Health, cognitive, and psychosocial factors as predictors of mortality in an elderly community sample

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Abstract

Study objective—To examine whether cognitive and psychosocial factors predict mortality once physical health is controlled.

Design—A prospective study of community dwelling elderly. Mortality was assessed over a period of 3-4 years after the baseline assessment of predictors. The data were analysed using the Cox proportional hazards model.

Setting—Canberra and Queanbeyan, Australia.

Participants—A sample of 897 people aged 70 or over and living in the community, drawn from the compulsory electoral roll.

Results—For the sample as a whole, the significant predictors of mortality were male sex, poor physical health, poor cognitive functioning, and low neuroticism. Men had an adjusted relative risk of mortality of 2.5 compared with women. For the male sub-sample, poor self rated health and a poor performance on a speeded cognitive task were significant predictors, while for women, greater disability, low systolic blood pressure, and a low score on a dementia screening test were the strongest predictors.

Conclusions—Mortality was predicted by physical ill health and poor cognitive functioning. Psychosocial factors such as socioeconomic status, psychiatric symptoms, and social support did not add to the prediction of mortality, once sex, physical health, and cognitive functioning were controlled. Mortality among men was more than twice that of women, even when adjusted for other predictors.

There is now an extensive literature examining predictors of mortality in samples of the general population, particularly in the elderly. Much interest has centred on whether psychosocial factors are predictors of mortality once physical health is controlled.

While physical diseases are clearly the main predictors of mortality, there has been much interest in self rated health. Single questions asking the respondent about their general health can predict mortality better than more comprehensive measures of physical health. Furthermore, self rated health tends to predict better for men than women. The reasons for this strong association are only partly understood.1

Poor cognitive functioning has been found to be a predictor in several studies.2-5 Some of the excess mortality is probably caused by dementia diseases and their complications, but an association has been found even when demented subjects are excluded, retaining those with sub-clinical cognitive impairment.1, 7 Perhaps the most interesting issue now is which aspects of cognitive functioning are the best predictors. For example, one recent study implicated mental speed.3

Social support is one of the most extensively researched psychosocial factors. There are now a large number of studies showing that a low level of social support predicts mortality,6-9 although other studies have failed to find an association.10-12 The mechanism of this association is not understood.

There is mixed evidence about common psychiatric disorders as predictors of mortality. Most of the work has been done with depression or with scales of neurotic symptoms. Controlling for physical health is very important when studying psychiatric disorders and symptoms, because physical ill health and disability are known risk factors for depression.9 When physical health is controlled, some studies have found an association with mortality,11-23 but others have been negative.13-24 The mixed findings may have resulted because some studies have included more comprehensive measures of physical health than others. Another explanation is that psychiatric disorders predict mortality only over shorter follow up periods.22

Personality has received comparatively little attention as a predictor of mortality. Currently, the most popular model of personality traits is the five factor model that posits factors of extraversion, neuroticism, conscientiousness, agreeableness, and openness/intellect. There is evidence that neuroticism and extraversion are not predictors of mortality,22-25 but one study found an association with low conscientiousness.26

Low socioeconomic status has been linked to mortality from a wide range of causes.27 Socioeconomic differences in health behaviours are responsible for some, but not all, of these differences.27 Health behaviours can also be broadly grouped under psychosocial factors. While smoking is a well known risk factor for mortality, the evidence in the elderly shows both positive28-30 and non-significant results.31, 32 This may be because elderly...
smokers are a survival élite. Physical activity has also been investigated, with both positive and non-significant results. Most studies tend to focus on only one type of psychosocial factor. Here we report on a study that allows the simultaneous investigation of a variety of psychosocial and cognitive factors as predictors of mortality while controlling for physical health. Baseline information included physical health (including self rated health), cognitive functioning, common psychiatric symptoms, social support, personality, socioeconomic status, and health behaviours.

Method

The sample has been described in detail elsewhere. Briefly, the subjects were 456 men and 441 women, aged 70 or over at the time of baseline assessment and living in the community in Canberra or Queanbeyan, Australia. The subjects were sampled from the compulsory electoral roll with a response rate of 69%.

Assessment of mortality

Predictor variables were assessed in 1990–1991 and then surviving subjects were reinterviewed in 1994. Dates of any intervening deaths were established by contacting relatives, from searching the National Death Index maintained by the Australian Institute of Health and Welfare, and from death notices in the local newspaper. Mortality status was established for all but 10 respondents. Survival was calculated as the number of days from the time of Wave 1 assessment to either death or Wave 2 assessment. For the three men and three women who had to have died, but for whom no date of death was available, a survival of 650 days was assigned, being the median survival of those who died.

