



Views on aging: older adults' self-perceptions of age and of health

Yael Benyamini¹ · Edith Burns²

Published online: 16 November 2019
© Springer Nature B.V. 2019

Abstract

Perceptions of age and perceptions of health have each been found to predict future health and well-being, yet surprisingly, studies typically focused on one or the other. Studies on perceived age suggested that its effects on longevity may be mediated by perceived health. Within each of these lines of research, the constructs have not been consistently operationalized, making it difficult to generalize across studies. We aimed to investigate the associations of different measures of perceptions of age and of health with one another and with longevity. Data collected at baseline from the 851 participants of the Rutgers Aging and Health longitudinal study (mean age 73) included perceptions of age and health, each assessed with four different single-item measures, sociodemographic, and health measures. Mortality was followed-up for 10 years. All four health perceptions and two of the age perceptions (Age-group identity and nearness-to-death) were associated with survival time. Age and health perceptions had similar independent effects in models that included measures of both types, controlling for demographics and chronic conditions, though not after controlling for age. In contrast with our hypothesis, health perceptions did not mediate the association between age perceptions and mortality. Findings regarding health perceptions were generally consistent across measures, whereas age perception measures differed in their associations with various outcomes, indicating that they assess different subjective age constructs. The findings correspond with proposed explanations for the predictive effect of age and health perceptions and support the significant though weaker independent effects of age perceptions compared with health perceptions.

Keywords Perceived age · Subjective age · Self-rated health · Self-assessed health · Mortality · Older adults

Introduction

Coping with the challenges of old age is a complex issue, further complicated by societal attitudes toward aging. We develop psychological mechanisms to cope with these challenges, including perceptions of age and of health that contribute to our ability to optimally attain desired goals. Though one would expect perceptions of health and age to be related, they have not often been studied together: Self-ratings of health have been examined primarily by epidemiologists and sociologists as predictors of future health.

Self-perceptions of age and aging have mostly been studied by psychologists, focusing on a variety of health and psychological outcomes. The current study aimed to investigate how these constructs are associated with one another and with longevity.

Early studies compared both perceptions with objective standards—e.g., subjective age versus chronological age, self-rated health (SRH) versus physician ratings. These studies reported that most people feel younger than their actual age (Kastenbaum et al. 1972). SRH appeared at first to be an indicator of morale or self-image (Friedsam and Martin 1963). It was usually found to be more “optimistic” than objective information (Chipperfield 1993). Interest in these subjective perceptions increased when they were found to predict later health outcomes, even after controlling for demographics and health conditions: both predict mortality and physical functioning (Idler and Benyamini 1997; Idler and Kasl 1995; Westerhof et al. 2014).

Despite the similarities between these two lines of inquiry, they were mostly distinct from one another: Studies

Responsible editor: Matthias Kliegel, Guest editors: Verena Klusmann and Anna E. Konradt.

✉ Yael Benyamini
benyael@tauex.tau.ac.il

¹ Bob Shapell School of Social Work, Tel Aviv University, 6997801 Tel Aviv, Israel

² Department of Medicine, Hofstra Northwell School of Medicine, Manhasset, NY 11030, USA

of health perceptions rarely included age perceptions; studies of age perceptions mostly used health perceptions as covariates (e.g., Levy et al. 2002) or outcomes (Wurm et al. 2017). Even when both types of perceptions were included in the same study, it is difficult to draw general conclusions because of the variability in the operationalization of both health and age perceptions. The current study used several operationalizations of each type.

Theoretical approaches to the associations between age and health perceptions

From a self-theoretical perspective, both age and health perceptions can be viewed as forms of self-knowledge, actively created by individuals (Benyamini 2011; Diehl et al. 2015). Motives such as self-consistency and self-enhancement may be at play in constructing these perceptions, particularly as one ages (Westerhof and Wurm 2015). Both are constructed within a personal, social, and cultural context (Jylhä 2009; Montepare 2009). This is emphasized in a life-span developmental perspective that follows the processes of change and continuity of one's self-identity, including age identity: such a perspective argues that both age-symbolic social life events and physical health events can make age more salient and negatively affect subjective age (Barrett and Montepare 2015).

Age and perceptions of old age may affect the extent to which physical health events are incorporated into one's overall evaluation of health (Jylhä 2009). A life-span perspective would predict that both age and health perceptions would be associated, because they may affect one another and because of mechanisms working to maintain continuity in these self-perceptions, to the extent possible given objective changes. Support for these propositions can be found in a review that described associations between perceptions of aging and a variety of health measures (including SRH) in cross-sectional and longitudinal studies: perceptions of aging predicted future physical functioning and longevity, and health experiences affected aging perceptions (Warmoth et al. 2016).

When SRH was examined, cross-lagged analyses showed interdependence between this measure and subjective age (Spuling et al. 2013). Similarly, subjective age and SRH each contributed to changes over time in the other construct (Rippon and Steptoe 2018). In both of these studies, the effects over time for physical and mental health measures other than SRH were only from subjective age to future health. Other studies also suggest that the more prominent direction of effects is from perceptions of age to future health. Aging perceptions had a greater impact on physical health conditions than vice versa (Wurm et al. 2007). Westerhof and Wurm (2015) supported this direction in their literature review on subjective age, health, and longevity. They interpreted the

literature to mean that a “younger” age identity contributes to well-being, which in turn results in better health and survival. An “older” age identity may lead to attributing health problems to old age, resulting in poorer perceived health and mortality (Stewart et al. 2012). In other words, “subjective age” is hypothesized to affect health measures, including SRH, which in turn predicts longevity.

Another theoretical perspective that Westerhof and Wurm (2015) adopted to explain the associations between subjective age and health is the Stereotype Embodiment Theory (Levy 2009), also based on a life-span view. It proposes that as they grow older, individuals internalize society's negative views on aging and apply them to their own aging. These views may become self-fulfilling prophecies, affecting functioning, health, and longevity, through psychological (e.g., accumulating psychological resources), behavioral (e.g., health behaviors), and physiological pathways (see also Wurm et al. 2017).

