The Health Consequences of Multiple Morbidity in the Elderly

The Alameda County Study

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Longitudinal data from the Alameda County Study are used to examine three health consequences of multiple or co-morbidity, defined as the coexistence of two or more chronic conditions and/or symptoms. Age-adjusted analyses of the consequences of baseline co-morbidity show significant associations in both age groups with 17-year mortality, and with the development of multiple new conditions and the occurrence of depression over a 9-year follow-up. After adjustments for sociodemographic characteristics and health behaviors, all associations with multiple new conditions remain significant. The association with depressive symptoms, however, remains significant for the younger age group only and the associations with mortality become nonsignificant in both age groups.

It is common in clinical practice to encounter patients, particularly older patients, with more than one disease or condition. In order to improve documentation in complex clinical situations, a great deal of work has gone into developing clinical record-keeping systems that

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allow for the tracking of multiple problems in an individual patient (Weed, 1971). Epidemiologic research, in contrast, has traditionally focused on the distribution and determinants of specific, individual disease entities in populations. The epidemiologic study of the coexistence of multiple diseases and conditions, referred to in this article as co-morbidity, has been rarely undertaken, yet offers an additional way to understand the health problems of populations such as the elderly in which co-morbidity is common; an opportunity to examine whether such co-morbidity carries with it increased risks for additional physical or psychological health problems, functional disability and ultimately increased risk for mortality. This article demonstrates the high prevalence of co-morbidity in a representative sample of older persons and examines the possible consequences of such co-morbidity in terms of increased risk for multiple new conditions, depression and mortality.

The presence of co-morbidity at the time of death has become increasingly common (Manton & Stallard, 1984). Using 1979 U.S. death certificates with causes of death grouped into 72 selected categories, Israel and colleagues found more than one cause of death on 73% of death certificates (Israel, Rosenberg, & Curtin, 1986). This was an increase over multiple cause-of-death reporting in 1917 (35%) and 1955 (60%) and was attributed to the aging of the population, an increase in deaths due to chronic diseases, and more complete reporting on death certificates.

The prevalence of co-morbidity in representative samples of the population, however, has not been widely researched. There is reason to believe that such co-morbidity is common in the elderly. For example, in the 1984 National Health Interview Survey, 53.3% of persons age 75 and older reported having arthritis, while 34.5% reported heart disease (Ries, 1986). If the occurrence of each of these two diseases is independent of the other, then some 18% of those aged 75 and older would be expected to suffer from both (i.e., the product of this independent probabilities of occurrence). To the extent that the co-occurrence of two diseases is not independent (e.g. hypertension and coronary heart disease), co-morbidity from them will be even more common than the product of their independent probabilities would suggest.

What evidence there is suggests that co-morbidity rises with age and is associated with increased risk of mortality. A study in Great Britain found that in 200 patients in a geriatric unit the mean number of diseases was six (Wilson, Lawson, & Brass, 1962). In terms of specific conditions, hypertension was identified in 40% of the patients and found to be linked to heart and brain disorders. Interestingly, no other significant associations were identified among 15 of the most prevalent conditions. In an investigation of breast cancer patients, co-morbidity was found to be more frequent among those age 65 and older compared to younger individuals (Donegan, 1984). When compared to the younger group, co-existent cancer at another site was twice as frequent in the older group, diabetes was four times as frequent, and thyroid disease twice as frequent. In a similar study of diabetes patients, co-morbidity was present in only 8% of those younger than 55 years compared to 35% of those age 55 and older (Kaplan & Feinstein, 1974). Co-morbidity was also judged in the older group to be more commonly of a "life-threatening nature." In this study, both vascular co-morbidity (i.e., co-morbid conditions likely related to the patient's diabetes) and nonvascular co-morbidity (i.e., co-morbidity unrelated to the diabetes) were associated with increased 5-year mortality. Interestingly, as in the study by Wilson et al. (1962), a large proportion of the patients (37%) had co-morbidity that was judged to be from diseases not clearly related to the patient's existing diabetes. Those with "diabetes-related" co-morbidity made up 41% of this sample of 188 patients, with the remaining 22% showing no co-morbidity. Studies of cancer patients have also shown that the presence of co-morbidity is associated with poorer prognosis, especially in the elderly (Donegan, 1984; Patterson, 1984).

