Change in Self-Rated Health and Mortality Among Community-Dwelling Disabled Older Women

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Purpose: Our study assessed whether change in self-rated health is a stronger predictor of mortality than baseline self-rated health and the most recent self-rated health (prior to death or loss to follow-up) among disabled older women. Design and Methods: The Women’s Health and Aging Study examined disabled older women at baseline and every 6 months for 3 years. During the follow-up period, 253 out of the 905 examined participants died. Cox regression models with time-dependent covariates were used. Results: After baseline characteristics were adjusted for, baseline self-rated health was not related to mortality. After covariates at the most recent observation and covariates measured only at baseline were controlled for, the most recent self-rated health was not associated with mortality either. After time-dependent covariates and covariates measured only at baseline were adjusted for, decline in self-rated health was significantly associated with increased mortality. Implications: Change in self-rated health is a stronger predictor of mortality than self-rated health at baseline and at the most recent observation. Older women with “fair” health are worse off if they are on a declining health trajectory than if their “fair” health is stable. Family caregivers and clinicians need to closely monitor change in self-rated health among disabled older women.

Key Words: Change in self-rated health, Mortality, Disabled older women, Time-dependent covariates

The effectiveness of self-rated health as a predictor of mortality in older adults has been recognized for the past 20 years (Benyamini & Idler, 1999; Deeg & Bath, 2003; Idler, 2003; Idler & Benyamini, 1997; Idler & Kasl, 1991; Jylha, Guralnik, Ferrucci, Jokela, & Heikkinen, 1998; Spiers, Jagger, Clarke, & Arthur, 2003). However, some studies have shown that poor self-rated health is not predictive of mortality among older women (Deeg & Kriegsman, 2003; Hays, Schoenfeld, Blazer, & Gold, 1996; van Doorn & Kasl, 1998). Explanations for the inconsistent findings include differences in cultural settings and study designs, such as sample stratification, age range, covariates selected in the model, and duration of follow-up (Bath, 2003; Deeg & Bath, 2003; McCallum, Shadbolt, & Wang, 1994).

Recently, researchers have suggested that the failure to examine self-rated health as a dynamic evaluation may lead to underestimation of the true association between self-rated health and mortality (Fayers & Sprangers, 2002; Ferraro & Kelly-Moore, 2001). Self-rated health is a dynamic rather than static perception, which is related to an individual’s changes in health status over time (Fayers & Sprangers; Ferraro & Kelly-Moore; Han, 2002; Strawbridge & Wallhagen, 1999). Thus, self-rated health is likely to change during a long follow-up period. One study demonstrated that baseline self-rated health was associated only with 4-year mortality and not with 9-year mortality in older women (Benyamini, Blumstein, Lusky, & Modan, 2003). This is consistent with the notion that the longer the period of follow-up, the less likely the health status measured at baseline would stay the same over time.

Very few studies, such as those by Ferraro and Kelly-Moore (2001) and Strawbridge and Wallhagen
(1999), have considered self-rated health as a dynamic
evaluation and have investigated its association with
mortality. Strawbridge and Wallhagen used self-
rated health as a time-dependent (change over time)
covariate in a Cox regression model and found that
change in self-rated health was predictive of
mortality among women; in their study, time in-
ervals between follow-up interviews were at least 9
years and participants were aged 21 or older at
baseline. Ferraro and Kelly-Moore found that
change in self-rated health was predictive of
mortality among Black and White adults; in their
study, time intervals between follow-up interviews
ranged from 5 to 10 years and participants were aged
25 to 74 at baseline (National Center for Health
Statistics, 1987). Ferraro and Kelly-Moore men-
tioned that people adjust their health ratings in the
last few years of their lives to reflect declines in
health status. The intervals of these two studies
could have been too long to detect some significant
change in self-rated health, particularly if it occurred
a year or two prior to death.