These pathways coincide with the factors associated with subjective health, which were proposed as explanations for its validity in predicting survival. SRH is strongly associated with health behaviors; it reflects internal (physiological, psychological) and external (social, financial) resources which may attenuate health declines and contribute to coping with health threats or recovering from illness (Idler and Benyamini 1997). Our main hypothesis is based upon the model proposed by Westerhof and Wurm (2015): *Older adults' subjective perceptions of their health and of their age will be associated with mortality over the next 10 years, controlling for socio-demographics and health conditions at baseline. The effect of age perceptions on mortality will be mediated by the effect of health perceptions.*

Inter-relationships and operationalization of age and health perceptions

Self-perceptions of age and health are multi-dimensional constructs, integrating a complex array of information from internal and external sources (Benyamini et al. 1999; Kornadt et al. 2019). Perceptions of one's general health status seem to be a more coherent construct, reflected by the typical way of measuring it using a single item. Though variations of SRH items exist, they all essentially ask the respondent to rate their health on a ranked scale. When the two most commonly used measures, general and age-comparative SRH, were included in the same study, the responses were usually highly correlated (Baron-Epel et al. 2004). More importantly, findings regarding the predictive validity of SRH are similar, regardless of item wording, response options, or the language used (Idler and Benyamini 1997). This suggests that differences between ways of assessing perceived health are not substantial.

In contrast, self-perceptions of age and aging have been defined and assessed in many different ways: subjective age, perceptions of one's own aging, awareness of age-related changes (Klusmann et al. 2019), and a distinct related construct, subjective nearness-to-death (Palgi 2016). Some of these measures are based on single items, which ask very different questions: Some ask about subjective age, others about the Age-group with which one identifies, and yet others, about the age to which one *thinks* they will live. In practice, these single items are often used to compute an index in relation to one's actual age: for example, "felt age," the difference between subjective and actual age, sometimes dividing it by actual age to obtain "proportional felt age" (Rubin and Berntsen 2006); "subjective nearness-to-death," the difference between actual age and the age to which a person thinks s/he will live (Palgi et al. 2014).

There are also multi-item scales assessing self-perceptions of age. For both single and multi-item measures, some used general items, while others examined domain-specific age perceptions (e.g., physical, social, psychological). Despite greater differences among measures (and less consistency in findings), overall outcomes are similar across studies. However, different measures of age perceptions have rarely been studied together (Westerhof et al. 2014; Westerhof and Wurm 2015). This is similar to health perception research, where any given study typically used one operationalization (Idler and Benyamini 1997). Different measurement approaches for age and health perceptions and their associations to future outcomes have rarely been compared within the same cohort of older adults.

The current study aimed to fill these gaps in the literature by comparing the associations of different perceptions of age and of health with each other and with longevity. We utilized existing data from the Rutgers Aging and Health Study to examine four different measures of each type of perception in parallel. This allowed us to *compare the results between subjective perceptions of age and of health as well as within different measures of each construct*. All of our measures are single items, considered to be subjective judgments which integrate large amounts of information relevant to one's age (Spuling et al. 2013) and health perceptions (Benyamini et al. 1999; Jylhä 2009). Their integrative nature may explain their predictive validity in relation to future health outcomes.

Method

Participants

The sample included the 851 participants of the Rutgers Aging and Health (RAH) study, a longitudinal survey of older adults living in a retirement community (Benyamini et al. 1999). Mean age at baseline was 73(\pm 7) years, 60%

women, 99% white, 61% married/cohabiting, and 18% working. Twenty-five percent had high school education or lower, 31% some college or post-high school vocational education, and 44% had a college or higher degree. Details on recruitment procedures are described elsewhere (Benyamini et al. 1999). Attrition due to withdrawal, severe illness, relocation, or death averaged 9% per year.

Procedure

The current study used data from in-depth, in-person baseline interviews and 10-year mortality. Ninety-five percent of interviews were conducted in respondents' homes. After undergoing informed consent, interviewers read all questions aloud and recorded participants' responses directly into a computer. Interviewers were trained by a board-certified geriatrician on techniques for probing for medical conditions.

Mortality follow-up

Mortality was followed-up for almost 10 years (116 months). Of the original 851 participants, 233 (27%) passed away during the follow-up period. Deaths were initially identified by obituaries in the community newspaper and verified by family members, and/or the central office, which maintained a complete list of residents for legal purposes. Living individuals were contacted directly (or status verified with close family members). Twenty-five people were lost to follow-up and censored at the last month they were known to be alive.

Instruments and measures

Socio-demographics: age, gender, and level of education.

Perceptions of health were assessed using four different questions: (1) general self-ratings of health [Gen-SRH]: "In general, would you say your health is... poor, fair, good, very good, or excellent?" (response scale: 1 = poor to 5 = excellent); (2) age-comparative self-rating of health [Comp-SRH]: "Compared to other people your own age, would you say that your general health is... poor, fair, good, very good, or excellent?" (same 1-5 response scale); (3) agreement to health being excellent [Exc-SRH]: "How much do you agree with the following statement: My health is excellent" (response scale: 1 = strongly disagree to 5 = strongly agree); and (4) agreement to health being poor [Poor-SRH]: "How much do you agree with the following statement: My health is poor" (same 1-5 response scale).

Perceptions of age were assessed in four different ways: (1) Age-group identity [Age-group]: "What age group best reflects how you feel (not necessarily your actual age): Teenage, young adult, early middle age, late middle age, nearly old, old, very old?" (1 = teenager to 7 = very

old); (2) comparative age [Comp-age]: “Compared to other people your actual age, do you feel much younger, younger, about the same, older, much older?” (1 = much younger to 4 = older, no participants chose ‘much older’); (3) felt age: “How old do you feel? Give me the number of years that best describes how old you feel (not necessarily your actual age).” The response was subtracted from one’s chronological age [Age – felt age] (proportional felt age, i.e., dividing this measure by age as proposed by Rubin and Berntsen (2006), was very strongly correlated with Age – felt age and yielded the same findings, which are therefore not reported); (4) subjective nearness-to-death: “Till what age do you think you will live?”. One’s chronological age was subtracted from the response [Age die – age].

