Self-Rated Health Changes and Oldest-Old Mortality

Eric M. Vogelsang

Department of Sociology and Center for Demography and Ecology, University of Wisconsin–Madison.

Objectives. This study explores how 2 measures of self-rated health (SRH) change are related to mortality among oldest-old adults. In doing so, it also considers how associations between SRH and mortality may depend on prior SRH.

Method. Data come from the Asset and Health Dynamics survey—the oldest-old portion of the Health and Retirement Study—and follow 6,233 individuals across 13 years. I use parametric hazard models to examine relationships between death and 2 measures of short-term SRH change—a computed measure comparing SRH at time *t*–1 and *t*, and a respondent-provided retrospectively reported change.

Results. Respondents who demonstrate or report any SRH change between survey waves died at a greater rate than those with consistent SRH. After controlling for morbidity, individual characteristics, and SRH, those who changed SRH categories between survey waves and those who retrospectively reported an improvement in health continue to have a greater risk of death, when compared with those with no change.

Discussion. These findings suggest that the well-established associations between SRH status and mortality may understate the risk of death for oldest-old individuals with recent subjective health improvements.

Key Words: Hazard models—Mortality—Oldest-old—Self-rated health—United States.

THE relationship between self-rated health (SRH) and mortality is well established, with Idler and Benyamini's influential summary of 27 studies (Idler & Benyamini, 1997) cited in thousands of academic papers. Recent research, including a meta-analysis of 22 studies (DeSalvo, Bloser, Reynolds, He, & Muntner, 2006), continues to demonstrate a strong association between SRH and mortality, even after controlling for a number of demographic and health-related covariates (Benyamini, 2008; Jylhä, 2009). Idler and Benyamini offered four explanations for these associations—SRH is inclusive, dynamic, influences future behavior, and accounts for health-related resources (Benyamini, 2008; Idler & Benyamini, 1997). The second explanation—also referred to as the "trajectory hypothesis" (Wolinsky & Tierney, 1998)—posits that SRH reflects *changes* in health and life circumstances, past experiences, and expectations (Ferraro & Kelley-Moore, 2001; Miller & Wolinsky, 2007). Although relationships between SRH and mortality may be partially explained by these dynamic evaluations, the operationalization of SRH can influence how and to what extent these processes are reflected in the measure. In particular, most mortality studies do not account for SRH changes over time. This is problematic if these changes have independent relationships with mortality or if they alter the well-established statistical relationships between SRH and the risk of death. The consequences of subjective health changes may be particularly relevant to oldest-old adults, a population with high rates of mortality and morbidity. Oldest-old individuals also employ evaluative processes that likely differ from other age groups when reporting SRH and SRH change (French, Sargent-Cox, & Luszcz, 2012; Sargent-Cox, Anstey, & Luszcz, 2008).

SRH in Mortality Studies

Although SRH is usually derived from a five-category survey measure of general subjective health status (i.e., "excellent," "very good," "good," "fair," and "poor"), it is operationalized in a number of ways (e.g., as a dichotomous variable of "fair" or "poor" vs all other responses). As a correlate of mortality, SRH is often treated as a simple time-constant variable, even when multiple observations are available (Lyyra, Leskinen, Jylhä, & Heikkinen, 2009). In fact, only 3 of the 27 studies (Deeg, Van Zonneveld, Van der Maas, & Habbema, 1989; Svärdsudd & Tibblin, 1990; Thomas, Kelman, Kennedy, Ahn, & Yang, 1992) in Idler and Benyamini's seminal review operationalized SRH as something other than a baseline measure. This may be problematic because the relationship between SRH and mortality appears stronger in the "shorter term" (e.g., within 1–4 years; Benyamini, Blumstein, Lusky, & Modan, 2003; Meinow, Kåreholt, Parker, & Thorslund, 2004) and SRH responses can change over time. If three or more waves of longitudinal data are available, SRH can be modeled as a time-dependent correlate of mortality—although a surprisingly limited number of studies have done so (Ferraro & Kelley-Moore, 2001; Gerber, Benyamini, Goldbourt, & Drory, 2009; Han et al., 2005; Lyyra et al., 2009).

One reason why repeated shorter-interval SRH measures may have stronger relationships with subsequent mortality is that they are more likely to reflect SRH's dynamic properties. Unfortunately, even repeated SRH measures are not sufficient to completely evaluate the trajectory hypothesis because not all individuals reporting the same SRH status at a particular time share the same trajectory.

Incorporating SRH change measures along with SRH may be one way to better reflect SRH's dynamic qualities, and doing so may alter associations between subjective health and mortality. For example, associations between SRH and subsequent death may depend on the existence or direction of SRH change. In addition, SRH change itself may be related to mortality; especially because there is reason to believe that sources of SRH change (e.g., health shocks, recovery from health problems) could have independent associations with the risk of death (Benitez-Silva & Ni, 2008). This study focuses on two measures of short-term subjective health change—computed SRH change and retrospectively reported SRH change. These measures have rarely been incorporated in mortality studies or compared with each other (Erdogan-Ciftci, van Doorslaer, & Bago, 2010). In addition, prior studies have largely focused on SRH declines, have provided inconsistent results, and have typically not used data from the United States.

Computed SRH Change

One method of operationalizing SRH change is to calculate the difference in SRH responses between times $t-1$ and t—a "computed SRH change"—that can reveal improving, deteriorating, or steady SRH. If a respondent is consistently evaluating SRH over time, then computed SRH changes reveal improvements or declines in subjective general health that are sufficient to move past a SRH cut point. Alternatively, computed SRH changes (or lack thereof) could be a result of changes in evaluative processes due to cut-point shifts, peer effects, or reporting inconsistencies (Benitez-Silva & Ni, 2008).

Although general SRH likely has a dynamic component, one reason to expect that SRH at time t may not *completely* capture an individual's dynamic health is that it does not account for SRH at time $t-1$. In other words, it is only a measure of the "destination" state and individuals with disparate trajectories may report the same SRH status. For example, those who report "good" SRH at time t could have reported better health ("excellent" or "very good"), worse health ("fair" or "poor"), or the same health ("good") at time $t-1$. This would be problematic if these three subgroups face statistically different risks of death but are treated as one when calculating the relationships between SRH and mortality. Incorporating computed SRH change in longitudinal studies is straightforward because it does not require additional survey questions or recollection of past health. As such, computed SRH change is not sensitive to information loss and is not biased toward the current health state (Knox & King, 2009).

