Chapter Two
Empirical Results on the Association Between
Marital Status and Mortality
Among the Seriously Ill

In this chapter, I will look at the role of marital status and marital status transitions in mortality. As indicated in the past chapter, there is a substantial literature suggesting that marital status may be quite important in its mortality implications. In particular, I will be looking at the *magnitude* by which one's risk of death increases after the loss of a spouse, and the *duration* of that increased risk. In this chapter I move through two sets of analyses. First I look at how probands with different diseases suffer from the loss of a spouse. Then I switch focus to look at how spouses suffer from the loss of probands – and how that varies as a function of the disease with which the proband has been diagnosed.

In this chapter I do *not* make explicit references back to the many hypotheses discussed in the preceding chapter, and listed in Table 1.2. Instead, I present the data as they stand, on their own. I do this for two reasons. First, the data are somewhat complicated, and bear discussion on their own terms without the added complexity of links to large literatures; I can draw those links later. Second, the data are somewhat novel and may prompt explanations beyond those already hypothesized. So over the next several pages I will present a series of analyses looking at the impact of marital

transitions on mortality. There have been a few similar studies. (Korenman, Goldman and Fu 1997; Lillard and Panis 1996; Lillard and Waite 1995) I address the comparability of my results in detail in Chapter 3.

In general, my approach is to estimate Cox regression models predicting mortality after controlling for a number of covariates. This is a quite general framework for estimating the effect of covariates on the time until an event occurs, while taking into account both confounding variables and possible incompleteness of follow-up. (Allison 1995) In general we run separate models by gender. There are two reasons for this. First, there is an enormous research literature indicating the fundamental importance of gender to most facets of life; equality of effect is an empirical question, rather than a presupposition. Second, there are clear differences in the biologic hardiness of men and women among the elderly, suggesting that the effect curves might be quite different at many levels. Rather than estimate complicated models with dozens of gender interactions, we estimate separate models for simplicity of presentation.

These models are run within the Care after the Onset of Serious Illness cohort (COSI), about which more will be said shortly. COSI is an incidence cohort of Medicare beneficiaries newly diagnosed with 1 of 13 serious conditions in 1993. The idea is that by looking at people who are reasonably ill, we would be able to use the Medicare claims to accurately ascertain their health status; thus, there would be far less unmeasured health heterogeneity in this sample than in the general population. Furthermore, this population experiences a large force of mortality – thus we will

have sufficient numbers of events for the stable analysis of rare occurrences. And, not inconsequentially, we have a natural starting point for our analyses: the onset of a new disease.

There are some other general advantages to the COSI cohort. They include the highly accurate and complete ascertainment of mortality both for probands (our usual cases of interest, as in the comparison between Couple A and Couple B in Figure 1.1) and their spouses. Even small errors in mortality ascertainment can lead to substantial biases in estimates of the marital mortality effect. (Korenman, Goldman and Fu 1997) The administrative data that underlie the claims have been shown to have more accurate health information for the development of comorbidity measures than do surveys. (Pope et al. 1998; Zhang, Iwashyna and Christakis 1999)

There are certain disadvantages. Most prominent is the lack of many social variables of interest: household-level wealth and kin network information. We are able to detect whether or not the proband qualified for Medicaid-support during 1993; this provides a binary indicator for relative poverty. We also have the median income of the ZIP code in which the proband resides. This is clearly not a perfect proxy for household-level wealth, and a quite poor approximation of household-level income. However, among the elderly, particularly the ill elderly, income is assuredly not the right measure of the financial resources available for mobilization in times of crisis – the average income of level of the neighborhood in which the proband lives may come closer to this. Beyond this, we have no direct measures of social support or kin availability – beyond, obviously, the marital status of the cohort members. Many of

these variables may be causally secondary to marital status, but their empirical import cannot be tested in the data at hand.

The plan for this chapter is as follows. First I introduce the reader to the COSI cohort, discussing the important elements of its design, and the strength and weaknesses of some of the control variables to be used. Then I turn to looking at the effect of marital status at the time of diagnosis on survival following diagnosis with a serious illness. The reader may have noted that the theoretical work makes predications about marital status transitions, not marital status per se. Nonetheless, it is a useful orienting exercise to look at the models of marital status at diagnosis, and it will serve as bridge to the more complicated transition models. Finding these results rather modest, I then examine the mortality implications of marriage in a different way: rather than look at the effect of having a living spouse or not at diagnosis, I look within those married at diagnosis and examine the impact of loss of a spouse. I conclude with a number of sensitivity analyses, demonstrating the robustness of the previous results.

2.1   Data

For the purposes of this project, the COSI cohort consists of 174,162 men and 327,060 women who were newly diagnosed with a serious illness in 1993 and for whom their marital status could be ascertained. Details of the precise definitions of each disease are relegated to a technical appendix, along with a literature review supporting the particular definitions chosen. Because of the limitations of the data,

we use the first hospitalization of the patient to approximate the onset of disease. In general, diseases were chosen which would likely result in a sudden hospitalization, to remove possible lead-time bias.

Thirteen conditions were chosen which represent the most common causes of death from chronic disease in the United States. They were: two forms of heart disease: myocardial infarction ("heart attack") and congestive heart failure; cerebrovascular accident ("stroke"); hip fracture; and several malignancies, such as colon, lung, urinary tract, head and neck, liver and biliary tract, pancreatic, and central nervous system cancer, as well as lymphoma and leukemia. The latter 6 relatively rare categories are aggregated into a "bad cancer" category for some sub-group analyses here in light of their similar mortality and refractoriness to treatment, with an acknowledgment of their divergent pathophysiologies. These conditions were chosen because they also have rather distinct "start" times – there comes a point in these conditions at which the proband will be hospitalized, and that will represent a threshold change in the intensity of disease. Ideally, the time between when this threshold change occurs and when the proband presents would not be influenced by social factors under study – this corresponds to the well-known epidemiologic problems of ascertainment bias and lead-time bias. We cannot directly test the degree of such biases within our data; however, in the SEER data, there was very little difference in the distribution of stage of colon cancer at presentation as a function of marital status (Iwashyna 1999), a finding others have noted in more coarse-grained models. (Goodwin et al. 1987) As colon cancer is the condition with probably the

greatest degree of "prodromal" symptoms – that is, "warning symptoms" that occur at very early stages of the disease – of those included in COSI, this is quite reassuring.

Mortality follow-up for all cohort members and their spouses was obtained from the highly complete Health Care Financing Administration Vital Status files through June 30, 1999. This provides up to 6.5 years of follow-up for all cohort members, and at least 5.5 years.

2.1.1   Detection of Marriage

Marital status is not directly available in the Medicare claims. However, certain regularities in the assignment of benefits and coding structure allows for the detection of substantial numbers of married couples and widows. The details of these methods have been published elsewhere, (Iwashyna et al. 1998) with discussion (Iwashyna et al. 2000; Kestenbaum 2000) and external validation. (Iwashyna et al. 2001)

In general, we can detect all married couples where one spouse earned twice as much as the other. When this is true, after taking into account Social Security ceilings on relevant income, the lower-earning retired spouse automatically receives a (larger) benefit as a "dependent spouse" than as a primary beneficiary. This leads to the assignment of Health Insurance Claim Numbers by which husbands and wives can be uniquely linked as long as both of them have ever qualified for Medicare (even if no claims were ever filed). In this way, it is possible to directly detect about 30% of couples in which both members are at least age 65. (Kestenbaum 1997) When one

member of such couples dies, their mortality information can still be retrieved, allowing the determination of the precise date on which the surviving spouse became a widow/er. In addition, if the higher earning member of the couple dies first – regardless of the degree of imbalance in earnings – then the surviving widow can be linked to deceased spouse.

Our analytic cohort consists of all individuals who met the diagnosis-based COSI empanelment criteria and whose marital status could be ascertained as either currently married or widowed to a uniquely identified person. However, there is an un-analyzable residual category of people containing those who are life-long single, married but undetected, and widowed but undetected; they are necessarily excluded. All analyses here compare the currently-married to the widowed in order to estimate the effects of marriage. As various non-married states may be heterogenous in their mortality implications, care will be exercised in the interpretation of results.

The general characteristics of the COSI cohort are shown in Table 2.1. There are 174,162 men and 327,060 women; their marital status is shown in Figure 2.1 The men are slightly younger than the women, and substantially more likely have a spouse who is still alive. The distributions of disease are broadly similar, with men having relatively somewhat more hip attacks and cancer, women having more heart fractures. 28.9% of men and 18.3% of women have a cancer diagnosis.

2.1.2 Definition of Comorbidities

In order to make valid mortality comparisons between groups with any hope of causal argument, differences in health at baseline must be taken into account. One fruitful way to operationalize "health" for such purposes is the notion of comorbidity burden. A comorbidity is a chronic disease of substantial mortality, morbidity, or management burden. The number of such comorbid conditions a patient has are often aggregated into comorbidity index to provide a simple scalar measure. This notion corresponds nicely with the way clinicians judge "how sick" a patient is.

Among the most popular comorbidity indices in claims data research are those based on the work of Mary Charlson and her collaborators,(Charlson et al. 1987) particularly as implemented in the ICD-9-CM codes for computerized use. (D'Hoore, Sicotte and Tilquin 1993; Deyo, Cherkin and Ciol 1992; Romano, Roos and Jollis 1993a) While several alternative risk adjustment approaches have also been published,(Brailer et al. 1996; DesHarnais et al. 1990; Elixhauser et al. 1998; Fowles et al. 1996; Iezzoni 1997; Iezzoni et al. 1994; Kuykendall et al. 1995; Schwartz et al. 1996; Starfield et al. 1991; Weiner et al. 1991) the Charlson method is extremely popular and has been used extensively. (Christakis and Escarce 1996; D'Hoore, Sicotte and Tilquin 1993; D'Hoore, Bouckaert and Tilquin 1996; Iwashyna et al. 1998; Roos et al. 1989) Direct comparisons between these alternative scales are relatively rare, and the choice of the Charlson index is somewhat arbitrary. (Ghali et al. 1996; Hughes et al. 1996; Romano, Roos and Jollis 1993b; Roos, Sharp and Cohen 1991) On the whole, these indices have been developed for the prediction of *mortality*

following *hospitalization*, a situation operationally identical to the purposes to which they will be put here.

In a separate paper, we took advantage of the longitudinal, individually-linked inpatient, outpatient, and physician claims available in the Medicare Current Beneficiary Survey. (Zhang, Iwashyna and Christakis 1999) In a representative sample of Medicare beneficiaries, we examined the performance of Charlson scores based on alternative sources of data. Statistically and empirically significant improvements in the prediction of mortality were obtained by incorporating alternative sources of data —particularly two years of inpatient lookback combined with one year of outpatient and auxiliary claims lookback — but only if indices derived from distinct sources of data are entered into the regression distinctly. Further, we found that these improvements in explanatory power were largely true whether or not one also controlled for Charlson scores based on self-reported health history and / or based on the secondary diagnoses from the claim for the index hospitalization.

2.1.3   Race

The persistent racial differences in health in the United States are well-known. (Martin and Soldo 1997) Medicare data, however, have certain well-known limitations with respect to their racial classification system, and the race codes provided in the claims can only be reliably used for white/non-white comparisons. (Lauderdale and Goldberg 1996) However, our data included the actual names of

beneficiaries. As such, we were able to apply well-validated algorithms for identifying Hispanic and Asian-American ethnicities, substantially improving the adequacy of the racial/ethnic classification system we can use here. (Lauderdale and Kestenbaum 2000; Word and Perkins Jr. 1996)

2.1.4   SES Indicators

There is a substantial body of research demonstrating differences in health as function of wealth, and strongly arguing that causality runs from wealth to health rather than vice versa. (Smith 1999) For the current project, we have two measures of financial resources. The first is an indicator of whether the proband qualified for Medicaid supplementation of Medicare fees during 1993. This measure has been used previously (Escarce et al. 1993), and clearly shown to detect a population of much lower financial resources. (Carpenter 1998; Clark and Hulbert 1998; Ettner 1998; Khandker and McCormack 1999; Liu, Long and Aragon 1998; Parente and Evans 1998; Pope et al. 1998) However, it is also rather coarse.

Linkage to geographical data sources provides an appealing supplement. We have linked at the ZIP-code level to 1990 Decennial Census median incomes; ZIP codes aggregate 25,000 – 50,000 people. This provides a continuous measure that is likely well-correlated with household-level total financial resources. The interpretive validity of this approach has been hotly contested, with strongly contradictory interpretation being drawn from very similar empirical results. (Davey Smith, Ben-Shlomo and Hart 1999; Geronimus and Bound 1998; Geronimus, Bound and Neidert

1996; Greenwald et al. 1994; Hofer et al. 1998; Hyndman et al. 1995; Krieger 1992; Summer and Wolfe 1978) This debate has been reviewed at some length elsewhere. (Iwashyna 2000) The major interpretive difficulty comes because geographical data may tend to under-control for variation in economic resources – for example, it will fail to take into account the fact that African-Americans in general have lower levels of wealth at the same income levels as whites. (Oliver and Shapiro 1995)

For our purposes here, the biases generally will not contradict the results that we will report below. As the widowed are generally poorer than the married, the bias of the unmeasured financial resources would tend to overestimate the effect of marriage. This would be a problem to the degree that widowhood results from lower financial resources – that is, if the poor are more likely to become widowed. If the lower financial resources of widowhood result from the process of spousal loss itself (e.g. after the result of high medical expenses during a catastrophic illness), then the "wealth effect" is causally secondary to the marital status effect (*i.e.*, it is the mechanism of the marital status effect), and should *not* be controlled in the regressions.

2.2   Whole Cohort Analyses

Figure 2.2 presents the simple survival curves for men and women for the cohort as a whole, separately by gender. Here we are looking at the survival of probands as a function of time of death of the spouse: did the spouse die before diagnosis, or after it? (This is similar to the comparison between Couples A and B in

the Figure 1.1.) These curves use the Kaplan-Meier (KM) approach to dealing with censored data; they are not adjusted for any covariates, including the substantial difference in the age distribution of the married and the widowed. The married appear to have better mortality. The overall mortality profiles are quite severe, with 76.7% of men and 71.8% of women dying by the cessation of follow-up. Prominent in these curves is the steep initial mortality upon diagnoses of many of these conditions (particularly myocardial infarction and stroke).

Note that all regression results presented below have been confirmed for within the subgroup that survives their initial hospitalization. None of my conclusions are sensitive to this.

Figure 2.3 presents the simple survival curves for three age groups, again separately for men and women. (Men are in Figure 2.3a, women in Figure 2.3b.) Even this quite crude adjustment removes nearly all of the apparent benefit of being married relative to being widowed.

2.2.1   Survival Analyses for All Cases

In Table 2.2 we present the first of many survival analyses predicting mortality. These are Cox regressions – the so-called "proportional hazards" model of semi-parametric survival analysis. Separate models are estimated for men and for women. Coefficients are presented as hazard ratios; a hazard ratio of 1 is associated with no difference in the expected mortality between the groups on that coefficient. A hazard ratio greater than 1 is associated with an increased hazard of death – which

is to say that those individuals die more quickly. As hazard ratios are exponentiated

transformations of the actual coefficients estimated by the regression, they have

asymmetric confidence intervals. (That is, the hazard ratio $= e^\beta$.) In order to

minimize the complexity of these tables, p-values are presented to summarize the

standard error information.

As will be the convention for all the Cox models presented here, separate

models are presented in columns. The rows are divided into a number of sections. In

the upper section we present the results for marital status, and the hazard ratio

associated with a 1 year increase in age. This provides a useful metric that will be

discussed at length below. In the lower section we present the results for the control

variables. At the very bottom is the sample size for the regression

Let us look at the first column of Table 2.2. This presents the results for all

men in our cohort, looking at the impact of covariates on mortality following

diagnosis with any COSI illness. At the very bottom of the column, we see that this

regression was estimated in a cohort of 174,162 men. We see that increasing age is

associated with an increasing hazard of death, with a hazard ratio of 1.054 for each

additional year. Turning to the controls section, we see that there is substantial

heterogeneity among primary diagnoses in their force of mortality. Pancreatic cancer

stands out as a particularly lethal condition. Moving down, we see that individuals

with increasing levels of comorbidity are associated with higher hazards of death.

African-Americans face a higher hazard of death than do whites. Individuals who are

poor enough to have qualified for Medicaid face a higher hazard of death. An

increase in the median income of a proband's neighborhood is associated with a decrease in the hazard of death for men. On either of these metrics of financial resources, the wealthy live longer even after controlling for a host of health factors.

Now, return to the top panel of the first column. We see that having a wife dead at the time of diagnosis is associated with a statistically significant increase in mortality for men. That is, the widowed and the married do not seem to face the same force of mortality following diagnosis. However the increased hazard of death is only 1.9%. Still, it is in general difficult to have good intuitions as to what a "large" hazard ratio is. Therefore I convert the hazard ratios for the effect of marriage into "age-equivalents". That is, I divide the coefficients for the loss of a spouse by the coefficient for an additional year of age; this provides a natural comparable metric for the coefficients: "How much older does a married man have to be, in order to have the same hazard of death as a man who has lost his spouse?" (When quite small, hazard ratios closely approximate the coefficients, so one can get a sense of this by dividing the hazard ratios; to be exact it must be done on the untransformed coefficients.) The point estimate suggests that a married man needs to be only a few months older in order to have the same mortality as man who is widowed.

A very similar picture is presented for women in the second column of the table. Again, increasing age, increasing comorbidity, non-white race, and relative poverty are all associated with statistically significant increases in mortality. In this case, there does not appear to be any protective effect of marital status, even at the trivial level found among men. Marriage appears to be equivalent to the increased

risk associated with aging less than one month. It is worth emphasizing, however, that in all of the foregoing, the probands were already diagnosed with a serious illness; so marital status is associated with only a minute survival advantage among the already ill in this data.

2.2.2   Survival Analyses by Condition

The COSI cohort as a whole is not a representative sample of the elderly, or even the sick elderly. Instead, it is a series of disease-based cohorts. Within a given diagnostic category, all anchored at a common event of disease-onset, there is assuredly greatly reduced unobserved health heterogeneity. In these cohorts, wherein the health of individuals is relatively homogenous (particularly after comorbidity adjustment), we can look at the impact of marital status at diagnosis with less fear of confounding.

Table 2.3 presents the results by primary diagnosis for men. Table 2.4 presents the similar results for women. In 12 of the 16 cases (8 conditions by 2 genders) there is no statistically significant difference in the mortality between the married and the widowed, conditional upon diagnosis with one of these serious illnesses For four of the sixteen conditions, there appears to be a modest effects – all in the direction of widowhood being *protective*. In all of the cases, the magnitudes are quite modest – typically equivalent to a few months of difference in age, and at the most equal to only 2.5 years difference in age at diagnosis (*not* life expectancy). Overall, this is a replication of the cross-sectional findings of Korenman, Goldman

and Fu (1997) that widowhood in and of itself is not necessarily associated with higher mortality. This appears to be the result of the combined effects of selection (those widows who benefited most from marriage have died) and from adaptation (as replacements for marriage are found). Since there are individuals in our sample who have been widowed for over 20 years, the direct relevance of these findings to understanding the mechanism of marital mortality reduction is unclear at best, as others have argued. (Goldman 1993, 1994)

2.3   Loss of Spouse Analyses

Having found quite modest effects of marital status, *per se*, on mortality, we then turn to asking: what is the effect of the loss of a spouse? After all, some of the widows in our sample had survived their spouse by decades; some degree of both adaptation and healthy-survivor selection is likely to have come into play. The modeling strategy is quite similar to that in the preceding sections. We take a Cox regression predicting mortality following diagnosis with a serious illness, and control for age, race, income, and comorbidity burden. In this case, we look only at those who are married and coresiding with their spouse at the time of diagnosis. We look at the effect of the death of a spouse thereafter using time-varying covariates. This flexible approach lets us examine the time course of any increase in mortality associated with the loss of spouse – how fast does the risk of death increase? For how long does it stay elevated?

