Association between a self-rated health question and mortality in young and old dialysis patients: a cohort study

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ABSTRACT

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

Methods 1,443 predominantly white patients from 38 dialysis centres in The Netherlands participating in the Netherlands Cooperative Study on the Adequacy of Dialysis (NECOSAD-2) between 1997 and 2004. Cox proportional hazards model estimated the association between SRH and all-cause mortality. Interaction of SRH with age (<65 years, ≥65 years) was examined in an additive model.

Results Mean age of patients was 59.6 (±14.8) years, with 61% male 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 (9/63 = 14.3%), good (148/473 = 31.3%), fair (194/508 = 38.2%), and poor (45/71 = 63.4%). Patients with poor, fair or good health ratings had a higher mortality risk than those with excellent/very good health ratings (adjusted Hazard Ratio adjusted \[HR_{adj}\]: 3.56, 95% confidence interval \[CI\]: 1.71-7.42; \[HR_{adj}\]: 2.09, 95% CI: 1.06-4.12; \[HR_{adj}\]: 1.87, 95% CI: 0.95-3.70, respectively), independent of a range of risk factors. No age interaction with SRH was found.

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.
INTRODUCTION

“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 on 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- and clinical-based studies, a strong association between SRH and mortality persists even after controlling for demographic, clinical and health factors. A study of 2,885 catheterised coronary heart disease patients 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.

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

Despite improvements in dialysis treatments, mortality rates remain high especially among 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 HD 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 a SRH item in predicting mortality among a large sample of both HD and peritoneal dialysis (PD) patients. Interactions of age with SRH in their effect on mortality also were examined.
METHODS

PATIENT SAMPLE
The Netherlands Co-operative Study on the Adequacy of Dialysis (NECOSAD-2)\textsuperscript{19,20} 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 centres 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 patients’ treatment modality and clinical condition to be stabilised. 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 till death or until 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)\textsuperscript{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 due to its low frequency, as in previous studies.\textsuperscript{4,22}

In addition to patients’ demographics, clinical information for 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 (BMI) (kg/m\textsuperscript{2}), serum albumin level (g/dL), and smoking status.\textsuperscript{23-26} Residual renal function was indicated by the residual glomerular filtration rate (rGFR), calculated as the mean renal clearance of urine and creatinine corrected for body surface area (mL/min/1.73m\textsuperscript{2} [to covert to mL/s/1.73m\textsuperscript{2}, multiply by 0.01667]). Comorbidity was determined from chart reviews and categorised into the 3-point Davies score,\textsuperscript{27} which was calculated according to the 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.\textsuperscript{28} Nutritional status of the patients was assessed by using the validated and standardised 7-point Subjective Global Assessment (SGA) scale.\textsuperscript{29} 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 centres according to standardised procedures.

**Statistical analyses**

Differences between continuous variables were assessed using Kruskall-Wallis test, whereas categorical outcomes were tested using the Chi-square test. Associations between the four categories of SRH and all-cause mortality were estimated using a Cox proportional hazards model, with the 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, BMI, nutritional status, rGFR, serum albumin, and smoking (no/yes).

Possible age effects on the SRH-mortality association were examined by assessing for biologic interaction according to Rothman. Age was dichotomised in these analyses: older patients were defined as being ≥ 65 years. Separate variables were then created for each SRH category with each age. Hazard ratios (HRs) for the eight categories were then calculated. Biologic interaction was defined as a departure from additive risks, as described in Hallan et al. Patients <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, Illinois).

**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, resulting in a sample of 1,443 patients. Patients were followed up for an average of 2.7 years (± 1.8). Mean age was 59.7 years (±14.8), 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, younger, had higher level of education, were more likely to be treated with PD, and to have glomerulonephritis as the primary cause of kidney disease, had less comorbid illnesses, had a greater rGFR, had greater levels of serum albumin, were better nourished, and were less likely to smoke compared to those with poor SRH. Patients with missing SRH tended to have lower rGFRs, and poorer nutrition, but no difference in death rates between the two groups was noted.
Sixty-six (61.1%) patients with poor SRH died during follow-up, as compared to 13 (17.8%) deaths in the excellent/very good group. Cardiovascular deaths accounted for the most deaths in all 4 groups: excellent/very good (50.1%), good (45.3%), fair (45.2%), and poor (43.2%).