Methodologically, there could be two possible problems with including computed SRH changes in mortality studies that already control for SRH. One, the two measures may be highly correlated because computed SRH change utilizes SRH in its calculation. Two, possible relationships between computed SRH change and mortality may differ by SRH. For example, the mortality implications of a computed SRH improvement may vary if the respondent is reporting "fair" or "excellent" at time t. The former implies "poor" prior health at $t-1$, whereas the latter suggests the respondent now shares the same category as those reporting the best health. One way to account for these two concerns is to incorporate interactions between SRH status at time t and computed SRH change (e.g., "good and unchanged," "good from worse health"), although this approach has not been implemented in prior studies.

Several papers have sought to identify mechanisms and health measures behind SRH change (Benyamini, Blumstein, Murad, & Lerner-Geva, 2011; Leinonen, Heikkinen, & Jylhä, 2001, 2002), but few have examined how SRH change itself may be related to mortality, and results are inconclusive. Computed SRH decline was found to be associated with increased mortality risk in studies of disabled community-dwelling elderly women in the United States (Han et al., 2005), elderly in Leganes, Spain (Sanchez-Santos, Zunzunegui, Otero-Puime, Cañas, & Casado-Collado, 2011), and people living in the southeastern part of the Netherlands (Erdogan-Ciftci et al., 2010), whereas another Dutch study concluded that computed SRH changes were not related to 5-year elderly mortality (Galenkamp, Deeg, Braam, & Huisman, 2012a). Interestingly, a study of middle-aged Danes living in suburban Copenhagen concluded that stable SRH (compared with changes in either direction) was related to lower mortality (Nielsen et al., 2009).

Retrospectively Reported SRH Change

Another method of operationalizing short-term SRH change is to ask respondents if they feel that their health has improved, declined, or stayed constant between times $t-1$ and t—a "retrospectively reported SRH change." Given that dynamic SRH measures have only been used recently and sparsely, it is not surprising that these types of changes have been described a number of different ways, including "retrospectively reported health changes" (Erdogan-Ciftci et al., 2010), "self-assessed change in health" (Gunasekara, Carter, & Blakely, 2012), "self-comparative health" (Sargent-Cox et al., 2010), and "time-comparative SRH" (Alfonso et al., 2012). Hereafter, I will use "RR-SRH change" for simplicity and brevity.

In some instances, RR-SRH change may be equivalent to computed SRH change, although RR-SRH change does not require longitudinal data. Alternatively, there are four reasons to believe that RR-SRH change may capture information, expectations, experiences, and dynamics that are not conveyed in other survey measures—including computed SRH change and SRH itself. One, RR-SRH change is likely less sensitive to shifts in individual cut points between SRH categories over time (Benitez-Silva & Ni, 2008; Erdogan-Ciftci

et al., 2010) that lead some individuals feeling the same at *t*−1 and *t* to demonstrate computed SRH changes. Two, RR-SRH change may reveal health change when an individual did not change enough to warrant a SRH category shift. Relatedly, RR-SRH change can alleviate some of the issues that result from ceiling (floor) effects—when individuals already at the highest (lowest) SRH levels cannot report further improvement (decline) using the standard SRH measure (Gunasekara, Carter, & Blakely, 2012). Three, as a retrospective measure at one time point, RR-SRH change is likely more sensitive to information loss and bias toward the present state, when compared with computed SRH change. Lastly, unlike computed SRH change (which is computed without the respondent's knowledge), RR-SRH change is a direct question asking a respondent to explicitly consider health change over a specified time period.

Similar to computed SRH changes, RR-SRH changes have been mostly employed in mortality studies outside of the United States, and results have been inconsistent. RR-SRH declines have been associated with increased mortality risk among Dutch elderly (Deeg et al., 1989) and community-dwelling elderly men in Perth, Australia (Alfonso et al., 2012), whereas RR-SRH *improvements* have also been associated with increased mortality among oldest-old Australians (Sargent-Cox et al., 2010). Conversely, no relationships were found between RR-SRH change and mortality among British elderly in Nottingham (Bath, 2003) and Dutch adults (Erdogan-Ciftci et al., 2010).

SRH Changes and the Oldest-Old Adults

Although SRH has been linked to mortality among those in their 90s (Nybo et al., 2003), there is evidence that the correlation between subjective and objective health weakens at oldest ages (Heller, Ahern, Pringle, & Brown, 2009; Pinquart, 2001). Instead, previous research suggests that SRH evaluations evolve to reflect changing reference points, psychological symptoms, comparison with others, expected states of health, and aged-based norms (Fayers & Sprangers, 2002; French et al., 2012; Henchoz, Cavalli, & Girardin, 2008; Sargent-Cox et al., 2008). In general, the surprisingly high stability and optimism seen in general SRH measures at oldest ages underscores an adaption to and normalizing of morbidity (Dening et al., 1998; Leinonen et al., 2002). One way this might manifest itself is through SRH "improvements" that are present even when health did not actually improve. In addition, one Finnish study found that the majority of oldest-old individuals with RR-SRH declines did not demonstrate an equivalent change in SRH (Leinonen et al., 1998). Generally, there are reasons to believe that some methodological benefits of both computed SRH changes (i.e., addressing concerns of recall and memory loss) and RR-SRH changes (i.e., capturing a subjective health change not seen otherwise) may be particularly salient among this age group.

The oldest-old portion of the U.S. population (often, 80-plus) is the fastest growing age group and it experiences high rates of morbidity and mortality (Kinsella & He, 2009). The goal of this study is to identify relationships between two types of short-term SRH change and death among this age group. In doing so, I consider how well-established relationships between general SRH and mortality differ after including these two measures. Because morbidity tends to attenuate relationships between SRH and mortality (DeSalvo et al., 2006), I also examine the extent to which chronic health conditions and disability account for any identified associations between SRH change and the risk of death. This manuscript is the first to use a nationally representative sample of U.S. oldest-old adults to examine relationships between these two SRH change measures and mortality.

METHOD

Data

Data come from the Asset and Health Dynamics Among the Oldest Old (AHEAD), a national longitudinal cohort study of older Americans conducted every 2 years. The AHEAD survey was first administered in 1993 to a sample of 7,447 elderly born in 1923 or earlier as well as their spouses, and the response rate was 81.6%. The first survey wave employed a national probability sample with supplemental oversamples of blacks, Hispanics, and Florida residents (Heeringa, 1995). A total of 794 individuals died between Waves 1 and 2. Because computed SRH changes require two waves of data to compute, this study's analytical sample and baseline are the 6,653 elderly individuals who were alive at Wave 2 (1995). The mean age at baseline for these respondents was 79.1 for men and 80.0 for women. According to the 1995 U.S. Life Table, the average age 79-year-old man could expect to live an additional 7.7 years, whereas the average woman could expect to live 8.9 additional years. I use observations from six waves of data (1995, 1998, 2000, 2002, 2004, and 2006) to estimate the risk of death through 2008. To ensure generalizability to oldest-old adults, I do not include spouses in my analysis. During this time, there were 23,938 completed surveys (mean age = 82.8), including proxy responses, and 4,675 (70%) of the 1995 sample died (mean age at death = 86.7). Death dates were matched to the National Death Index.