The rise in co-morbidity with age is of particular note in light of current demographic trends. Census estimates project that by the year 2000 there will be some 35 million Americans aged 65 or over, representing 13% of the total population and that by 2020 this number will rise to over 51 million, or 17% of the population (U.S. Bureau of the Census, 1984). Clearly, the group for whom co-morbidity is of greatest concern is sizable and growing.

The analyses presented here consider three possible consequences of co-morbidity: mortality, onset of *multiple* new morbidity, and depression. For each analysis, the patterns of association are examined and compared for those above and below age 60.

Methods

The analyses presented here utilize data from the Alameda County Study conducted by the Human Population Laboratory of the State of California, Department of Health Services. The details of the Alameda County Study design and sampling have been reported elsewhere (Berkman & Breslow, 1983; Hochstim, 1970). Briefly, in 1965 a representative sample of some 7,000 adult residents of Alameda County aged 20 and older was asked to complete an extensive questionnaire about behavioral, social and psychological aspects of their lives as well as self-reported health status. Respondents were re-interviewed in 1974 (N = 4,864). The current analyses focus on those respondents who were at least age 38 in 1965, limiting the sample to those individuals who, if they survived, were at least age 55 by 1982. At baseline in 1965, 4,174 participants were age 38 or older. Of these, 890 (21%) were age 65 or over and 564 were age 70 or older.

In the following analyses, multiple or co-morbidity is measured from self-reports of any of 22 chronic conditions and symptoms (see Table 2 for itemized list). Baseline morbidity is measured by counting the number of reported conditions and/or symptoms in 1965. With the use of such self-report measures the question of measurement validity arises. In the case of our items, previous analyses comparing respondents' self-reports with their medical records indicate a high level of agreement (Meltzer & Hochstim, 1970). For analysis purposes, three indicator variables were created to reflect the presence of 1, 2, or 3 (or more) conditions. This approach does give equal weight to conditions and symptoms that vary in severity and counts separately such things as high blood pressure, chest pain, and heart trouble that may well reflect one underlying "disease." However, examination of the mortality rates for people reporting 0, 1, 2, and 3 or more of these conditions and/or symptoms indicates that mortality rates increase as reports of morbidity increase. Previous analyses of these data also suggest the validity of these self-reports, indicating that self-reports of chest pain, heart trouble, and trouble breathing are significant predictors of death from coronary heart disease (Kaplan & Kotler, 1985). These patterns of association provide evidence for the predictive validity of our summary measure of co-morbidity and suggest that those reporting a greater number of conditions and symptoms are, in fact, subject to a greater morbidity burden.

For those who were resurveyed nine years after baseline in 1974, it was possible to study the risk of developing *multiple* new chronic conditions and symptoms. New chronic conditions and/or symptoms were identified as those conditions and/or symptoms that were said to be present in 1974 but had not been reported in 1965. The outcome used for the analyses of new *co*-morbidity compares those who developed two or more new conditions and/or symptoms between 1965 and 1974 (i.e., those with multiple new conditions) to those who developed none or only one.

Analyses of the consequences of baseline co-morbidity examine not only its association with subsequent 9-year incidence of multiple new conditions but also its association with 9-year depressive symptomatology and 17-year all-cause mortality. As in the analyses of new co-morbidity, the analyses of depression include those respondents who were resurveyed in 1974. The measure of depressive symptoms is based on self-reports of 18 items. This measure has been used in a number of studies and is conceptually equivalent to the CES-D and other symptom checklists used in epidemiological studies (Kaplan, Roberts, Camacho, & Coyne, 1987). Respondents are considered to be "depressed" if they score greater than one standard deviation above the mean.

