Association Between a Self-Rated Health Question and Mortality in Young and Old Dialysis Patients: A Cohort Study

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Background: Self-rated health (SRH) has been shown to predict mortality in large community-based studies; however, large clinical-based studies of this topic are rare. We assessed whether an SRH item predicts mortality in a large sample of incident dialysis patients beyond sociodemographic, disease, and clinical measures and possible age interaction.

Study Design: Prospective cohort study.

Setting & Participants: 1,443 predominantly white patients from 38 dialysis centers in The Netherlands participating in the Netherlands Cooperative Study on the Adequacy of Dialysis-2 between 1997 and 2004.

Predictor: SRH score completed at 3 months after the start of dialysis therapy (baseline).

Outcomes & Measurements: Cox proportional hazards model estimated the association between SRH and all-cause mortality. Interaction of SRH with age (<65 and ≥65 years) was examined in an additive model.

Results: Mean age of patients was 59.6 ± 14.8 years, with 61% men and 69% married/living together. Mean follow-up was 2.7 ± 1.8 years. Deaths per SRH group in the multivariate analyses sample: excellent/very good (9 of 63 patients; 14.3%), good (148 of 473 patients; 31.3%), fair (194 of 508 patients; 38.2%), and poor (45 of 71 patients; 63.4%). Patients with poor, fair, or good health ratings had a greater mortality risk than those with excellent/very good health ratings (adjusted hazard ratio [HRadj], 3.56; 95% confidence interval [CI], 1.71 to 7.42; HRadj, 2.09; 95% CI, 1.06 to 4.12; HRadj, 1.87; 95% CI, 0.95 to 3.70, respectively) independent of a range of risk factors. No age interaction with SRH was found.

Limitations: Although the SRH-mortality association remained strong despite extensive adjustments, unknown residual confounding could still exist.

Conclusion: SRH is an independent predictor of mortality in incident dialysis patients. Patients with poor SRH in both age strata had a significantly increased risk of mortality even after controlling for demographic and clinical confounders. Patient self-assessment of health can be an invaluable and economical complement to clinical measures in risk assessment.


INDEX WORDS: Self-rated health; mortality; dialysis; age interaction.

How are you feeling today? So simple a question, and so often asked as a polite opener during consultation, can provide a wealth of information about patients’ health perceptions and outcomes. Irrespective of its phrasing, this seemingly simple global self-rated health (SRH) item has been shown to be as powerful in predicting mortality as more detailed health assessments or objective clinical measures. In both community-1,3 and clinical-based studies,4,5 a strong association between SRH and mortality persisted even after controlling for demographic, clinical, and health factors. A study of 2,885 catheterized patients with coronary heart disease reported that patients with poor self-health ratings had a significantly increased risk of both all-cause and coronary heart disease–related mortality, even after extensive adjustment for mortality risk factors.6

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To our knowledge, only 1 study with dialysis patients used SRH to investigate its association with mortality. This study of prevalent elderly hemodialysis patients found that poorer SRH at baseline was associated with 5 times greater mortality during 7 years of follow-up. Other studies evaluating health status and mortality in dialysis patients have used composite scores from detailed health assessments in their analysis. Limitations of these studies included the use of prevalent patients, inclusion of only hemodialysis patients, or small samples.

Despite improvements in dialysis treatments, mortality rates remain high, especially for elderly patients. The interaction of age on the association between SRH and mortality has been examined in populations other than dialysis patients with mixed results. These studies showed either a negative age interaction or no interaction. A study of hemodialysis patients using the Medical Outcomes Survey Short-Form 36 scale found that poor scores on the Physical Component Scale (which includes general health) were a stronger predictor of mortality in younger than older patients.

Our study therefore aims to assess the usefulness of an SRH item in predicting mortality in a large sample of both hemodialysis and peritoneal dialysis patients. Interactions of age with SRH in their effect on mortality also were examined.