When a respondent was unable or unwilling to be interviewed, an identical and full proxy interview was conducted. Although both respondent-provided SRH and proxy-provided SRH have been associated with mortality (Ayalon & Covinsky, 2009), these measures are not equivalent and should not be used interchangeably (Benyamini et al., 2003; Vuorisalmi, Sarkeala, Hervonen, & Jylhä, 2012). As such, responses that utilized proxies at time *t* or *t*−1 are not included in my analyses (17.9% of respondents); and

the remaining 19,655 responses represent 353,960 person-years. Potential implications of dropping these surveys are discussed in the *Results* section.

Measures

My analyses include three different operationalizations of SRH and SRH change, all of which are time varying. The first is a standard five-category measure of SRH or "general health status" at time *t*. A second measure—computed SRH change—is calculated by subtracting respondents' SRH response at time *t*−1 from SRH at time *t*. A vast majority (86%) of computed SRH changes were moderate—47% had no change in SRH values, whereas 18% of respondents improved one category and 23% declined one category. The third measure, RR-SRH changes, is a separate survey question that asks a respondent at time *t* if his or her health is "better," the "same," or "worse" since the prior interview (*t*−1). To enhance comparability between these two change measures, any computed SRH improvement was coded as "better," whereas any decline was coded as "worse." Although two waves of data are necessary to calculate computed SRH changes, consecutive measurements were not required for either SRH change measure subsequent to Wave 2. For computed SRH changes, *t*−1 was replaced by "the most recent completed survey" if the respondent did not complete a survey at *t*−1 (2.2% of all observations). For RR-SRH changes, "over the past 2 years" was replaced by "since the last interview."

Descriptive statistics can be found in Table 1. The four covariates included in most studies of SRH and mortality are: age, chronic conditions, socioeconomic status (SES), and sex (Idler & Benyamini, 1997). In this study, I incorporate these characteristics as well as race, marital status, employment status, and disability (including activities of daily living limitations and mobility limitations). Educational categories are "less than high school," "high school," "some college," and "college graduate." Income is classified as "low," "medium," and "high." Low-income elderly (20.3% of the sample) were those that earned less than the average annual social security benefit ($10,000) for retired workers in 2000 (Apfel, 2000). Medium income (>$10,000 and ≤$30,000) and high income (>$30,000) comprised about 50% and 30% of the sample, respectively.

My measure of chronic conditions is a count of seven health problems (high blood pressure, diabetes, cancer, lung disease, heart problems, stroke, and psychiatric problems) and indicates whether a doctor ever told the respondent he or she has that particular condition. The two disability indices denote a count of tasks that a respondent reported at least "some difficulty" performing. The first disability measure (activities of daily living [ADLs]) includes five tasks—bathing, eating, dressing, walking across a room, and getting in or out of bed. The second measure (mobility) also consists of five tasks—walking several blocks, walking

Table 1. Descriptive Statistics of Health Measures and Sociodemographic Variables, Asset, and Health Dynamics Among the Oldest-Old Survey, 1995–2006, Net of Proxies

	Mean/proportion
Computed SRH improvement	22.2%
Computed SRH decline	30.8%
RR-SRH improvement	7.6%
RR-SRH decline	33.4%
SRH: Excellent	8.1%
From worse	4.1%
Unchanged	4.0%
SRH: Very good	23.4%
From worse	8.8%
Unchanged	11.2%
From better	3.4%
SRH: Good	32.3%
From worse	6.6%
Unchanged	15.7%
From better	10.0%
SRH: Fair	25.4%
From worse	2.7%
Unchanged	11.6%
From better	11.1%
SRH: Poor	10.8%
Unchanged	4.5%
From better	6.3%
Age at death (*SD*)	86.7 (6.1)
Age at survey (*SD*)	82.2 (5.4)
Female	64.0%
White	86.9%
Married	41.0%
Employed	6.8%
Education	
<HS	37.2%
HS graduate	31.5%
Some college	17.8%
College graduate	13.5%
Income	
≤$10,000	20.3%
>$10,000 & <$30,000	49.7%
≥$30,000	30.0%
Chronic conditions, count, 0–7 (*SD*)	1.5 (1.2)
ADL limitations, count, 0–5 (*SD*)	0.5 (1.1)
Mobility limitations, count, 0–5 (*SD*)	1.4 (1.6)
N	19,655

Notes. ADL = activities of daily living; HS = high school; RR-SRH = retrospectively reported SRH; SRH = self-rated health.

one block, walking across the room, climbing several flights of stairs, and climbing one flight of stairs. Missing items were rare—less than 1% of survey respondents had some missing covariate values.

Statistical Analysis

I employ Gompertz proportional hazard models with sample weights to estimate mortality risk. This specification allows age to influence the shape of the baseline hazard and is appropriate for risks that increase exponentially over time (Cleves, Gould, Gutierrez, & Marchenko, 2010; Erdogan-Ciftci et al., 2010). Individuals lost to

survey attrition are censored subsequent to their last response, whereas survival time is calculated to the closest month.

My analytic strategy involved estimating six models. The first is a baseline model consisting of only sociodemographic covariates and SRH. This model examines whether the well-established relationships between SRH and mortality hold for AHEAD respondents. The next three models incorporate computed SRH changes (Model 2), RR-SRH changes (Model 3), and both change measures (Model 4) to ascertain whether they have independent relationships with mortality when included with general SRH.

Model 5 allows for an interaction between SRH status and computed SRH change. This model helps establish whether any relationships between computed SRH change and mortality identified in Model 4 differ by a respondent's SRH status at time *t*. Similar to prior research (Erdogan-Ciftci et al., 2010), the final model (Model 6) integrates health indicators (chronic conditions and disability) to determine whether these measures explain relationships between SRH, SRH changes, and mortality.