Illness burden The respondent’s medical history was assessed by a detailed review of 70 diseases from 19 illness categories, with open-ended probes for additional illnesses in each category (e.g., “Have you ever had any of the following heart or cardiovascular diseases...?”, ending with “Any other... heart disease?”). Categories included cardiovascular, lung, allergies, infections, cancer, non-cancerous tumors/cysts, stomach/intestinal, immune, nervous system, genital/urinary, joint/bone/muscle, kidney, blood, skin, diabetes, thyroid, eye, ear, and mental illnesses. Six internists rated the severity of each of the 70 diseases, from 1 to 100 (trivial = 1, extremely life-threatening = 100). Cronbach’s alpha reliability coefficient for the six ratings across 427 disease codes was .97. To determine weights for each illness, the highest and lowest physician ratings were dropped, and the remaining four ratings averaged (the average range of these four ratings was within 10 points). An *illness burden* score was computed for each participant: the sum of the illnesses reported in his/her medical history, with each illness weighted by its mean severity rating. Note that this measure takes into account the “typical” severity of each illness (not severity for a given individual). However, it is based on a very extensive review of the individual’s medical history and reported illnesses are weighted by their severity, a more elaborate procedure than is typically used when extracting medical history from self-reports.

Recent illnesses comprised three variables based on the number of episodes of acute illness, onset or flare-up of chronic illness, and injuries reported at baseline for the prior 3 months, weighted by the participant’s own rating of severity of the episode, on a scale of 1 (not at all) to 5 (very much). In the 3 months preceding the interview, 27% reported acute illnesses, 33% reported chronic illnesses, and 7% reported injuries. All major illnesses were recorded in the medical history. If any had begun or flared-up within the 3 months preceding the interview, they were coded in both the medical history and the recent illness sections.

Statistical analyses

First, we computed Pearson correlations to test: (a) associations among age perceptions, among health perceptions, and between measures from the two sets; and (b) associations between perception measures (age and health) and the participants’ demographic and health characteristics. Next, Cox regression models were constructed to estimate the hazard ratios (HR) and 95% confidence intervals (CIs) for time-to-death associated with baseline perceptions of health and age. This was first done for each perception measure in three steps: (1) HR for mortality for the perception measure; (2) adjusting for baseline demographic and health covariates (age, sex, education, illness burden, and recent chronic flare-ups/acute illnesses/injuries); and (3) also adjusting for age. Since two of the age perception measures—Age – felt age and Age die – age—were constructed as an index that included age in the computation, controlling for age may be “over-controlling,” and therefore, it is presented consistently yet separately for all measures. Finally, we tested models in which two perceptions were included each time—one age perception and one health perception—using the three steps listed above. These models assessed the independent contribution of each measure and enabled a test of the mediation of the age perception to mortality effect by health perception. Six such models were tested, for all combinations of age and health perceptions in which the crude HR was significant for both measures. For the mortality prediction models, all perception measures were coded so that the highest (reference) category indicated better health/younger age.

Results

Descriptive information presented in Table 1 showed that on average, participants felt 14 years younger than their actual age, range 66 years younger to 30 years older (median 12, interquartile range, IQR 8–18). The mean age till which they think they will live was 13 years older than their actual age (range 1–44 years, median 11, IQR 7–17). For health perception measures, responses spread over the entire scale, though most of the participants viewed their health as good or better.

Correlations within health perception measures ranged between |.53| and |.76| (Table 1). Correlations within the age perception measures ranged from |.15| to |.53|, significantly lower than the former ($Z_s > 2.68$, $ps < .01$; except for the correlation between Age-group and Age – felt age, $r = -.53$, which was similar to the strength of intercorrelations between the health perceptions). The correlations between measures from the two sets mostly resembled the correlations among the age perceptions.

Health perceptions were more strongly related to “objective” self-reported health measures—i.e., illness burden and

Table 1 Descriptive information and Pearson correlations among the study variables at baseline

Measure	Gen-SRH	Comp-SRH	Exc-SRH	Poor-SRH	Age-group	Comp-age	Age – felt age	Age die – age*
Mean	3.51	3.75	3.48	1.85	4.15	2.09	14.09	13.05
SD	.97	.92	.99	.72	1.00	.74	10.22	7.55
Range	1–5	1–5	1–5	1–5	1–7	1–4	–30 to 66	1–44
Gen-SRH	–	.76	.65	–.55	–.27	–.27	.21	.35
Comp-SRH			.63	–.53	–.26	–.37	.28	.29
Exc-SRH				–.61	–.25	–.30	.21	.33
Poor-SRH					.21	.26	–.20	–.23
Age-group						.31	–.53	–.34
Comp-age							–.43	–.16
Age – felt age								–.15
Age	–.20	.05	.13	.10	.34	–.04	.08	–.57
Gender (male)	–.05	.00	.03	–.00	.09	–.12	–.05	–.07
Education	.07	.08	.07	–.08	.08	–.01	–.01	.14
Illness burden	–.38	–.30	–.34	.27	.16	.12	–.08	–.18
Recent flare-ups of chronic conditions	–.24	–.22	–.26	.19	.05	.09	–.06	–.10
Recent acute illnesses	–.08	–.10	–.10	.07	–.01	.09	–.04	.00
Recent injuries	–.02	–.02	–.01	–.03	–.03	–.02	.02	.01

All correlations above $r = .11$ are significant at $p < .001$ and marked in bold; correlations above $r = .07$ are significant at $p < .05$

*Nearness-to-death; 31% refused to answer till what age they will live so the data on this measure are based on $n = 586$

recent flare-ups of chronic conditions. Gender and education were mostly unrelated to the health and age perceptions, as were recent acute illnesses and injuries. Actual age was related only to some of the perceptions: Gen-SRH, Exc-SRH, Age-group, and nearness-to-death. It was unrelated to age-comparative health or age perceptions.