2.3.1 Cohort Definition

The descriptive statistics for the married-at-diagnosis subset of the COSI cohort are described in Table 2.5, which parallels the structure of Table 2.1 for the cohort as a whole. There are 108,368 men; 72.5% will die before the end of follow-up. There are 58,416 women, 62.5% of whom will die before the end of follow-up. 9.0% of these (sick) men and 25.0% of these (sick) women will experience a marital status transition during the follow-up: that is, their spouse will die before they do. Only in 0.4% of men and 0.7% of women will these events occur in the same 30 day period in which the proband dies.

2.3.2 Survival Analyses for All Causes

Regression results are presented in Table 2.6 for the married COSI cohort as a whole. In the first column we see the effect for men. Again, in the third panel, we see that African-Americans, poorer, and sicker individuals die more quickly. There are even gradients of increasing risk across the comorbidity measures.

In the first panel is the hazard ratio for age, showing that each additional year of age at the time of diagnosis is associated with a 5% increase in the hazard of death for the proband. The effects of the loss of a spouse are parameterized as a series of 4 indicator variables. The first indicates the hazard of death of a man who has lost a spouse within the last year, relative to someone who is still married, holding all else constant. The second indicator indicates the relative hazard of death during the second year after the death of the spouse for those who are still alive. The third

indicator indicates the relative hazard of death during the third year after the loss of

the spouse, that is, days 730 through 1095 after the spouse's death for those who are

still alive. The fourth indicator indicates the relative hazard of death thereafter, from

day 1096 to the end of follow-up, up to a maximum of 6.5 years after the loss of a

spouse. This highly flexible parameterization has the marked benefit of not forcing

an arbitrary form onto the hazards, when no such form can be strongly recommended

based on past work. It has the disadvantage that the estimates can be somewhat

unstable when we look within subgroups – such as within diagnosis by gender. Since

this is the first work exploring this area, it seemed that avoiding arbitrary smoothing

at the outset would be best.

Looking in the second panel, these numbers have again been transformed into

age equivalents. Again, these answer the question "How much older does a married

man have to be, in order to have the same hazard of death as a man who has lost his

spouse x years ago?" It appears that for the cohort as a whole, the loss of a spouse is

associated with a risk of death equivalent to being 4 years older at diagnosis, and that

that risk *may* decline slightly towards the equivalent of 3 years by the "long-term".

In the second column of the table, we can see the results for women, which

are quite similar. Again, the covariates all perform as expected. There is a highly

statistically significant difference in the hazard of death between those who have lost

a spouse in the last year and those who are still married, an effect equal to about 2.5

years of age. This effect may decline modestly in the long-term, but does not seem to

disappear.

2.3.3   Survival Analyses by Condition for Married Men

A more complicated picture must be told when looking within diagnostic categories. This is done for men in Table 2.7. In the first column we see the results for those who have had a myocardial infarction. Men who have just lost their spouse suffer an increased hazard of death, equal to about 3 years of age. This stays fairly constant thereafter. This is displayed graphically in Figure 2.4a, where the age-equivalent hazard ratios are graphed; this is precisely the same data

A different pattern is seen for the other non-cancer diagnoses. For each of these, there is a similar initial hazard of death, but it declines to a statistically insignificant and substantively negligible level by three years after the death of their spouse. For those who survive this bereavement period, they appear to have the same risk of death as someone who has never lost their spouse but is only 6 months older.

A third pattern appears for most of the malignancies. Precise results are tabulated in the latter columns of Table 2.7. They are also shown graphically in Figure 2.4b. In each case, the immediate bereavement period is associated with an increased risk of death – with point estimates typically higher than the noncancer diagnoses. However, these effects quickly decay towards zero and become statistically insignificant. Part of this may be the extraordinary force of mortality of many of these diseases; 93.1% of men with lung cancer die by the end of follow-up, in contrast to 72.5% for the sample as whole. Only 3.1% of men with lung cancer have a wife die in the interval between their own diagnosis and death; thus there are

relatively few events from which to estimate marital mortality effects, and even less "space" for people to be long-term survivors.

Finally, there is the case of those with urinary tract cancers. As the reader may recall, these do not include men with prostate cancer. This cancer shows a pattern similar to that of heart attack patients, but with even more striking detriments to those who lose a spouse. Here the loss of a spouse is associated with a risk of death equivalent to being over 5 years older at diagnosis, and that trend appears to increase with time since bereavement.

All of these models are parameterized in the tables so that the significance tests verify whether or not the hazard ratio is one in a given period after the loss a spouse. An alternative – but equivalent – parameterization is necessary to confirm that the increased risk of bereavement decreases at the times that I have suggested it does. (That is, to ask: is the hazard ratio in the second year after the loss of a spouse different than the hazard ratio of during the first year of bereavement.) These models have been run and confirm at conventional significance levels the patterns presented here. They also suggest that the zig-zag pattern that appears in the cancer diagnoses for both men and women (to be presented below) is largely statistical noise, not a true cyclic pattern.

2.3.4   Survival Analyses by Condition for Married Women

Women display a similar heterogeneity of responses to the loss of a spouse. The full regression results for female probands, by primary diagnosis, are shown in

Table 2.8. These results are presented graphically in Figure 2.5. In this case, three patterns appear.

For women diagnosed with a myocardial infarction, the loss of a spouse is associated with an increased hazard of death thereafter. These results are shown in the first column of Table 2.8, and graphed in Figure 2.5a. The point estimate of the effect for the first year of bereavement is 3.0 years, very similar to the magnitude for men. And the effect appears relatively constant through the end of follow-up.

For women as for men, those who suffered from stroke, hip fracture, and congestive heart failure show a similar, second pattern. In each case, the first year after diagnosis is associated with an increased risk of death – the same increase in hazard associated with being about 2.5 years older. As with men, these detrimental effects of the loss of a spouse appear to decay. In the case of women, they decay quite rapidly, vanishing by the end of the second year of bereavement, possibly even sooner. By three years out, there is no statistically significant difference in the mortality of those who have lost a spouse and those who are still married.

In contrast to the preceding similarity between men and women, there is a rather marked difference in the case of those afflicted with cancer. In this case, the loss of a spouse is inconsequential from a mortality perspective. The point estimates of the effects are quite unstable, occasionally reaching statistical significance, but without any apparent pattern. Although relatively few women suffer from urinary tract cancers, in this case they appear to have a similar course to that of other women with malignancies.

2.3.5   Summary for Probands

Four patterns appear in the data:

- *Enduring Bereavement*: there is an immediate rise in the hazard of death following the loss of the spouse. Although there is a slight decline after the first year, the hazard never returns to the pre-bereavement level – that is, after the death of a spouse, in the time period in our data, the widowed are always at an increased risk of death. Men and women who have had a heart attack displayed this pattern, as did men with urinary tract cancer.

- *Prolonged Bereavement*: there is an immediate rise in the hazard of death. The widowed face increased mortality for two to three years, but then return to their baseline risk of death as if they had not lost a spouse. Men who have congestive heart failure, a hip fracture, or a stroke displayed this pattern.

- *Brief Bereavement*: the widowed are at an increased risk of death only during the first year after the death of their partner. Men with cancer and women with congestive heart failure, a hip fracture and a stroke displayed this pattern.

- *No Bereavement*: the widowed face no significant increase in their mortality following the loss of a spouse. Women with cancer displayed this pattern.

Striking – and personally unexpected – was the similarity in the *magnitude* of the effects across patterns. Among those probands who showed a statistically discernable increased mortality during the first year after the death of their spouse, the effects clustered at a magnitude equivalent to about 3 years of increased age. (The effects were modestly higher for men with cancer.)

The presentation of the curves in this chapter suggests that an area-under-the-curve, or "total years of life lost" summary statistic might be used. However, no such statistic can be generated in a valid way in the case of Cox regression models with time-varying covariates. As such, we must use a qualitative assessment of which diseases are most sensitive to the loss of a spouse – that is, which diseases make probands most likely to die after the loss of a spouse. Given the general equivalence in the *magnitude* of effects across diseases, I will make my interpretations based primarily on *duration* of effect. That is, I contend that men and women who have had an M.I., and show the enduring bereavement pattern, have a greater effect than men with cancer, who show the brief bereavement pattern. Longer periods of bereavement are an indicator of greater sensitivity to the loss of the spouse – and, to foreshadow, presumably greater dependence on the spouse for one's health. We will return shortly to the implications that these results have for the many hypotheses formulated in the first chapter. First, however, we need to estimate another set of hazard ratios from the COSI data.

2.4   Loss of Proband Analyses

For a number of the theories discussed in the last chapter, cleaner tests could be developed by looking at the "well" spouses of our COSI cohort members. That is, suppose a husband is in COSI. Then we can look at his *wife's* mortality following his diagnosis. We can see how that varies depending on what his disease was. These are the comparisons between Couples C and D that were schematized in Figure 1.1.

Given the high mortality of COSI members, we can examine the impact of spousal loss on this population of relatively healthy spouses. Naturally, we develop Charlson scores in order to control for spousal health at base line.

The basic demographics of the spousal cohorts are shown in Tables 2.9. Given well-known homophily in mating, these results look quite similar to those in Table 2.5. Of note, however, are the much lower baseline Charlson scores – as expected, the spouses are much more healthy than the COSI members. Throughout the following, I will maintain the convention of referring to the COSI member as the proband, and the "well" member the spouse.

The tables and figures here precisely parallel those of the preceding sections. We are looking at a cohort, all of whom are married at the baseline, and examining the effects of the loss of a proband on the spouse's mortality. We also examine how these patterns vary as a function of the disease from which the proband suffered. Let's begin with the husbands of women in COSI; the regression results are presented in Table 2.10. We see that increasing spousal age is associated with an increased hazard of death. The hazard ratio of age varies very little as function of the proband's disease as would be expected.

The trajectories of the hazard ratios of death after spousal loss are graphed in Figure 2.6. All disease show evidence of an increased risk of death during the first year after spousal loss, with that increased risk declining thereafter. It appears, however, that the trajectories are in general "flatter" than we observed among the COSI probands themselves – that is, there appears to be a more persistent

disadvantage to losing a spouse among the well than among the ill. The risk of death for those husbands whose wives died with malignancies are in general higher than others. There is considerable crisscrossing for the hazards of those husbands who died with a disease other than cancer – there is no clear ordering of the relative hazards of deaths among those without a malignancy.

In Table 2.11, and graphically in Figure 2.7, the results for the wives of husband who were in COSI. Again, there appears to be a clear increase in risk in the immediate bereavement period of 1 year, with a general decline thereafter. For wives, there is somewhat less variability across husband's diseases. The only pattern seems to be that loss of a proband to cancer or MI is associated with a greater risk of death than the loss of a proband to stroke or congestive heart failure. Indeed, after the first year, women who have lost a husband who had CHF are at no increased risk of mortality relative to those whose husband with CHF is still alive.

2.4.1   Summary for Spouses

Two general patterns seem worthy of comment. The first is the enduring effects of spousal loss. As shown in Tables 2.7 and 2.8, most sick individuals suffer only a passing decrement from losing a well spouse. In contrast, these results show that generally well-individuals suffer an enduring decrement in health from losing a sick spouse. The second pattern is the greater symmetry between men and women among the well. Conditional on having a sick spouse, the effect of the loss of that sick spouse on a well individual is relatively independent of gender.

2.5   The Impact of Alzheimer's Dementia

Several of the tests proposed in Chapter 1 exploit the cognitive problems caused by Alzheimer's Dementia. Alzheimer's can have profound mental effects while leaving an individual's physical functioning, per se, relatively unharmed; this makes it an interesting case from a social scientific perspective, while by no means minimizing the real suffering of those who it afflicts and who care for its sufferers.

The detection of Alzheimer's in the Medicare claims is generally believed to be imperfect. Two different approaches were taken to its detection. For probands – all of whom by definition have an index admission – we examined their claim for the index admission to see if Alzheimer's was noted as a comorbidity. 3.7% of male and 4.5% of female probands were identified as having Alzheimer's. These number represent an unknown (likely modest, perhaps 50%) sensitivity but presumably have high specificity. For spouses, for whom we have far fewer claims, we surveilled all claims, including outpatient, physician/supplier and skilled nursing facilities for a diagnosis. 2.3% of male and 1.4% of female spouses were thereby identified as having Alzheimer's.

I then ran Cox models hoping to see if the presence of Alzheimer's in one party influenced the magnitude of the bereavement effects. (The regressions also controlled for a main effect of Alzheimer's, as well as all the socio-demographic and comorbidity controls of the past regressions.) Given the relative paucity of detected Alzheimer's patients I expected that caution would be needed in the interpretation of the results.

The results for men are presented in Table 2.12. The first set of results examine the impact on male probands of having a wife who had Alzheimer's. None of the interactions attained statistical significance – formally, there was insufficient evidence to state that the bereavement effect varied between those whose spouse did and did not have Alzheimer's. The point estimates are large and in inconsistent directions; were the same estimates measured with greater precision, they would be substantively interesting to us, although difficult to interpret. I can only summarize this regression as "inconclusive".

In the case of male spouses who lost a proband who suffered from Alzheimer's, there appears to be more of a trend. Here three of the four coefficients suggest that much of the bereavement effect is attenuated when a spouse has Alzheimer's; again, however, the standard errors are so large as to prevent any formal interpretation. Finally, we have the case of male probands who themselves had Alzheimer's. Here, again none of the coefficients is statistically different from zero. But in this case, the point estimates are quite small, suggesting that there really is no effect. (Note, however, that the quite large standard errors could be masking an effect of significant size.) A broadly similar story can be told about the effects of own and husband's Alzheimer's for women – there may be an effect, but the current data do not allow sufficiently precise estimation to be sure.[1]

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[1] The comparison group here – people who lose a spouse who has Alzheimer's – is simply quite rare. This may be precisely the time when a case-control methodology is required, despite its interpretive limits; for some things cohorts simply re not efficient.

2.6   Caregiver Burden as Time Since Diagnosis

In order to assess the impact of caregiver burden on spousal health, we checked to see if the hazard of death associated with the loss of the proband varied as a function of the time since the diagnosis of the proband. For none of the conditions was this interaction statistically significant. This complements the other finding with regard to burden: that diseases with "substantial" burden are not consistently different in their impact than those of minimal caregiver burden.

2.7   Sensitivity Analyses

In the following, I present a series of ancillary analyses to help determine how sensitive our results are to modeling choices, and to interpretive problems.

2.7.1   Selection Test A: Decreasing Magnitude with Age of Spouse

In order to test the possibility of positive assortative mating, we asked: "Does the age of the spouse when the proband gets sick influence the impact of loss of the proband on the spouse?" We looked at the impact of proband loss on spousal mortality to maximize the possibility that an effect would be detected – since so many probands die, we have more stable and precise estimates of the impact of proband loss on spousal mortality than vice versa. Only for women married to males who had an M.I. was there any evidence that this interaction was significant ($\chi^2 = 12.12$ with 4 degrees of freedom, p=0.0165); in none of the 15 other gender/disease regressions was there any support. That is, there seems to be no systematic relationship between

the age at which a spousal loss occurs and its impact on the mortality of the surviving spouse. The hypotheses that the marital mortality effect might be caused by positive assortative mating – the accuracy of which should decline with time since matching – finds no substantial support.

2.7.2   Selection Test B: Joint Health

As mentioned in the last chapter, it is possible that spousal death may simply serve as an proxy for the proband's health, rather than as a true shock to the proband itself. If this was true, we would expect a similar correlation of the onset of disease. That is, if the association between the times of death of spouses is caused by both spouses getting sick at the same time for some reason, then we should, in fact, see both members of the couple being diagnosed with serious disease more often than expected by chance. This is tested in Table 2.14, and husbands who are in COSI are *not* found to be at an increased risk for having wives in COSI. That is, in this admittedly highly stringent test, there is no evidence to support a positive correlation in the timing of the onset of disease among husbands and wives.

As a second test of this form of selection, I checked to see if there is any heterogeneity among the empanelling diseases in their likelihood of being associated with having a spouse also in COSI. I empirically chose CNS cancer as the reference category, as it had the lowest point estimate of the odds of having a spouse in COSI in a logistic regression that also controlled for age and sex. A group test of significance of all of the disease coefficients had a chi-squared of 22.8 with 12 degrees of

freedom, or a probability of 0.0298. In a dataset of more than 160,000 cases this suggests there is very little variation across diseases in one's odds of being newly diagnosed with a serious illness in 1993 and also having your spouse fall ill with a serious illness at the same time. In and of itself, this suggests that either (1) there is an as-of-yet unknown behavioral component to the onset of the rare cancers; or (2) that the behavioral component of the risk of onset of diseases like heart attack and hip fracture is not that highly shared between spouses.

2.7.3   Selection Test C: Impact of Spousal Loss

For both men and women with a spouse alive at baseline, the same regressions as were presented in Tables 2.7 and 2.8 were re-executed. Deaths of a spouse who had a cardiac arrest were to be compared to deaths from all other sources by interacting an indicators for "spouse died from a cardiac arrest" with the 4-indicator parameterization, and jointly testing the significance of all four interactions. However, there were too few patients who lost spouses to cardiac arrests in our sample (less than 200 over-all) in order reliably estimate any effects.

2.7.4   Proportionality Violations

The core models presented in Tables 2.7 and 2.8 were checked for violations of the proportionality assumption in the case of the effects of spousal loss. This is analytically equivalent to checking if the effects of spousal loss varied with duration of illness. The χ^2 tests are presented in Table 2.15 – they show no more than trivial

deviations from the proportionality assumption. Inspection of the coefficients indicated that our interpretation would not be altered by these violations.

Similarly, the age coefficients were tested for proportionality violations. In this case, nearly all coefficients showed statistically significant violations. The results are shown in Table 2.16. While statistically significant, the coefficients are rather small. However, across the range of time observed in the data (potentially up to 6.5 years of follow-up), some nontrivial differences in the estimated effect could be noted. However, none of the bereavement coefficients were sensitive to this violation or its correction. In all, this suggests that the interpretation of the "age equivalent" transformations of the bereavement coefficients needs to use these transformations as a general guide, not an exact figure. I do not believe any of my conclusions are sensitive to these differences.

2.7.5   Survival of Initial Admission

Preliminary versions of the models presented in this chapter were all re-executed in that population which survived their initial hospitalization. None of the results presented varied substantially or interestingly.