RESULTS

Table 2 compares respondents' computed SRH changes to their RR-SRH changes. These two measures matched in less than half (45.7%) of all instances, and in 6.1% of cases, they change in opposite directions (i.e., RR-SRH indicated improvement, whereas computed SRH indicated decline, and vice versa). Similar degrees of congruity (49.3%, 49.4%, 47.1%, and 60.2%) were found in Americans older than 50 (Benitez-Silva & Ni, 2008), New Zealanders (Gunasekara et al., 2012), Finnish elderly (Leinonen et al., 1998), and Dutch adults (Erdogan-Ciftci et al., 2010), respectively. This table also indicates the proportion of respondents in each category that died before the subsequent survey. Not surprisingly, those whose SRH declined (either reported or computed) died at the greatest rates. More interestingly, individuals that reported or demonstrated a SRH improvement died more often than those with no SRH change.

Table 3 summarizes results from the multivariate hazard models. Hazard ratios (HRs) greater than (less than) 1.0 indicate that the variable is associated with greater (lower) mortality. Results from Model 1 are similar to those found

in prior studies—when compared with "good," reporting "excellent" (HR = 0.57) and "very good" (HR = 0.70) SRH is related to a lower risk of mortality. The opposite is true for "fair" (HR = 1.68) and "poor" (HR = 3.21) responses. Although SRH is sometimes dichotomized into "good or better" and "fair or worse" health, I found the HRs of dying for those who report "fair" and "poor" SRH—both relative to "good" and each other—to be statistically and substantively different. In addition, men, those not employed, and whites have a greater mortality risk.

Model 2 introduces computed SRH changes. Results from this model indicate that computed SRH improvements are associated with an additional risk of death (HR = 1.56), whereas computed SRH declines have no relationship with mortality. These results suggest that within any particular SRH category at time *t*, individuals with worse prior SRH have a greater risk of death. They also imply that the bivariate relationship between computed SRH decline and mortality presented in Table 2 is already captured by an individual's SRH status at time *t* (i.e., the "destination" SRH state).

Model 3 is the same as Model 2 but employs RR-SRH changes instead of computed SRH changes. In this model, both RR-SRH improvements (HR = 1.32) and declines (HR = 1.24) are related to greater risks of death, when compared with those that report no change. Introducing either computed SRH changes (Model 2) or RR-SRH changes (Model 3) did little to change the relationships between time-varying SRH and mortality identified in Model 1.

Model 4 is a combination of Models 2 and 3. In this model, the mortality HRs of SRH, computed SRH change, and RR-SRH change identified in Models 1 through 3 are essentially unchanged. This provides evidence that these two SRH change indicators have independent associations with mortality that are distinct from relationships between general SRH and mortality. It also suggests that multicollinearity concerns between these three subjective health measures may not be problematic.

Model 5 introduces variables that represent an interaction between SRH and computed SRH change. These mutually exclusive categories segregate every SRH response at time *t* by its computed SRH change. For example, respondents reporting "poor" SRH at time *t* either had "poor" SRH at

Table 2. Comparison Between Computed SRH Change and Retrospectively Reported SRH Change (RR-SRH), Asset, and Health Dynamics Among the Oldest Old Survey, 1995–2006, Net of Proxies (*N* = 19,655)

| RR-SRH change | Computed SRH change | | | | Die before next wave |
	Improvement	Unchanged	Decline	Total	
Improvement	**2.5%**	3.4%	1.7%	7.6%	12.8%
Unchanged	15.3%	**28.9%**	14.8%	59.0%	10.4%
Decline	4.4%	14.7%	**14.3%**	33.4%	19.1%
Total	22.2%	47.0%	30.8%	100.0%	13.5%
Die before next wave	13.4%	11.9%	15.9%	13.5%	

Note. SRH = self-rated health.
Bold represents congruity between computed SRH change and RR-SRH change

Table 3. Estimated Hazard Ratios (HRs) From Gompertz Models of All-Cause Mortality: HRs and 95% Confidence Intervals (CIs)

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Computed SRH improvement[a]			1.56***	1.39–1.76			1.55***	1.38–1.74			1.33***	1.18–1.50
Computed SRH decline[a]			0.99	0.89–1.09			0.98	0.89–1.08			1.10*	1.00–1.22
RR-SRH improvement[a]					1.32***	1.12–1.57	1.30**	1.10–1.53	1.29**	1.09–1.53	1.20*	1.02–1.42
RR-SRH decline[a]					1.24***	1.12–1.37	1.24***	1.12–1.37	1.24***	1.12–1.37	1.09#	0.98–1.21
SRH: Excellent	0.57***	0.45–0.71	0.49***	0.39–0.62	0.58***		0.51***	0.40–0.64			0.71**	0.56–0.90
From worse						0.47–0.74			0.82	0.62–1.10		
Unchanged									0.45***	0.32–0.65		
SRH: Very good	0.70***	0.61–0.80	0.64***	0.56–0.74	0.72***	0.63–0.82	0.66***	0.57–0.75			0.78***	0.67–0.89
From worse									0.98	0.80–1.198		
Unchanged									0.65***	0.53–0.81		
From better									0.67*	0.47–0.94		
SRH: Good (reference)	1.00	1.00–1.00	1.00	1.00–1.00	1.00	1.00–1.00	1.00	1.00–1.00			1.00	1.00–1.00
From worse									1.56***	1.29–1.89		
Unchanged (ref. Model 5)									1.00	1.00–1.00		
From better									0.91	0.75–1.11		
SRH: Fair	1.68***	1.51–1.87	1.79***	1.61–2.00	1.59***	1.42–1.78	1.69***	1.51–1.90			1.38***	1.23–1.54
From worse									2.43***	1.91–3.08		
Unchanged									1.66***	1.41–1.96		
From better									1.65***	1.40–1.95		
SRH: Poor	3.21***	2.84–3.63	3.62***	3.18–4.12	2.88***	2.52–3.29	3.25***	2.83–3.74			2.01***	1.73–2.34
Unchanged									3.13***	2.56–2.82		
From better									3.15***	2.64–3.75		
Female	0.57***	0.52–0.63	0.57***	0.52–0.63	0.57***	0.52–0.63	0.57***	0.52–0.63	0.57***	0.52–0.63	0.58***	0.52–0.63
Race: white	1.22**	1.07–1.40	1.24**	1.08–1.42	1.21**	1.06–1.39	1.23**	1.08–1.41	1.24*	1.08–1.41	1.13#	0.99–1.29
Married	0.95	0.86–1.06	0.96	0.86–1.06	0.95	0.86–1.06	0.95	0.86–1.06	0.95	0.86–1.06	1.02	0.91–1.13
Employed	0.77*	0.61–0.97	0.80#	0.63–1.01	0.78*	0.62–0.99	0.81#	0.64–1.02	0.81#	0.64–1.02	0.91	0.72–1.15
Education												
HS graduate[b]	1.05	0.95–1.17	1.06	0.95–1.18	1.05	0.95–1.17	1.06	0.95–1.18	1.06	0.95–1.18	1.06	0.95–1.19
Some college[b]	1.04	0.91–1.18	1.06	0.93–1.21	1.04	0.91–1.18	1.06	0.93–1.21	1.06	0.93–1.21	1.07	0.94–1.21
College graduate[b]	0.95	0.82–1.11	0.98	0.85–1.14	0.95	0.82–1.11	0.98	0.84–1.14	0.98	0.84–1.14	0.95	0.82–1.11
Income												
Low[c]	1.00	0.90–1.13	0.99	0.88–1.12	1.01	0.89–1.13	0.99	0.88–1.11	0.99	0.88–1.11	1.00	0.89–1.12
High[c]	0.90#	0.81–1.01	0.91	0.81–1.02	0.90#	0.80–1.01	0.91#	0.81–1.02	0.91#	0.81–1.01	0.94	0.84–1.05
Chronic conditions, count											1.34***	1.29–1.39
ADL limitations, count											1.06**	1.02–1.10
Mobility limitations, count											1.10***	1.06–1.14
Gamma	0.15***	0.14–0.15	0.15***	0.14–0.16	0.15***	0.14–0.15	0.15***	0.15–0.16	0.15***	0.15–0.16	0.15***	0.14–0.16
Log likelihood	−6,755		−6,739		−6,759		−6,725		−6,724		−6,441	
Akaike information criterion	13,580		13,512		13,553		13,488		13,498		12,927	
N	19,589		19,574		19,577		19,562		19,562		19,449	