Assessment of predictor variables

The predictor variables were organised into separate blocks as follows.

Physical health

Physical health was assessed in several ways as described previously. Global self rated health was assessed by asking “Would you say your overall health nowadays is excellent, good, fair or poor?” A count was made of 21 common symptoms (for example, cramps, breathing difficulties, indigestion, headaches) occurring in the past month. A count was also made of reported diseases from a list of 28 items, such as heart attacks, high blood pressure, diabetes, thyroid dysfunction, cancers. Disability was assessed by a scale of activities of daily living. Subjects were asked how often they had experienced pain in the past month (1=never to 6=constantly). Measures of hearing and visual impairment were derived from the subject ratings of how well they could see and hear in different situations. Scores ranges from 5 to 16 with higher scores indicating greater impairment. Blood pressure was measured twice a few minutes apart, the results averaged and the categories constructed of systolic hypertensives (140+ mm Hg), normotensives (120–139 mm Hg), and hypotensives (<120 mm Hg); and diastolic hypertensives (>85 mm Hg), normotensives (75–85 mm Hg), and hypotensives (<75 mm Hg).

Cognitive functioning

Four tests assessed various aspects of cognitive functioning: a brief screening test for dementia, the Mini-Mental State Examination (MMSE); the Episodic Memory Test, which consists of four short memory tasks; the Symbol-Letter Modalities Test (SLMT), which is a measure of cognitive speed; and the National Adult Reading Test (NART), a test of crystallised intelligence that relies on the reading of words that are not pronounced phonetically.

Social support

Subjects were classified as living alone or with others. There were also three social support scales measuring the extent of the subject’s social network (Network), the availability of help if needed (Help Available), and the availability of close and confiding relationships (Close Friends). These were derived from a short form of the Interview Schedule for Social Interaction (ISSI), which included items covering the availability of social integration, the availability of attachments, the adequacy of social integration and some additional items on the availability of proximate help that were particularly relevant to the elderly.

Psychiatric symptoms

Subjects were assessed with the Scale for Depressive Symptoms, the number of depression symptoms out of a possible 28, which are used in diagnostic algorithms, and the Goldberg Anxiety and Depression Scales, which are counts of nine symptoms of depression and nine of anxiety.

Personality

Subjects completed the Extraversion and Neuroticism scales of the short form of the Eysenck Personality Questionnaire-Revised. Each scale consists of the count of positive responses to 12 questions about how a respondent usually behaves, feels or acts.

Socioeconomic status

Socioeconomic status was measured by years of education and by an ordinal occupational status scale that ranged from 1: semi or unskilled to 5: managerial/professional. Women who were involved in home duties were assigned their husband's occupational status.

Health behaviours

Subjects were asked whether they currently smoked or had ever smoked. Inactivity was measured by asking respondents how often “these days” they engaged in each of six different activities such as reading a newspaper or physical activity. Responses were summed, with higher scores indicating greater inactivity.
Table 1 Predictor variables at Wave 1. Those alive at Wave 2 compared with those who died between waves.