Figure 2.1: Marital Status in COSI

COSI Cohort

WOMEN
327,060

MEN
174,162

Widowed
at Diagnosis
268,644

Married
at Diagnosis
58,416

Widowed
at Diagnosis
65,794

Married
at Diagnosis
108,368
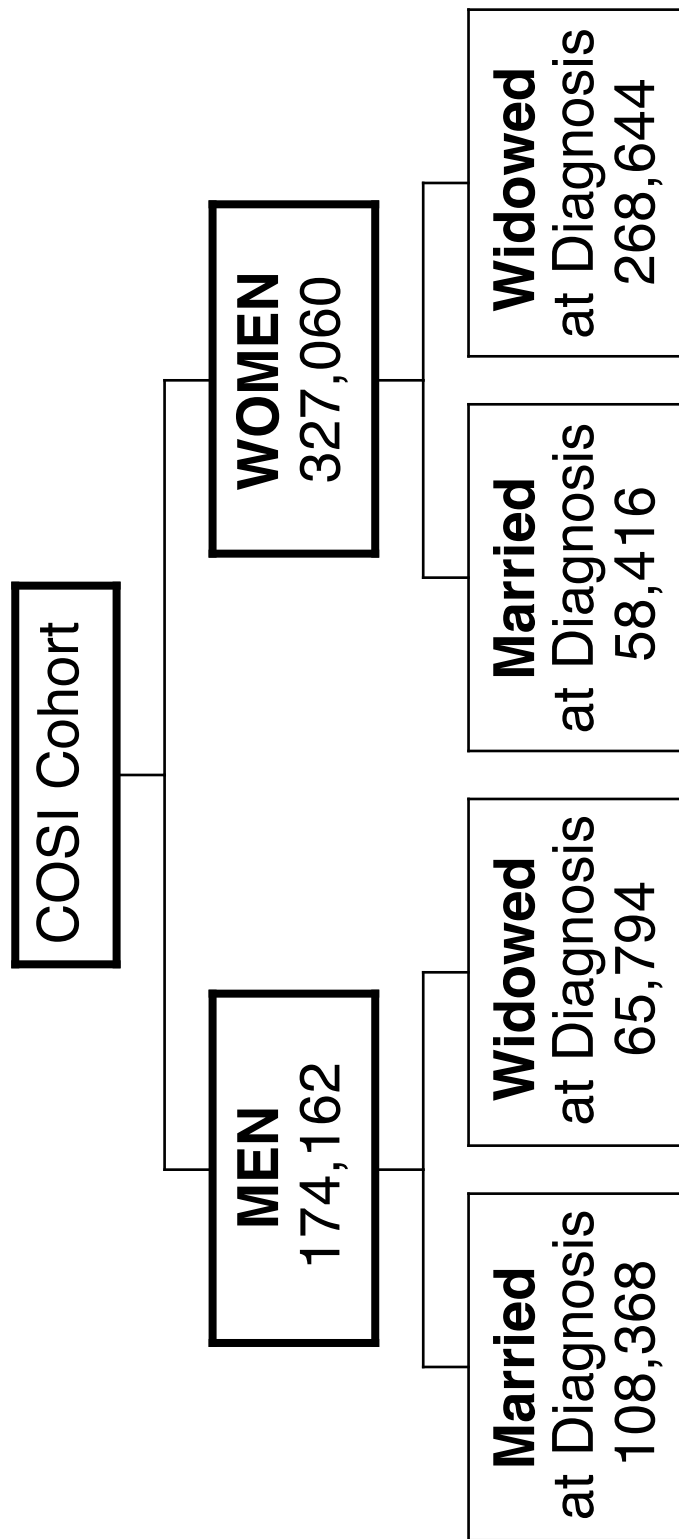
Figure 2.2: Survival Following Diagnosis

Legend: Married Women, Widowed Women, Married Men, Widowed Men

X-axis: Months Since Diagnosis (0, 6, 12, 18, 24, 30, 36, 42, 48, 54, 60, 66, 72, 78)