### Table 1. Patients’ demographic and clinical characteristics at baseline (n=1,443)

<table>
<thead>
<tr>
<th>Variable (number missing)</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>% Male*</td>
<td>67.1</td>
<td>65.9</td>
<td>56.6</td>
<td>61.1</td>
</tr>
<tr>
<td>Age*</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>
</tr>
<tr>
<td>% White (61)</td>
<td>91.8</td>
<td>89.3</td>
<td>89.3</td>
<td>87.0</td>
</tr>
<tr>
<td>% Low education* (65)*</td>
<td>47.9</td>
<td>47.7</td>
<td>58.2</td>
<td>58.3</td>
</tr>
<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>% HD*</td>
<td>53.4</td>
<td>57.4</td>
<td>69.5</td>
<td>75.9</td>
</tr>
<tr>
<td>Prim. cause of kidney disease (%)*</td>
<td>Diabetess Mellitus 23.3</td>
<td>10.9</td>
<td>19.0</td>
<td>25.0</td>
</tr>
<tr>
<td></td>
<td>Glomerulonephritis</td>
<td>15.4</td>
<td>12.8</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>Renal Vascular Disease</td>
<td>8.2</td>
<td>18.2</td>
<td>16.9</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>61.6</td>
<td>55.5</td>
<td>51.3</td>
</tr>
<tr>
<td>Davies comorbidity score (%) (23)*</td>
<td>None</td>
<td>68.5</td>
<td>53.5</td>
<td>38.0</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>26.0</td>
<td>39.4</td>
<td>48.4</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>4.1</td>
<td>5.9</td>
<td>11.4</td>
</tr>
<tr>
<td>rGFRb (mL/min/1.73m²) (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)c (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>11.0</td>
<td>16.3</td>
<td>30.0</td>
<td>41.8</td>
</tr>
<tr>
<td>5 or less</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>% Non-smoker (33)*</td>
<td>72.6</td>
<td>72.2</td>
<td>71.9</td>
<td>56.5</td>
</tr>
</tbody>
</table>

The number of missing values of each covariate is presented in brackets after the covariate
* Significant at p < .05, using Kruskall-Wallis test for continuous variables and Chi-square test for categorical variables
a Education: Low (primary school, lower vocational training; High (lower general secondary education, pre-university education, high vocational training, university)
b rGFR: residual glomerular filtration rate
To convert serum albumin in g/dL, to g/L, multiply by 10
c SGA: Subjective Global Assessment. Higher scores indicate better nutritional status (7=well nourished, 6=nourished, ≤5=malnourished)
d BMI: body mass index

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 HD patients with poorer SRH, lower serum albumin levels, and less nourished. However, comparison of death rate between patients included in the analyses and those excluded showed no difference. As shown in Figure 1, survival rates of the patients reporting
Self-rated health and survival

excellent/very good health were consistently higher compared to 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 inclusion of demographics, disease, clinical, and health variables into the model reduced the influence of SRH, nevertheless, a significant risk for mortality remained in patients who rated their health as poor (adjusted HR [HR_adj], 3.56; 95% confidence interval [CI], 1.71 to 7.42), fair (HR_adj, 2.09; 95% CI, 1.06 to 4.12) or good (HR_adj, 1.87; 95% CI, 0.95 to 3.70) compared with those who rated their health as excellent/very good. Of the covariates included into 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).