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Alive Mean (SD)</th>
<th>Died Mean (SD)</th>
<th>p value (t-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70–74</td>
<td>43.6% (33.7%)</td>
<td>33.7%</td>
<td>0.000</td>
</tr>
<tr>
<td>75–79</td>
<td>33.1% (28.5%)</td>
<td>28.5%</td>
<td>0.000</td>
</tr>
<tr>
<td>80–84</td>
<td>16.9% (22.1%)</td>
<td>22.1%</td>
<td>0.000</td>
</tr>
<tr>
<td>85+</td>
<td>6.3% (15.7%)</td>
<td>15.7%</td>
<td>0.000</td>
</tr>
<tr>
<td>Sex: % male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47.7% (64.0%)</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 shows the means and standard deviations for each of the predictor variables considered, for those who died and those who survived. For the total sample, models were tested with interaction terms between sex and each of the predictor variables and between age (coded as age by 10-year intervals) and each of the predictors. Linearity assumptions in the interval variables were investigated by recoding these variables into quintiles, treating them as categorical variables and using polynomial contrasts in the Cox regressions. Proportionality assumptions were also tested and found to hold. The set of variables that were significantly associated with survival in any one of these analyses was then included in a set of predictors to form the final model. All possible two-way interactions in this model were tested and because of the large number of such terms a level of 0.01 was adopted. None was significant. Analyses were made using SPSS for Windows, version 7.5.
survived until Wave 2. At Wave 1, those who died during the subsequent 3.6 years were older and more likely to be male, were in poorer health and were more disabled, had poorer cognitive functioning, were more depressed, showed greater inactivity, and had poorer social networks (even though fewer lived alone). However, there were no differences on the anxiety scale, in personality scores, in socioeconomic status or smoking history. Some subjects were unable to complete the interview, especially the personality questionnaire. These persons tended to be older, had greater disability, were less active, were more likely to have systolic hypotension, and had poorer cognitive scores on tasks that were completed. Significant departures from linearity and so were entered as categorical variables in the analyses. All other variables could be treated as linear in their quintiles. In table 2, the reference category for continuous predictors is either the lowest or highest quintile, and the relative risks are presented comparing the extreme categories of the lowest with the highest quintile. This method provides an indication of the “policies” of the lowest with the highest quintile. Relative risk calculated as exp(4 coefficients and relative risks adjusted for all other predictors in the final model*).

Table 2

<table>
<thead>
<tr>
<th>Age (5 year age groups)</th>
<th>Men and women</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>β</td>
<td>RR (95%CI)</td>
<td>β</td>
<td>RR (95%CI)</td>
</tr>
<tr>
<td>70–74 (reference)</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>75–79</td>
<td>—0.19</td>
<td>0.82 (0.52, 1.29)</td>
<td>—0.13</td>
</tr>
<tr>
<td>80–84</td>
<td>—0.06</td>
<td>0.96 (0.57, 1.60)</td>
<td>0.06</td>
</tr>
<tr>
<td>85+</td>
<td>0.44</td>
<td>1.57 (0.85, 2.89)</td>
<td>0.68</td>
</tr>
<tr>
<td>Sex</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>Female (reference)</td>
<td>0.93</td>
<td>2.72 (1.83, 4.04)</td>
<td>—</td>
</tr>
<tr>
<td>Male</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>General health</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>Excellent (reference)</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>Good</td>
<td>—0.29</td>
<td>0.75 (0.44, 1.28)</td>
<td>—0.29</td>
</tr>
<tr>
<td>Poor</td>
<td>—0.17</td>
<td>0.81 (0.44, 1.47)</td>
<td>—0.01</td>
</tr>
<tr>
<td>ADL</td>
<td>0.74</td>
<td>1.82 (0.85, 3.87)</td>
<td>0.97</td>
</tr>
<tr>
<td>0 (reference level)</td>
<td>0.21†</td>
<td>1.11†</td>
<td>—</td>
</tr>
<tr>
<td>4+ (upper quintile)</td>
<td>2.29† (1.30, 3.75)</td>
<td>1.52† (0.79, 2.94)</td>
<td>—</td>
</tr>
<tr>
<td>Total illnesses</td>
<td>0.29‡</td>
<td>0.33‡</td>
<td>—</td>
</tr>
<tr>
<td>0 (reference level)</td>
<td>1.00</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>4+ (upper quintile)</td>
<td>3.15† (1.74, 5.70)</td>
<td>3.45† (1.71, 6.98)</td>
<td>3.21‡ (1.00, 10.29)</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>Hypotensive</td>
<td>0.51</td>
<td>1.66 (0.92, 3.00)</td>
<td>0.23</td>
</tr>
<tr>
<td>Normotensive (reference)</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>Hypertensive</td>
<td>0.08</td>
<td>1.09 (0.72, 1.64)</td>
<td>0.05</td>
</tr>
<tr>
<td>SMMTQF</td>
<td>0.22</td>
<td>0.34‡</td>
<td>0.34‡</td>
</tr>
<tr>
<td>≥112 (reference level)</td>
<td>1.00</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>&lt;84 (lowest quintile)</td>
<td>2.42† (1.27, 4.62)</td>
<td>3.86‡ (1.76, 8.45)</td>
<td>3.68</td>
</tr>
<tr>
<td>MMSE</td>
<td>0.16</td>
<td>0.16</td>
<td>0.07‡</td>
</tr>
<tr>
<td>30 (reference level)</td>
<td>1.00</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>&lt;24 (lower quintile)</td>
<td>1.68† (1.05, 3.12)</td>
<td>1.34 (0.67, 2.50)</td>
<td>4.21‡ (1.43, 12.41)</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>—0.16‡</td>
<td>—0.21†</td>
<td>0.02‡</td>
</tr>
<tr>
<td>0 (reference level)</td>
<td>1.00</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>6+ (upper quintile)</td>
<td>0.53 (0.31, 0.90)</td>
<td>0.42 (0.22, 0.80)</td>
<td>1.09 (0.40, 2.99)</td>
</tr>
</tbody>
</table>