Cox regression models tested each of the eight measures as a predictor of time-to-death over the next 10 years. Each analysis was run in three blocks: (1) the perception measure; (2) adding gender, education, illness burden and recent chronic flare-ups, acute illnesses and injuries; and (3) adding actual age. Table 2 shows HRs for each level of health perception compared to the reference level of best health on that measure. For all four measures, the lowest perceived health level doubled or even tripled the risk for mortality, before and after adjusting for covariates. Models with and without controlling for age were generally similar. Among the covariates in the final models, only age, gender, and recent injuries significantly added to the prediction of mortality.

Table 3 shows results of similar, three-block models for age perception measures. For Age-group and Age die – age (nearness-to-death), the level indicating oldest age more than doubled the risk for mortality, while the other two measures, Comp-age and Age – felt age, were unrelated to mortality. After controlling for the covariates listed above, without age, the risk associated with Age-group and with Age die – age remained similar and significant. Once age was entered into the model, these two measures were no longer associated

with mortality. Among the covariates in the final models, age, gender, illness burden, and recent injuries significantly predicted mortality in all four models.

Finally, we tested the combined contributions of health and age perceptions by running models which included a health perception and an age perception in the same model. Each model included either Gen-SRH, Comp-SRH or Poor-SRH, and either Age-group or Age die – age. Altogether six different models were tested with variables for each entered in three steps as before. Findings were similar across the six models: When a health perception and age perception were entered together with no covariates, each independently predicted mortality. Controlling for covariates (without age) did not substantially change HRs, at least for the lowest level of health perception/oldest age perception. When age was added to the models, only health perception remained significant.

We conducted sensitivity analyses to control for reverse causation (Rippon and Steptoe 2018), repeating all the hazards models and excluding deaths within the first 12 months, and again within the first 24 months. Although the HRs were somewhat lower, the overall pattern of results had not changed. For example, the crude HR for Gen-SRH decreased from 3.12 to 2.83, then (unexpectedly) increased to 3.06 (excluding deaths within 12 months, then 24 months, respectively). For Age-group, HRs for the respective models decreased from 2.71 to 2.39, then 2.18 ($p < .001$). Thus, the associations between perceptions of age and of health and

Table 2 Hazard ratios (95% confidence intervals) for mortality associated with perceptions of health over a 10-year follow-up

Measure	<i>n</i>	Crude	Adjusted ^a	Adjusted + age ^b
Gen-SRH***				
Poor/fair	111	3.12*** (2.21-4.41)	3.14*** (2.13-4.63)	2.45*** (1.66-3.62)
Good	327	1.58** (1.18-2.12)	1.50** (1.11-2.03)	1.29 (.95-1.75)
Very good/exc.	412	1.00 (reference)	1.00 (reference)	1.00 (reference)
Comp-SRH***				
Poor/fair	68	2.48*** (1.67-3.68)	2.36*** (1.55-3.59)	2.68*** (1.77-4.06)
Good	253	1.44* (1.09-1.92)	1.39* (1.04-1.86)	1.38* (1.03-1.86)
Very good/exc.	521	1.00 (reference)	1.00 (reference)	1.00 (reference)
Exc-SRH**				
Disagree	180	1.94*** (1.44-2.60)	1.87*** (1.36-2.58)	1.82*** (1.31-2.52)
Neither agree nor disagree	157	1.12 (.79-1.60)	1.17 (.82-1.68)	.99 (.69-1.42)
Agree	512	1.00 (reference)	1.00 (reference)	1.00 (reference)
Poor-SRH***				
Agree	35	3.05*** (1.92-4.83)	2.70*** (1.64-4.45)	2.93*** (1.79-4.79)
Neither agree nor disagree	48	1.49 (.91-2.45)	1.56 (.94-2.61)	1.31 (.79-2.19)
Disagree	764	1.00 (reference)	1.00 (reference)	1.00 (reference)

Significant hazard ratios are marked in bold

* $p < .05$; ** $p < .01$; *** $p < .001$

^aAdjusted for baseline sex, education, illness burden, recent chronic flare-ups/acute illnesses/injuries

^bAdjusted for age, in addition to the covariates listed above

Table 3 Hazard ratios (95% confidence intervals) for mortality associated with perceptions of age over a 10-year follow-up

Measure	<i>n</i>	Crude	Adjusted ^a	Adjusted + age ^b
Age-group				
Old or very old	46	2.71*** (1.67–4.42)	2.49*** (1.51–4.09)	1.23 (.73–2.05)
Late middle age or nearly old	459	1.54** (1.15–2.07)	1.41* (1.05–1.89)	1.00 (.74–1.35)
Teenage, young adult, or early middle age	332	1.00 (reference)	1.00 (reference)	1.00 (reference)
Comp-age				
Older	13	1.16 (.42–3.19)	.91 (.32–2.61)	1.12 (.40–3.13)
About the same	229	.85 (.58–1.23)	.98 (.67–1.43)	1.07 (.73–1.57)
Younger	417	.86 (.62–1.20)	.89 (.64–1.24)	.92 (.66–1.27)
Much younger	178	1.00 (reference)	1.00 (reference)	1.00 (reference)
Age – felt age				
Continuous	805	1.00 (.98–1.01)	.99 (.98–1.01)	1.01 (.99–1.02)
Age die – age (nearness-to-death)				
Refused to estimate age die	265	2.25*** (1.61–3.14)	2.12*** (1.51–2.97)	1.17 (.81–1.69)
Age die within 10 years	260	2.16*** (1.54–3.03)	1.89*** (1.31–2.65)	1.01 (.70–1.46)
Age die more than 10 years	325	1.00 (reference)	1.00 (reference)	

Significant hazard ratios are marked in bold

* $p < .05$; ** $p < .01$; *** $p < .001$

^aAdjusted for baseline sex, education, illness burden, recent chronic flare-ups/acute illnesses/injuries

^bAdjusted for age, in addition to the covariates listed above

mortality reflect more than very poor perceptions of individuals who were close to death.

