Model 2: Social Network Index (coded 1-4) Lowest (4)/highest (1)	2.46	1.58-3.82	1.64	1.11-2.42	1.52	1.09-2.10	1.69	1.24-2.29

^aSource: Alameda County Study.
^bRelative hazard from Cox proportional hazards regression analysis, with all seven risk factors included and with adjustment for age and self-reported health status at baseline.
^cConfidence interval.

have indicated that the increased risk associated with lower socioeconomic position is not found among older persons (Kaplan, Secman, Cohen et al. 1987; Kitagawa and Hauser 1973). For example, in analyses of the data collected in the Alameda County Study, there was a substantial decrease in the association between low socioeconomic position and 17-year mortality for those older than 60 years at baseline (Kaplan, Seeman, Cohen et al. 1987). In respondents under age 60, those who had inadequate incomes (total family income adjusted for family size and compared to federal standards) had a 20 to 27 percent higher risk of death than those with very adequate incomes. For those over 60, there was no increased risk associated with inadequate income compared with very adequate income (relative hazard = 0.94; 95 percent confidence interval = 0.88-1.01).

These findings are surprising because there are no obvious reasons why the association between socioeconomic position and health should decline with age. Indeed, if socioeconomic position is a measure of the resources that people have to address various health-related needs, then one might expect this association to increase in older persons where the risks of most disease are higher. However, it is possible that these results merely represent difficulties in the measurement of socioeconomic resources at older ages. For example, changes in income following retirement may lead to persons who were previously classified in higher socioeconomic strata being classified in lower strata. Alternatively, the association might decline due to the previously higher rates of death among people in lower socioeconomic positions, a survivor effect.

To further examine the association between socioeconomic position and mortality in older persons, we examined the impact of changes in socioeconomic position on subsequent mortality (Kaplan and Haan 1986). Utilizing the same procedures used in the analyses of change in behavioral and social risk factors, the association between 1965-1974 income change and mortality after 1974 was assessed. Unlike the results that considered only baseline socioeconomic position, changes in income were significantly associated with increased mortality risk in older persons (Table 2.4). Those who were 59 years or older who reported a decrease in income of \$10,000 during the previous nine years had 1.20 times the risk of death over the next nine years compared with those who reported no change in income. Note that these are not inflation-adjusted dollars, so those who reported the same income had, in fact, experienced a reduction in buying power.

relatives, number of close friends and relatives seen at least once per month, and total numbers of contacts per month with these were considered.

These analyses demonstrated a consistent pattern of results whereby decreases in social contacts were associated with increased risk of death in the subsequent nine-year period. There is a 20 to 77 percent increase in the risk of death for those who report significant decreases in social contacts over the previous nine-year period compared to those who report no changes. Significant effects are found for all four measures of social connections, and the results are similar for men and women. These results represent the results of analyses in which there is adjustment for baseline health problems (diabetes, heart trouble, stroke, chest pain, trouble breathing, and high blood pressure) in multivariate models. This is an important issue because health problems might lead to decreases in social contacts due to limited activity. On the other hand, it is also possible that, as people get sick, some kinds of contacts might increase, such as visits from friends or relatives who are taking care of the sick respondent.

To further examine the impact of new illness on the association between changes in social connections and mortality, analyses were carried out in which only respondents who reported no chronic conditions or symptoms at baseline were included in the analyses. In addition, indicators of new (1974) health problems were included in the analyses. Thus, it was possible to assess the impact of changes in social contacts on the subsequent mortality experience of respondents, taking into account changes in health status. The results were very similar to those in the previous figure. The increased risk was within 10 percent of those in the previous analyses, indicating that changes in health status do not account for the increased risk associated with changes in social contacts.

Socioeconomic factors

There is a consistent body of knowledge which indicates that there are strong associations between socioeconomic position and health. Generally, poorer health is found among those of lower socioeconomic position (Antonovsky 1967; Kaplan, Haan, Syme et al. 1987; Syme and Berkman 1976). This pattern is found using a variety of measures of socioeconomic position (e.g., income, education, or occupation) and for a wide variety of diseases and health outcomes. A number of studies

Table 2.4 Association between income change (1965-1974) and nine-year (1974-1983) all-cause mortality in those over 50 years old in 1965, Alameda County Study

Adjustment variables	Relative hazard of \$10,000 decline compared to no decline	95% Confidence interval
Age and sex	1.20	1.02-1.41
+ Baseline health	1.22	1.04-1.44
+ Incident health problems (baseline healthy only)	1.27	1.01-1.61

Source: Alameda County Study.

Adjustment for baseline (1965) physical health problems had little effect on this association. Those who reported a decrease in income of \$10,000 had 1.22 times the risk of those who reported no change in income. Similarly, when only those with no health problems at baseline were considered, and there was statistical adjustment for incident health problems, there was still a significant association (relative hazard = 1.27). In all of these analyses, the baseline level of income is adjusted for, and in none of the three is there a significant or otherwise meaningful, relationship between level of income and risk. However, in all three analyses, changes in income are associated with risk. These results suggest that the dynamics of socioeconomic position are more strongly related to risk of death in older persons than are single point estimates of socioeconomic position.