Notes. ADL = activities of daily living; HS = high school; RR-SRH = retrospectively reported SRH; SRH = self-rated health.
[a]Reference category is "no change."
[b,c]Reference categories are "Education: less than high school graduate" and "Income: medium," respectively.
***$p \leq .001$; **$p \leq .01$; *$p \leq .05$; #$p \leq .10$.

time *t*−1 ("poor, unchanged") or were in one of the other (better) four SRH categories at *t*−1 ("poor, from better"). This model estimates whether the relationships between computed SRH change and mortality identified in Models 2 and 4 differ by SRH status. For example, "Does the increased risk of death associated with a computed SRH improvement differ if SRH at time *t* is 'excellent', compared to 'good'?" Results from this model provide no evidence of an interaction. That is, the higher risk of death identified in Models 2 and 4 for those demonstrating computed SRH improvements was similar for every given level of SRH at time *t*. Similarly, computed SRH decline was not significantly different than "unchanged" for every given level of SRH. Model fit statistics also prefer the more parsimonious Model 4.

My final model (Model 6) extends Model 4 by including counts of health conditions and disabilities that may explain relationships between SRH change and mortality. Not surprisingly, each reported chronic condition (HR = 1.34), activity of daily living limitation (HR = 1.06), and mobility limitation (HR = 1.10) is associated with a greater risk of death. Including these measures mitigates (but does not eliminate) the greater mortality hazard associated with both computed SRH improvements and RR-SRH improvements. It also weakens the relationships between SRH and mortality. After including these health measures, the mortality hazard for RR-SRH decline is no longer different than that of "no change," indicating that the association between RR-SRH decline and mortality identified in Model 4 is accounted for by new or worsening health conditions and disabilities. Lastly, Model 6 suggests that the omission of these morbidity measures in earlier models obscures a slightly greater risk of dying (HR = 1.10) for those with computed SRH declines. This difference was attributable to individuals with a computed SRH decline that reported zero chronic health conditions. Variance inflation factor scores (range: 1.05–4.27) for all variables included in Model 6 provide no indication that multicollinearity among SRH and the two SRH change measures is a concern.

To test the sensitivity of these results, I estimated three additional sets of models. The first set included proxy respondents. For computed SRH changes, these estimates were essentially unchanged. For RR-SRH changes, a decline was related to a slightly higher risk of death (HR = 1.13), whereas improvement was not—reflecting the greater degree to which respondents employing proxies died and "reported" RR-SRH declines. The second set of models disaggregated computed SRH change by the number of categories moved. In these models, I found that results remained significant for those that improved one through three categories (essentially all improvements). For computed SRH declines, the results were essentially unchanged for those declining one or two categories (85% of those that declined) and were not significant for those declining three or four categories (1.4% of all respondents). The third set of models included a baseline time-constant SRH measure

(Wave 1 SRH). Results from this set indicate that baseline SRH is related to mortality, but its inclusion did not alter the associations between SRH changes and mortality. Instead, its inclusion slightly attenuated the relationships between time-varying SRH and mortality, similar to prior studies.

DISCUSSION

This manuscript provides evidence that two measures of SRH change are independently associated with oldest-old mortality, and their inclusion did not significantly alter the well-established relationship between SRH status and the risk of death. Perhaps most interestingly, *both* measures of SRH improvement were independently and positively related to mortality. These relationships differ from prior similar research that found only computed SRH changes were related to mortality (Erdogan-Ciftci et al., 2010) or maintained that RR-SRH changes are a preferred measure of health dynamics to predict expected longevity (Benitez-Silva & Ni, 2008). Inclusion of both SRH improvement measures appears particularly important for the AHEAD respondents since 27% of the sample demonstrated either a computed SRH improvement or a RR-SRH improvement, but less than 3% of the sample had both.

Computed SRH Changes

This is only the second study to link SRH improvements to an increased risk of mortality (Nielsen et al., 2009), and these results have two important implications for elderly demonstrating these changes. One, they underscore the notion that computed SRH improvements imply worse prior SRH that may continue to have (lagged) associations with mortality. Two, the results provide evidence that oldest-old individuals may be changing their SRH evaluative cut points or subjective health norms. That is, the mortality "benefits" of moving to an improved SRH category do not appear to carry over in the short term, and this could be because health did not improve in the traditional sense. A supplemental analysis indicates that the count of chronic conditions and mobility/ADL limitations did not significantly differ between respondents with a computed SRH improvement and respondents with no computed SRH change. This further suggests that computed SRH improvements are more attributable to other sources (e.g., changes in subjective health standards). Both the proportion demonstrating computed SRH improvements in this survey (22.2%) and the implications of these results are significant; especially since these results were consistent across SRH categories. For example, 41% of all elderly individuals that reported "excellent" or "very good" SRH at time *t* reported worse SRH at *t*−1—and I estimate that these respondents, despite their recent improved assessment, have the same mortality risk as those reporting "good" SRH in two consecutive waves.