Table 4 shows the model for the combination of Gen-SRH and Age-group. When both were entered together

(Model 1), the HR for Age-group remained significant yet decreased from 2.71 (95% CI 1.67–4.42; see Table 3) to 2.14 (95% CI 1.30–3.53). Although this decline is in the direction of the hypothesized mediation effect, it was not

Table 4 Hazard ratios (95% confidence intervals) for mortality associated with general self-rated health and Age-group identity

Measure	Model 1	Model 2 ^a	Model 3 ^b
Gen-SRH			
Poor/fair	2.89*** (2.02–4.12)	2.94*** (1.97–4.36)	2.52*** (1.70–3.76)
Good	1.50** (1.11–2.03)	1.42* (1.04–1.94)	1.29 (.95–1.77)
Very good/excellent	1.00 (reference)	1.00 (reference)	1.00 (reference)
Age-group			
Old or very old	2.14** (1.30–3.53)	2.00** (1.21–3.32)	1.06 (.63–1.78)
Late middle age or nearly old	1.36* (1.02–1.83)	1.29 (.96–1.73)	.93 (.69–1.26)
Teenage, young adult, or early middle age	1.00 (reference)	1.00 (reference)	1.00 (reference)
Gender (male)		.48*** (.36–.63)	.53*** (.41–.70)
Education		.94 (.86–1.02)	.95 (.87–1.02)
Illness burden		1.00 (1.00–1.00)	1.00 (1.00–1.00)
Recent chronic flare-ups		.96 (.88–1.05)	.97 (.92–1.02)
Recent acute illnesses		.97 (.91–1.02)	.98 (.90–1.07)
Recent injuries		1.16* (1.01–1.34)	1.21** (1.05–1.39)
Age (in years)			1.09*** (1.07–1.12)

Significant hazard ratios are marked in bold

* $p < .05$; ** $p < .01$; *** $p < .001$

^aAdjusted for baseline sex, education, illness burden, recent chronic flare-ups/acute illnesses/injuries

^bAdjusted for age, in addition to the covariates listed above

statistically significant (ratio = 1.27, 95% CI 0.63–2.54, $p = .51$). In the other five combinations, respective declines were lower and there was no evidence of a mediation effect.

Figure 1a, b shows the survival plots associated with the second block of the analysis from Table 4; that is, for each perception while controlling for the other and for all covariates except age. The plots for the final model, with age, are not shown because for Gen-SRH they are similar and for Age-group the mortality risk disappeared. Similar findings emerged for other combinations of health and age perceptions: Entering a health perception and an age perception into the same model yielded significant independent associations of both perceptions with mortality, with all covariates except for age; when age was added, only the health perception remained significant.

Discussion

Our study replicates and extends previous findings on the associations of age and health perceptions with mortality. Poor health perceptions doubled, and in some cases almost tripled the risk for mortality, compared to the reference category of best health; adjusting for demographic and health covariates did not substantially change these risks. In contrast, only Age-group and nearness-to-death roughly doubled the risk for mortality, even after controlling for the

covariates. These effects disappeared after controlling for age. Interestingly, participants who refused to estimate survival age had mortality risks similar to those estimating their own mortality within the next 10 years.

The similarity in findings (before adjusting for age) is not surprising. When individuals were asked to directly rate the bases for their perceptions of health (Benyamini et al. 2003) or of nearness-to-death (Palgi et al. 2018), factors such as energy and general level of physical activity were highly rated. In general, the literature shows that both types of perceptions are based on social and biological cues: Social comparisons and anchors in one's surroundings affect both age (Montepare 2009) and health perceptions (Spini et al. 2007). The similar sources can explain the intercorrelations among health and age perceptions in our study.

When entered together, the HRs for mortality diminished, particularly for subjective age. Though this trend was in the direction of our hypothesis (i.e., health perceptions would mediate effects of age perception on mortality), the mediation effect was not significant. This is in contrast with the theoretical framework proposed by Westerhof and Wurm (2015) on the basis of previous research suggesting that health perceptions serve as mediators of the effects of subjective age on mortality (Westerhof and Wurm 2015). It also contrasts with reports of associations between age perceptions and future health that were significant even after controlling for age (e.g., Stephan et al. 2018). The difference in these findings may be sample size dependent: Controlling only for demographics including age, the HRs for