BEHAVIORAL, SOCIAL, AND SOCIOECONOMIC FACTORS AND FUNCTIONAL ABILITY

The previous results provide evidence that behavioral, social, and socioeconomic aspects of older individuals' lives are related to their mortality risk. As such, they provide important insights into potentially modifiable risk factors that might be related to variations in health among the elderly. However, death represents only a single endpoint along a continuous dimension of health. Because it is of great interest and importance to examine less extreme outcomes and to try to tap "quality of life," epidemiologists and geriatricians have increasingly turned to measures of functional health status and "active life expectancy" (Kane and Kane 1981; Kaplan et al. 1984; Katz et al. 1983;

Nagi 1976). Functional health status is generally defined as the ability of an individual to carry out activities that are related to "normal" levels of functioning. Often functional health measures assess difficulties in carrying out the most basic functions, such as activities of daily living (Jette and Branch 1981; Katz and Apkom 1976), but assessment of higher levels of functioning or functioning in a variety of domains is also possible (Nagi 1976; Rosow and Breslau 1966).

Little is currently known concerning the factors that are related to functional status. Most of the available information is based on cross-sectional analyses, which limit our ability to make the kind of causal interpretations that underlie prevention efforts. Guralnik (1985) made use of the Alameda County Study to assess whether behavioral, social and socioeconomic factors were prospectively related to functional health status in persons older than 65. In order to accomplish this, he interviewed all persons at least 65 years old in 1984 who had participated in the Alameda County Study's third wave (1982-1983) of data collection. Vital status was determined for 98 percent ($n = 508$) of those who were located. Respondents were given a telephone interview, which used both existing (Jette and Branch 1981; Katz and Apkom 1976; Nagi 1976; Rosow and Breslau 1966) and newly developed scales to tap a wide range of levels of functional health status, including the assessment of high levels of functioning. Thus, the interview ranged from assessment of difficulties in carrying out activities of daily living to frequency of participation in various athletic activities. A summary measure of functional health status was then generated from these items.

Guralnik then used regression techniques to examine the association between risk factors measured 19 years earlier in 1965 and the summary index of 1984 functional health status. The regression models included adjustment for 1965 age, sex, race, and physical health. It is important to point out that these analyses are, by necessity, restricted to those who survived to at least age 65 in 1984, and one might expect that the impact of many risk factors would have already been felt via mortality.

The results were strikingly consistent with the patterns presented above for mortality outcomes. Behavioral risk factors such as smoking, little leisure-time physical activity, and deviations from moderate weight in 1965 were all significantly related to better functional health status in 1985. Similarly, social factors were also significantly associated with level of functioning. Both being married and participating in

However, within the Alameda County sample, there was a wide range of levels of functioning. The observed relationships between behavioral, social, and socioeconomic risk factors and functional ability outcomes indicate that these risk factors may have an important role in preserving good functioning and postponing the need for long-term care. These factors may also be important in determining the level of disability associated with new illness (Cummings et al., submitted for publication; Kaplan and DeLongis 1983). Finally, analyses of data from the Alameda County Study and from other sources (McCoy and Edwards 1981; Vicente et al. 1979; Vicente et al. 1980-1981; Weisert and Scanlon 1985; Wiley 1983) indicate that social and socioeconomic risk factors may be important determinants of institutionalization.

The finding that behavioral, social, and socioeconomic risk factors are related to both mortality and functional ability in older persons could be interpreted as supporting Fries' conjecture concerning the "compression of morbidity." He has argued that we are witnessing a period in which biologic limitations on the life span are being approached, while, at the same time, preventive efforts are leading to the postponement of the onset of significant morbidity. The net result of these two trends, according to Fries (1980, 1983, 1984), will be a compression of morbidity in which the infirm portions of one's life are reduced to a smaller and smaller interval just preceding death.

Although behavioral, social, and socioeconomic forces do have the potential for increasing longevity and functioning, other evidence fails to support Fries' predictions. For example, analyses of trends in survival, age at death, and cause of death do not provide strong evidence for either the fixed life span, or declining morbidity accompanying increased survival (Manton 1982; Manton and Soldo 1985; Myers and Manton 1984).

The most important issue, simply stated, is whether or not people are living longer and, as a result, experiencing morbidity for a longer portion of their lives. If so, then this would have important policy implications for the care of older people. Some evidence suggests that this view is correct. For example, Verbrugge (1984) found that the prevalence of multiple morbidities has increased among the elderly. Similar trends have been seen in a comparison of the Alameda County Study's two cohorts (Haan et al., in preparation). The age-specific rates of disabilities were found to be significantly higher in the 1974 cohort than in the 1965 cohort.