After including chronic conditions and disability, computed SRH decline is associated with a slightly increased

risk of death, corroborating results of previous studies. Just as important, I find that most of the mortality risk associated with these decreases is already captured by SRH itself at time *t*.

Theory suggests (Jylhä, 2009; Knäuper & Turner, 2003) that standard SRH evaluations reflect cultural norms (e.g., "What constitutes 'good' health?") and multiple comparisons (e.g., "How does my health compare to people I know?"). These same evaluative processes have obvious relations to computed SRH change because computed SRH change is calculated using SRH itself. At the same time, researchers have begun to investigate what physical, psychological, and social factors could lead to computed SRH changes—illuminating why SRH changes may be independently associated with mortality. For example, computed SRH decline among the elderly has been linked to physical activity decline, cognitive capacity (Leinonen et al., 2001), and comorbidity (Heller et al., 2009; Galenkamp et al., 2013). Computed SRH improvements, on the other hand, have been connected to surviving a major health event (Diehr, Williamson, Patrick, Bild, & Burke, 2001) as well as active physical/social lives (Benyamini et al., 2011).

RR-SRH Changes

RR-SRH changes have rarely been included in mortality studies, despite the likelihood that these respondent-provided indicators measure subjective health dynamics not captured by either SRH or computed SRH change. Similar to computed SRH improvements, RR-SRH improvements are related to an increased risk of death in the most specified model. One explanation for these results is that for the oldest-old, treatment of health problems (e.g., hospital visits) may both cause a respondent to retrospectively feel an improvement and also be a marker of poor or deteriorating health (Gunasekara et al., 2012). In the AHEAD data, those with RR-SRH improvements (7.6% of the sample) have a 11% greater count of mobility limitations, a 26% higher count of chronic conditions, and a 50% higher count of ADL limitations, when compared with those that reported no change. In addition, those with RR-SRH improvements have a 36% greater count of new chronic conditions at time *t* that did not exist at time *t*−1; when compared with those that had no change. Controlling for health conditions and disability explains the association between RR-SRH declines and mortality, supporting previous research finding that RR-SRH declines and chronic conditions are closely tied (Leinonen et al., 2001).

Although much less developed than that of computed SRH changes, a few researchers have investigated the origins of RR-SRH changes. As just discussed, RR-SRH declines have been tied to functional performance and chronic conditions among oldest-old adults (Leinonen et al., 2001) as well as new or worsening health problems for young-old individuals (Choi, 2003). Conversely, RR-SRH improvements have

been linked to psychological adaption (Wells, de Vaus, Kendig, & Quine, 2009) and changes in health behavior (Choi, 2003). In general, the literature would benefit from researchers evaluating the relative importance of factors (e.g., objective health, social comparisons) in influencing SRH and SRH changes.

Conclusions

This paper does not suggest that general SRH lacks a dynamic component which partially contributes to the well-established relationships between SRH and mortality. Instead, it provides evidence that computed SRH changes and RR-SRH changes capture distinct dynamic qualities of subjective health that are not captured by SRH itself. Respondents likely consider their health trajectories as part of their SRH evaluations, but not all observations sharing a SRH category share the same dynamics. Computed SRH changes are one way to designate short-term SRH trajectories that exist within any general SRH category. RR-SRH changes, on the other hand, appear to capture changes that can only be actively diagnosed by the respondent or those that cannot be captured otherwise (e.g., those limited by ceiling/floor effects, those obscured by shifting cut points, within-category SRH changes). Investigating relationships between SRH change and oldest-old mortality is especially important because this age group experiences high rates of mortality and many other correlates (i.e., education, income) appear to decrease in significance with increasing age (Beckett, 2000).

There are a few important limitations to this study. For one, the findings are only generalizable to the oldest-old population—the mean age of a respondent was 80 in 1995, and this increased to 88 by 2006. In addition, the 1995 AHEAD survey includes a select group of individuals born in 1923 or earlier that survived until at least 72. Third, respondents whose SRH appear "consistent" at two time points may have had undocumented health changes between those two surveys. Lastly, I was restricted by the use of all-cause mortality, even though there is no reason to expect that certain causes of deaths (i.e., accidents) have relationships with SRH or SRH changes.

Recent research finds that SRH evaluative criteria and SRH reporting thresholds differ across groups. For example, the use of anchoring vignettes finds that SRH rating styles differ by gender (Grol-Prokopczyk, Freese, & Hauser, 2011), whereas the links between certain biomarkers and SRH differ by SES (Dowd & Zajacova, 2010). By extension, evaluative processes and mortality implications for both types of SRH changes will likely differ by social groups, age, and cultural context, and this remains an important path for future research. One benefit of this study is that these respondents are relatively homogeneous—they are mostly (86.9%) white, not employed (93.2%), and did not graduate college (86.5%).

SRH evaluations (and, therefore, SRH change evaluations) likely differ over the life course, and prior research suggests that elderly may lower their SRH standards over time (Galenkamp, Huisman, Braam, & Deeg, 2012b). If true, changes in SRH reference points could show (or obscure) SRH changes that would not be found otherwise. Older adults appear to both *use* age as an evaluative framework (e.g., "How is my health, considering my age?"; Wurm, Tomasik, & Tesch-Römer, 2008) and change their references *as they age* (e.g., more likely to compare with peers; Henchoz et al., 2008). Additional work remains to be done to understand how evaluative processes differ over time and how this may affect relationships between subjective health measures and mortality. For example, using renewed judgments of past health in surveys has allowed some researchers to identify recalibrations in SRH that occur due to a normalization of morbidity (Galenkamp et al., 2012a). Future research should also attempt to decompose calibration changes or reporting error from "true" shifts of subjective health categories over the life course.

The most surprising finding of this study is that two distinct and simple measures of SRH improvement predict an increased risk of death. Both the causes and mortality implications of these health improvements are likely to be very different for oldest-old adults, when compared with other age groups. Although improved well-being should remain a goal of healthy aging, the risks of death related to existing conditions may linger after treatment or normalized feelings of getting better. It may be helpful for health care providers to monitor SRH and SRH changes along with other health indicators, such as lab results. Fortunately, computed SRH change is easily created with longitudinal data. Reported SRH change is also a simple question to include in either surveys or office visits. Health care workers, researchers, and family members may be wise to have a skeptical view toward SRH "improvements" in advanced age.

CORRESPONDENCE

Correspondence should be addressed to Eric M. Vogelsang, MS, Department of Sociology and Center for Demography and Ecology, University of Wisconsin–Madison, 4412 Social Sciences Building, 1180 Observatory Drive, Madison, WI 53706. E-mail: evogelsa@ssc.wisc.edu.