Y-axis: Fraction Alive (0, 0.25, 0.5, 0.75, 1)
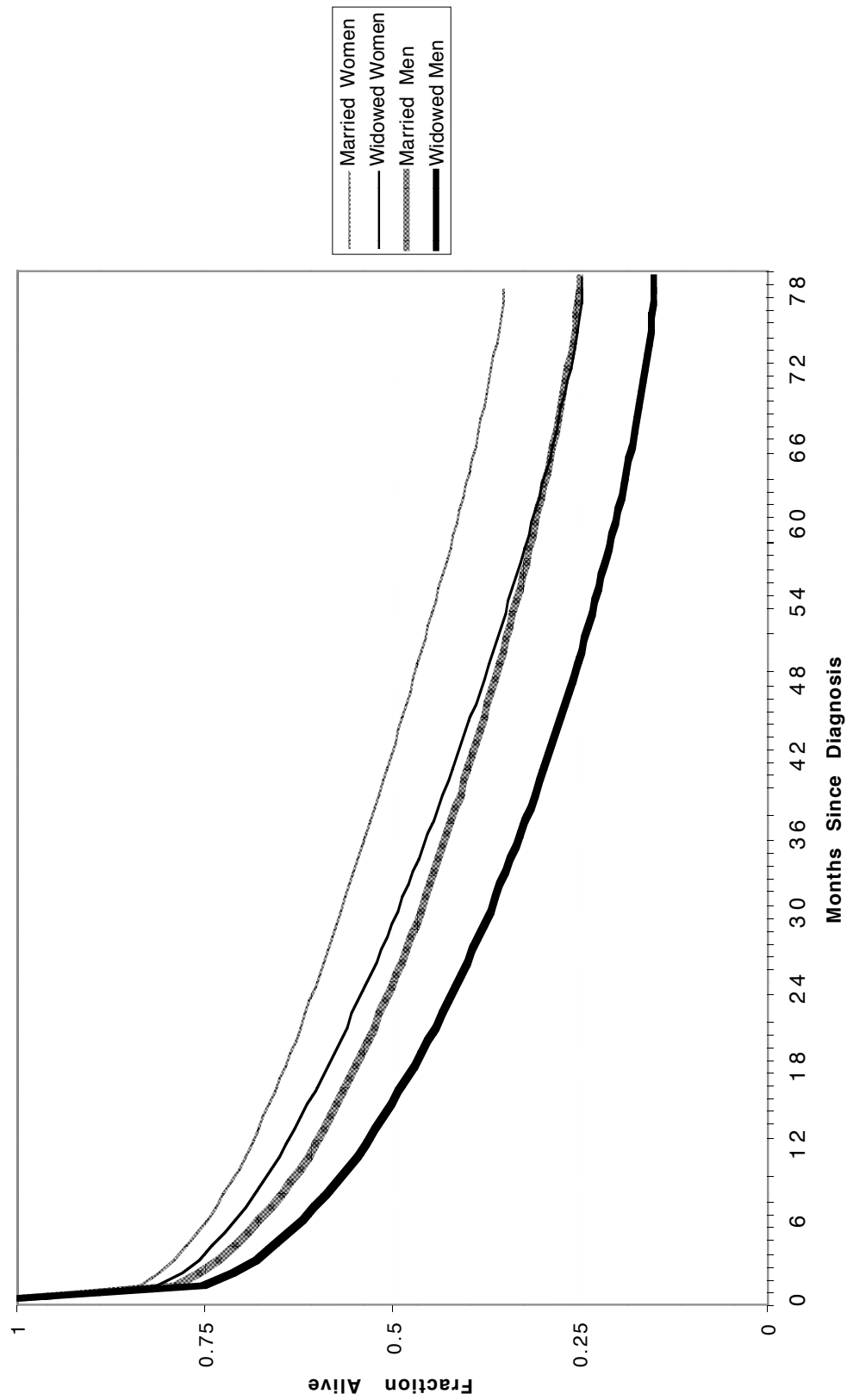
Figure 2.3a: Survival Following Diagnosis - Men
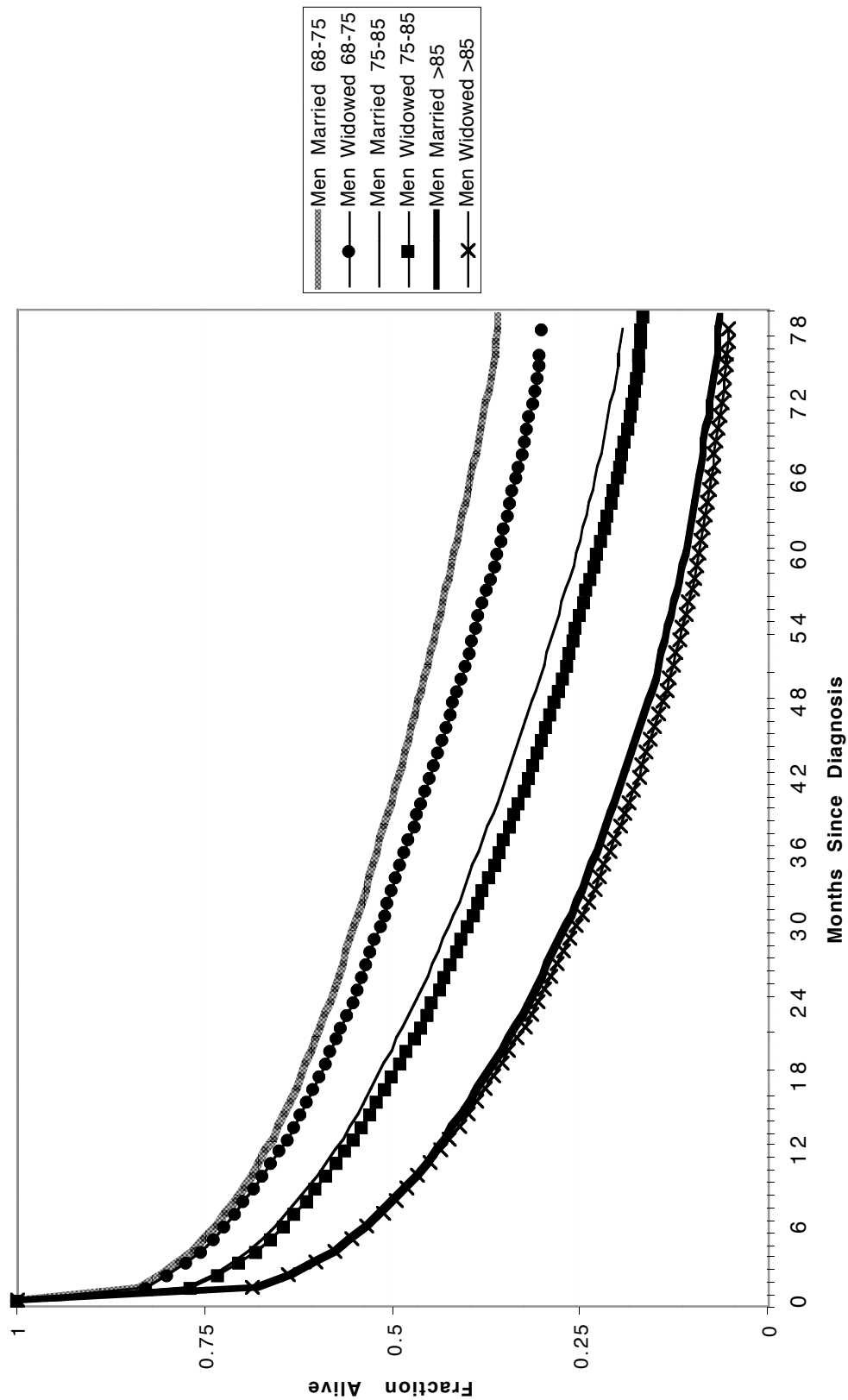
Figure 2.3b: Survival Following Diagnosis - Women
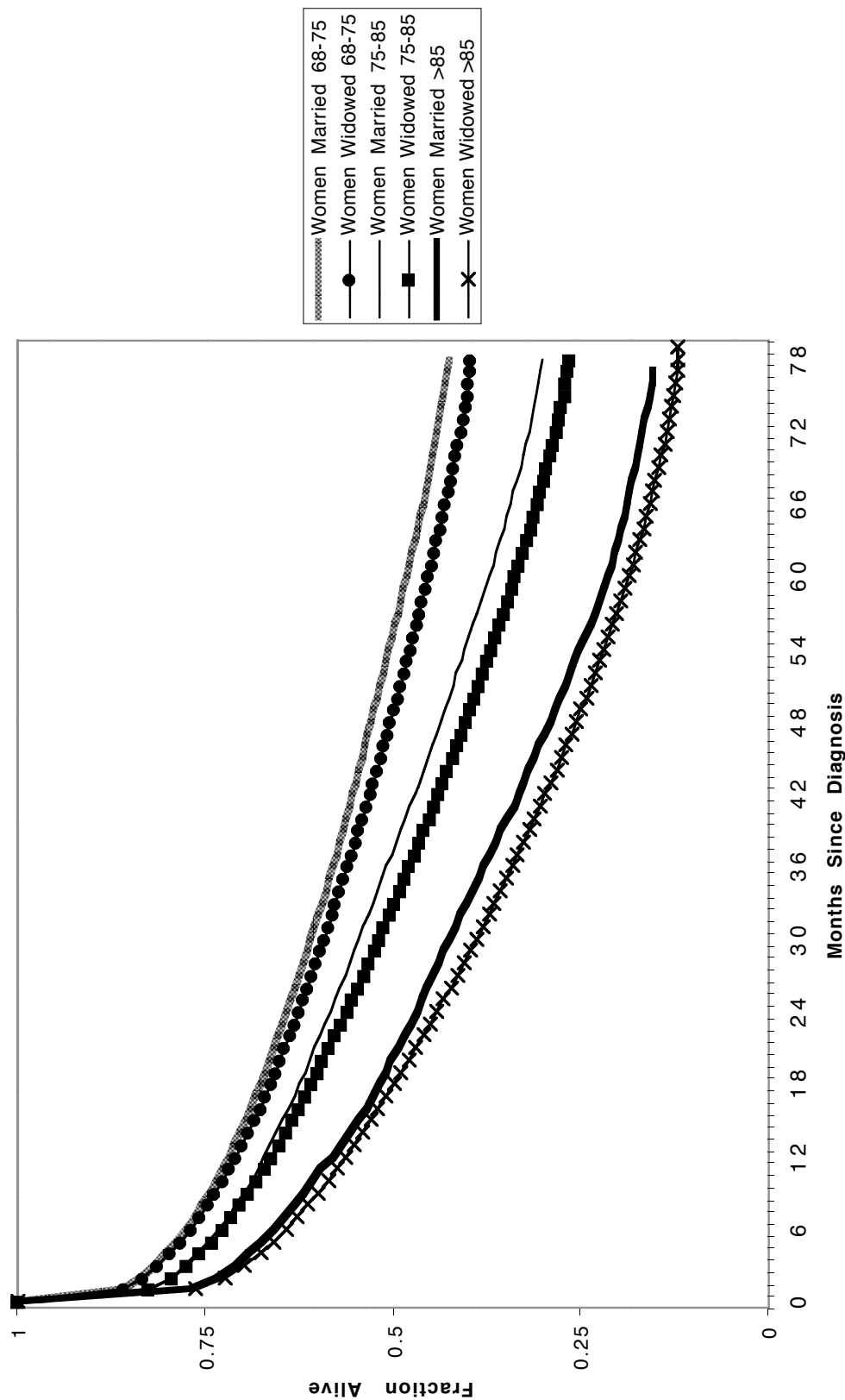
Figure 2.4a: Effects of Spousal Loss - Men
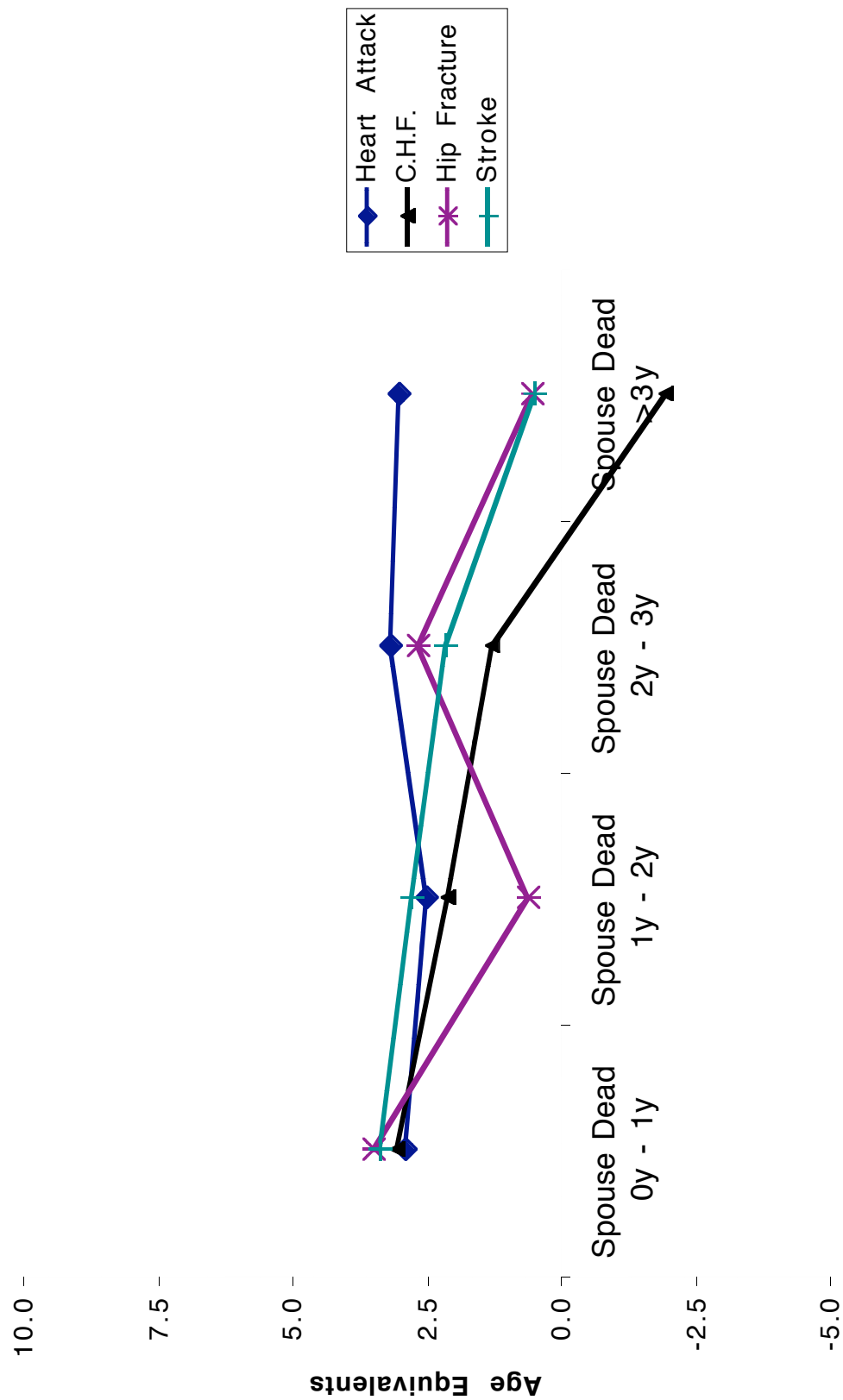
Figure 2.4b: Effects of Spousal Loss - Men
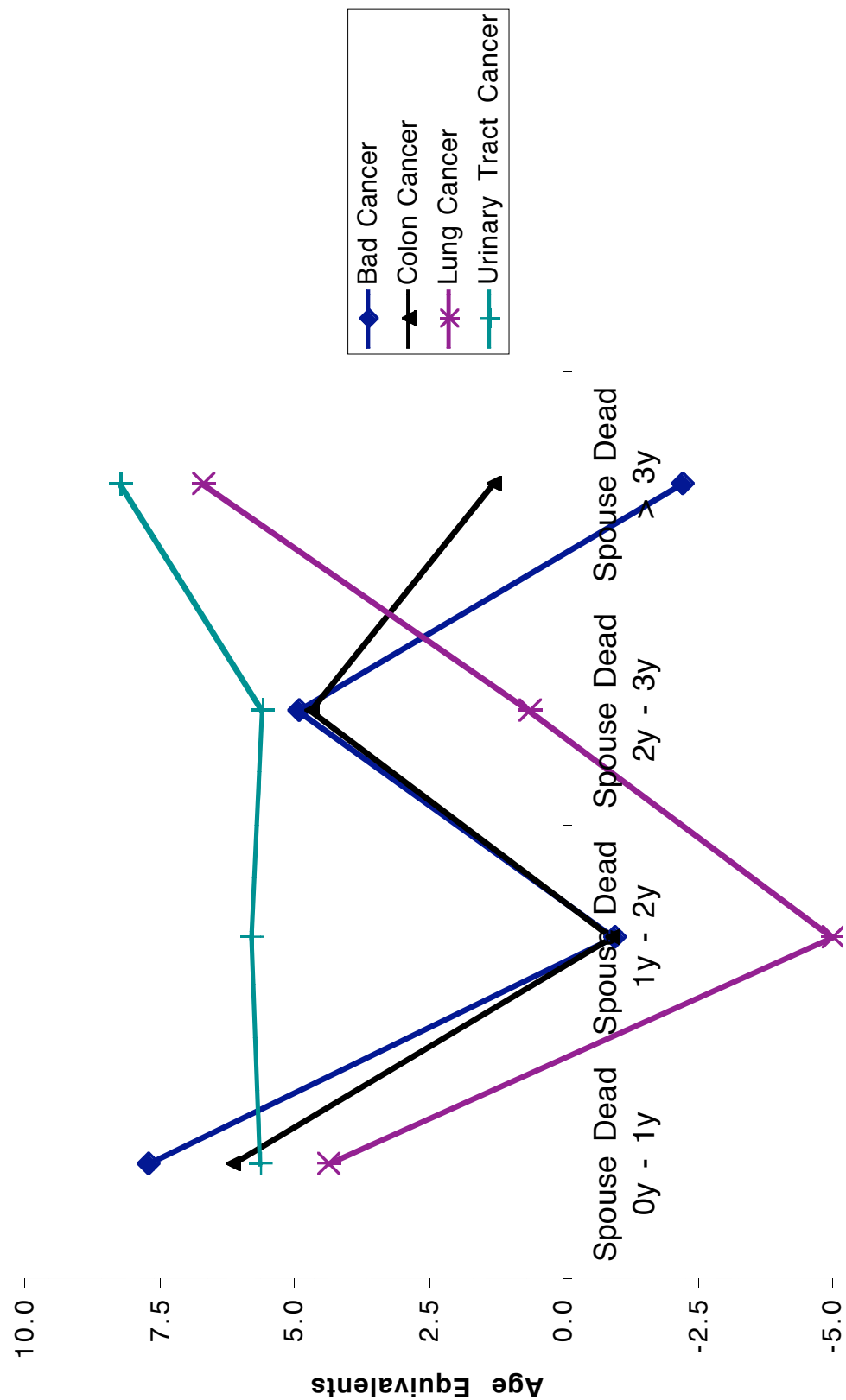
Figure 2.5a: Effects of Spousal Loss - Women
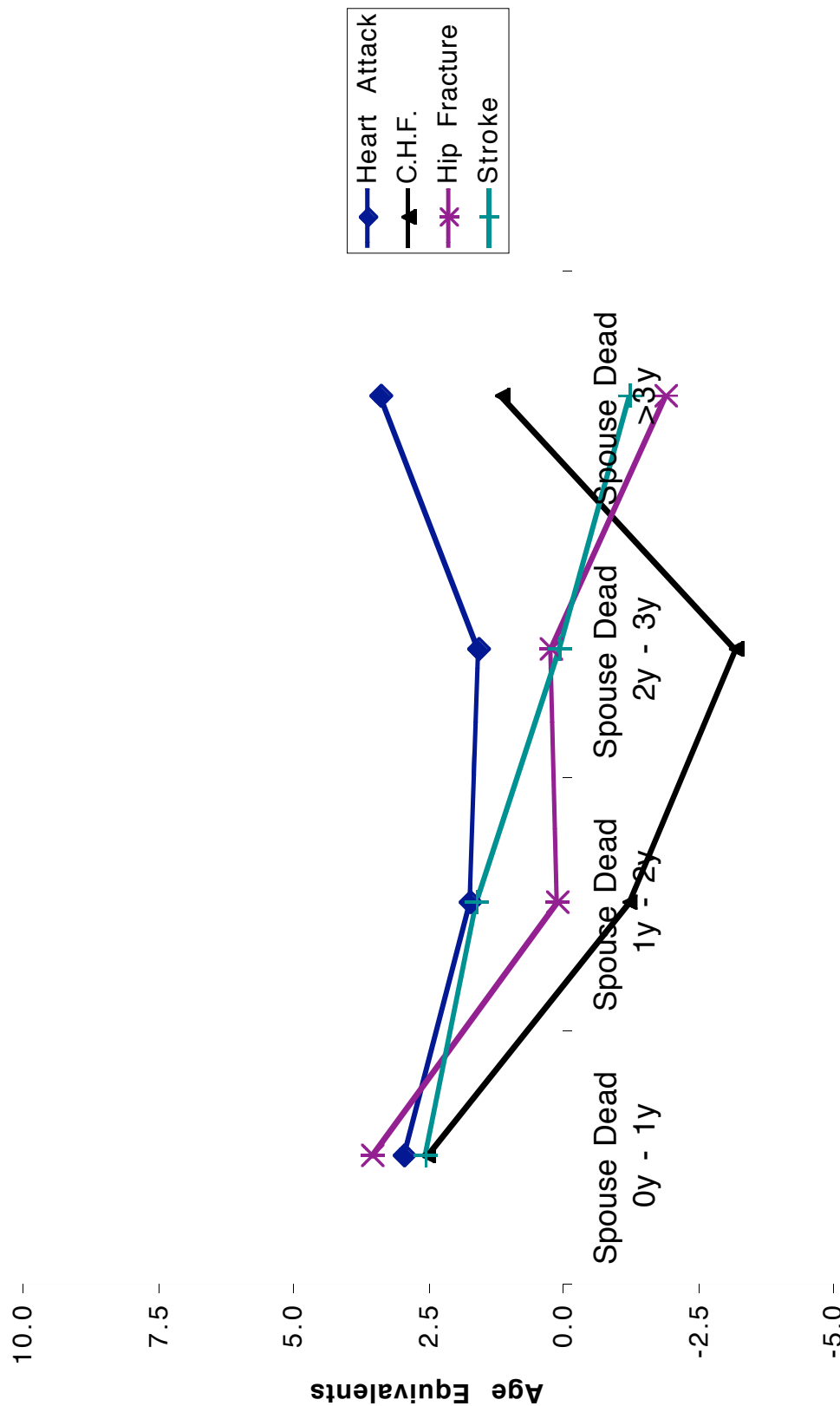
Figure 2.5b: Effects of Spousal Loss - Women
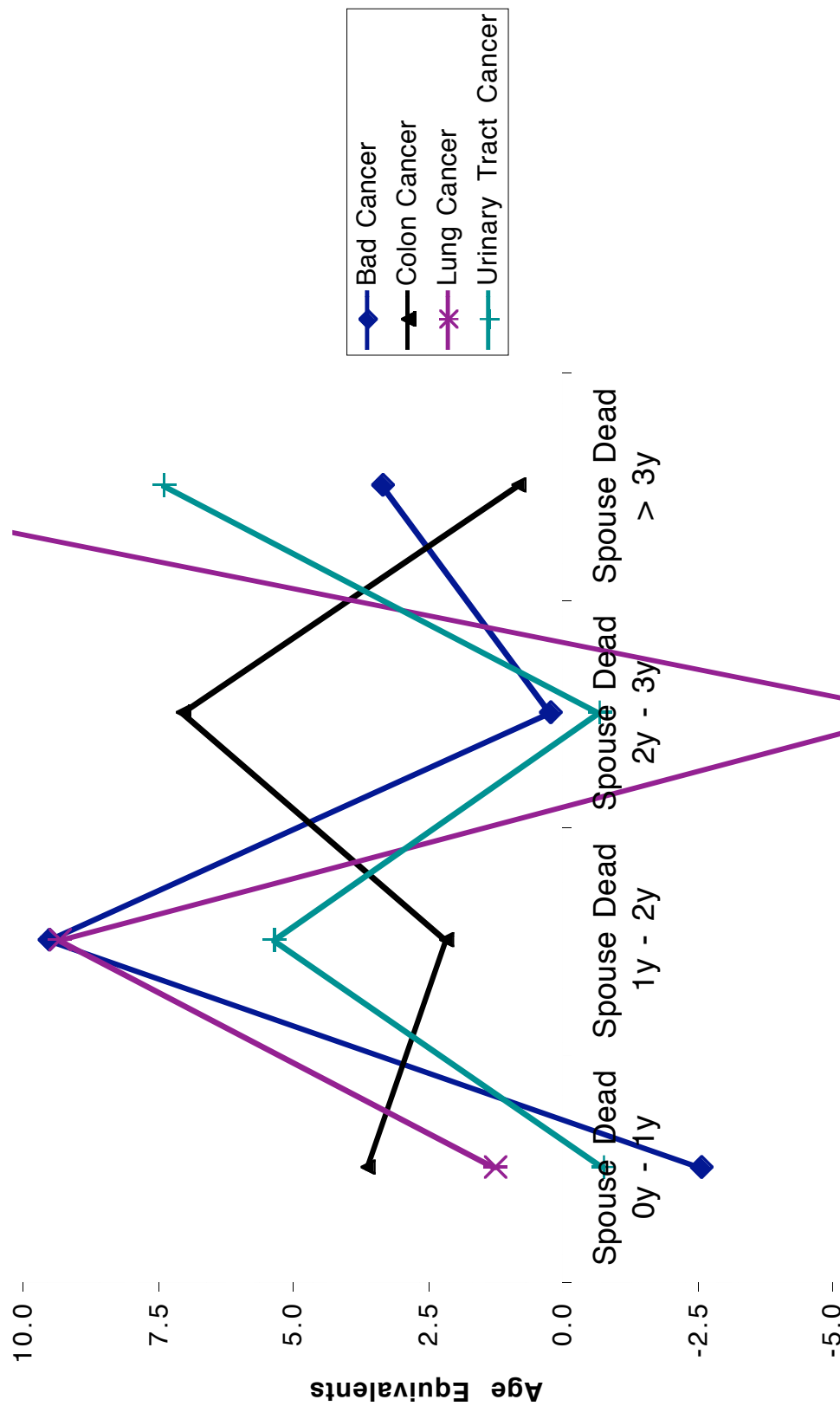
Figure 2.6a: Effects of Proband Loss - Men
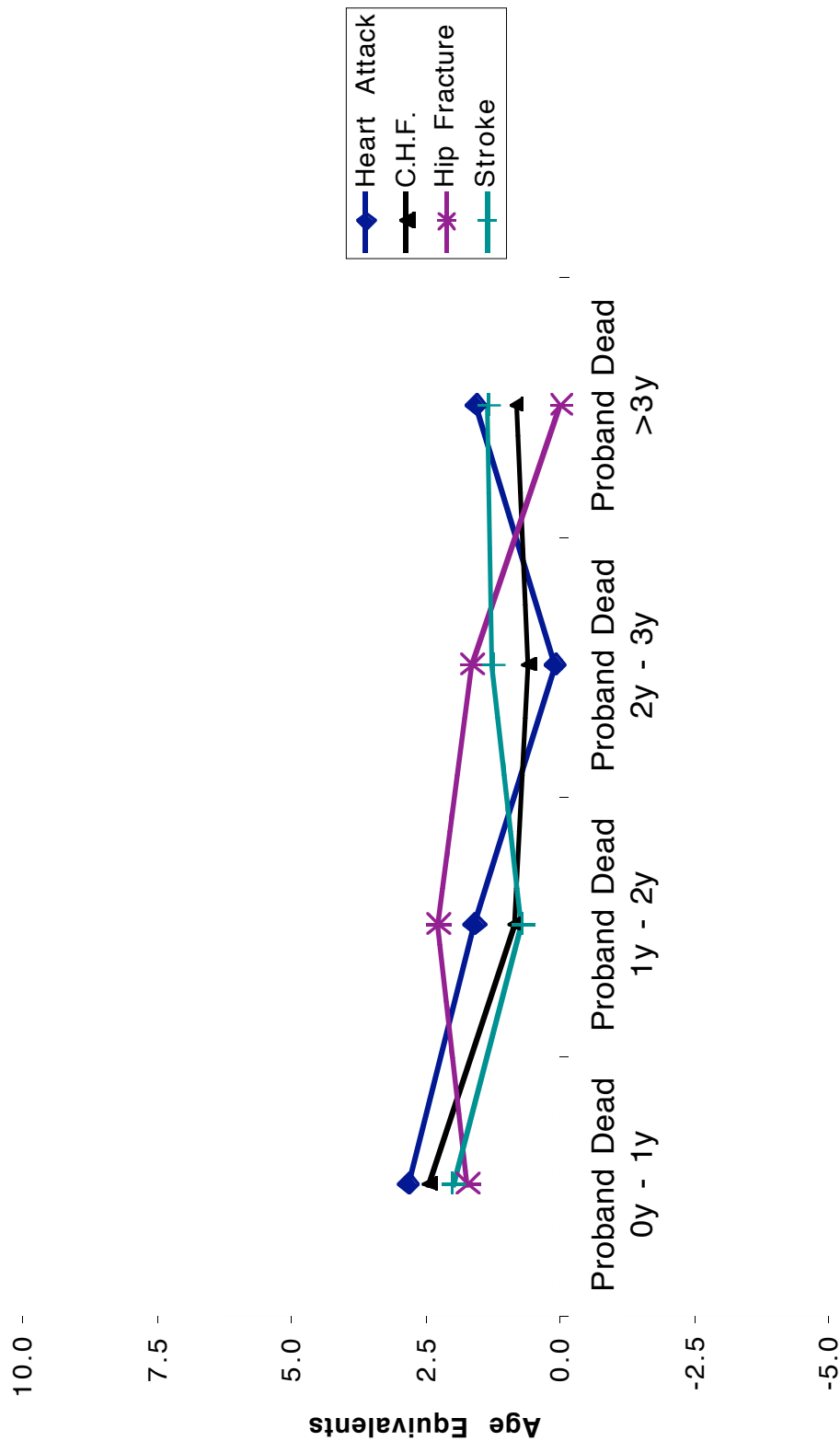
Figure 2.6b: Effects of Proband Loss - Men
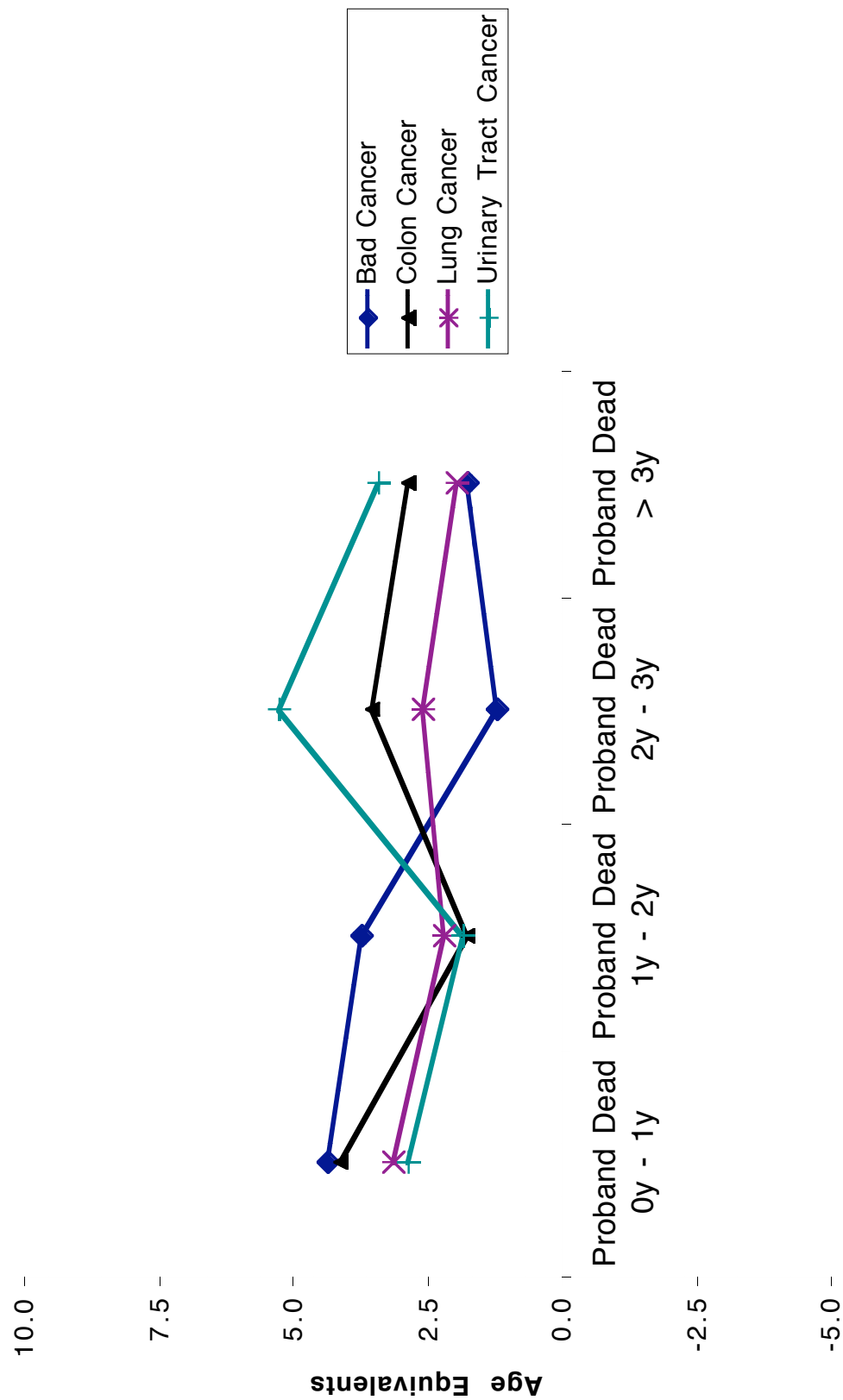
Figure 2.7a: Effects of Proband Loss - Women

Legend:
- Heart Attack
- C.H.F.
- Hip Fracture
- Stroke

Y-axis: Age Equivalents (10.0, 7.5, 5.0, 2.5, 0.0, -2.5, -5.0)