Figure 1. Unadjusted survival curves by self-rated health (SRH) at baseline till end of follow-up (n=1,115)
Table 2. Risk estimates of self-rated health (SRH) on mortality among ESRD patients

<table>
<thead>
<tr>
<th>Self-rated health (n)</th>
<th>Deaths (%)</th>
<th>Crude mortality rate/100yrs</th>
<th>Risk estimate (n=1115)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Unadjusted</td>
<td>Adjusted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Excellent/very good (63)</td>
<td>9 (14.3)</td>
<td>4.0</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Good (473)</td>
<td>148 (31.3)</td>
<td>10.0</td>
<td>2.58* 1.32-5.06</td>
<td>1.87 0.95-3.70</td>
</tr>
<tr>
<td>Fair (508)</td>
<td>194 (38.2)</td>
<td>14.2</td>
<td>3.78* 1.94-7.39</td>
<td>2.09* 1.06-4.12</td>
</tr>
<tr>
<td>Poor (71)</td>
<td>45 (63.4)</td>
<td>28.8</td>
<td>8.21* 4.01-16.80</td>
<td>3.56* 1.71-7.42</td>
</tr>
</tbody>
</table>

* Significant at p < .05
a Sample excludes all patients with missing data on the covariates used for adjustment
b Adjusted for age, sex, marital status, education, primary kidney disease, comorbidity, treatment modality, serum albumin, BMI, nutritional status, rGFR, and smoking

Table 3. Unadjusted mortality rates and adjusted risk estimates of SRH on mortality among younger (<65 years) and older (≥65 years) patients

<table>
<thead>
<tr>
<th>Age</th>
<th>Self-rated Health (n)</th>
<th>Deaths (n)</th>
<th>Crude Mortality Rate/100yrs (95% CI)</th>
<th>Adjusted Hazard Ratio* (95% CI)</th>
<th>Expected Hazard Ratioa</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 65 years</td>
<td>Excellent/Very Good (43)</td>
<td>2</td>
<td>1.4 (-)</td>
<td>1.00 (-)</td>
<td>6.26</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>11.52</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>10.58 (2.45-45.72)*</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>11.52</td>
</tr>
<tr>
<td>≥ 65 years</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>6.26</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>11.52</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>

* Significant p < .05
a Adjusted for sex, marital status, education, primary kidney disease, comorbidity, treatment modality, serum albumin, BMI, nutritional status, rGFR, and smoking
b 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)

In age stratified analyses listed in Table 3, younger patients with excellent/very good SRH had a lower mortality risk compared to 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. The mortality risks for older patients with excellent/very good health increased 4-fold compared to 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
the 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 the findings reported by Kutner *et al.* They found that elderly HD patients with poorer self-perceived health had a 5-fold increased mortality risk compared with those with better health perceptions. Similarly in our study, elderly patients with poor SRH had 5 times the mortality risk. However, their study with a small sample of prevalent patients adjusted only for age and comorbidity. The present results also are similar to studies of 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.

The mechanism behind the association between poor SRH and increased mortality is still not fully understood. A possible explanation is that SRH can influence health behaviours, which, in turn, affect health status. Poor health perceptions can lead to poorer self-care or to non-compliance with treatment, which can adversely affect health outcomes. Kidney transplant recipients who reported having poorer health had 4.5 times greater risk of treatment non-compliance in comparison to those with better SRH. 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. For example, access to disease information could raise patient vigilance to 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.\textsuperscript{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 of 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 generalise to a non-white sample. However, our sample distribution is reflective of the Dutch population. Moreover, studies with non-white general population samples reported similar strong associations of SRH with mortality.\textsuperscript{35,36}

In this study, we investigated the effect of SRH measured soon after 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 theorised that SRH could also reflect a dynamic perspective on health status.\textsuperscript{1} Patients could be judging their health based on perceptions of past incidents of illness and of the general decline in their health. Future studies could examine the contribution of changes in SRH to the prediction of mortality and other indicators of present and future health.

With its reliability,\textsuperscript{37,38} 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.\textsuperscript{39}

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