REFERENCES

Alfonso, H., Beer, C., Yeap, B. B., Hankey, G. J., Flicker, L., & Almeida, O. P. (2012). Perception of worsening health predicts mortality in older men: The health in men study (hims). *Archives of Gerontology and Geriatrics*, *56*, 363–368. doi:10.1016/j.archger.2012.04.005

Apfel, K. S. (2000). Fast facts & figures about social security. *Social Security Administration: Office of Policy, Office of Research, Evaluation and Statistics*, 1–35.

Ayalon, L., & Covinsky, K. (2009). Spouse-rated vs self-rated health as predictors of mortality. *Archives of Internal Medicine*, *169*, 2156–2161. doi:10.1001/archinternmed.2009.386

Bath, P. A. (2003). Differences between older men and women in the self-rated health–mortality relationship. *The Gerontologist*, *43*, 387–395. doi:10.1093/geront/43.3.387

Beckett, M. (2000). Converging health inequalities in later life-an artifact of mortality selection? *Journal of Health and Social Behavior*, *41*, 106–119. doi:10.2307/2676363

Benitez-Silva, H., & Ni, H. (2008). Health status and health dynamics in an empirical model of expected longevity. *Journal of Health Economics*, *27*, 564–584. doi:10.1016/j.jhealeco.2007.09.008

Benyamini, Y. (2008). Self-ratings of health and longevity: A health psychologist's viewpoint on epidemiological findings. *The European Health Psychologist*, *10*, 10–13.

Benyamini, Y., Blumstein, T., Lusky, A., & Modan, B. (2003). Gender differences in the self-rated health–mortality association: Is it poor self-rated health that predicts mortality or excellent self-rated health that predicts survival? *The Gerontologist*, *43*, 396–405. doi:10.1093/geront/43.3.396

Benyamini, Y., Blumstein, T., Murad, H., & Lerner-Geva, L. (2011). Changes over time from baseline poor self-rated health: For whom does poor self-rated health not predict mortality? *Psychology & Health*, *26*, 1446–1462. doi:10.1080/08870446.2011.559231

Choi, N. G. (2003). Determinants of self-perceived changes in health status among pre-and early-retirement populations. *The International Journal of Aging and Human Development*, *56*, 197–222. doi:10.2190/T8JD-1P30-6MFT-8WHA

Cleves, M., Gould, W., Gutierrez, R., & Marchenko, Y. (2010). *An introduction to survival analysis using stata*. College Station, TX: Stata Corp.

Deeg, D. J. H., Van Zonneveld, R., Van der Maas, P., & Habbema, J. (1989). Medical and social predictors of longevity in the elderly: Total predictive value and interdependence. *Social Science & Medicine*, *29*, 1271–1280. doi:10.1016/0277-9536(89)90067-1

Dening, T. R., Chi, L. Y., Brayne, C., Huppert, F. A., Paykel, E. S., & O'Connor, D. W. (1998). Changes in self-rated health, disability and contact with services in a very elderly cohort: A 6-year follow-up study. *Age and Ageing*, *27*, 23–33. doi:10.1093/ageing/27.1.23

DeSalvo, K. B., Bloser, N., Reynolds, K., He, J., & Muntner, P. (2006). Mortality prediction with a single general self-rated health question. *Journal of General Internal Medicine*, *21*, 267–275. doi:10.1111/j.1525-1497.2005.00291.x

Diehr, P., Williamson, J., Patrick, D. L., Bild, D. E., & Burke, G. L. (2001). Patterns of self-rated health in older adults before and after sentinel health events. *Journal of the American Geriatrics Society*, *49*, 36–44. doi:10.1046/j.1532-5415.2001.49007.x

Dowd, J., & Zajacova, A. (2010). Does self-rated health mean the same thing across socioeconomic groups? Evidence from biomarker data. *Annals of Epidemiology*, *20*, 743–749. doi:10.1016/j.annepidem.2010.06.007

Erdogan-Ciftci, E., van Doorslaer, E., & Bago, U. (2010). Do self-perceived health changes predict longevity? *Social Science & Medicine*, *71*, 1981–1988. doi:10.1016/j.socscimed.2010.09.003

Fayers, P. M., & Sprangers, M. A. G. (2002). Understanding self-rated health. *Lancet*, *359*, 187–188. doi:10.1016/S0140-6736(02)07466-4

Ferraro, K. F., & Kelley-Moore, J. A. (2001). Self-rated health and mortality among black and white adults. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, *56*, 195–205. doi:10.1093/geronb/56.4.S195

French, D. J., Sargent-Cox, K., & Luszcz, M. A. (2012). Correlates of subjective health across the aging lifespan understanding self-rated health in the oldest old. *Journal of Aging and Health*, *24*, 1449–1469. doi:10.1177/0898264312461151

Galenkamp, H., Deeg, D. J. H., Braam, A. W., & Huisman, M. (2012a). "How was your health 3 years ago?" predicting mortality in older adults using a retrospective change measure of self-rated health. *Geriatrics & Gerontology International*, *13*, 678–686. doi:10.1111/j.1447-0594.2012.00963.x

Galenkamp, H., Deeg, D. J., Huisman, M., Hervonen, A., Braam, A. W., & Jylhä, M. (2013). Is self-rated health still sensitive for changes in disease and functioning among nonagenarians? *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, *68*, 848–858. doi:10.1093/geronb/gbt066

Galenkamp, H., Huisman, M., Braam, A., & Deeg, D. (2012b). Estimates of prospective change in self-rated health in older people were biased owing to potential recalibration response shift. *Journal of Clinical Epidemiology*, *65*, 978–988. doi:10.1016/j.jclinepi.2012.03.010

Gerber, Y., Benyamini, Y., Goldbourt, U., & Drory, Y. (2009). Prognostic importance and long-term determinants of self-rated health after initial acute myocardial infarction. *Medical Care*, *47*, 342–349. doi:10.1097/MLR.0b013e3181894270

Grol-Prokopczyk, H., Freese, J., & Hauser, R. M. (2011). Using anchoring vignettes to assess group differences in general self-rated health. *Journal of Health and Social Behavior*, *52*, 246–261. doi:10.1177/0022146510396713

Gunasekara, F. I., Carter, K., & Blakely, T. (2012). Comparing self-rated health and self-assessed change in health in a longitudinal survey: Which is more valid? *Social Science & Medicine*, *74*, 1117–1124. doi:10.1016/j.socscimed.2011.11.038

Han, B., Phillips, C., Ferrucci, L., Bandeen-Roche, K., Jylha, M., Kasper, J., & Guralnik, J. M. (2005). Change in self-rated health and mortality among community-dwelling disabled older women. *The Gerontologist*, *45*, 216–221. doi:10.1093/geront/45.2.216

Heeringa, S. (1995). *Technical description of the asset and health dynamics among the oldest old (ahead) study sample design*. Ann Arbor, MI: Population Studies Center.