X-axis: Proband Dead 0y - 1y, Proband Dead 1y - 2y, Proband Dead 2y - 3y, Proband Dead >3y
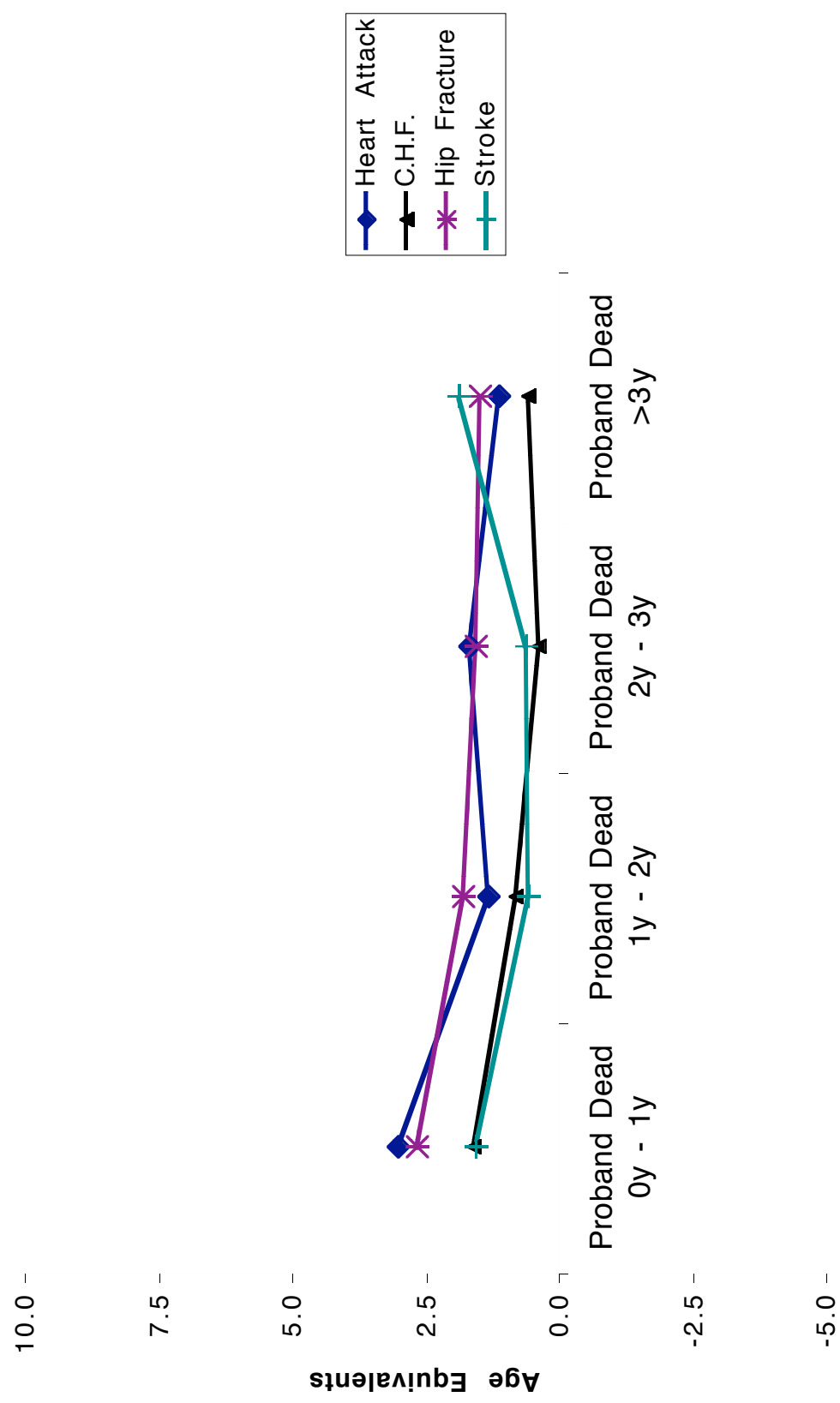
Figure 2.7b: Effects of Proband Loss - Women
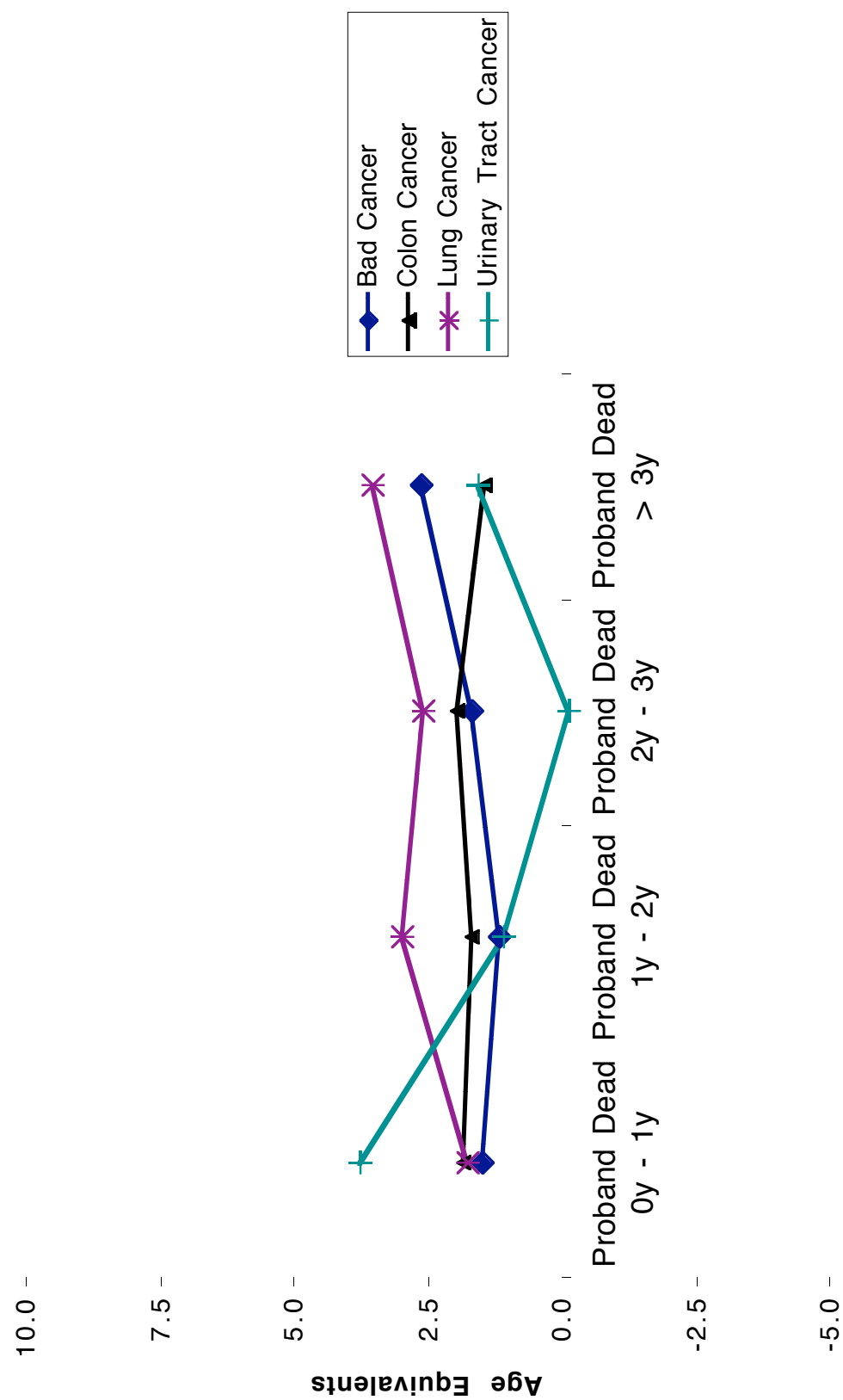
Table 2.1: Characteristics of Full COSI Cohort

	Men	Women
N=	174,162	327,060
Age	78.9	80.6
Married	62.2%	17.9%
Race		
White	88.8%	89.7%
Black	5.2%	6.0%
Hispanic	0.5%	0.3%
Asian	2.3%	1.7%
Other	3.2%	2.2%
Medicaid Beneficiary	8.4%	16.7%
Median Income ($1000)	29.8	30.1
Primary Diagnosis		
M.I.	21.1%	15.5%
C.H.F.	20.5%	21.6%
Stroke	19.5%	20.8%
Hip Fracture	10.0%	23.7%
Any Cancer	28.9%	18.3%
Lung	8.6%	4.3%
Colon	6.9%	5.9%
Urinary Tract	5.1%	1.7%
Bad Cancers	8.3%	6.4%
Liver & Biliary Tract	0.7%	0.6%
C.N.S.	0.5%	0.4%
Head & Neck	1.1%	0.5%
Lymphoma	2.8%	2.4%
Leukemia	2.1%	1.4%
Pancreatic	1.2%	1.2%
Charlson Score (1st Yr. Mean)	0.60	0.51
Hospitalizations (1st Yr. Mean)	0.52	0.53
Charlson Score (2nd Yr. Mean)	0.42	0.37
Hospitalizations (2nd Yr. Mean)	0.40	0.40
Charlson Score (3rd Yr. Mean)	0.33	0.29
Hospitalizations (3rd Yr. Mean)	0.35	0.35
Survival, Mean (Days)	947.8	1087.8
% Dying by 6/30/99	76.7%	71.8%

Table 2.2: Cox Models for Mortality of Full COSI Cohort

	Men		Women	
	Hazard Ratio	p-value	Hazard Ratio	p-value
Age (1 yr.)	1.054	<.0001	1.056	<.0001
Spouse Dead at Dx	1.019	0.0029	1.004	0.4524
Age Equivalents				
Spouse Dead at Dx	0.358		0.073	
Race (vs. White)				
Black	1.037	0.0033	0.983	0.0527
Hispanic	0.945	0.0027	0.961	0.0152
Asian	0.930	0.0600	0.945	0.1317
Other	1.557	<.0001	1.384	<.0001
Medicaid Recipient	1.145	<.0001	1.129	<.0001
ZIP Median Income ($1000)	0.998	<.0001	1.001	0.0005
Primary Diagnosis				
M.I.	0.299	<.0001	0.341	<.0001
C.H.F.	0.401	<.0001	0.362	<.0001
Stroke	0.335	<.0001	0.341	<.0001
Hip Fracture	0.320	<.0001	0.244	<.0001
Cancers:				
Lung	1.000	(ref.)	1.000	(ref.)
Colon	0.332	<.0001	0.335	<.0001
Liver	1.089	0.0038	1.102	<.0001
C.N.S.	1.133	0.0005	1.081	0.0116
Head & Neck	0.449	<.0001	0.468	<.0001
Pancreas	1.287	<.0001	1.289	<.0001
Lymphoma	0.594	<.0001	0.598	<.0001
Leukemia	0.600	<.0001	0.570	<.0001
Urinary Tract	0.302	<.0001	0.346	<.0001
Comorbidity Measures				
1st Year Before Admission				
No Hospitalizations	1.047	<.0001	1.010	0.1784
Charlson = 0	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.255	<.0001	1.256	<.0001
Charlson = 2	1.466	<.0001	1.453	<.0001
Charlson = 3	1.564	<.0001	1.581	<.0001
Charlson = 4	1.724	<.0001	1.755	<.0001
Charlson = 5	1.811	<.0001	1.874	<.0001
Charlson = 6	2.315	<.0001	2.316	<.0001
Charlson > 6	2.409	<.0001	2.384	<.0001

Table 2.2: Cox Models for Mortality of Full COSI Cohort (cont)

	Men		Women	
2nd Year Before Admission	Hazard Ratio	p-value	Hazard Ratio	p-value
No Hospitalizations	1.074	<.0001	1.044	<.0001
Charlson = 0	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.222	<.0001	1.205	<.0001
Charlson = 2	1.308	<.0001	1.305	<.0001
Charlson = 3	1.388	<.0001	1.391	<.0001
Charlson = 4	1.451	<.0001	1.496	<.0001
Charlson = 5	1.478	<.0001	1.550	<.0001
Charlson = 6	1.622	<.0001	1.797	<.0001
Charlson > 6	1.655	<.0001	1.574	<.0001
3rd Year Before Admission				
No Hospitalizations	1.079	<.0001	1.032	<.0001
Charlson = 0	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.208	<.0001	1.181	<.0001
Charlson = 2	1.284	<.0001	1.280	<.0001
Charlson = 3	1.442	<.0001	1.376	<.0001
Charlson = 4	1.456	<.0001	1.455	<.0001
Charlson = 5	1.481	<.0001	1.548	<.0001
Charlson = 6	1.427	<.0001	1.478	<.0001
Charlson > 6	1.456	<.0001	1.574	<.0001
N	174,162		327,060	
Events	133,656		234,766	
Censored	40,506		92,294	

Table 2.3: Impact of Marital Status at Diagnosis on Survival of Men

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.072	<.0001	1.052	<.0001	1.056	<.0001	1.066	<.0001
Spouse Dead at Dx	0.982	0.2287	1.008	0.5154	0.970	0.0889	1.002	0.9068
Age Equivalents								
Spouse Dead at Dx	-0.261		0.157		-0.559		0.031	
Race (vs. White)								
Black	0.995	0.8822	0.952	0.0655	0.932	0.144	1.059	0.0192
Hispanic	0.924	0.0781	0.898	0.0063	0.850	0.0088	0.929	0.0629
Asian	1.027	0.7862	0.910	0.2403	0.919	0.5607	0.782	0.004
Other	1.765	<.0001	1.426	<.0001	1.316	<.0001	1.491	<.0001
Medicaid Recipient	1.203	<.0001	1.097	<.0001	1.148	<.0001	1.168	<.0001
ZIP Median Income ($1000)	0.997	<.0001	1.000	0.4856	0.999	0.0608	0.998	0.0007
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	1.103	0.0009	1.068	0.0034	1.000	0.9923	1.044	0.1118
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.422	<.0001	1.186	<.0001	1.372	<.0001	1.287	<.0001
Charlson = 2	1.744	<.0001	1.369	<.0001	1.534	<.0001	1.518	<.0001
Charlson = 3	1.948	<.0001	1.514	<.0001	1.585	<.0001	1.554	<.0001
Charlson = 4	2.188	<.0001	1.558	<.0001	1.669	<.0001	1.860	<.0001
Charlson = 5	2.203	<.0001	1.693	<.0001	1.602	<.0001	1.828	<.0001
Charlson = 6	2.847	<.0001	2.676	<.0001	1.852	<.0001	2.268	<.0001
Charlson > 6	2.913	<.0001	2.919	<.0001	2.259	<.0001	2.716	<.0001

Table 2.3: Impact of Marital Status at Diagnosis on Survival of Men (Page 2 of 4)

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
2nd Year Before Admission								
No Hospitalizations	1.097	0.0011	1.112	<.0001	1.074	0.027	1.041	0.1238
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.294	<.0001	1.201	<.0001	1.263	<.0001	1.226	<.0001
Charlson = 2	1.432	<.0001	1.289	<.0001	1.325	<.0001	1.297	<.0001
Charlson = 3	1.522	<.0001	1.425	<.0001	1.379	<.0001	1.370	<.0001
Charlson = 4	1.589	<.0001	1.439	<.0001	1.457	<.0001	1.459	<.0001
Charlson = 5	1.545	<.0001	1.388	0.0005	1.284	0.0293	1.629	<.0001
Charlson = 6	1.559	<.0001	1.590	<.0001	1.838	<.0001	1.647	<.0001
Charlson > 6	1.560	<.0001	2.296	<.0001	1.467	0.0008	2.071	<.0001
3rd Year Before Admission								
No Hospitalizations	1.062	0.0318	1.086	0.0003	1.051	0.118	1.103	0.0001
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.245	<.0001	1.166	<.0001	1.226	<.0001	1.250	<.0001
Charlson = 2	1.433	<.0001	1.231	<.0001	1.245	<.0001	1.409	<.0001
Charlson = 3	1.616	<.0001	1.388	<.0001	1.330	<.0001	1.558	<.0001
Charlson = 4	1.553	<.0001	1.361	<.0001	1.454	<.0001	1.572	<.0001
Charlson = 5	1.664	<.0001	1.335	0.0116	1.257	0.1009	1.725	<.0001
Charlson = 6	1.510	0.0005	1.292	0.0127	1.558	0.0006	1.841	<.0001
Charlson > 6	1.672	<.0001	1.742	<.0001	1.264	0.12	1.356	0.0116
N	36767		35714		17399		33934	
Events	23308		29143		14202		25626	
Censored	13459		6571		3197		8308	

Table 2.3: Impact of Marital Status at Diagnosis on Survival of Men (Page 3 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Ca.	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.030	<.0001	1.053	<.0001	1.030	<.0001	1.052	<.0001
Spouse Dead at Dx	1.005	0.8024	0.966	0.1744	0.952	0.0158	0.885	<.0001
Age Equivalents								
Spouse Dead at Dx	0.169		-0.670		-1.664		-2.410	
Race (vs. White)								
Black	1.099	0.0196	1.228	<.0001	1.042	0.2343	1.261	0.001
Hispanic	1.194	0.0022	1.034	0.6686	1.072	0.2943	1.051	0.6201
Asian	1.571	0.0003	0.863	0.2581	0.988	0.9147	0.917	0.6715
Other	1.767	<.0001	1.544	<.0001	1.654	<.0001	1.735	<.0001
Medicaid Recipient	1.059	0.1283	1.288	<.0001	1.117	0.0009	1.319	<.0001
ZIP Median Income ($1000)	0.998	0.0081	0.998	0.0093	0.997	0.0002	0.997	0.0112
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	0.864	<.0001	1.034	0.4365	1.123	0.0025	1.080	0.1348
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.089	0.0562	1.224	0.0005	1.150	0.0026	1.342	<.0001
Charlson = 2	1.198	0.0002	1.308	<.0001	1.278	<.0001	1.522	<.0001
Charlson = 3	1.270	<.0001	1.491	<.0001	1.199	0.003	1.885	<.0001
Charlson = 4	1.302	0.001	1.590	<.0001	1.288	0.0014	2.019	<.0001
Charlson = 5	1.433	0.0011	1.668	0.0015	1.282	0.0477	2.317	<.0001
Charlson = 6	1.489	<.0001	3.598	<.0001	1.837	<.0001	3.057	<.0001
Charlson > 6	1.835	<.0001	4.511	<.0001	1.874	<.0001	3.352	<.0001

Table 2.3: Impact of Marital Status at Diagnosis on Survival of Men (Page 4 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Ca.	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
2nd Year Before Admission								
No Hospitalizations	1.029	0.4311	1.077	0.1095	1.035	0.3801	1.040	0.4537
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.108	0.0405	1.314	<.0001	1.096	0.0601	1.266	0.0006
Charlson = 2	1.241	<.0001	1.213	0.0049	1.102	0.0668	1.395	<.0001
Charlson = 3	1.325	<.0001	1.614	<.0001	1.034	0.6083	1.488	<.0001
Charlson = 4	1.174	0.1103	1.607	<.0001	1.158	0.0997	1.259	0.1192
Charlson = 5	1.215	0.1842	1.710	0.0025	1.178	0.2159	1.391	0.1317
Charlson = 6	1.207	0.1363	2.099	<.0001	1.302	0.0229	1.586	0.0107
Charlson > 6	1.227	0.155	1.977	<.0001	1.084	0.5054	2.124	<.0001
3rd Year Before Admission								
No Hospitalizations	1.093	0.012	1.051	0.2704	1.071	0.0756	1.036	0.4893
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.149	0.0063	1.165	0.0153	1.107	0.0386	1.176	0.0209
Charlson = 2	1.156	0.0106	1.222	0.0053	1.112	0.0525	1.096	0.2485
Charlson = 3	1.497	<.0001	1.365	0.0007	1.103	0.1593	1.438	0.0006
Charlson = 4	1.160	0.2357	1.254	0.1217	1.135	0.2053	1.990	<.0001
Charlson = 5	1.078	0.7075	1.551	0.0575	1.156	0.4421	1.330	0.27
Charlson = 6	1.540	0.0017	1.396	0.0569	0.960	0.7817	1.185	0.4608
Charlson > 6	1.457	0.0426	1.651	0.0352	1.101	0.6391	1.249	0.4036
N	14532		12073		14901		8842	
Events	12912		8420		14047		5998	
Censored	1620		3653		854		2844	