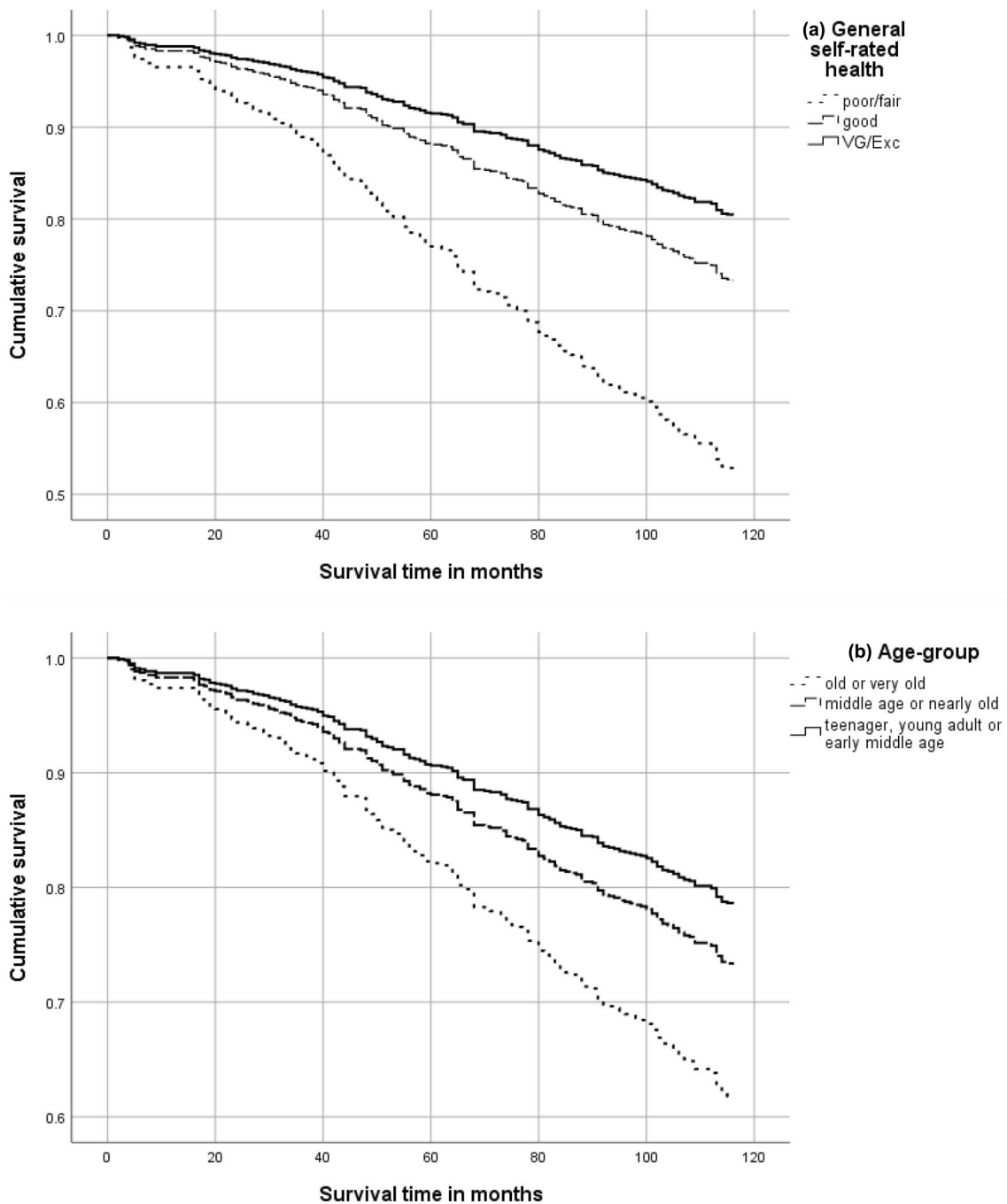


Fig. 1 Survival plots for **a** general self-rated health and **b** Age-group identity, controlling for one another and for covariates (baseline sex, education, illness burden, recent chronic flare-ups/acute illnesses/injuries)

mortality for Age-group (1.27) and for nearness-to-death (1.22) became nonsignificant, yet they were of the same size as the overall effect for subjective age on mortality found in a meta-analysis of eight studies, reporting significant but small effects of subjective aging on survival (1.25; Westerhof et al. 2014).

The lack of support for the mediation hypothesis raises questions regarding the interplay between the two

perceptions: Is feeling older part of the conception of how healthy you are? Or does feeling healthy contribute to feeling younger? Data at multiple points in time are needed to investigate these questions. At the daily level, a diary study found simultaneous (but not time-ordered) associations (Kotter-Grühn et al. 2015). Data collected over several years suggest that both directions may be at play over the years (Rippon and Steptoe 2018; Spuling et al. 2013).

No less important is the finding that both perceptions, health and age, significantly predicted mortality even when entered together. This has been previously reported (e.g., Sargent-Cox et al. 2013), yet because the focus of such studies was on age perceptions, an important conclusion was not highlighted: the implication that age and health perceptions each contain *unique* information related to survival. In other words, even within a group of people with older age identity, mortality risk is higher among those with poorer health perception. This is not surprising, as one would expect a strong association between perceived health and mortality. However, the finding could also be viewed in the other direction: Among those rating their health as poor, differences in mortality risk may be due to differences in their age perception.

This explanation alludes to the limits of the validity of health perceptions: Individuals with poor self-rated health who survived the next few years or even improved did not differ in the number of health conditions from those who died; they differed in other factors, such as helping their children and grandchildren and leaving the house more frequently (Benyamini et al. 2011) and caring for grandchildren was related to older women's younger subjective age (Bordone and Arpino 2016). Such factors may lead to a younger age identity *despite* health problems, in turn preserving health through behavioral and psychological pathways, as predicted by theories of age perceptions.

The choice of perception measure—age or health—depends on the outcomes sought. While it is expected that subjective health measures will be stronger predictors of mortality as these relations may be more direct, subjective age measures might be better predictors of psychological well-being. Future research may compare these perceptions in relation to well-being outcomes.

Associations of age perceptions with longevity differed among measures, supporting calls for better conceptualization and consistent definitions of this construct (e.g., Kotter-Grühn et al. 2016). Particularly, distinctions between subjective age and subjective nearness-to-death may be important. Previous research called for distinguishing between age-related processes and death-related ones because they may differ in their effect on they people view their world and react to it (Palgi et al. 2014).

It is interesting to note the role of symptomatic health episodes in the 3 months preceding the baseline interview: Only incidences or flare-ups of chronic conditions, not acute illnesses or injuries, were concurrently associated with health (not age) perceptions. Older adults have a long history of interpreting and managing somatic sensations and health events, leading them to discount events perceived as minor and time-limited. The findings uncover the limits to the accuracy of their health expertise, as it was the recent injuries, not the chronic flare-ups, which were associated with a greater mortality risk in the long term. Though people

seem to discount their importance, injuries may create new or ambiguous symptoms that are not easily assessed or self-managed, yet are indicators of failing health and/or initiate a vicious cycle that ultimately leads to functional losses and death.

The bases for the validity of health and age perceptions

The similar effects of health and age perceptions may be related to the bases for their predictive validity. Explanations for the predictive associations of health and age perceptions with future health outcomes broadly fall into two categories, accuracy and causal effects (Idler and Benyamini 1997; Westerhof and Wurm 2015). The health perception literature mainly tested and confirmed the accuracy explanation, assuming that health perceptions reflect unmeasured yet valid aspects (Idler and Benyamini 1997). Subjective perceptions take into account internal sensations and vague symptoms that could mark declines and affect one's rating of health and of age. This argument is supported by studies showing that subjective health perceptions (Leshem-Rubinow et al. 2015) and subjective age perceptions (Levy and Bavishi 2018; Stephan et al. 2015, 2019b) are related to biomarkers.