Analyses of 17-year mortality (1965-1982) include all those aged 38 or older at baseline. A computer-matching procedure was used to identify deceased members of the cohort from the California Death Registry and other sources (Belloc, 1973; Arellano, Peterson, Petitti, & Smith, 1984). Additional deaths were discovered via active tracing of sample members in 1974 and 1982-1983. Between 1965 and 1982, 1,219 respondents aged 38 or older at baseline died; respondents not known to have died are assumed to be alive. Underascertainment of deaths appears to be very slight; during the first nine years of follow-up it was found to be approximately 4% (Belloc, 1973).

As indicated, the analyses of multiple new morbidity and depressive symptomatology use only those respondents resurveyed after nine years. As with any longitudinal follow-up, there is the issue of sample attrition and its possible impact on the analyses. Due to strenuous tracking efforts at the time of the 1974 follow-up, 95.6% of the original cohort were located and 81.4% of the survivors completed questionnaires (Berkman & Breslow, 1983). Analyses comparing those lost to follow-up with the remaining cohort have suggested that bias due to sample attrition is not a serious problem (Wiley & Camacho, 1980; Berkman & Breslow, 1983).

In examining the possible associations of baseline measures of co-morbidity with our three outcomes, all analytic models include controls for demographic, behavioral, and social risk factors as well as baseline functional disability. Demographic characteristics examined include age, sex, race, and socioeconomic position. Seven behavioral risk factors previously shown to be associated with increased mortality risk in the Alameda County Study (Berkman & Breslow, 1983; Wingard, 1984; Belloc, 1973) were examined in these analyses: smoking, being more than 10% under or more than 30% over one's "ideal" weight as determined from the Metropolitan Life Insurance Company standards, engaging in no regular physical activity, excessive alcohol consumption, getting more than 8 hours of sleep per night or less than 7, eating breakfast only irregularly, and snacking. Four types of social ties examined here have also been shown to be associated with mortality and morbidity (Seeman, Kaplan, Knudsen, Cohen, & Guralnik, 1987; Berkman & Syme, 1979). They reflect (1) marital status (i.e., married/not married), (2) contacts with close friends and relatives, (3) membership in a church group, and (4) memberships in other types of groups. The second measure of social ties reflects more general social isolation, measured by few (if any) contacts with friends and relatives. Those who reported less than five total contacts per month with family and close friends were classified as isolated. Functional disability was assessed as being present or absent based on two questionnaire items asking about problems with mobility and self-care.

Cox proportional hazards models were used in the mortality analyses as information on date of death was available. All other analyses use multiple logistic models. The parameter of interest in the proportional hazards models is the estimated relative hazard—a measure that can be interpreted as the approximate "instantaneous" relative risk associated with a particular risk factor. This estimate is essentially an average of estimated relative risks for many very short time intervals over the length of the 17-year follow-up period. These relative hazards estimate the risk of mortality for those with a given number of conditions *relative* to the mortality risk of those with *no* reported conditions. The parameter of interest in the logistic analyses is the estimated odds ratio associated with the risk factor of interest—

TABLE 1
Baseline (1965) Prevalence of Health Conditions in Alameda County for Those Aged 38-59 and 60 and Older

	Age Group 38-59* (N = 2897)	60+ (N = 1277)
Number of Conditions		
0	34.9	23.8
1	22.2	20.3
2	17.0	15.3
3 or more	25.9	40.6

*Percentage of age group.

baseline co-morbidity in the analyses of 9-year incidence of depression and of multiple new health conditions. These odds ratios compare the odds of experiencing multiple new conditions or depression for those with a given number of conditions *relative* to the same odds for those with no reported conditions.

Because it was of some interest to examine and compare the consequences of co-morbidity at different ages, results are presented for two age groups, comparing those aged 60 and older to a younger group aged 38-59.

Results

Prevalence of multiple morbidity

Initial 1965 baseline data from Alameda County clearly show a high prevalence of co-morbidity. Among those aged 60 and older, 56% reported more than one condition with some 41% reporting 3 or more conditions (see Table 1). Even in the younger groups, 43% reported more than one condition in 1965.