Table 2.4: Impact of Marital Status at Diagnosis on Survival of Women

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.064	<.0001	1.052	<.0001	1.061	<.0001	1.066	<.0001
Spouse Dead at Dx	0.995	0.7545	1.015	0.228	0.944	<.0001	1.023	0.0727
Age Equivalents								
Spouse Dead at Dx	-0.081		0.294		-0.973		0.356	
Race (vs. White)								
Black	1.028	0.2671	0.930	<.0001	0.963	0.1846	0.956	0.006
Hispanic	1.034	0.3909	0.926	0.021	0.916	0.0207	0.930	0.034
Asian	0.973	0.7864	1.095	0.2877	0.926	0.3323	0.864	0.0485
Other	1.478	<.0001	1.353	<.0001	1.208	<.0001	1.359	<.0001
Medicaid Recipient	1.107	<.0001	1.128	<.0001	1.205	<.0001	1.106	<.0001
ZIP Median Income ($1000)	0.998	<.0001	1.003	<.0001	1.002	<.0001	1.000	0.2917
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	1.065	0.008	1.053	0.0007	0.981	0.2336	0.982	0.3094
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.378	<.0001	1.233	<.0001	1.340	<.0001	1.241	<.0001
Charlson = 2	1.615	<.0001	1.424	<.0001	1.588	<.0001	1.455	<.0001
Charlson = 3	1.764	<.0001	1.510	<.0001	1.734	<.0001	1.583	<.0001
Charlson = 4	1.892	<.0001	1.797	<.0001	1.843	<.0001	1.743	<.0001
Charlson = 5	2.125	<.0001	1.886	<.0001	1.957	<.0001	1.821	<.0001
Charlson = 6	2.568	<.0001	3.065	<.0001	2.852	<.0001	2.444	<.0001
Charlson > 6	2.526	<.0001	2.648	<.0001	2.773	<.0001	2.643	<.0001

Table 2.4: Impact of Marital Status at Diagnosis on Survival of Women (Page 2 of 4)

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
2nd Year Before Admission								
No Hospitalizations	1.061	0.0094	1.122	<.0001	0.998	0.9182	1.017	0.3288
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.203	<.0001	1.215	<.0001	1.293	<.0001	1.168	<.0001
Charlson = 2	1.349	<.0001	1.340	<.0001	1.403	<.0001	1.281	<.0001
Charlson = 3	1.508	<.0001	1.401	<.0001	1.444	<.0001	1.324	<.0001
Charlson = 4	1.547	<.0001	1.513	<.0001	1.652	<.0001	1.470	<.0001
Charlson = 5	1.519	<.0001	1.564	<.0001	1.790	<.0001	1.491	<.0001
Charlson = 6	1.707	<.0001	2.057	<.0001	1.955	<.0001	1.740	<.0001
Charlson > 6	1.899	<.0001	1.747	<.0001	1.794	<.0001	1.529	<.0001
3rd Year Before Admission								
No Hospitalizations	1.052	0.0227	1.065	<.0001	1.027	0.0914	0.999	0.9672
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.215	<.0001	1.145	<.0001	1.299	<.0001	1.159	<.0001
Charlson = 2	1.351	<.0001	1.229	<.0001	1.397	<.0001	1.243	<.0001
Charlson = 3	1.488	<.0001	1.420	<.0001	1.469	<.0001	1.334	<.0001
Charlson = 4	1.542	<.0001	1.562	<.0001	1.426	<.0001	1.493	<.0001
Charlson = 5	1.581	<.0001	1.497	<.0001	1.698	<.0001	1.494	<.0001
Charlson = 6	1.482	0.0002	1.523	<.0001	1.513	<.0001	1.552	<.0001
Charlson > 6	1.286	0.0247	1.733	<.0001	2.134	<.0001	1.565	<.0001
N	50750		70616		77640		68102	
Events	33529		52884		51956		49329	
Censored	17221		17732		25684		18773	

Table 2.4: Impact of Marital Status at Diagnosis on Survival of Women (Page 3 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Ca.	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.032	<.0001	1.049	<.0001	1.033	<.0001	1.056	<.0001
Spouse Dead at Dx	1.010	0.5801	0.929	0.0016	1.013	0.5422	0.933	0.121
Age Equivalents								
Spouse Dead at Dx	0.316		-1.540		0.398		-1.273	
Race (vs. White)								
Black	1.141	<.0001	1.155	<.0001	1.049	0.2319	1.180	0.0208
Hispanic	1.165	0.0051	0.978	0.7749	1.094	0.2688	0.770	0.0581
Asian	1.088	0.5394	1.000	0.9993	0.906	0.5271	0.516	0.1858
Other	1.475	<.0001	1.428	<.0001	1.578	<.0001	1.656	<.0001
Medicaid Recipient	1.017	0.4755	1.249	<.0001	1.034	0.242	1.191	0.0008
ZIP Median Income ($1000)	0.999	0.2513	1.000	0.7388	0.998	0.0035	0.997	0.0266
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	0.874	<.0001	0.986	0.6718	1.116	0.0035	0.969	0.5808
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.083	0.0276	1.160	0.0009	1.166	0.0009	1.180	0.0397
Charlson = 2	1.132	0.0019	1.349	<.0001	1.242	<.0001	1.336	0.0014
Charlson = 3	1.113	0.0406	1.540	<.0001	1.381	<.0001	1.470	0.0008
Charlson = 4	1.136	0.1243	1.807	<.0001	1.461	<.0001	1.734	0.0009
Charlson = 5	1.393	0.0057	1.952	<.0001	1.287	0.0749	1.429	0.1477
Charlson = 6	1.334	<.0001	2.877	<.0001	1.554	<.0001	3.023	<.0001
Charlson > 6	1.836	<.0001	3.898	<.0001	1.768	<.0001	2.687	<.0001

Table 2.4: Impact of Marital Status at Diagnosis on Survival of Women (Page 4 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Ca.	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
2nd Year Before Admission								
No Hospitalizations	1.025	0.3933	0.950	0.1499	0.988	0.7556	1.061	0.3559
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.058	0.1762	1.197	0.0002	1.088	0.0955	1.164	0.0935
Charlson = 2	1.102	0.039	1.210	0.0008	1.022	0.6973	1.288	0.0111
Charlson = 3	1.124	0.0662	1.339	0.0003	1.103	0.1813	1.364	0.0149
Charlson = 4	1.044	0.6463	1.295	0.0391	1.097	0.4142	1.482	0.0661
Charlson = 5	1.065	0.6997	1.780	0.0006	1.164	0.3432	1.092	0.7895
Charlson = 6	1.372	0.0108	1.660	<.0001	1.364	0.0066	1.838	0.0016
Charlson > 6	0.984	0.911	1.090	0.5926	0.954	0.7595	2.425	0.0022
3rd Year Before Admission								
No Hospitalizations	1.010	0.7289	0.969	0.3812	1.066	0.0968	1.041	0.5277
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.038	0.3885	1.110	0.0424	1.115	0.0283	1.199	0.0453
Charlson = 2	1.123	0.0206	1.116	0.0683	1.128	0.0415	1.503	<.0001
Charlson = 3	1.137	0.0574	1.258	0.0054	1.148	0.0833	0.999	0.9959
Charlson = 4	1.110	0.3552	1.291	0.0649	1.169	0.1778	1.713	0.022
Charlson = 5	1.652	0.0127	1.399	0.2063	1.580	0.0226	1.108	0.8046
Charlson = 6	1.318	0.037	1.547	0.0014	1.043	0.7723	1.625	0.1002
Charlson > 6	1.247	0.2164	1.825	0.0075	1.289	0.1509	3.669	0.0062
N	21022		19379		14050		5501	
Events	18116		12644		12696		3612	
Censored	2906		6735		1354		1889	

Table 2.5: Characteristics of the Married Members of COSI

	Men	Women
N=	108,368	58,416
Age	77.3	76.2
Race		
White	90.2%	91.3%
Black	4.2%	4.7%
Hispanic	2.3%	2.5%
Asian	0.6%	0.5%
Other	2.7%	1.0%
Medicaid Beneficiary	6.5%	9.7%
Median Income ($1000)	29.9	29.8
Primary Diagnosis		
Heart Attack	22.9%	18.4%
C.H.F.	19.4%	19.3%
Stroke	19.2%	20.3%
Hip Fracture	8.1%	19.5%
Any Cancer	30.5%	22.5%
Lung	8.9%	5.4%
Colon	7.3%	7.2%
Urinary Tract	5.4%	2.0%
Bad Cancers	8.9%	8.0%
Liver & Biliary Tract	0.7%	0.7%
C.N.S.	0.6%	0.5%
Head & Neck	1.1%	0.6%
Lymphoma	3.1%	3.2%
Leukemia	2.1%	1.6%
Pancreatic	1.2%	1.4%
Comorbidity Adjustment		
Charlson Score (1st Yr. Mean)	0.57	0.50
Any Hospitalization (1st Yr.)	29.6%	28.9%
Hospitalizations (1st Yr. Mean)	0.49	0.49
Charlson Score (2nd Yr. Mean)	0.40	0.35
Any Hospitalization (2nd Yr.)	24.3%	23.5%
Hospitalizations (2nd Yr. Mean)	0.38	0.37
Charlson Score (3rd Yr. Mean)	0.31	0.28
Any Hospitalization (3rd Yr.)	21.7%	21.1%
Hospitalizations (3rd Yr. Mean)	0.33	0.32
Survival (Days)	1040.8	1244.5
% Dying by 6/30/99	72.5%	62.5%
Spouse Dies First	9.0%	25.1%
Spouse Dies Same Period	0.4%	0.7%

Table 2.6: Cox Models for Mortality for Married COSI Cohort

	Men		Women	
	H.R.	p	H.R.	p
Age (1 yr.)	1.055	<.0001	1.054	<.0001
Spouse Dead 0y - 1y	1.244	<.0001	1.169	<.0001
Spouse Dead 1y - 2y	1.147	<.0001	1.099	0.0008
Spouse Dead 2y - 3y	1.194	<.0001	1.052	0.1325
Spouse Dead > 3y	1.089	0.0196	1.085	0.0106
Age Equivalents				
Spouse Dead 0y - 1y	4.078		2.969	
Spouse Dead 1y - 2y	2.562		1.795	
Spouse Dead 2y - 3y	3.312		0.964	
Spouse Dead > 3y	1.592		1.551	
Race (vs. White)				
Black	1.086	<.0001	0.974	0.3011
Hispanic	0.969	0.1893	0.878	0.0001
Asian	0.987	0.7919	0.854	0.0433
Other	1.624	<.0001	1.317	<.0001
Medicaid Recipient	1.148	<.0001	1.190	<.0001
ZIP Median Income ($1000)	0.998	<.0001	0.999	0.0264
Primary Diagnosis				
Heart Attack	1.000	(ref.)	1.000	(ref.)
C.H.F.	1.435	<.0001	1.181	<.0001
Stroke	1.159	<.0001	1.048	0.0075
Hip Fracture	1.117	<.0001	0.745	<.0001
Cancers:				
Lung	3.565	<.0001	3.335	<.0001
Colon	1.160	<.0001	1.035	0.1684
Liver	4.010	<.0001	4.021	<.0001
C.N.S.	4.380	<.0001	4.015	<.0001
Head & Neck	1.652	<.0001	1.382	<.0001
Pancreas	4.632	<.0001	5.093	<.0001
Lymphoma	2.148	<.0001	2.005	<.0001
Leukemia	2.203	<.0001	2.056	<.0001
Urinary Tract	1.033	0.0804	1.023	0.5879

(continued)

Table 2.6: Cox Models for Married COSI Cohort (Page 2 of 2)

	Men H.R.	p	Women H.R.	p
Comorbidity Measures				
1st Year Before Admission				
No Hospitalizations	1.089	<.0001	1.039	0.0667
Charlson = 0	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.322	<.0001	1.332	<.0001
Charlson = 2	1.579	<.0001	1.567	<.0001
Charlson = 3	1.689	<.0001	1.764	<.0001
Charlson = 4	1.874	<.0001	1.923	<.0001
Charlson = 5	2.046	<.0001	2.084	<.0001
Charlson = 6	2.712	<.0001	2.715	<.0001
Charlson > 6	2.570	<.0001	2.815	<.0001
2nd Year Before Admission				
No Hospitalizations	1.081	<.0001	1.025	0.2502
Charlson = 0	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.253	<.0001	1.220	<.0001
Charlson = 2	1.359	<.0001	1.424	<.0001
Charlson = 3	1.443	<.0001	1.567	<.0001
Charlson = 4	1.484	<.0001	1.684	<.0001
Charlson = 5	1.523	<.0001	1.786	<.0001
Charlson = 6	1.745	<.0001	1.806	<.0001
Charlson > 6	1.894	<.0001	2.101	<.0001
3rd Year Before Admission				
No Hospitalizations	1.100	<.0001	1.043	0.0459
Charlson = 0	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.275	<.0001	1.289	<.0001
Charlson = 2	1.350	<.0001	1.379	<.0001
Charlson = 3	1.517	<.0001	1.436	<.0001
Charlson = 4	1.619	<.0001	1.656	<.0001
Charlson = 5	1.587	<.0001	1.598	<.0001
Charlson = 6	1.447	<.0001	1.584	<.0001
Charlson > 6	1.644	<.0001	1.626	<.0001
N	108,368		58,416	
Died	78,526		36,484	
Censored	29,842		21,932	

Table 2.7: Impact of Loss of a Spouse on Survival of Men

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.073	<.0001	1.053	<.0001	1.060	<.0001	1.067	<.0001
Spouse Dead 0y - 1y	1.227	0.0003	1.172	0.0006	1.226	0.0014	1.247	<.0001
Spouse Dead 1y - 2y	1.194	0.0098	1.117	0.0625	1.037	0.6639	1.198	0.0022
Spouse Dead 2y - 3y	1.251	0.0056	1.069	0.3619	1.170	0.1048	1.152	0.0533
Spouse Dead > 3y	1.239	0.0057	0.905	0.2005	1.032	0.7625	1.034	0.6599
Age Equivalents								
Spouse Dead 0y - 1y	2.903		3.073		3.497		3.404	
Spouse Dead 1y - 2y	2.517		2.143		0.624		2.786	
Spouse Dead 2y - 3y	3.178		1.292		2.694		2.182	
Spouse Dead > 3y	3.042		-1.933		0.541		0.516	
Race (vs. White)								
Black	1.088	0.0778	1.012	0.7482	1.067	0.4204	1.071	0.0529
Hispanic	0.909	0.0893	0.920	0.1197	0.870	0.1103	0.958	0.4049
Asian	1.170	0.1848	0.822	0.0637	1.009	0.9616	0.770	0.0161
Other	1.870	<.0001	1.447	<.0001	1.404	<.0001	1.535	<.0001
Medicaid Recipient	1.170	<.0001	1.119	0.0002	1.171	<.0001	1.171	<.0001
ZIP Median Income ($1000)	0.996	<.0001	0.999	0.3467	0.999	0.5342	0.998	0.0009
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	1.148	0.0004	1.157	<.0001	1.032	0.5298	1.066	0.0812
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.552	<.0001	1.291	<.0001	1.389	<.0001	1.320	<.0001
Charlson = 2	1.934	<.0001	1.524	<.0001	1.718	<.0001	1.648	<.0001
Charlson = 3	2.250	<.0001	1.659	<.0001	1.741	<.0001	1.593	<.0001
Charlson = 4	2.601	<.0001	1.649	<.0001	1.799	<.0001	2.011	<.0001
Charlson = 5	2.496	<.0001	2.078	<.0001	2.081	<.0001	2.063	<.0001
Charlson = 6	3.280	<.0001	3.451	<.0001	2.052	<.0001	2.761	<.0001
Charlson > 6	3.482	<.0001	3.399	<.0001	2.371	<.0001	2.828	<.0001

Table 2.7: Impact of Loss of a Spouse on Survival of Men (Page 2 of 4)

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
2nd Year Before Admission								
No Hospitalizations	1.096	0.0137	1.096	0.004	1.090	0.075	1.082	0.0254
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.279	<.0001	1.234	<.0001	1.350	<.0001	1.294	<.0001
Charlson = 2	1.452	<.0001	1.320	<.0001	1.360	<.0001	1.440	<.0001
Charlson = 3	1.602	<.0001	1.475	<.0001	1.394	<.0001	1.471	<.0001
Charlson = 4	1.465	<.0001	1.426	<.0001	1.531	<.0001	1.583	<.0001
Charlson = 5	1.566	<.0001	1.344	0.0182	1.462	0.0234	1.752	<.0001
Charlson = 6	1.676	<.0001	1.734	<.0001	1.615	0.0025	1.839	<.0001
Charlson > 6	1.893	<.0001	2.371	<.0001	1.764	0.0003	2.265	<.0001
3rd Year Before Admission								
No Hospitalizations	1.040	0.2733	1.112	0.0006	1.085	0.0825	1.093	0.0102
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.280	<.0001	1.225	<.0001	1.376	<.0001	1.301	<.0001
Charlson = 2	1.500	<.0001	1.273	<.0001	1.350	<.0001	1.437	<.0001
Charlson = 3	1.744	<.0001	1.488	<.0001	1.333	0.0005	1.622	0.0005
Charlson = 4	1.650	<.0001	1.527	<.0001	1.706	<.0001	1.763	<.0001
Charlson = 5	1.689	<.0001	1.457	0.0104	1.265	0.2159	1.932	<.0001
Charlson = 6	1.423	0.018	1.195	0.1975	1.901	0.0001	2.018	<.0001
Charlson > 6	2.002	<.0001	1.677	0.0012	1.313	0.2524	1.793	0.0001
N	24811		20977		8742		20818	
Died	14358		16380		6720		14847	
Censored	10453		4597		2022		5971	
% Dying by end of follow-up	57.9%		78.1%		76.9%		71.3%	
Predeceasing spouse	2390		2025		1058		2128	
% with Predeceasing Spouse	9.6%		9.7%		12.1%		10.2%	
Spouse Dies at Same Time (n)	73		97		65		64	