METHODS

Patient Sample

The Netherlands Cooperative Study on the Adequacy of Dialysis (NECOSAD-2) is a prospective observational study investigating the adequacy and quality of care for patients on dialysis treatment in The Netherlands. Between January 1997 and December 2004, incident patients from 38 dialysis centers throughout The Netherlands were recruited with informed consent. Eligibility included age older than 18 years, no previous renal replacement therapy, and survival of the initial 3 months of dialysis therapy. A baseline of 3 months was chosen to allow for patient treatment modality and clinical condition to be stabilized. This study was approved by all local medical ethics committees.

Patients rated their health status at the baseline visit 3 months from the start of dialysis therapy. Patients were followed up until death or censoring. Reasons for censoring included loss to follow-up, transplantation, or end of follow-up on March 1, 2005.

Measurements

Patients rated their perceived health on a single general health item from the Medical Outcomes Survey Short-Form 36 (SF-36)21: “How would you say your health is in general?” There were 5 possible responses, ranging from 1, excellent, to 5, poor. The excellent category was merged with that of very good in our analyses because of its low frequency, as in previous studies.

In addition to patient demographics, clinical information for the main known risk factors for mortality in dialysis patients was collected. These included residual renal function, comorbidity, primary cause of kidney disease, nutritional status, body mass index (kilograms per meter squared), serum albumin level (grams per deciliter), and smoking status. Residual renal function was indicated by residual glomerular filtration rate (rGFR), calculated as mean renal clearance of urine and creatinine corrected for body surface area (milliliters per minute per 1.73 m² [to convert to mL/s/1.73 m², multiply by 0.01667]). Comorbidity was determined from chart reviews and categorized into the 3-point Davies score, which was calculated according to type and number of comorbidities present. Primary cause of kidney disease was classified using the European Renal Association-European Dialysis and Transplantation Association (ERA-EDTA) codes. Nutritional status of patients was assessed by using the validated and standardized 7-point Subjective Global Assessment Scale. We defined a non-smoker as someone who had never smoked or had stopped smoking for at least 3 months. All clinical data were collected by designated staff in the participating centers according to standardized procedures.

Statistical Analyses

Differences between continuous variables were assessed using Kruskal-Wallis test, whereas categorical outcomes were tested using χ² test. Associations between the 4 categories of SRH and all-cause mortality were estimated by using a Cox proportional hazards model, with excellent/very good SRH as the reference category. Proportional hazard assumptions were checked by inspecting log minus log plot. Covariates adjusted for included age (as a continuous variable), sex, education (low/high), marital status, primary cause of kidney disease, comorbidity, treatment modality, body mass index, nutritional status, rGFR, serum albumin level, and smoking (no/yes).

Possible age effects on the SRH-mortality association were examined by assessing for biological interaction according to Rothman. Age was dichotomized in these analyses: older patients were defined as 65 years or older. Separate variables were then created for each SRH category with each age. Hazard ratios (HRs) for the 8 categories were calculated. Biological interaction was defined as a departure from additive risks, as described in Hallan et al. Patients younger than 65 years who rated their health as excellent/very good served as the referent in these analyses. Statistical analyses were performed using SPSS, version 12.0 (SPSS Inc, Chicago, IL).

RESULTS

Of 1,672 eligible patients, 190 (11%) with missing SRH and 39 (2%) without data for length of follow-up or age were excluded, result-
ing in a sample of 1,443 patients. Patients were followed up for an average of 2.7 years. Mean age was 59.7 years, with 61% men and 69% married or living together (Table 1). Forty-six percent of the sample rated their health as excellent/very good or good. These patients tended to be men and younger, had a higher level of education, were more likely to be treated with peritoneal dialysis and have glomerulonephritis as the primary cause of kidney disease, had less comorbid illnesses, had a greater rGFR, had greater serum albumin levels, were better nourished, and were less likely to smoke compared with those with poor SRH. Patients with missing SRH tended to have lower rGFRs and poorer nutrition, but no difference in death rates between the 2 groups was noted.

Sixty-six patients (61.1%) with poor SRH died during follow-up compared with 13 deaths (17.8%) in the excellent/very good group. Cardiovascular deaths accounted for the most deaths in all 3 groups: excellent/very good (50.1%), good (45.3%), fair (45.2%), and poor (43.2%).