Table 2 presents a more detailed examination of the age-specific distributions of this baseline co-morbidity. For each of the 22 conditions it lists total baseline prevalence and for those reporting a given condition, gives the percentage reporting that condition "alone," the percentage reporting that condition "along with one other condition"

TABLE 2
Distribution of Baseline Morbidity (1965)

Condition	Total 1965 Prevalence (% of age group reporting condition)	Percentage of Reported Cases Mentioned: Alone	Along With 1 Other Condition	Along With 2+ Other Conditions
A. Age 38-59 (N = 2897)				
Arthritis	14.8%	7.9%	17.4%	74.7%
Asthma	3.0	10.5	22.1	67.4
Back Pain	25.2	18.7	21.8	59.5
Bronchitis	3.8	10.9	22.7	66.4
Cancer	1.1	21.2	27.3	51.5
Chest Pain	11.4	8.2	16.4	75.5
Constant Cough/Heavy Colds	6.3	12.6	17.0	70.3
Diabetes	2.4	26.1	23.2	50.7
Epilepsy	0.3	33.3	11.1	55.6
Frequent Headaches	18.0	18.6	20.3	61.1
Gallbladder Trouble	1.8	13.7	17.7	68.6
Heart Trouble	2.9	2.4	16.5	81.2
High Blood Pressure	10.7	22.8	20.3	56.9
Leg Cramps	16.0	12.9	16.6	70.5
Liver Trouble	0.6	0.0	12.5	87.5
Pain in Joints/Stiffness	22.3	11.0	23.1	65.9
Paralysis	1.1	9.4	6.3	84.4
Short of Breath	14.0	7.1	16.5	76.4
Stomach Pain	7.1	8.3	22.3	69.4
Stomach/Duodenal Ulcer	5.1	16.1	18.8	65.1
Stroke	0.4	0.0	0.0	100.0
Tuberculosis	0.2	0.0	40.0	60.0
B. Age 60+: (N = 1277)				
Arthritis	39.4%	7.8%	16.9%	75.4%
Asthma	3.5	0.0	13.3	86.7
Back Pain	28.3	8.9	11.1	80.1
Bronchitis	4.7	3.3	10.0	86.7
Cancer	3.7	12.8	21.3	66.0
Chest Pain	13.6	1.2	2.3	96.6
Constant Cough/Heavy Colds	5.5	2.9	7.1	90.0
Diabetes	5.4	13.0	29.0	58.0
Epilepsy	0.2	0.0	50.0	50.0
Frequent Headaches	13.5	7.6	9.3	83.1
Gallbladder Trouble	4.2	5.7	9.4	84.9
Heart Trouble	14.5	3.2	6.5	90.3
High Blood Pressure	25.5	11.4	18.8	69.8
Leg Cramps	28.4	10.5	10.7	78.8
Liver Trouble	1.1	0.0	14.3	85.7
Pain in Joints/Stiffness	29.8	5.5	15.0	79.5
Paralysis	2.0	0.0	7.7	92.3
Short of Breath	17.0	2.8	8.3	88.9
Stomach Pain	6.7	2.4	9.4	88.2
Stomach/Duodenal Ulcer	5.4	11.6	17.4	71.0
Stroke	2.7	2.9	14.3	82.9
Tuberculosis	0.2	0.0	0.0	100.0

and the percentage reporting it "along with 2 or more other conditions."

In terms of baseline prevalence, the figures are not particularly high. Only back pain and pain in one's joints were reported by more than 20% of the younger age group and only arthritis had a prevalence of over 30% among those 60 and older. However, among those who did report a condition, the probability of their having additional conditions is high, especially in the older age group. For this latter group, the proportion reporting any single condition (and no other) is never greater than 13% while over 70% of those reporting any condition (except diabetes, epilepsy, and cancer) also report two or more others.

Consequences of multiple morbidity

As indicated, the following analyses examine three possible health consequences of co-morbidity—17-year all-cause mortality, 9-year incidence of multiple new health problems, and 9-year incidence of depressive symptoms. Table 3 presents the results of a proportional hazards regression analysis of the association between baseline co-morbidity and 17-year mortality risk. The relative hazards in the upper portion of the table represent the age-adjusted relative hazards for deaths from all causes associated with having one, two, or three (or more) conditions and/or symptoms. The reference group in each case is those with no conditions or symptoms.