Table 2.7: Impact of Loss of a Spouse on Survival of Men (Page 3 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Cancer	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.031	<.0001	1.049	<.0001	1.031	<.0001	1.053	<.0001
Spouse Dead 0y - 1y	1.265	0.0036	1.341	0.0004	1.143	0.1388	1.338	0.0033
Spouse Dead 1y - 2y	0.972	0.8239	0.958	0.7239	0.858	0.3588	1.348	0.0175
Spouse Dead 2y - 3y	1.162	0.3281	1.252	0.0905	1.020	0.9282	1.335	0.0691
Spouse Dead > 3y	0.935	0.7001	1.064	0.6539	1.227	0.3408	1.530	0.0031
Age Equivalents								
Spouse Dead 0y - 1y	7.700		6.134		4.378		5.638	
Spouse Dead 1y - 2y	-0.930		-0.897		-5.017		5.782	
Spouse Dead 2y - 3y	4.918		4.698		0.649		5.595	
Spouse Dead > 3y	-2.201		1.297		6.701		8.235	
Race (vs. White)								
Black	1.174	0.0028	1.335	<.0001	1.024	0.6084	1.380	0.0018
Hispanic	1.237	0.0033	1.078	0.4392	1.053	0.5369	1.062	0.6114
Asian	1.921	<.0001	0.954	0.7678	1.061	0.6809	1.203	0.4505
Other	1.859	<.0001	1.599	<.0001	1.704	<.0001	1.573	<.0001
Medicaid Recipient	1.064	0.2341	1.246	0.001	1.128	0.01	1.265	0.0034
ZIP Median Income ($1000)	0.998	0.0187	0.997	0.0216	0.997	0.0004	0.996	0.0029
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	0.900	0.008	1.079	0.1787	1.137	0.0078	1.091	0.1807
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.147	0.0154	1.334	0.0002	1.209	0.0012	1.303	0.0023
Charlson = 2	1.334	<.0001	1.366	0.0002	1.245	0.0009	1.540	<.0001
Charlson = 3	1.431	<.0001	1.558	<.0001	1.204	0.0169	2.184	<.0001
Charlson = 4	1.275	0.0186	1.464	0.0139	1.477	0.0002	2.013	<.0001
Charlson = 5	1.476	0.0073	1.666	0.0195	1.181	0.3225	2.159	0.002
Charlson = 6	1.652	<.0001	5.020	<.0001	1.933	<.0001	4.017	<.0001
Charlson > 6	2.006	<.0001	4.250	<.0001	1.994	<.0001	3.925	<.0001

Table 2.7: Impact of Loss of a Spouse on Survival of Men (Page 4 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Cancer	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
2nd Year Before Admission								
No Hospitalizations	1.035	0.4462	1.088	0.1622	1.024	0.6411	1.044	0.5279
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.092	0.1663	1.237	0.0114	1.133	0.0483	1.300	0.0043
Charlson = 2	1.291	0.0001	1.288	0.0044	1.091	0.1962	1.561	<.0001
Charlson = 3	1.311	0.0025	1.709	<.0001	1.069	0.4239	1.572	0.0003
Charlson = 4	1.482	0.003	1.703	0.0008	1.163	0.169	1.682	0.005
Charlson = 5	1.384	0.0891	1.939	0.0036	1.143	0.4536	1.715	0.0469
Charlson = 6	1.279	0.1402	2.309	<.0001	1.398	0.0221	1.854	0.0056
Charlson > 6	1.522	0.0208	1.794	0.0052	1.263	0.122	1.789	0.0118
3rd Year Before Admission								
No Hospitalizations	1.125	0.008	1.075	0.219	1.115	0.026	1.115	0.109
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.207	0.0036	1.324	0.0007	1.135	0.0417	1.309	0.0043
Charlson = 2	1.236	0.0032	1.140	0.1624	1.223	0.0036	1.143	0.1996
Charlson = 3	1.664	<.0001	1.449	0.0025	1.070	0.4455	1.428	0.0124
Charlson = 4	1.176	0.3566	1.282	0.1762	1.193	0.1816	1.978	0.0004
Charlson = 5	0.918	0.7656	1.673	0.1579	1.279	0.3082	1.905	0.0749
Charlson = 6	1.442	0.0211	1.363	0.1554	1.043	0.8287	1.332	0.3254
Charlson > 6	1.478	0.0987	1.682	0.0564	1.249	0.3712	1.892	0.0416
N	9609		7904		9688		5819	
Died	8369		5184		9018		3650	
Censored	1240		2720		670		2169	
% Dying by end of follow-up	87.1%		65.6%		93.1%		62.7%	
Predecasing spouse	484		746		307		575	
% with Predeceasing Spouse	5.0%		9.4%		3.2%		9.9%	
Spouse Dies at Same Time (n)	27		34		25		28	

Table 2.8: Impact of Loss of a Spouse on Survival of Women

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.067	<.0001	1.047	<.0001	1.060	<.0001	1.068	<.0001
Spouse Dead 0y - 1y	1.212	0.0023	1.122	0.0175	1.230	<.0001	1.184	0.0006
Spouse Dead 1y - 2y	1.119	0.1387	0.946	0.3640	1.007	0.8988	1.112	0.0742
Spouse Dead 2y - 3y	1.107	0.2495	0.864	0.0467	1.013	0.8352	1.005	0.9431
Spouse Dead > 3y	1.244	0.0068	1.053	0.4267	0.896	0.0742	0.922	0.2618
Age Equivalents								
Spouse Dead 0y - 1y	2.965		2.506		3.553		2.567	
Spouse Dead 1y - 2y	1.734		-1.209		0.120		1.614	
Spouse Dead 2y - 3y	1.567		-3.183		0.222		0.076	
Spouse Dead > 3y	3.367		1.124		-1.885		-1.234	
Race (vs. White)								
Black	1.045	0.4958	0.946	0.2814	0.991	0.9250	0.967	0.4757
Hispanic	1.002	0.9815	0.904	0.1500	0.745	0.0015	0.796	0.0025
Asian	1.114	0.5715	0.807	0.2602	0.889	0.5996	0.814	0.1630
Other	1.392	0.0058	1.128	0.3102	1.092	0.5382	1.408	0.0033
Medicaid Recipient	1.191	0.0001	1.155	<.0001	1.314	<.0001	1.174	<.0001
ZIP Median Income ($1000)	0.996	0.0027	1.001	0.4770	1.002	0.0831	0.999	0.2334
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	1.160	0.0131	1.123	0.0076	0.967	0.4725	1.061	0.2312
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.554	<.0001	1.370	<.0001	1.455	<.0001	1.346	<.0001
Charlson = 2	1.871	<.0001	1.559	<.0001	1.808	<.0001	1.726	<.0001
Charlson = 3	2.164	<.0001	1.658	<.0001	2.178	<.0001	1.915	<.0001
Charlson = 4	2.216	<.0001	1.788	<.0001	2.124	<.0001	2.001	<.0001
Charlson = 5	2.366	<.0001	2.327	<.0001	1.722	0.0006	2.154	<.0001
Charlson = 6	3.230	<.0001	4.460	<.0001	3.384	<.0001	3.407	<.0001
Charlson > 6	4.395	<.0001	3.035	<.0001	5.121	<.0001	4.037	<.0001

Table 2.8: Impact of Loss of a Spouse on Survival of Women (Page 2 of 4)

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
2nd Year Before Admission								
No Hospitalizations	1.100	0.1011	1.096	0.0365	0.971	0.5381	0.971	0.5351
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.343	<.0001	1.220	0.0007	1.351	<.0001	1.152	0.0176
Charlson = 2	1.595	<.0001	1.470	<.0001	1.565	<.0001	1.355	<.0001
Charlson = 3	1.880	<.0001	1.438	<.0001	1.758	<.0001	1.446	<.0001
Charlson = 4	1.854	<.0001	1.532	0.0012	1.898	<.0001	1.622	<.0001
Charlson = 5	1.882	<.0001	1.847	0.0008	2.183	<.0001	1.656	<.0001
Charlson = 6	1.920	<.0001	1.647	0.0033	1.864	0.0004	2.038	<.0001
Charlson > 6	2.984	<.0001	3.888	<.0001	3.751	<.0001	1.656	0.0039
3rd Year Before Admission								
No Hospitalizations	1.095	0.1104	1.080	0.0879	0.958	0.3539	1.080	0.0974
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.446	<.0001	1.198	0.0028	1.224	0.0013	1.385	<.0001
Charlson = 2	1.519	<.0001	1.413	<.0001	1.442	<.0001	1.412	<.0001
Charlson = 3	1.594	<.0001	1.496	<.0001	1.222	0.0574	1.477	<.0001
Charlson = 4	1.826	<.0001	2.151	<.0001	1.119	0.5294	1.694	<.0001
Charlson = 5	1.414	0.0594	2.011	0.0037	1.291	0.3359	1.971	<.0001
Charlson = 6	1.703	0.0251	1.553	0.0265	1.636	0.0232	1.784	0.0010
Charlson > 6	1.022	0.9410	1.397	0.2533	3.511	<.0001	2.347	0.0021
N	10729		11277		11389		11858	
Died	5888		7470		6181		7417	
Censored	4841		3807		5208		4441	
% Dying by end of follow-up	54.9%		66.2%		54.3%		62.5%	
Predecasing spouse	2622		2930		4020		3012	
% with Predeceasing Spouse	24.4%		26.0%		35.3%		25.4%	
Spouse Dies at Same Time (n)	69		81		90		96	

Table 2.8: Impact of Loss of a Spouse on Survival of Women (Page 3 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Cancer	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.031	<.0001	1.044	<.0001	1.032	<.0001	1.063	<.0001
Spouse Dead 0y - 1y	0.925	0.4215	1.169	0.0828	1.041	0.7212	0.955	0.8182
Spouse Dead 1y - 2y	1.337	0.0148	1.097	0.4265	1.342	0.0650	1.386	0.1408
Spouse Dead 2y - 3y	1.007	0.9676	1.355	0.0216	0.813	0.4506	0.960	0.8960
Spouse Dead > 3y	1.108	0.5439	1.036	0.8037	1.580	0.0400	1.571	0.0883
Age Equivalents								
Spouse Dead 0y - 1y	-2.554		3.626		1.276		-0.754	
Spouse Dead 1y - 2y	9.513		2.150		9.339		5.343	
Spouse Dead 2y - 3y	0.228		7.055		-6.572		-0.668	
Spouse Dead > 3y	3.359		0.821		14.522		7.394	
Race (vs. White)								
Black	0.993	0.9380	1.232	0.0208	0.911	0.3786	0.958	0.8405
Hispanic	0.958	0.6801	1.022	0.8861	1.007	0.9614	1.001	0.9975
Asian	1.099	0.7085	0.844	0.5296	0.783	0.4011	0.605	0.6180
Other	1.900	<.0001	0.895	0.6339	1.407	0.0425	2.306	0.0016
Medicaid Recipient	1.038	0.5887	1.436	<.0001	1.179	0.0517	1.113	0.5002
ZIP Median Income ($1000)	0.998	0.1751	1.001	0.7022	0.994	0.0002	0.993	0.0728
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	0.835	0.0017	0.934	0.3889	1.059	0.4849	1.122	0.4909
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.046	0.5882	1.261	0.0399	1.140	0.2097	1.331	0.1953
Charlson = 2	1.144	0.1439	1.225	0.1401	1.163	0.1970	1.498	0.1056
Charlson = 3	1.193	0.1386	1.478	0.0202	1.061	0.7145	2.331	0.0033
Charlson = 4	1.088	0.6824	2.631	<.0001	1.999	0.0013	1.990	0.1023
Charlson = 5	1.530	0.1463	1.572	0.2763	3.606	0.0766	2.690	0.1734
Charlson = 6	1.439	0.0187	3.142	<.0001	1.619	0.0008	2.921	0.0018
Charlson > 6	2.066	<.0001	3.693	<.0001	1.727	0.0004	1.615	0.3576

Table 2.8: Impact of Loss of a Spouse on Survival of Women (Page 4 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Cancer	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
2nd Year Before Admission								
No Hospitalizations	1.085	0.2200	0.984	0.8544	0.892	0.2144	0.984	0.9221
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.038	0.7085	1.307	0.0302	0.998	0.9876	1.154	0.5375
Charlson = 2	1.089	0.4388	1.353	0.0292	0.968	0.8117	1.215	0.5124
Charlson = 3	1.161	0.3196	1.436	0.1008	0.977	0.8953	2.060	0.0208
Charlson = 4	1.117	0.6640	1.207	0.5330	1.170	0.5412	1.157	0.7677
Charlson = 5	0.681	0.3678	1.749	0.1884	1.287	0.5342	2.862	0.1855
Charlson = 6	1.606	0.0695	1.965	0.0047	1.208	0.3870	2.898	0.0013
Charlson > 6	1.613	0.1177	1.231	0.6254	1.090	0.7956	2.031	0.4888
3rd Year Before Admission								
No Hospitalizations	1.080	0.2796	0.999	0.9864	1.074	0.3591	0.979	0.8972
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.133	0.2437	1.275	0.0622	1.333	0.0071	1.137	0.6216
Charlson = 2	1.045	0.7216	1.216	0.1842	1.143	0.3227	1.677	0.0617
Charlson = 3	1.450	0.0171	1.599	0.0145	1.313	0.1213	2.564	0.0387
Charlson = 4	1.591	0.0783	0.964	0.9284	1.124	0.6867	1.726	0.3484
Charlson = 5	1.454	0.5043	.	.	1.053	0.9035	0.741	0.7811
Charlson = 6	1.634	0.0542	1.858	0.0053	1.111	0.6899	5.010	0.0168
Charlson > 6	1.461	0.2531	9.157	0.0003	1.280	0.4636	4.349	0.1777
N	4647		4185		3174		1157	
Died	3801		2312		2799		616	
Censored	846		1873		375		541	
% Dying by end of follow-up	81.8%		55.2%		88.2%		53.2%	
Predecasing spouse	533		1000		284		244	
% with Predeceasing Spouse	11.5%		23.9%		8.9%		21.1%	
Spouse Dies at Same Time (n)	37		28		23		7	

Table 2.9: Characteristics of the Spouses of the COSI Cohort

	Male Spouses of Female COSI Cohort Members	Female Spouses of Male COSI Cohort Members
N=	58,416	108,368
Age	79.1	75.0
Race		
White	91.5%	91.3%
Black	4.7%	4.3%
Hispanic	0.5%	0.6%
Asian	2.4%	2.2%
Other	0.9%	1.6%
Medicaid Beneficiary	9.7%	6.5%
Median Income ($1000)	29.8	29.9
Comorbidity Adjustment		
3-Yr. Charlson	0.750	0.448
Hospitalized in last 3 years?	91.1%	62.5%
Survival (Days)	1659.2	1955.9
% Dying	46.6%	22.9%

Table 2.10: Impact of Loss of a COSI Women on Male Spouses' Survival

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.083	<.0001	1.082	<.0001	1.088	<.0001	1.081	<.0001
Proband Dead 0y - 1y	1.252	<.0001	1.212	<.0001	1.159	0.0009	1.170	0.0003
Proband Dead 1y - 2y	1.138	0.0181	1.071	0.1585	1.214	<.0001	1.056	0.2668
Proband Dead 2y - 3y	1.010	0.8736	1.047	0.3973	1.150	0.0148	1.103	0.0626
Proband Dead > 3y	1.135	0.0067	1.066	0.1623	1.001	0.9864	1.110	0.0186
Age Equivalents								
Proband Dead 0y - 1y	2.819		2.440		1.750		2.016	
Proband Dead 1y - 2y	1.621		0.870		2.299		0.700	
Proband Dead 2y - 3y	0.125		0.583		1.657		1.259	
Proband Dead > 3y	1.588		0.811		0.012		1.340	
Race (vs. White)								
Black	0.830	0.0157	1.095	0.1145	0.830	0.0734	0.969	0.5567
Hispanic	0.912	0.3392	0.714	0.0003	0.730	0.0017	0.858	0.0966
Asian	0.907	0.6990	0.682	0.1071	0.704	0.1754	0.671	0.0251
Other	1.191	0.2559	1.172	0.2462	1.310	0.0328	1.096	0.4946
Medicaid Recipient	1.263	<.0001	1.193	<.0001	1.256	<.0001	1.181	<.0001
ZIP Median Income ($1000)	0.997	0.0311	0.999	0.4683	0.999	0.4553	0.999	0.2283
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	0.973	0.6775	0.999	0.9874	0.952	0.3723	0.946	0.3361
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.739	<.0001	1.468	<.0001	1.416	<.0001	1.635	<.0001
Charlson = 2	1.908	<.0001	1.865	<.0001	1.690	<.0001	1.807	<.0001
Charlson = 3	2.522	<.0001	2.130	<.0001	1.984	<.0001	2.096	<.0001
Charlson = 4	2.349	<.0001	2.570	<.0001	2.711	<.0001	2.162	<.0001
Charlson = 5	2.680	<.0001	2.111	<.0001	2.191	<.0001	3.403	<.0001
Charlson = 6	3.659	<.0001	3.507	<.0001	4.444	<.0001	3.500	<.0001
Charlson > 6	5.040	<.0001	4.990	<.0001	5.660	<.0001	4.764	<.0001

Table 2.10: Impact of Loss of a COSI Women on Male Spouses' Survival (Page 2 of 4)

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
2nd Year Before Admission								
No Hospitalizations	1.037	0.5594	1.064	0.2751	0.973	0.6025	1.041	0.4737
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.512	<.0001	1.480	<.0001	1.269	0.0006	1.514	<.0001
Charlson = 2	1.602	<.0001	1.669	<.0001	1.459	<.0001	1.498	<.0001
Charlson = 3	1.845	<.0001	1.907	<.0001	1.667	<.0001	2.033	<.0001
Charlson = 4	2.129	<.0001	1.908	<.0001	1.695	<.0001	1.911	<.0001
Charlson = 5	2.381	<.0001	1.945	0.0002	1.846	0.0026	1.703	0.0110
Charlson = 6	3.319	<.0001	1.855	0.0017	2.257	0.0001	2.249	<.0001
Charlson > 6	3.484	<.0001	1.811	0.0153	2.265	0.0007	1.450	0.1079
3rd Year Before Admission								
No Hospitalizations	0.960	0.4787	1.050	0.3907	0.974	0.5981	1.083	0.1496
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.214	0.0140	1.397	<.0001	1.226	0.0030	1.454	<.0001
Charlson = 2	1.420	<.0001	1.695	<.0001	1.494	<.0001	1.656	<.0001
Charlson = 3	1.773	<.0001	1.553	<.0001	1.499	<.0001	1.824	<.0001
Charlson = 4	1.969	<.0001	2.353	<.0001	1.963	<.0001	1.736	0.0006
Charlson = 5	0.872	0.6884	2.379	0.0003	2.531	0.0007	2.361	0.0002
Charlson = 6	1.971	0.0034	2.147	0.0023	1.581	0.0371	2.331	<.0001
Charlson > 6	2.691	0.0067	1.418	0.2811	1.958	0.0281	1.710	0.0791
N	10729		11277		11389		11858	
Died	4746		5502		5993		5628	
Censored	5983		5775		5396		6230	
% Dying by end of follow-up	44.2%		48.8%		52.6%		47.5%	
Predecasing spouse	5017		6112		4512		6107	
% with Predeceasing Spouse	46.8%		54.2%		39.6%		51.5%	
Spouse Dies at Same Time (n)	69		81		90		96	