Of 1,443 patients, 328 patients with missing values for covariates for adjustment were excluded in the survival analyses. rGFR had the most missing values (n = 230) because of the unreliability or unavailability of 24-hour urine collection. Patients with missing covariate values were more likely to be older hemodialysis patients with poorer SRH, lower serum albumin levels, and less nourished. However, comparison of death rates between patients included in the analyses and those excluded showed no difference. As shown in Fig 1, survival rates of patients reporting excellent/very good health were consistently greater compared with those reporting good, fair, or poor health. Patients who perceived their health as poor had 8 times greater mortality risks compared with those with excellent/very good SRH (Table 2). Although the inclusion of demographic, disease, clinical, and

<table>
<thead>
<tr>
<th>Variable [no. of missing values]</th>
<th>Excellent/Very Good (n = 73)</th>
<th>Good (n = 589)</th>
<th>Fair (n = 673)</th>
<th>Poor (n = 108)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men* (%)</td>
<td>67.1</td>
<td>65.9</td>
<td>56.6</td>
<td>61.1</td>
</tr>
<tr>
<td>Age* (y)</td>
<td>51.6 ± 18.0</td>
<td>58.0 ± 15.5</td>
<td>61.5 ± 13.4</td>
<td>62.4 ± 13.9</td>
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<td>White (%) [61]</td>
<td>91.8</td>
<td>89.3</td>
<td>89.3</td>
<td>87.0</td>
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<tr>
<td>Low education*† (%) [65]</td>
<td>47.9</td>
<td>47.7</td>
<td>58.2</td>
<td>58.3</td>
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<tr>
<td>Married/living together (%) [63]</td>
<td>74.0</td>
<td>70.1</td>
<td>68.9</td>
<td>58.3</td>
</tr>
<tr>
<td>Hemodialysis* (%)</td>
<td>53.4</td>
<td>57.4</td>
<td>69.5</td>
<td>75.9</td>
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<td>Primary cause of kidney disease* (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>6.8</td>
<td>10.9</td>
<td>19.0</td>
<td>25.0</td>
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<td>Glomerulonephritis</td>
<td>23.3</td>
<td>15.4</td>
<td>12.8</td>
<td>11.1</td>
</tr>
<tr>
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<td>8.2</td>
<td>18.2</td>
<td>16.9</td>
<td>25.0</td>
</tr>
<tr>
<td>Others</td>
<td>61.6</td>
<td>55.5</td>
<td>51.3</td>
<td>38.9</td>
</tr>
<tr>
<td>Davies comorbidity score* (%) [23]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>68.5</td>
<td>53.5</td>
<td>38.0</td>
<td>18.5</td>
</tr>
<tr>
<td>Medium</td>
<td>26.0</td>
<td>39.4</td>
<td>48.4</td>
<td>63.0</td>
</tr>
<tr>
<td>High</td>
<td>4.1</td>
<td>5.9</td>
<td>11.4</td>
<td>17.6</td>
</tr>
<tr>
<td>rGFR* (mL/min/1.73 m²) [230]</td>
<td>3.9 ± 2.7</td>
<td>4.1 ± 2.9</td>
<td>3.9 ± 3.2</td>
<td>3.2 ± 2.6</td>
</tr>
<tr>
<td>Serum albumin* (g/dL) [52]</td>
<td>3.7 ± 0.5</td>
<td>3.7 ± 0.5</td>
<td>3.5 ± 0.5</td>
<td>3.4 ± 0.6</td>
</tr>
<tr>
<td>SGA score‡ (%) [95]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤5</td>
<td>11.0</td>
<td>16.3</td>
<td>30.0</td>
<td>41.8</td>
</tr>
<tr>
<td>6</td>
<td>38.4</td>
<td>34.8</td>
<td>34.3</td>
<td>31.5</td>
</tr>
<tr>
<td>7</td>
<td>49.3</td>
<td>42.6</td>
<td>29.0</td>
<td>14.8</td>
</tr>
<tr>
<td>BMI* (kg/m²) [49]</td>
<td>23.4 ± 3.4</td>
<td>24.8 ± 3.7</td>
<td>24.9 ± 4.3</td>
<td>25.1 ± 5.4</td>
</tr>
<tr>
<td>Nonsmoker* (%) [33]</td>
<td>72.6</td>
<td>72.2</td>
<td>71.9</td>
<td>56.5</td>
</tr>
</tbody>
</table>

Note: n = 1,443. To convert serum albumin in g/dL to g/L, multiply by 10; GFR in mL/min/1.73 m² to mL/s/1.73 m², multiply by 0.01667.