As shown in Table 3, in both age groups the presence of three (or more) conditions and/or symptoms was associated with a significantly increased risk of mortality (RH = 1.24 for those aged 60 or older and 1.64 for those aged 38-59). Having only one or two conditions and/or symptoms, however, was not associated with significantly increased mortality risks in either age group.

The second set of relative hazards, presented in the lower portion of Table 3, are from proportional hazards models that adjust for additional demographic, social, and behavioral risk factors. These include sex, race, socioeconomic position, marital status, contacts with friends and relatives, memberships in church and other groups, and seven health practices (physical activity, smoking, alcohol consumption, relative weight, nightly hours of sleep, and eating habits such as snacking and breakfast). Adjustments are also made for baseline functional disability.

TABLE 3
Cox-Proportional Hazards Analyses Predicting All-Cause Mortality (1965-1982) in Alameda County in Two Age Groups from Baseline Conditions and Symptoms

	Ages 38-59 (N = 2733)		*Ages 60+ (N = 1205)*	
	Relative Hazard	*95% CI*	*Relative Hazard*	*95% CI*
Adjusted for age conditions & symptoms				
1/0	1.12	(0.85-1.47)	0.88	(0.69-1.11)
2/0	1.13	(0.84-1.52)	1.21	(0.96-1.52)
3+/0	1.64***	(1.27-2.08)	1.24*	(1.03-1.49)
Adjusted for age, baseline disability, other demographic, social and behavioral risk factors conditions and symptoms				
1/0	1.03	(0.78-1.37)	0.91	(0.71-1.17)
2/0	1.01	(0.74-1.37)	1.16	(0.92-1.48)
3+/0	1.17	(0.90-1.54)	1.15	(0.93-1.42)

~.05 < p ≤ .10
*.01 < p ≤ .05; **.001 < p ≤ .01; ***p ≤ .001.
NOTE: Analyses are adjusted for age, then for baseline disability, demographic, social and behavioral risk factors. Adjustment variables include age, sex, race, socio-economic position, 1965 disability, marital status, social isolation, membership in church and non-church groups, smoking, breakfast habits, snacking, physical activity, hours of sleep per night, alcohol consumption, and average relative weight.

Notice that for both age groups, the significant mortality risks associated with having three or more conditions or symptoms, seen in the previous "age-adjusted" models, are no longer in evidence. Individual examination of the sets of demographic, social, and behavioral adjustment factors indicated that the addition of the behavioral factors accounted for most of the reduction in the association between co-morbidity and mortality risk. With adjustments for the demographic and social factors but *not* the behavioral factors, the relative hazard for those with three or more conditions remains significant in the younger age group (RH = 1.36; p = .02). With additional adjustment for the behavioral factors, this relative hazard drops to 1.17 (p = .23). The older age group shows a similar pattern. The relative hazard for those with three or more conditions is 1.20 (p = .11) without adjust-

TABLE 4

Logistic Regression Analyses Predicting 9-year Incidence of Two or More New Conditions or Symptoms in Alameda County (1965-1974) in Two Age Groups from Number of Baseline Conditions and Symptoms

	Ages 38-59 (N = 1976)		*Ages 60+ (N = 563)*	
	Odds Ratio	*95% CI*	*Odds Ratio*	*95%CI*
Adjusted for age conditions and symptoms				
1/0	1.88***	(1.48-2.40)	2.41***	(1.48-3.94)
2/0	3.55***	(2.73-4.61)	2.25**	(1.33-3.81)
3+/0	6.82***	(5.34-8.72)	6.82***	(4.37-10.64)
Analyses adjusted for age, baseline disability, demographic, social and behavioral risk factors conditions and symptoms				
1/0	1.73***	(1.33-2.25)	2.17**	(1.25-3.77)
2/0	3.12***	(2.35-4.15)	1.72~	(0.95-3.10)
3+/0	5.37***	(4.10-7.03)	5.41***	(3.21-9.12)

~ .05 < p ≤ .10
*.01 < p ≤ .05; **.001 < p ≤ .01; ***p ≤ .001.
NOTE: Analyses are adjusted for age, then for baseline disability, demographic, social and behavioral risk factors. Adjustment variables include age, sex, race, socio-economic position, 1965 disability, marital status, social isolation, membership in church and non-church groups, smoking, breakfast habits, snacking, physical activity, hours of sleep per night, alcohol consumption, and average relative weight.

ment for the behavioral factors, and drops to 1.15 (p = .18) after adjustment for these latter factors.