Thus, the association between change in self-rated
health and mortality reported by the two studies may
still be underestimated. Moreover, other studies have
found that poor self-rated health at baseline is not
related to mortality among elderly women (Deeg &
Kriegsman, 2003; Hays et al., 1996; van Doorn &
Kasl, 1998). The purpose of our study was to assess
whether change in self-rated health was predictive of
mortality among disabled older women, particularly
when all available transitions in self-rated health
were considered during 6-month intervals between
follow-up interviews. In addition, we investigated
whether change in self-rated health was a stronger
predictor of mortality among disabled older women
than either self-rated health at baseline or at the most
recent observation.

Methods

We used data from the Women’s Health and
Aging Study (WHAS). The WHAS, which was
conducted by the Johns Hopkins Medical Institution
in collaboration with the Laboratory of Epidemiol-
ogy, Demography, and Biometry at the National In-
stitute on Aging, assessed moderately to severely
disabled (but not severely cognitively impaired)
women who were 65 years or older at baseline (a
random sample, N = 1,002), and then reassessed
them every 6 months for 3 years (1992–1995). These
women represented approximately the one-third
most disabled older women living in the community.
The study design and characteristics of the study
sample have been described in detail elsewhere
(Guralnik, Fried, Simonsick, Kasper, & Lafferty,
1995; Kasper, Shapiro, Guralnik, Bandeen-Roche,
& Fried, 1999). Our study examined 905 women,
because 90 women did not report their self-rated
health or other relevant health characteristics at
baseline, and 7 women did not report years of
education. During the study period, 254 out of the
905 participants died. We determined mortality
status by proxy interviews, and we confirmed date
of death by death certificate.

The measure of self-rated health in WHAS was
a single question asked at each interview: “At the
present time, would you say that your health is
excellent, very good, good, fair, or poor?” Answers
were coded as 1 through 5, respectively. We used the
linear form of self-rated health to avoid the
coarseness caused by collapsing the five responses
into fewer categories and to keep Cox regression
models (with time-dependent self-rated health)
parsimonious. This approach is consistent with the
recent research by Ferraro and Kelly-Moore (2001),
which helps us to better understand the association
between change in self-rated health and mortality.
We measured the number of diseases by the total
number of self-reported diseases at each interview
(“whether a doctor told you that you had . . .”). We
assessed the number of instrumental activity of daily
living (IADL) difficulties by the number of items for
which the participant reported having difficulty; the
items included doing light housework, preparing
meals, shopping for groceries, managing money,
making phone calls, and taking medications. Diffi-
culty in walking was evaluated with this question:
“By yourself, that is, without help from another
person or special equipment, do you have any
difficulty in walking for a quarter of a mile, which
is about 2 or 3 blocks?” (Answers were coded as 1 =
no difficulty, 2 = a little difficulty, 3 = some
difficulty, 4 = a lot of difficulty, and 5 = not able to
walk one fourth of a mile.) Depressive symptoms
were assessed by using the 30-item Geriatric De-
pression Scale (coded as 0–30), which is a reliable
and valid measure of depression among older adults
(Yesavage et al., 1982–1983). These health indicators
were assessed at all seven interviews.

Sociodemographic factors included age, race
(White vs Black), years of education completed,
marital status (married vs other), and annual
household income with imputation for those not
reporting income (Simonsick, Guralnik, & Fried,
1999). Cognitive function was evaluated by using the
Mini-Mental State Examination (MMSE) (Folstein,
Folstein, & McHugh, 1975) at baseline. Participants
who had a MMSE score of less than 18 were
ineligible to participate in the WHAS. Years of
smoking were assessed only at baseline.

The use of time-dependent covariates in Cox
regression models offers us opportunities to better
understand dynamic relationships between investi-
gated variables and the outcome, taking into account
all available changes in self-rated health and
variations in covariates at each interview during
the follow-up period (Allison, 1995). In this way we
can consider baseline health status, the most recent
health status, and all available transitions in health status from interview to interview among those who survive. When the values of some time-dependent covariates are missing at some interviews among some participants, the time-dependent covariate option allows us to skip these interviews and to examine available data at next interviews. We used −2 log-likelihood statistics (−2LL) and Martingale residual methods to determine how our Cox regression models fit our data during the model building.