Abbreviations: rGFR, residual glomerular filtration rate; SGA, Subjective Global Assessment; BMI, body mass index.

*Significant at P < 0.05 using Kruskal-Wallis test for continuous variables and χ² test for categorical variables.

†Low education level defined as primary school, lower vocational training; high education level defined as lower general secondary education, pre-university education, high vocational training, university.

‡Higher scores indicate better nutritional status (7, well nourished; 6, nourished; ≤5, malnourished).
health variables into the model reduced the influence of SRH, a significant risk for mortality remained in patients who rated their health as poor (adjusted HR [HRadj], 3.56; 95% confidence interval [CI], 1.71 to 7.42), fair (HRadj, 2.09; 95% CI, 1.06 to 4.12) or good (HRadj, 1.87; 95% CI, 0.95 to 3.70) compared with those who rated their health as excellent/very good. Of the covariates included in the model, demographic (age, education, sex, and marital status) and disease variables (primary cause of kidney disease, comorbidity, and treatment modality) reduced the influence of SRH on mortality more than clinical and health variables (data not shown).

In age-stratified analyses listed in Table 3, younger patients with excellent/very good SRH had a lower mortality risk compared with those with poor SRH. Younger patients who rated their health as poor had an adjusted mortality risk 8 times greater compared with those with an excellent/very good health rating. Mortality risks for older patients with excellent/very good health increased 4-fold compared with younger patients with similar SRH. Compared with the reference group, the expected mortality risks for older patients with poor SRH when the effects of age and SRH are added up should be 11.52. However, an HRadj of 10.58 was observed for older patients with poor SRH. Because the observed and expected effects of age on SRH and mortality were similar, no biological interaction was present.

Similar stratified analyses were used to study interactions of sex and treatment on SRH and mortality. No sex or treatment interactions were found in the association between SRH and mortality (data not shown).

**DISCUSSION**

Our study shows that an SRH item is an independent predictor of mortality in a large sample of incident patients with end-stage renal disease. Patients who rated their health as poor had a significantly increased risk of death, even after controlling for a range of demographic and clinical confounders. This effect was apparent in both age strata (younger and older participants).

The strong associations between SRH and mortality in our study are in line with findings reported by Kutner et al. They found that elderly hemodialysis patients with poorer self-perceived health had a 5-fold increased mortality risk compared with those with excellent/very good SRH. Younger patients who rated their health as poor had an adjusted mortality risk 8 times greater compared with those with an excellent/very good health rating. Mortality risks for older patients with excellent/very good health increased 4-fold compared with younger patients with similar SRH. Compared with the reference group, the expected mortality risks for older patients with poor SRH when the effects of age and SRH are added up should be 11.52. However, an HRadj of 10.58 was observed for older patients with poor SRH. Because the observed and expected effects of age on SRH and mortality were similar, no biological interaction was present.

Similar stratified analyses were used to study interactions of sex and treatment on SRH and mortality. No sex or treatment interactions were found in the association between SRH and mortality (data not shown).
pared with those with better health perceptions. Similarly in our study, elderly patients with poor SRH had more than 5 times the mortality risk. However, their study with a small sample of prevalent patients adjusted for only age and comorbidity. The present results also are similar to studies of patients with other chronic illness, such as coronary heart disease and cancer, for which patients with poor SRH were 3 times more likely to die compared with those with better SRH.4,6

The mechanism behind the association between poor SRH and increased mortality is still not fully understood.32 A possible explanation is that SRH can influence health behaviors, which, in turn, affect health status.1 Poor health perceptions can lead to poorer self-care or noncompliance with treatment, which can adversely affect health outcomes. Kidney transplant recipients who reported having poorer health had 4.5 times greater risk of treatment noncompliance in comparison to those with better SRH.33 Another possible explanation is that self-rating of health is a more accurate and inclusive indicator of health status compared with the clinically observed health risk factors.1 For example, access to disease information could raise patient vigilance to a possible decline in health, which, in turn, influences their health ratings. Data from the First National Health and Nutrition Examination Survey (NHANES) Follow-up Epidemiologic Study suggests that individuals with a diagnosed circulatory system disease with poor self-health ratings at baseline had greater all-cause and disease-specific mortality risks compared with healthy individuals or individuals newly diagnosed at baseline who had similar health ratings.34 These mortality risks remained even after adjustments for known risk factors.