* Results for factors that add significantly to the model are indicated in bold. † β associated with an increase in the predictor of one quintile. ‡ β associated with a decrease in the predictor of one quintile. § Relative risk for a person in the category nominated, compared with the reference category. ¶ Relative risk calculated as exp(4(βi)); 95% CI calculated as exp 4(|βi|±1.96se(βi))).
dementia were excluded from the analysis. The most important physical health variables were total number of illnesses for both men and women, poor self rated health in men, and activities of daily living and systolic hypotension in women.

Discussion
Excess mortality in men at all ages is well recognised, and this study found that men were more than twice as likely to die as women, adjusting for other covariates. Most studies of the predictors of mortality, however, either report men and women separately, not comparing their adjusted risks, or fail to report it. Our results show that the sex difference is not mediated by any of the covariates we included. There is evidence that hormonal exposures earlier in life are important, because castrated men have a lower mortality than intact men, and even a lower mortality than castrated women. However, hormonal exposures may affect other more proximal health or psychosocial predictors of mortality in old age, and the identity of these other predictors remains a mystery.

Age was not a significant covariate once adjustment was made for health and cognitive performance, but was significant if only physical health was controlled, especially for men in the oldest age group. Cognitive performance, especially speeded tasks such as the SLMT, deteriorates rapidly with age. If cognitive impairment is linked to terminal decline, it may be a stronger predictor of mortality than age over short periods of time. Some other studies on predictors of mortality continued to find a strong age effect even when a wide range of other covariates were included. However, these studies had a longer follow up than ours. When mortality is predicted over long periods, age may be a better predictor than baseline health measures that were taken many years previously.

When men and women were analysed separately, the general pattern of the results was the same, in that the variables selected came from the physical health and cognitive functioning domains. However, the specific variables selected from within these domains were different. For example, self rated health was selected as a physical health predictor for men, while for women it was disability in activities of daily living. A number of other studies have found that self rated health is a better predictor of mortality for men than for women. Similarly, in the domain of cognitive functioning, the Symbol-Letter Modalities Test was selected for men, while the Mini-Mental State Examination was selected for women. The finding that a test of mental speed is a good predictor for men may be a better predictor than baseline health measures that were taken many years previously.

Depression was also a univariate predictor of mortality, but was not selected in the multivariate model. The major risk factor for depression in old age is physical ill health, so the effect reported in some studies could be because of inadequate control for physical health.

Socioeconomic status did not even emerge as a univariate predictor, although lower socioeconomic levels and greater inequality within populations have been associated with higher mortality in many studies. This study, however, was conducted in a comparatively homogeneous community that has a much higher level of education and occupational status than the rest of Australia, with comparatively few people having only primary school education or working in unskilled occupations.

The only social support variable found to be significant at the univariate level was the size of the support network. This is consistent with earlier studies, and indicates that social support may be an important factor in predicting mortality. However, it is not clear whether this is a direct effect or whether it is mediated by other factors such as health or cognitive functioning.

In conclusion, this study has provided new information about the predictors of mortality in old age. The results are consistent with previous studies, and suggest that both physical and mental health are important predictors of mortality. However, the specific variables selected were different for men and women, and the relative importance of different factors may vary across different populations. Further research is needed to investigate the mechanisms underlying these findings, and to determine whether they are generalizable to other populations.
the social network, but neither it nor any of the other social support variables was selected in the multivariate model. It should be noted that these items measuring social support in this study were more extensive in their coverage than those used in surveys reporting a protective effect. Other Australian studies have also shown no or only a weak association of social support variables with mortality.17–19

In conclusion, the strength of this study lies in the wide range of psychosocial variables considered, together with its allowance for confounding. While many of these variables had simple associations with mortality, once other variables were controlled it was only the cognitive functioning variables that retained an association.

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