First, we examined changes in self-rated health among disabled older women over time. Second, we conducted bivariate analyses to examine the associations between self-rated health (baseline self-rated health, self-rated health at the most recent observation, or time-dependent self-rated health) and mortality by using three Cox regression models separately (Models 1–3).

Third, we conducted multivariate analyses to investigate the associations between self-rated health (baseline self-rated health, self-rated health at the most recent observation, or time-dependent self-rated health) and mortality with an additional five Cox regression models. Models 4–6 tested the associations between self-rated health (self-rated health at baseline, self-rated health at the most recent observation, or time-dependent self-rated health) and mortality after adjusting for covariates assessed at baseline. Model 7 examined the association between self-rated health at the most recent observation and mortality after controlling for covariates examined only at baseline (years of education, marital status, race, income, cognitive function, and years of smoking) and covariates at the most recent observation (age, the number of diseases, the number of IADL difficulties, walking difficulty, and depressive symptoms). Model 8 investigated the association between the most recent self-rated health and mortality after controlling for the same baseline covariates as in Model 7 and time-dependent covariates (age, the number of diseases, the number of IADL difficulties, walking difficulty, and depressive symptoms). Model 9 examined the association between time-dependent self-rated health and mortality after adjusting for the same covariates as in Model 8. We performed analyses by using SAS statistical software (SAS Institute, 1996).

Results

The mean self-rated health of the examined participants during the available interviews was 3.39 (SD = 0.79). Compared with the baseline, the mean change in self-rated health for all available interviews (mean self-rated health for all available interviews minus self-rated health at baseline) was 0.06 (SD = 0.72). The direction of overall change in self-rated health was toward poor health, but the magnitude of it was small. This overall stability in self-rated health over time might have masked substantial declines and improvements made by certain participants: 142 participants (16%) had at least 1 SD of improvement in self-rated health; 106 participants (12%) had at least 1 SD of decline in self-rated health; 93 participants (10%) had at least 1 unit of improvement in self-rated health; and 76 participants (8%) had at least 1 unit of decline in self-rated health.

Table 1 shows the results of Models 1–3 on the associations between self-rated health and mortality at the bivariate level. Relative hazard (RH), 95% confidence intervals (CIs), and p values are presented. Baseline self-rated health, self-rated health at the most recent observation, and time-dependent self-rated health are predictive of mortality. Compared with self-rated health at baseline and at the most recent observation, time-dependent self-rated health is the strongest predictor of mortality among disabled older women at the bivariate level. With each additional 1 unit of decline in self-rated health, a disabled older woman was 1.29 times more likely to die (RH = 1.29, 95% CI = 1.14–1.46, p = .0001). If a disabled older woman’s self-rated health changed from excellent to poor (4 units of decline), she was 2.77 times (1.29^4 = 2.77) more likely to die.

Table 1 also shows the results of Models 4–6 on the association between self-rated health (self-rated health at baseline, self-rated health at the most recent observation, or time-dependent self-rated health) and mortality, after we controlled for characteristics assessed at baseline. Self-rated health at baseline is no longer predictive of mortality among disabled older women. Change in self-rated health is a stronger predictor of mortality than self-rated health at the most recent observation among these disabled older women. With each additional 1 unit of decline in self-rated health, a disabled older woman was 1.32 times more likely to die (RH = 1.32, 95% CI = 1.16–1.51, p = .0001). If a disabled older woman’s