Table 4 presents analyses that examine the association between baseline co-morbidity and the risk of having two or more *new* conditions and/or symptoms develop during a 9-year follow-up (1965-1974). Respondents reporting two or more new conditions and/or symptoms at the 9-year follow-up are compared with those reporting no new conditions or symptoms or only one.

As shown in Table 4, two models were again examined, the first adjusting for age only, the second for a more complete set of factors including demographic, social and behavioral risk factors and functional disability. The age-adjusted odds ratios in the upper portion of Table 4 clearly show that co-morbidity at baseline is significantly

associated with increased risk of multiple new morbidity in both age groups. The odds ratios for those with one, two, and three (or more) conditions are all significant. The presence of even one condition at baseline is associated with an increased risk of multiple new conditions developing during the follow-up period for both age groups (OR = 1.88 and 2.41 respectively for those aged 38-59 and 60 or more). For those with two conditions at baseline, the two age groups show odds ratios of 3.55 and 2.25 respectively for those aged 38-59 and those aged 60 and older. For those with three or more conditions at baseline, both age groups show odds ratios of 6.82.

As shown in the lower portion of Table 4, adjusting further for demographic, behavioral, and social risk factors and functional disability does not alter these patterns for either age group, although the strength of the associations is reduced somewhat. Interestingly, for those aged 38-59 there appears to be a dose-response relationship between the number of baseline conditions and increasing risk of developing two or more new conditions. For those aged 60 or more, the pattern is less clear. In this latter group, those with three (or more) conditions at baseline are still at highest risk but those with one or with two conditions show fairly similar risks.

The final analyses examined here look at the possible consequences of co-morbidity in terms of psychological health. Logistic regression was used to examine the association between baseline co-morbidity and subsequent 9-year depressive symptomatology. As shown in the upper portion of Table 5, age-adjusted odds ratios indicate that for both age groups, the presence of three or more conditions at baseline is associated with significantly increased risk of depression (independent of baseline depression status) (OR = 2.66 and 2.24 respectively for those aged 38-59 and 60 or more). After adjustments for functional disability, demographic, social and behavioral factors, however, only the younger age group continues to show a significant association (OR = 1.99; lower portion Table 5).

Discussion

These analyses of the health consequences of co-morbidity provide some intriguing findings. The age difference in the association between co-morbidity and subsequent depressive symptomatology is

TABLE 5
Logistic Regression Analyses Predicting 9-Year Incidence of Depression in Alameda County (1965-1974) in Two Age Groups from Baseline Conditions and Symptoms

	Ages 38 - 59 (N = 1960)		*Ages 60+ (N = 528)*	
	Odds Ratio	*95% CI*	*Odds Ratio*	*95% CI*
Adjusted for age and baseline depression status conditions & symptoms				
1/0	1.18	(0.79-1.97)	1.93~	(0.95-3.92)
2/0	1.46~	(0.97-2.20)	1.00	(0.43-2.35)
3+/0	2.66***	(1.88-3.76)	2.24***	(1.19-4.22)
Analyses adjusted for age, baseline depression plus baseline disability, demographic, social and behavioral risk factors conditions and symptoms				
1/0	1.10	(0.70-1.71)	1.59	(0.72-3.52)
2/0	1.26	(0.80-1.99)	0.50	(0.18-1.45)
3+/0	1.99***	(1.33-2.98)	1.48	(0.70-3.15)