Nevertheless, the evidence presented in this chapter does point to

group activities in 1965 were associated with better functional status in 1984. Socioeconomic factors, measured by family income adjusted for family size and categorized according to 1965 federal standards, were also significantly associated with functional health. Those with higher adjusted family incomes in 1965 had better functional health status in 1984.

In summary, the consistency and strength of the associations between behavioral, social, and socioeconomic factors and both mortality and functional ability are striking. These factors account for substantial variations in the health experience of older persons, even in a period spanning almost two decades after reaching 70 years of age. Overall, these findings provide little evidence that supports the notion that the health experience of older individuals is not influenced by a broad range of risk factors. Indeed, for some risk factors, the effects are actually stronger during the later years (Kaplan, Seeman, Cohen et al. 1987). One is left, then, with a feeling of optimism, for these results suggest that there is reason enough to hope that prevention efforts directed at these risk factors will be able to improve both the length and quality of life.

PREVENTION IN AGING HEALTH POLICY

Encouraging as these results are, there are several necessary provisos that are important to state. The sparse nature of the data must be emphasized; epidemiologic investigations focusing on the elderly are, on the whole, a rather recent event. It also needs to be emphasized that epidemiologic analyses of the type reported in this chapter cannot, in themselves, be taken as definitive evidence that intervention in behavioral, social, or socioeconomic risk factors will have the desired results. Although many epidemiologic studies have led to interventions that have produced results consistent with observed associations between risk factors and health outcomes, we cannot automatically assume that this will be the case.

It must also be remembered that the results from the Alameda County Study indicating a link between behavioral, social, and socioeconomic factors and health are based on analyses that were restricted to noninstitutionalized persons; thus, they are not necessarily applicable to those older persons in long-term care or other institutions. On the other hand, the vast majority of older persons are not in institutions.

an important role for behavioral, social, and socioeconomic factors in the health of older persons. The analyses of the associations between changes in risk factors and subsequent health status are particularly compelling in this regard since associations between baseline risk factors and mortality at older ages might simply reflect the accumulated effect of lifetime exposure to these risk factors.

Although prevention directed at the development of risk factors in the young is, ultimately, the most efficacious strategy for many chronic diseases, we believe that results such as those presented here indicate that there is an important role for prevention throughout the life span. However, the issue of what kind of prevention resources should be directed at older persons remains. Undoubtedly, good access to high-quality medical care is important. However, the majority of older persons are not ill, so interventions outside of the medical environment are important.

The observation that individual behaviors, social organization and interaction, and economic status are related to the health of older persons suggests that a broad approach to intervention is required. In fact, because risk factors at these levels are tied together in a dynamic way, with changes in one level affecting changes at another (Kaplan 1985), a broad approach is necessary. There is a growing recognition that an environmental or community-based approach to disease prevention and health promotion is desirable (Puska et al. 1981; Syme 1986), and just such an approach may be called for with respect to older persons. Forces in the social and physical environment are important determinants of risk behavior, social isolation, and economic position, and it may be necessary to intervene in these forces to have an effect on risk factors for the elderly. For example, an intervention in the physical environment that increases the safety of elderly people and thus increases their willingness to go outside might decrease their social isolation and lead to better health. There is, in fact, some evidence that such an approach works (Minkler et al. 1982-1983). A major advantage of such an environmental approach is that the effectiveness of the intervention is not limited to the currently "at risk" portion of the population at the time of intervention but, ideally, extends forward as new persons enter this "at risk" group. Thus, in the previous example, making the environment safer for older persons who currently live in that area will help prevent social isolation of future older residents.

Similarly, sedentariness, smoking, and other behavioral risk factors may have powerful environmental supports, and attempts to change

these risk factors in older persons may encounter resistance or failure if these environmental supports are not considered. From a policy perspective, it becomes important to develop intervention strategies that combine this environmental approach with more traditional individually oriented approaches.

An environmentally oriented approach may also be appropriate for the increased risk associated with lower socioeconomic position. It is undoubtedly true that persons in lower socioeconomic strata suffer from inadequate financial resources with which to address the demands in their lives. However, in addition to these limited resources, there is a broad range of features characteristic of the social and physical environments lived in by people in lower socioeconomic strata that may lead to poor health. Evidence from analyses currently under way in the Alameda County Study indicates that these features are, in themselves, associated with increased health risks for individuals, independent of individual risk factors. Interventions directed at reducing socioeconomic effects on the health of older persons may need to be directed at these social and environmental properties.

In summary, there is ample evidence that a variety of behavioral, social, and socioeconomic features of older persons' lives are related to their health and independence. Other evidence, which there is not enough space to review at this time, indicates that many of these features are also associated with higher levels of overall well-being. The evidence does not suggest that poor health, dependence, and social isolation are inevitable consequences of getting old. Rather, it suggests opportunities for intervention that can significantly improve the health and functioning of older persons. Within these opportunities lies at least a partial solution to the challenges created by an aging population.

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