Residual confounding could be a possible limitation of our study. We might not have fully adjusted for all clinical variables that could influence the association between SRH and mortality. However, this might be less of an issue because it seems unlikely that other unknown clinical variables would have a significant effect. We found that adjustment for clinical variables after demographic and disease variables did not substantially reduce the risk estimate of SRH on mortality.

Second, our sample was predominantly white. As such, our results might not generalize to a nonwhite sample. However, our sample distribution is reflective of the Dutch population. Moreover, studies of nonwhite general population samples reported similar strong associations of SRH with mortality.35,36

In this study, we investigated the effect of SRH measured soon after the start of dialysis therapy on mortality. We found that SRH was an independent predictor of mortality in dialysis patients with up to 7 years of follow-up. It has been theorized that SRH could also reflect a dynamic perspective on health status.1 Patients could be judging their health based on perceptions of past incidents of illness and the general decline in their health. Future studies could exam-

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>SRH (no. of values)</th>
<th>No. of Deaths</th>
<th>Crude Mortality Rate/100 y (95% CI)</th>
<th>Adjusted Hazard Ratio* (95% CI)</th>
<th>Expected Hazard Ratio†</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;65</td>
<td>Excellent/very good (43)</td>
<td>2</td>
<td>1.4 (—)</td>
<td>1.00 (—)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Good (300)</td>
<td>45</td>
<td>4.9 (0.89-15.18)</td>
<td>2.79 (0.67-11.54)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fair (287)</td>
<td>65</td>
<td>8.3 (1.57-26.28)</td>
<td>3.63 (0.88-14.93)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor (41)</td>
<td>23</td>
<td>24.5 (4.71-84.89)</td>
<td>8.05 (1.88-34.54)‡</td>
<td></td>
</tr>
<tr>
<td>≥65</td>
<td>Excellent/very good (20)</td>
<td>7</td>
<td>9.0 (1.36-31.49)</td>
<td>4.47 (0.92-21.75)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Good (173)</td>
<td>103</td>
<td>18.6 (3.45-56.62)</td>
<td>7.96 (1.94-32.55)‡</td>
<td>6.26</td>
</tr>
<tr>
<td></td>
<td>Fair (221)</td>
<td>129</td>
<td>22.3 (4.28-70.00)</td>
<td>8.33 (2.03-34.17)‡</td>
<td>7.10</td>
</tr>
<tr>
<td></td>
<td>Poor (30)</td>
<td>22</td>
<td>35.3 (7.10-128.71)</td>
<td>10.58 (2.45-45.72)‡</td>
<td>11.52</td>
</tr>
</tbody>
</table>

Abbreviations: SRH, self-rated health; HR, hazard ratio; CI, confidence interval.
*Adjusted for sex, marital status, education, primary kidney disease, comorbidity, treatment modality, serum albumin level, body mass index, nutritional status, residual glomerular filtration rate, and smoking.
†Expected hazard ratio is the adjusted hazard ratio that would have been expected under the hypothesis that independent effects add up to have a joint risk (that is, no biological interaction is present).
‡Significant \( P < 0.05 \).
ine the contribution of changes in SRH to the prediction of mortality and other indicators of present and future health.

With its reliability, predictive ability, and economy of administration, the SRH can be a useful complement to clinical measures in assessing health outcomes of dialysis patients. Better prognoses could in turn improve decision making and clinical care.  

In conclusion, our study using a large sample of incident dialysis patients from 38 dialysis centers throughout The Netherlands shows that patient self-assessments of health can be an invaluable and economical complement to clinical measures in risk assessment and promotion of better health outcomes.

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