The age perception literature tends to place more emphasis on the causal explanation (Wurm et al. 2017), though it has also been used in relation to health perceptions (Idler and Benyamini 1997). This explanation argues that such perceptions are self-fulfilling prophecies, encouraging a more physically, psychologically, and socially active life, resulting in accumulation of psychological and physical resources that in turn contribute to better health and well-being (Wurm et al. 2013). In contrast, negative perceptions lead to a vicious cycle that consumes resources and accelerates disease and disability processes. These trajectories may also reflect common genetic sources, as both types of perceptions have been related to polygenic scores for factors such as education, body mass index, and depressive symptoms (Harris et al. 2016; Stephan et al. 2019a). Such causal explanations are more difficult to test even in longitudinal survey studies.

This points to the question of which perceptions should be focused upon when aiming to improve older adults' well-being. Perceptions of age can be manipulated, resulting in improved physical and cognitive performance (Levy 2003), and positive self-perceptions of aging can be promoted, leading to better mental health (Beyer et al. 2019). In contrast, it may be difficult and potentially risky to attempt to manipulate subjective perceptions of health, e.g., a patient perceives their health as poor, while their physician thinks differently. If the physician succeeds in convincing the person that they are healthier than they think, they might stop taking essential

medication (e.g., for hypertension), leading to adverse outcomes. Therefore, interventions related to health perceptions may be most beneficial if indirect. For example, changes in health behaviors, activity, and social engagement could be beneficial for improving both health perceptions and future health. Such changes may be initiated through changes in age perceptions, which are likely to be a more promising route for improving physical functioning and activity (Brothers and Diehl 2017; Stephan et al. 2013; Wolff et al. 2014).

Our study has several limitations. First, the sample size is not large in comparison to more extensive epidemiological surveys (e.g., Stephan et al. 2018). Second, it is not a representative sample; participants were recruited in a single private retirement community and were financially relatively well-off. The advantage is that retention rates and the ability to obtain mortality information were good for an aged sample. In addition, participants' motivation allowed us to conduct extensive interviews, which provided a unique opportunity to study a variety of health and age perception measures in the same sample. Third, we used only single items, which did not allow for tests of multi-dimensional perceptions. However, despite the psychometric disadvantages of single items, they may be valid because they provide a more accurate integration of internal and external information on health and aging.

The relationship between subjective health and age is complex (Spuling et al. 2013) and deserves further study. Research on interventions that monitor both types of perceptions could provide more information on their inter-relationships across time. In the end, our perceptions of both age and health become integrated into our self-identity and their interplay may teach us how older adults maintain positive views of themselves, or fail to do so in face of the losses of old age.

Acknowledgements This research was supported by Grant AG03501 from the National Institute on Aging to Howard Leventhal and Elaine Leventhal. We thank Howard Leventhal for his thoughtful comments.

References

- Baron-Epel O, Shemy G, Carmel S (2004) Prediction of survival: a comparison between two subjective health measures in an elderly population. *Soc Sci Med* 58:2035–2043. [https://doi.org/10.1016/S0277-9536\(03\)00412-X](https://doi.org/10.1016/S0277-9536(03)00412-X)
- Barrett AE, Montepare JM (2015) “It’s about time”: applying life span and life course perspectives to the study of subjective age. *Ann Rev Gerontol Geriatr* 35:55–77. <https://doi.org/10.1891/0198-8794.35.55>
- Benyamini Y (2011) Editorial: why does self-rated health predict mortality? An update on current knowledge and a research agenda for psychologists. *Psychol Health* 26:1407–1413. <https://doi.org/10.1080/08870446.2011.621703>
- Benyamini Y, Leventhal EA, Leventhal H (1999) Self-assessments of health: what do people know that predicts their mortality? *Res Aging* 21:477–500. <https://doi.org/10.1177/0164027599213007>
- Benyamini Y, Leventhal EA, Leventhal H (2003) Elderly people’s ratings of the importance of health-related factors to their self-assessments of health. *Soc Sci Med* 56:1661–1667. [https://doi.org/10.1016/s0277-9536\(02\)00175-2](https://doi.org/10.1016/s0277-9536(02)00175-2)
- 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? *Psychol Health* 26:1446–1462. <https://doi.org/10.1080/08870446.2011.559231>
- Beyer A-K, Wolff JK, Freiburger E, Wurm S (2019) Are self-perceptions of ageing modifiable? Examination of an exercise programme with vs. without a self-perceptions of ageing-intervention for older adults. *Psychol Health* 34:661–676. <https://doi.org/10.1080/08870446.2018.1556273>
- Bordone V, Arpino B (2016) Do grandchildren influence how old you feel? *J Aging Health* 28:1055–1072. <https://doi.org/10.1177/0898264315618920>
- Brothers A, Diehl M (2017) Feasibility and efficacy of the Aging-Plus program: changing views on aging to increase physical activity. *J Aging Phys Act* 25:402–411. <https://doi.org/10.1123/japa.2016-0039>
- Chipperfield JG (1993) Incongruence between health perceptions and health problems: implications for survival among seniors. *J Aging Health* 5:475–496. <https://doi.org/10.1177/089826439300500404>
- Diehl M, Wahl H-W, Brothers A, Miche M (2015) Subjective aging and awareness of aging: toward a new understanding of the aging self. *Ann Rev Gerontol Geriatr* 35:1–28. <https://doi.org/10.1891/0198-8794.35.1>
- Friedsam HJ, Martin HW (1963) A comparison of self and physician’s health ratings in an older population. *J Health Hum Behav* 4:179–183. <https://doi.org/10.2307/2948660>
- Harris SE et al (2016) Molecular genetic contributions to self-rated health. *Int J Epidemiol* 46:994–1009. <https://doi.org/10.1093/ije/dyw219>
- Idler EL, Benyamini Y (1997) Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav* 38:21–37. <https://doi.org/10.2307/2955359>
- Idler EL, Kasl SV (1995) Self-ratings of health: do they also predict change in functional ability? *J Gerontol B* 50:S344–S353
- Jylhä M (2009) What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Soc Sci Med* 69:307–316. <https://doi.org/10.1016/j.socscimed.2009.05.013>
- Kastenbaum R, Derbin V, Sabatini P, Artt S (1972) “The Ages of Me”: toward personal and interpersonal definitions of functional aging. *Aging Human Dev* 3:197–211. <https://doi.org/10.2190/tujr-wtxk-866q-8qu7>
- Klusmann V, Notthof N, Beyer A-K, Blawert A, Gabrian M (2019) The psychological assessment of views on ageing: a review of methods and innovative extensions. *Eur J Ageing (this issue)*
- Kornadt AE, Kessler E-M, Wurm S, Bowen CE, Gabrian M, Klusmann V (2019) Views on aging: a life span perspective. *Eur J Ageing (this issue)*. <https://doi.org/10.1007/s10433-019-00535-9>
- Kotter-Grühn D, Neupert SD, Stephan Y (2015) Feeling old today? Daily health, stressors, and affect explain day-to-day variability in subjective age. *Psychol Health* 30:1470–1485. <https://doi.org/10.1080/08870446.2015.1061130>
- Kotter-Grühn D, Kornadt AE, Stephan Y (2016) Looking beyond chronological age: current knowledge and future directions in the study of subjective age. *Gerontology* 62:86–93. <https://doi.org/10.1159/000438671>
- Leshem-Rubinow E et al (2015) Self-rated health is associated with elevated C-Reactive Protein even among apparently healthy individuals. *Isr Med Assoc J* 17:213–218