<table>
<thead>
<tr>
<th>Models</th>
<th>Variable</th>
<th>RH*</th>
<th>95% CI*</th>
<th>P value</th>
<th>−2LL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Baseline SRH</td>
<td>1.15</td>
<td>1.03–1.30</td>
<td>0.014</td>
<td>2698</td>
</tr>
<tr>
<td>2</td>
<td>The most recent SRH</td>
<td>1.23</td>
<td>1.09–1.39</td>
<td>0.0004</td>
<td>2679</td>
</tr>
<tr>
<td>3</td>
<td>Decline in SRH (TDC)</td>
<td>1.29</td>
<td>1.14–1.46</td>
<td>0.0001</td>
<td>2675</td>
</tr>
<tr>
<td>4</td>
<td>Baseline SRH</td>
<td>1.12</td>
<td>0.98–1.28</td>
<td>0.108</td>
<td>2627</td>
</tr>
<tr>
<td>5</td>
<td>The most recent SRH</td>
<td>1.24</td>
<td>1.09–1.41</td>
<td>0.001</td>
<td>2605</td>
</tr>
<tr>
<td>6</td>
<td>Decline in SRH (TDC)</td>
<td>1.32</td>
<td>1.16–1.51</td>
<td>0.0001</td>
<td>2600</td>
</tr>
</tbody>
</table>

*K = Relative hazard; CI = confidence interval; SRH = self-rated health; TDC = time-dependent covariate.

After adjusting for covariates assessed at baseline (age, years of education, marital status, race, income, cognitive function, years of smoking, the number of IADL difficulties, the number of diseases, walking difficulty, and depressive symptoms).

Table 1. Associations Between Death and Self-rated Health Examined in Three Different Ways (N = 905)
At the most recent observation was no longer predictive of mortality among disabled older women. Higher mortality was associated being married, presenting a lower cognitive function at baseline, and having more years of smoking at baseline, and with having more walking difficulty at the most recent observation.

Table 3 presents the results of Model 8 on the association between the most recent self-rated health and mortality after we adjusted for covariates examined only at baseline and other time-dependent covariates with all available time-indexed transitions over time. Again, self-rated health at the most recent observation was not related to mortality. Higher mortality was associated with fewer years of education and more years of smoking at baseline, and with older age, a greater number of diseases, walking difficulty, and depressive symptoms over the follow-up period.

Table 4 shows the results of Model 9 on the association between time-dependent self-rated health and mortality after we controlled for the same covariates as in Model 8. Our results show that with each additional 1 unit of decline in self-rated health, a disabled older woman was 1.18 times more likely to die (RH = 1.18, 95% CI = 1.02–1.36, p = .021). If a disabled older woman’s self-rated health changed from excellent to poor (4 units of decline), she was 3.04 times (1.324 = 3.04) more likely to die.

### Table 2. Model 7: Association Between Death and the Most Recent Self-rated Health After Adjusting for Covariates Assessed Only at Baseline and Other Covariates at the Most Recent Observation (N = 905, –2LL = 2623)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>RH 95% CI*</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-rated health at the most recent observation</td>
<td>1.13 (0.98–1.30)</td>
<td>0.081</td>
</tr>
<tr>
<td>Age at the most recent observation</td>
<td>1.00 (0.98–1.02)</td>
<td>0.889</td>
</tr>
<tr>
<td>Years of education at baseline</td>
<td>0.89 (0.78–1.01)</td>
<td>0.076</td>
</tr>
<tr>
<td>Marital status (married vs. others) at baseline</td>
<td>0.67 (0.46–0.98)</td>
<td>0.042</td>
</tr>
<tr>
<td>Race (white vs. black)</td>
<td>1.19 (0.85–1.66)</td>
<td>0.313</td>
</tr>
<tr>
<td>Income at baseline</td>
<td>1.08 (0.91–1.24)</td>
<td>0.266</td>
</tr>
<tr>
<td>Cognitive function at baseline</td>
<td>0.95 (0.90–0.99)</td>
<td>0.042</td>
</tr>
<tr>
<td>Years of smoking at baseline</td>
<td>1.13 (1.02–1.25)</td>
<td>0.017</td>
</tr>
<tr>
<td>Number of diseases at the most recent observation</td>
<td>1.05 (0.97–1.13)</td>
<td>0.204</td>
</tr>
<tr>
<td>Number of IADL difficulties at the most recent observation</td>
<td>1.07 (0.96–1.19)</td>
<td>0.222</td>
</tr>
<tr>
<td>Walking difficulty at the most recent observation</td>
<td>1.57 (1.09–2.25)</td>
<td>0.014</td>
</tr>
<tr>
<td>Depressive symptoms at the most recent observation</td>
<td>1.02 (0.99–1.05)</td>
<td>0.085</td>
</tr>
</tbody>
</table>