Table 2.10: Impact of Loss of a COSI Women on Male Spouses' Survival (Page 3 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Cancer	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.086	<.0001	1.090	<.0001	1.079	<.0001	1.098	<.0001
Proband Dead 0y - 1y	1.435	<.0001	1.426	<.0001	1.269	0.0120	1.308	0.0906
Proband Dead 1y - 2y	1.363	0.0002	1.166	0.0974	1.181	0.1127	1.191	0.3394
Proband Dead 2y - 3y	1.107	0.2611	1.359	0.0012	1.217	0.0743	1.638	0.0061
Proband Dead > 3y	1.157	0.0604	1.280	0.0031	1.161	0.1555	1.379	0.0490
Age Equivalents								
Proband Dead 0y - 1y	4.378		4.118		3.133		2.872	
Proband Dead 1y - 2y	3.754		1.782		2.188		1.870	
Proband Dead 2y - 3y	1.232		3.559		2.583		5.278	
Proband Dead > 3y	1.768		2.865		1.963		3.437	
Race (vs. White)								
Black	1.008	0.9454	1.018	0.8684	1.158	0.3181	1.069	0.7917
Hispanic	1.079	0.6090	0.817	0.2910	1.120	0.6062	1.090	0.7812
Asian	0.592	0.2001	1.186	0.5592	0.512	0.1885	0.000	0.9570
Other	1.464	0.0763	1.455	0.0701	3.012	<.0001	0.987	0.9751
Medicaid Recipient	1.208	0.0306	1.347	0.0009	1.227	0.0816	1.042	0.8207
ZIP Median Income ($1000)	1.000	0.9937	0.998	0.4227	0.997	0.2489	1.002	0.6379
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	1.064	0.5899	0.955	0.6644	1.096	0.5365	1.281	0.2914
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.789	<.0001	1.455	0.0054	1.609	0.0080	2.118	0.0081
Charlson = 2	2.486	<.0001	1.575	0.0014	1.699	0.0041	1.486	0.1944
Charlson = 3	2.136	<.0001	2.375	<.0001	2.269	<.0001	2.853	0.0023
Charlson = 4	2.901	<.0001	1.858	0.0138	3.708	<.0001	3.860	0.0005
Charlson = 5	3.519	<.0001	3.583	<.0001	1.196	0.6861	5.155	0.0133
Charlson = 6	3.985	<.0001	2.361	0.0031	4.009	<.0001	6.625	0.0001
Charlson > 6	9.645	<.0001	4.675	<.0001	8.714	<.0001	11.235	0.0004

Table 2.10: Impact of Loss of a COSI Women on Male Spouses' Survival (Page 4 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Cancer	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
2nd Year Before Admission								
No Hospitalizations	1.002	0.9880	1.029	0.7701	1.134	0.3331	0.798	0.2469
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.425	0.0064	1.427	0.0079	1.436	0.0329	1.964	0.0047
Charlson = 2	1.323	0.0510	1.752	<.0001	1.883	0.0002	1.356	0.2468
Charlson = 3	2.140	<.0001	1.830	0.0004	3.404	<.0001	2.242	0.0125
Charlson = 4	1.305	0.2798	1.848	0.0071	2.945	0.0001	2.600	0.1701
Charlson = 5	2.111	0.0533	2.751	0.0016	7.660	<.0001	6.814	0.0047
Charlson = 6	2.638	0.0029	2.961	<.0001	0.764	0.6381	1.861	0.3204
Charlson > 6	1.857	0.0616	4.852	<.0001	16.850	<.0001	2.831	0.1019
3rd Year Before Admission								
No Hospitalizations	0.982	0.8504	0.995	0.9592	0.944	0.6414	1.195	0.3708
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.592	0.0001	1.365	0.0209	1.399	0.0408	1.215	0.4416
Charlson = 2	1.580	0.0016	2.013	<.0001	1.429	0.0519	0.963	0.9093
Charlson = 3	1.699	0.0038	2.441	<.0001	2.062	0.0004	0.732	0.4855
Charlson = 4	2.110	0.0085	1.863	0.0119	1.398	0.2936	1.986	0.4335
Charlson = 5	4.223	0.0061	6.241	0.0011	1.567	0.5376	0.585	0.4804
Charlson = 6	2.894	0.0144	1.319	0.7831	1.248	0.6241	.	.
Charlson > 6	5.419	0.0031	0.684	0.5983	5.093	0.0110	.	.
N	4647		4185		3174		1157	
Died	1856		1753		1271		449	
Censored	2791		2432		1903		708	
% Dying by end of follow-up	39.9%		41.9%		40.0%		38.8%	
Predeceasing spouse	3500		1948		2610		529	
% with Predeceasing Spouse	75.3%		46.5%		82.2%		45.7%	
Spouse Dies at Same Time (n)	37		28		23		7	

Table 2.11: Impact of Loss of a COSI Men on Female Spouses' Survival

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.095	<.0001	1.094	<.0001	1.092	<.0001	1.094	<.0001
Proband Dead 0y - 1y	1.317	<.0001	1.157	0.0007	1.267	<.0001	1.154	0.0017
Proband Dead 1y - 2y	1.129	0.0193	1.078	0.1123	1.171	0.0164	1.054	0.2868
Proband Dead 2y - 3y	1.165	0.0055	1.036	0.4788	1.147	0.0572	1.058	0.2907
Proband Dead > 3y	1.110	0.0169	1.055	0.2222	1.140	0.0392	1.183	0.0002
Age Equivalents								
Proband Dead 0y - 1y	3.034		1.623		2.689		1.594	
Proband Dead 1y - 2y	1.337		0.836		1.794		0.585	
Proband Dead 2y - 3y	1.683		0.394		1.558		0.628	
Proband Dead > 3y	1.150		0.596		1.489		1.871	
Race (vs. White)								
Black	1.061	0.4682	1.084	0.2184	0.897	0.4046	0.975	0.6856
Hispanic	0.922	0.4114	1.042	0.6603	0.975	0.8585	1.018	0.8521
Asian	0.701	0.1848	0.762	0.2158	1.500	0.1626	0.649	0.0490
Other	0.283	<.0001	0.300	<.0001	0.196	<.0001	0.355	<.0001
Medicaid Recipient	1.255	<.0001	1.120	0.0191	1.139	0.0322	1.186	0.0003
ZIP Median Income ($1000)	1.000	0.7099	0.999	0.6073	1.000	0.8961	1.001	0.5784
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	0.996	0.9446	0.979	0.7305	0.961	0.6126	0.846	0.0041
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	2.016	<.0001	1.881	<.0001	1.889	<.0001	1.617	<.0001
Charlson = 2	2.417	<.0001	2.319	<.0001	2.013	<.0001	2.382	<.0001
Charlson = 3	2.903	<.0001	3.119	<.0001	2.673	<.0001	2.120	<.0001
Charlson = 4	2.879	<.0001	2.289	<.0001	4.202	<.0001	3.372	<.0001
Charlson = 5	5.158	<.0001	4.538	<.0001	6.581	<.0001	3.060	<.0001
Charlson = 6	6.613	<.0001	5.234	<.0001	5.937	<.0001	4.893	<.0001
Charlson > 6	4.528	<.0001	6.663	<.0001	6.319	<.0001	8.539	<.0001

Table 2.11: Impact of Loss of a COSI Men on Female Spouses' Survival (Page 2 of 4)

	Heart Attack		C.H.F.		Hip Fracture		Stroke	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
2nd Year Before Admission								
No Hospitalizations	1.035	0.5538	0.969	0.5580	0.816	0.0055	0.974	0.6425
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.720	<.0001	1.634	<.0001	1.337	0.0029	1.468	<.0001
Charlson = 2	1.924	<.0001	1.968	<.0001	1.289	0.0225	1.900	<.0001
Charlson = 3	2.158	<.0001	1.728	<.0001	1.836	<.0001	1.734	<.0001
Charlson = 4	2.521	<.0001	2.598	<.0001	2.232	0.0010	2.265	<.0001
Charlson = 5	2.596	<.0001	2.320	<.0001	1.313	0.4932	3.217	<.0001
Charlson = 6	4.210	<.0001	4.690	<.0001	2.554	0.0005	3.219	<.0001
Charlson > 6	2.916	<.0001	1.285	0.4004	2.433	0.1027	0.974	0.9427
3rd Year Before Admission								
No Hospitalizations	1.007	0.9095	0.891	0.0285	1.002	0.9784	0.939	0.2609
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.510	<.0001	1.332	<.0001	1.476	0.0002	1.499	<.0001
Charlson = 2	1.696	<.0001	1.519	<.0001	1.475	0.0009	1.610	<.0001
Charlson = 3	1.969	<.0001	1.955	<.0001	1.721	0.0006	1.838	<.0001
Charlson = 4	2.368	<.0001	1.876	0.0002	2.321	0.0026	2.049	<.0001
Charlson = 5	1.835	0.0142	2.110	0.0059	6.867	<.0001	1.801	0.0547
Charlson = 6	1.949	0.0009	1.857	0.0017	1.851	0.0930	1.790	0.0478
Charlson > 6	2.548	0.0074	2.043	0.1558	3.113	0.0312	2.791	0.0009
N	24811		20977		8742		20818	
Died	4990		5316		2674		4901	
Censored	19821		15661		6068		15917	
% Dying by end of follow-up	20.1%		25.3%		30.6%		23.5%	
Predecasing spouse	13377		15118		6018		13626	
% with Predeceasing Spouse	53.9%		72.1%		68.8%		65.5%	
Spouse Dies at Same Time (n)	73		97		65		64	

Table 2.11: Impact of Loss of a COSI Men on Female Spouses' Survival (Page 3 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Cancer	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
Age (1 yr.)	1.089	<.0001	1.101	<.0001	1.086	<.0001	1.092	<.0001
Proband Dead 0y - 1y	1.136	0.0987	1.194	0.0281	1.157	0.0872	1.397	0.0002
Proband Dead 1y - 2y	1.107	0.2085	1.178	0.0560	1.282	0.0060	1.103	0.3506
Proband Dead 2y - 3y	1.155	0.0910	1.209	0.0366	1.238	0.0258	0.989	0.9216
Proband Dead > 3y	1.254	0.0043	1.150	0.0746	1.338	0.0019	1.148	0.1422
Age Equivalents								
Proband Dead 0y - 1y	1.496		1.843		1.768		3.799	
Proband Dead 1y - 2y	1.192		1.703		3.011		1.114	
Proband Dead 2y - 3y	1.690		1.973		2.588		-0.126	
Proband Dead > 3y	2.655		1.453		3.529		1.568	
Race (vs. White)								
Black	0.874	0.2422	1.167	0.1620	1.206	0.0413	1.124	0.5289
Hispanic	0.832	0.2214	0.859	0.4216	0.715	0.0871	1.303	0.2010
Asian	0.727	0.3445	0.637	0.2713	0.645	0.2868	1.260	0.6074
Other	0.335	<.0001	0.302	<.0001	0.496	0.0004	0.685	0.0933
Medicaid Recipient	1.316	0.0024	1.033	0.7725	1.100	0.2751	0.856	0.2650
ZIP Median Income ($1000)	1.001	0.5989	0.997	0.1348	1.003	0.1046	0.996	0.1472
Comorbidity Measures								
1st Year Before Admission								
No Hospitalizations	0.801	0.0187	0.863	0.1444	1.003	0.9799	0.899	0.3929
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.375	0.0114	1.538	0.0014	1.906	<.0001	1.855	<.0001
Charlson = 2	1.938	<.0001	2.360	<.0001	2.210	<.0001	2.676	<.0001
Charlson = 3	2.175	<.0001	2.603	<.0001	2.537	<.0001	2.526	<.0001
Charlson = 4	3.851	<.0001	2.971	<.0001	2.843	<.0001	3.182	<.0001
Charlson = 5	2.354	0.0044	2.272	0.0379	3.993	<.0001	4.434	<.0001
Charlson = 6	3.880	<.0001	3.776	<.0001	8.468	<.0001	3.684	<.0001
Charlson > 6	7.429	<.0001	7.294	<.0001	13.677	<.0001	3.588	0.0060

Table 2.11: Impact of Loss of a COSI Men on Female Spouses' Survival (Page 4 of 4)

	Bad Cancer		Colon Cancer		Lung Cancer		Urinary Tract Cancer	
	H.R.	p	H.R.	p	H.R.	p	H.R.	p
2nd Year Before Admission								
No Hospitalizations	0.949	0.5885	1.013	0.8958	0.924	0.3891	0.967	0.7803
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.545	0.0006	1.522	0.0034	1.461	0.0020	1.306	0.1064
Charlson = 2	1.910	<.0001	1.781	<.0001	1.748	<.0001	2.084	<.0001
Charlson = 3	2.353	<.0001	1.881	0.0007	1.792	0.0003	3.280	<.0001
Charlson = 4	3.171	<.0001	3.252	<.0001	1.548	0.0644	2.190	0.0061
Charlson = 5	3.761	0.0001	1.307	0.6579	1.049	0.9063	6.476	0.0118
Charlson = 6	4.489	<.0001	1.866	0.0858	2.692	0.0001	4.404	<.0001
Charlson > 6	6.042	<.0001	4.270	0.0004	0.886	0.7350	5.912	0.0030
3rd Year Before Admission								
No Hospitalizations	0.940	0.4909	1.170	0.1616	0.994	0.9440	0.953	0.6874
Charlson = 0	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)	1.000	(ref.)
Charlson = 1	1.575	0.0003	1.777	0.0001	1.506	0.0010	1.554	0.0073
Charlson = 2	1.618	0.0006	1.888	0.0002	1.484	0.0053	1.375	0.1048
Charlson = 3	2.055	<.0001	3.098	<.0001	1.855	0.0003	1.004	0.9886
Charlson = 4	2.477	0.0005	2.387	0.0045	2.607	0.0006	1.524	0.1893
Charlson = 5	4.192	0.0152	5.285	<.0001	8.274	<.0001	3.944	0.0068
Charlson = 6	1.308	0.4503	4.663	<.0001	2.427	0.0242	2.125	0.1041
Charlson > 6	2.679	0.2011	2.624	0.1114	6.982	<.0001	2.312	0.1466
N	9609		7904		9688		5819	
Died	1995		1647		2117		1186	
Censored	7614		6257		7571		4633	
% Dying by end of follow-up	20.8%		20.8%		21.9%		20.4%	
Predeceasing spouse	8036		4810		8787		3353	
% with Predeceasing Spouse	83.6%		60.9%		90.7%		57.6%	
Spouse Dies at Same Time (n)	27		34		25		28	

Table 2.12: Impact of Alzheimer's Disease on Mortality in Men

Whose Mortality?	Whose Alzheimer's?	Bereavement	Coefficient	SE	p-value
Male Probands	Spouse	0-1y	0.217	0.023	<.0001
		1-2y	0.121	0.030	<.0001
		2-3y	0.152	0.037	<.0001
		>3y	0.094	0.038	0.0127
		0-1y * Alz	-0.061	0.101	0.5484
		1-2y * Alz	0.096	0.122	0.4318
		2-3y * Alz	0.209	0.136	0.1245
		>3y * Alz	-0.189	0.147	0.1995
Male Spouses	Proband	0-1y	0.210	0.021	<.0001
		1-2y	0.123	0.023	<.0001
		2-3y	0.109	0.025	<.0001
		>3y	0.107	0.022	<.0001
		0-1y * Alz	-0.082	0.079	0.3043
		1-2y * Alz	0.066	0.084	0.4313
		2-3y * Alz	-0.124	0.099	0.2108
		>3y * Alz	-0.085	0.080	0.2852
Male Probands	Proband	0-1y	0.212	0.023	<.0001
		1-2y	0.124	0.030	<.0001
		2-3y	0.157	0.036	<.0001
		>3y	0.076	0.037	0.0423
		0-1y * Alz	-0.031	0.100	0.7577
		1-2y * Alz	-0.024	0.132	0.853
		2-3y * Alz	0.088	0.156	0.5731
		>3y * Alz	-0.048	0.179	0.7902

Table 2.13: Impact of Alzheimer's Disease on Mortality in Women

Whose Mortality?	Whose Alzheimer's?	Bereavement	Coefficient	SE	p-value
Female Probands	Spouse	0-1y	0.155	0.023	<.0001
		1-2y	0.066	0.029	0.0227
		2-3y	0.018	0.035	0.6018
		>3y	0.034	0.033	0.3067
		0-1y * Alz	-0.019	0.104	0.8574
		1-2y * Alz	0.098	0.118	0.4037
		2-3y * Alz	-0.032	0.142	0.8206
		>3y * Alz	0.023	0.117	0.8464
Female Spouses	Proband	0-1y	0.224	0.030	<.0001
		1-2y	0.106	0.032	0.0012
		2-3y	0.108	0.035	0.0019
		>3y	0.152	0.030	<.0001
		0-1y * Alz	-0.073	0.134	0.5882
		1-2y * Alz	0.204	0.130	0.1159
		2-3y * Alz	0.053	0.141	0.7059
		>3y * Alz	0.027	0.115	0.8122
Female Probands	Proband	0-1y	0.146	0.024	<.0001
		1-2y	0.073	0.029	0.0127
		2-3y	-0.003	0.035	0.9271
		>3y	0.024	0.033	0.4644
		0-1y * Alz	0.045	0.085	0.5983
		1-2y * Alz	-0.075	0.111	0.4992
		2-3y * Alz	0.184	0.119	0.1232
		>3y * Alz	0.069	0.118	0.5592

Table 2.14: Selection into COSI

		Wives		
		In COSI	Not in COSI	Total
Husbands	In COSI	3,590	108,934	112,524
	Not in COSI	57,225	1,649,069	1,706,294
	Total	60,815	1,758,003	1,818,818

Odds ratio = .950   [95% Conf. Interval: .918 - .983]
Chi-squared(1) = 8.71 p = 0.0032

Table 2.15: Tests for Violation of Proportionality Assumption for Bereavement Effects

	Men		Women	
	Chi-Square	p-value	Chi-Square	p-value
Heart Attack	13.0	0.011	3.0	0.552
C.H.F.	7.2	0.124	0.9	0.919
Hip Fracture	1.4	0.839	4.0	0.403
Stroke	2.2	0.690	7.5	0.111
Bad Cancer	2.0	0.730	9.5	0.050
Colon Cancer	4.5	0.345	3.1	0.539
Lung Cancer	9.6	0.048	2.6	0.631
Urinary Tract Cancer	9.7	0.045	7.5	0.113

Table 2.16: Violation of Proprtionality Assumption on Age

Men	Age	Interaction	Interaction SE	1 Month Effect	5 Year Effect
Heart Attack	0.062	0.00042	0.00006	0.67%	40%
C.H.F.	0.048	0.00020	0.00006	0.42%	25%
Hip Fracture	0.057	0.00006	0.00009	0.10%	6%
Stroke	0.061	0.00016	0.00006	0.26%	16%
Bad Cancer	0.027	0.00031	0.00012	1.16%	69%
Colon Cancer	0.042	0.00027	0.00012	0.64%	38%
Lung Cancer	0.033	-0.00033	0.00016	-1.00%	-60%
Urinary Tract Cancer	0.042	0.00045	0.00013	1.08%	65%

Women	Age	Interaction	Interaction SE	1 Month Effect	5 Year Effect
Heart Attack	0.060	0.00029	0.00010	0.48%	29%
C.H.F.	0.042	0.00021	0.00009	0.49%	30%
Hip Fracture	0.045	0.00045	0.00010	1.00%	60%
Stroke	0.062	0.00015	0.00009	0.23%	14%
Bad Cancer	0.027	0.00022	0.00018	0.81%	49%
Colon Cancer	0.043	-0.00001	0.00018	-0.01%	-1%
Lung Cancer	0.032	-0.00002	0.00027	-0.05%	-3%
Urinary Tract Cancer	0.060	0.00004	0.00036	0.07%	4%

Non-proportionality is tested by interacted age with time since diagnosis.
The example effects are shown for the proprtionate change in the age coefficient
1 month and 5 years after diagnosis.