Heller, D. A., Ahern, F. M., Pringle, K. E., & Brown, T. V. (2009). Among older adults, the responsiveness of self-rated health to changes in charlson comorbidity was moderated by age and baseline comorbidity. *Journal of Clinical Epidemiology*, *62*, 177–187. doi:10.1016/j.jclinepi.2008.05.009

Henchoz, K., Cavalli, S., & Girardin, M. (2008). Health perception and health status in advanced old age: A paradox of association. *Journal of Aging Studies*, *22*, 282–290. doi:10.1016/j.jaging.2007.03.002

Idler, E. L., & Benyamini, Y. (1997). Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior*, *38*, 21–37. doi:10.2307/2955359

Jylhä, M. (2009). What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Social Science & Medicine*, *69*, 307–316. doi:10.1016/j.socscimed.2009.05.013

Kinsella, K., & He, W. (2009). *An aging world: 2008*. Washington, DC: National Institute on Aging, Census Bureau.

Knäuper, B., & Turner, P. A. (2003). Measuring health: Improving the validity of health assessments. *Quality of Life Research*, *12*, 81–89. doi:10.1023/A:1023589907955

Knox, S., & King, M. (2009). Validation and calibration of the sf-36 health transition question against an external criterion of clinical change in health status. *Quality of Life Research*, *18*, 637–645. doi:10.1007/s11136-009-9467-1

Leinonen, R., Heikkinen, E., & Jylhä, M. (1998). Self-rated health and self-assessed change in health in elderly men and women—a five-year longitudinal study. *Social Science & Medicine*, *46*, 591–597. doi:10.1016/S0277-9536(97)00205-0

Leinonen, R., Heikkinen, E., & Jylhä, M. (2001). Predictors of decline in self-assessments of health among older people—a 5-year longitudinal study. *Social Science & Medicine*, *52*, 1329–1341. doi:10.1016/S0277-9536(00)00249-5

Leinonen, R., Heikkinen, E., & Jylhä, M. (2002). Changes in health, functional performance and activity predict changes in self-related health:

A 10-year follow-up study in older people. *Archives of Gerontology and Geriatrics*, *35*, 79–92. doi:10.1016/S0167-4943(02)00017-1

Lyyra, T. M., Leskinen, E., Jylhä, M., & Heikkinen, E. (2009). Self-rated health and mortality in older men and women: A time-dependent covariate analysis. *Archives of Gerontology and Geriatrics*, *48*, 14–18. doi:10.1016/j.archger.2007.09.004

Meinow, B., Kåreholt, I., Parker, M., & Thorslund, M. (2004). The effect of the duration of follow-up in mortality analysis: The temporal pattern of different predictors. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, *59*, 181–189. doi:10.1093/geronb/59.3.S181

Miller, T. R., & Wolinsky, F. D. (2007). Self-rated health trajectories and mortality among older adults. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, *62*, 22–27. doi:10.1093/geronb/62.1.S22

Nielsen, A., Siersma, V., Kreiner, S., Hiort, L., Drivsholm, T., Eplov, L., & Hollnagel, H. (2009). The impact of changes in self-rated general health on 28-year mortality among middle-aged danes. *Scandinavian Journal of Primary Health Care*, *27*, 160–166. doi:10.1080/02813430903020446

Nybo, H., Petersen, H. C., Gaist, D., Jeune, B., Andersen, K., McGue, M., Vaupel, J. W., & Christensen, K. (2003). Predictors of mortality in 2,249 nonagenarians—the danish 1905-cohort survey. *Journal of the American Geriatrics Society*, *51*, 1365–1373. doi:10.1046/j.1532-5415.2003.51453.x

Pinquart, M. (2001). Correlates of subjective health in older adults: A meta-analysis. *Psychology and Aging*, *16*, 414–426. doi:10.1037/0882-7974.16.3.414

Sanchez-Santos, M. T., Zunzunegui, M. V., Otero-Puime, A., Cañas, R., & Casado-Collado, A. J. (2011). Self-rated health and mortality risk in relation to gender and education: A time-dependent covariate analysis. *European Journal of Ageing*, *8*, 281–289. doi:10.1007/s10433-011-0198-0

Sargent-Cox, K. A., Anstey, K. J., & Luszcz, M. A. (2008). Determinants of self-rated health items with different points of reference implications for health measurement of older adults. *Journal of Aging and Health*, *20*, 739–761. doi:10.1177/0898264308321035

Sargent-Cox, K. A., Anstey, K. J., & Luszcz, M. A. (2010). The choice of self-rated health measures matter when predicting mortality: Evidence from 10 years follow-up of the australian longitudinal study of ageing. *BMC Geriatrics*, *10*, 1–12. doi:10.1186/1471-2318-10-18

Svärdsudd, K., & Tibblin, G. (1990). Is quality of life affecting survival? The study of men born in 1913. *Scandinavian Journal of Primary Health Care. Supplement*, *1*, 55–60.

Thomas, C., Kelman, H. R., Kennedy, G. J., Ahn, C., & Yang, C. (1992). Depressive symptoms and mortality in elderly persons. *The Journal of Gerontology*, *47*, S80–S87. doi:10.1093/geronj/47.2.S80

Vuorisalmi, M., Sarkeala, T., Hervonen, A., & Jylhä, M. (2012). Among nonagenarians, congruence between self-rated and proxy-rated health was low but both predicted mortality. *Journal of Clinical Epidemiology*, *65*, 553–559. doi:10.1016/j.jclinepi.2011.11.001

Wells, Y., de Vaus, D., Kendig, H., & Quine, S. (2009). Health and wellbeing through work and retirement transitions in mature age: Understanding pre-post and retrospective measures of change. *The International Journal of Aging and Human Development*, *69*, 287–310. doi:10.2190/AG.69.4.c

Wolinsky, F. D., & Tierney, W. M. (1998). Self-rated health and adverse health outcomes: An exploration and refinement of the trajectory hypothesis. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, *53*, 336–340. doi:10.1093/geronb/53B.6.S336

Wurm, S., Tomasik, M. J., & Tesch-Römer, C. (2008). Serious health events and their impact on changes in subjective health and life satisfaction: The role of age and a positive view on ageing. *European Journal of Ageing*, *5*, 117–127.