### Table 3. Model 8: Association Between Death and the Most Recent Self-rated Health After Adjusting for Covariates Assessed Only at Baseline and Other Time-dependent Covariates (TDCs) (N = 905, –2LL = 2598)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>RH 95% CI*</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-rated health at the most recent observation</td>
<td>1.12 (0.98–1.29)</td>
<td>0.090</td>
</tr>
<tr>
<td>Age, TDC</td>
<td>1.03 (1.01–1.05)</td>
<td>0.014</td>
</tr>
<tr>
<td>Years of education at baseline</td>
<td>0.88 (0.77–0.99)</td>
<td>0.045</td>
</tr>
<tr>
<td>Marital status (married vs. others) at baseline</td>
<td>0.77 (0.53–1.13)</td>
<td>0.185</td>
</tr>
<tr>
<td>Race (white vs. black)</td>
<td>1.36 (0.98–1.88)</td>
<td>0.063</td>
</tr>
<tr>
<td>Income at baseline</td>
<td>1.07 (0.93–1.23)</td>
<td>0.326</td>
</tr>
<tr>
<td>Cognitive function at baseline</td>
<td>0.97 (0.92–1.02)</td>
<td>0.166</td>
</tr>
<tr>
<td>Years of smoking at baseline</td>
<td>1.15 (1.05–1.28)</td>
<td>0.005</td>
</tr>
<tr>
<td>Number of diseases, TDC</td>
<td>1.12 (1.04–1.21)</td>
<td>0.004</td>
</tr>
<tr>
<td>Number of IADL difficulties, TDC</td>
<td>1.09 (0.97–1.22)</td>
<td>0.122</td>
</tr>
<tr>
<td>Walking difficulty, TDC</td>
<td>1.78 (1.24–2.55)</td>
<td>0.002</td>
</tr>
<tr>
<td>Depression, TDC</td>
<td>1.03 (1.01–1.04)</td>
<td>0.040</td>
</tr>
</tbody>
</table>

### Table 4. Model 9: Association Between Death and Decline in Self-rated Health After Controlling for Covariates Assessed Only at Baseline and Other Time-dependent Covariates (TDCs) (N = 905, –2LL = 2596)

| Decline in self-rated health, TDC | 1.18 (1.02–1.36) | 0.021 |
| Age, TDC | 1.03 (1.01–1.05) | 0.011 |
| Years of education at baseline | 0.88 (0.77–1.01) | 0.059 |
| Marital status (married vs. others) at baseline | 0.78 (0.53–1.15) | 0.204 |
| Race (white vs. black) | 1.34 (0.96–1.86) | 0.087 |
| Income at baseline | 1.07 (0.93–1.22) | 0.374 |
| Cognitive function at baseline | 0.96 (0.92–1.02) | 0.158 |
| Years of smoking at baseline | 1.16 (1.05–1.29) | 0.003 |
| Number of diseases, TDC | 1.12 (1.04–1.21) | 0.004 |
| Number of IADL difficulties, TDC | 1.18 (0.97–1.41) | 0.148 |
| Walking difficulty, TDC | 1.76 (1.23–2.32) | 0.002 |
| Depression, TDC | 1.02 (0.99–1.04) | 0.094 |

*RH = Relative hazard; CI = confidence interval; IADL = instrumental activities of daily living.

self-rated health changed from excellent to poor (4 units of decline), she was 3.04 times (1.324 = 3.04) more likely to die.