~.05 < p ≤ .10
*.01 < p ≤ .05; **.001 < p ≤ .01; ***p ≤ .001.
NOTE: Adjustment variables include age, sex, race, socio-economic position, 1965 disability, marital status, social isolation, membership in church and non-church groups, never smoking, eating breakfast regularly, not snacking, being physically active, sleeping 7 or 8 hours, drinking less than 45 drinks per month, and average relative weight.

interesting. One could hypothesize that the stronger association in the younger age group is possibly due to the fact that having three or more conditions prior to the age of 60 is relatively less normative than is the case for those aged 60 or more, where co-morbidity is more common. In this context, it is perhaps not surprising that for younger individuals, the presence of co-morbidity is more strongly and independently associated with increased depressive symptomatology.

In terms of subsequent morbidity risks, the associations between the presence of preexisting conditions and the incidence of two or more new conditions is striking. Even after adjustments for other risk factors, those with three or more conditions at baseline are over five times more likely to develop two or more new conditions over the 9-year follow-up than are those without preexisting conditions. Even those with only one preexisting condition are at increased risk, being about twice as likely to develop two or more new conditions over the 9-year follow-up than are those without preexisting conditions.

We had no strong a priori reason to expect the magnitude of the association between reported numbers of prevalent conditions at baseline and the development of multiple new conditions. Several possible explanations for this finding may be hypothesized. A number of the conditions in our condition list have common risk factors, and respondents with one of these conditions at baseline who had such a risk factor would be more likely than someone without this risk factor to develop a related condition during follow-up. A more intrinsic biological explanation, however, might also be entertained. Those with one or more diseases at baseline might have generalized vulnerability to disease and overall decreased homeostatic reserves that increase their probability of developing other, unrelated diseases at a faster rate than those who are disease-free at baseline. Along these lines, one could hypothesize that for some individuals the presence of disease in one body system may be a marker of overall accelerated aging, leading to increased susceptibility to disease in other systems. Although this study does not allow for a definitive explanation for why those with prevalent disease are more likely to develop new diseases, the clinical and public health implications are nevertheless important. It would seem that the burden of morbidity continues to fall most heavily on those already burdened: The sick get sicker.

In spite of this, and perhaps most intriguing, we found no evidence of significantly increased mortality among those with multiple conditions once their mortality risks were adjusted for demographic, social, and behavioral risk factors. The relative weakness of these morbidity-mortality associations may be due in part to changes in levels of morbidity during the lengthy 17-year follow-up period. Comparisons of 17-year mortality risks based on initial 1965 morbidity status, for example, would be weakened by the appearance of new morbidity in those classified at baseline as having none. In general, the relative weakness of these associations of co-morbidity with mortality suggests that such summary indicators of "health status" do not adequately measure those dimensions of health status that affect mortality risks. By contrast, research has shown that functional disability (Guralnik

& Kaplan, 1987; Branch, 1980), behavioral factors (e.g., health practices) (Kaplan, Seeman, Cohen, Knudsen, & Guralnik, 1987b; Belloc, 1973; Branch & Jette, 1984), and social integration (Berkman & Syme, 1979; Seeman et al., 1987) are among such influential or "consequential" factors. Interestingly, what association there is between the presence of multiple conditions and increased mortality risk is reduced to nonsignificance with the adjustments for these very factors.

The strong role of behavioral factors in reducing the bivariate association between baseline morbidity and subsequent mortality risk is noteworthy. Possibly, behavioral risk factors such as smoking or relative weight may represent potential foci for interventions to reduce the mortality and morbidity risks associated with the presence of co-morbid conditions. Certainly our findings suggest potentially fruitful areas for further research on the links among behavioral risk factors, co-morbidity, and its consequences.

The data presented here also suggest the possible utility of intervention after the onset of multiple conditions to reduce their negative health consequences. For both the incidence of new morbidity as well as overall mortality, behavioral risk factors appear to account for at least part of the elevations in risk among those with multiple health conditions at baseline. Thus, although the prevalence of co-morbidity does rise with age, its consequences would not appear to be invariant. Changes in factors such as physical activity, smoking and relative weight may offer potential avenues for intervention to reduce the mortality and morbidity risks associated with existing conditions.

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