Table 2 shows the results of Model 7 on the association between self-rated health at the most recent observation and mortality after we controlled for covariates assessed only at baseline and covariates at the most recent observation. Self-rated health

The differences in the results of Models 7–9 demonstrate that change in self-rated health is a better predictor of mortality than the most recent self-rated health. In sum, the association between self-rated health and mortality was stronger in both

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\text{RH} = \frac{\text{Relative hazard}}{\text{Confidence interval}}; \text{IADL} = \text{instrumental activities of daily living.}
\]
the bivariate and the multivariate models with the use of change in self-rated health than with either self-rated health at baseline or at the most recent observation.

Discussion

Our study systematically examined the prognostic value of baseline self-rated health, self-rated health at the most recent observation, and change in self-rated health on mortality among disabled older women. Moreover, our study design with six 6-month-long time intervals between follow-up interviews allowed us to detect changes in self-rated health and other health indicators among moderately to severely disabled older women, particularly among those occurring 1 or 2 years before their death. If self-rated health of disabled older women were a current evaluation of their health conditions, self-rated health at the most recent observation (prior to death or loss of follow-up) would have been a stronger predictor of mortality than both self-rated health at baseline and change in self-rated health. Our results do not support this assumption. The use of time-dependent self-rated health and other time-dependent covariates in Cox regression models takes into account both the most recent health status and transitions in health status over time. Consistent with the study by Strawbridge and Wallhagen (1999), our study found that change in self-rated health is predictive of mortality among older women. Ferraro and Kelly-Moore (2001) found that change in self-rated health is a stronger predictor of mortality than baseline self-rated health among Black and White adults. Our study provided further evidence that change in self-rated health is a stronger predictor of mortality than self-rated health at baseline and at the most recent observation among disabled older women. In addition to self-rated health at any point, change in self-rated health has significant value in predicting mortality. Our results confirm the clinical notion that, although what older women rate their current health (e.g., excellent or fair) is important, how they arrive at their current health state (e.g., decline from excellent to fair) is even more important. For example, older women with “fair” health are worse off if they are on a declining health trajectory (e.g., from excellent to fair) than if their “fair” health is stable (no change in self-rated fair health). This basic phenomenon can also be seen in several other variables in our study (e.g., the number of diseases, the number of IADL difficulties, and walking difficulty), showing that their associations with mortality are stronger with the use of time-dependent covariates than the most recent observation.

Some studies support the earlier research of Maddox and Douglass (1973), suggesting the stability of self-rated health in terms of insignificant mean change over time. Our results show that mean-level stability in self-rated health over time among disabled older women is a result of multidirectional changes. In our study, self-rated health of some participants improved, whereas for others it stayed the same or declined over the follow-up period. If self-rated health of disabled older women were a static perception of their health status, self-rated health at baseline should have had the same prognostic value on mortality as self-rated health at the most recent observation. Our results do not support this assumption either. We found that change in self-rated health is a stronger predictor of mortality than self-rated health at baseline and at the most recent observation. Moreover, consistent with previous studies (Deeg & Kriegsman, 2003; Hayes et al., 1996; van Doorn & Kasl, 1998), in our study we did not find the association between baseline self-rated health and mortality among disabled older women. Disabled older women are conscious of changes in their health status and adjust their perception of their health accordingly.

It is not difficult to detect change in self-rated health over time. Family caregivers and health professionals should pay attention to not only self-rated health per se (e.g., excellent or fair; see Maddox, 1999) but also change in self-rated health over time (e.g., decline from excellent to fair) among community-dwelling disabled older women. Change in self-rated health can be a useful and simple screening tool for individuals with a high risk of mortality. A decline in self-rated health over time indicates that health status is deteriorating and mortality risk is increasing. Our study provides evidence that time intervals of 6 months between follow-up interviews allow us to effectively detect change in self-rated health among our participants. Therefore, at least every 6 months, family caregivers and health professionals should assess the self-rated health of community-dwelling older women who are moderately to severely disabled, and they should be cautious about their decline in self-rated health over time. If there is no apparent reason for the decline (e.g., no changes in walking difficulty or no changes in identified disease status), family caregivers should work with health professionals to find out why their loved ones rate their health worse than they did previously.

References


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