- Levy BR (2003) Mind matters: cognitive and physical effects of aging self-stereotypes. *J Gerontol B* 58:P203–P211. <https://doi.org/10.1093/geronb/58.4.P203>
- Levy BR (2009) Stereotype embodiment: a psychosocial approach to aging. *Curr Dir Psychol Sci* 18:332–336. <https://doi.org/10.1111/j.1467-8721.2009.01662.x>
- Levy BR, Bavishi A (2018) Survival advantage mechanism: inflammation as a mediator of positive self-perceptions of aging on longevity. *J Gerontol B* 73:409–412. <https://doi.org/10.1093/geronb/gbw035>
- Levy BR, Slade MD, Kunkel SR, Kasl SV (2002) Longevity increased by positive self-perceptions of aging. *J Pers Soc Psychol* 83:261–270. <https://doi.org/10.1037/0022-3514.83.2.261>
- Montepare JM (2009) Subjective age: toward a guiding lifespan framework. *Int J Behav Dev* 33:42–46. <https://doi.org/10.1177/0165025408095551>
- Palgi Y (2016) Subjective age and perceived distance-to-death moderate the association between posttraumatic stress symptoms and posttraumatic growth among older adults. *Aging Ment Health* 20:948–954. <https://doi.org/10.1080/13607863.2015.1047320>
- Palgi Y, Shrira A, Ben-Ezra M, Spalter T, Kavé G, Shmotkin D (2014) Age-related and death-related differences in emotional complexity. *Psychol Aging* 29:284–296. <https://doi.org/10.1037/a0036302>
- Palgi Y, Shrira A, Rubinstein T, Kavé G, Shmotkin D (2018) Which factors do older adults consider when estimating the time left for them to live? *J Gerontol B* 74:69–73. <https://doi.org/10.1093/geronb/gby048>
- Rippon I, Steptoe A (2018) Is the relationship between subjective age, depressive symptoms and activities of daily living bidirectional? *Soc Sci Med* 214:41–48. <https://doi.org/10.1016/j.socscimed.2018.08.013>
- Rubin DC, Berntsen D (2006) People over forty feel 20% younger than their age: subjective age across the lifespan. *Psychon Bull Rev* 13:776–780. <https://doi.org/10.3758/bf03193996>
- Sargent-Cox KA, Anstey KJ, Luszcz MA (2013) Longitudinal change of self-perceptions of aging and mortality. *J Gerontol B* 69:168–173. <https://doi.org/10.1093/geronb/gbt005>
- Spini D, Clémence A, Ghisletta P (2007) How are temporal and social comparisons related to appraisals of self-rated health during very old age? *Swiss J Psychol* 66:79–89. <https://doi.org/10.1024/1421-0185.66.2.79>
- Spuling SM, Miche M, Wurm S, Wahl H-W (2013) Exploring the causal interplay of subjective age and health dimensions in the second half of life. *Z Gesundheitspsychol* 21:5–15. <https://doi.org/10.1026/0943-8149/a000084>
- Stephan Y, Chalabaev A, Kotter-Grühn D, Jaconelli A (2013) “Feeling Younger, Being Stronger”: an experimental study of subjective age and physical functioning among older adults. *J Gerontol B* 68:1–7. <https://doi.org/10.1093/geronb/gbs037>
- Stephan Y, Sutin AR, Terracciano A (2015) Younger subjective age is associated with lower C-reactive protein among older adults. *Brain Behav Immun* 43:33–36. <https://doi.org/10.1016/j.bbi.2014.07.019>
- Stephan Y, Sutin AR, Terracciano A (2018) Subjective age and mortality in three longitudinal samples. *Psychosom Med* 80:659–664. <https://doi.org/10.1097/psy.0000000000000613>
- Stephan Y, Sutin AR, Kornadt A, Terracciano A (2019a) Polygenic scores for education, health, and personality as predictors of subjective age among older individuals of European ancestry: evidence from the Health and Retirement Study. *Psychol Aging* 34:139–144. <https://doi.org/10.1037/pag0000283>
- Stephan Y, Sutin AR, Terracciano A (2019b) Subjective age and Cystatin C among older adults. *J Gerontol B* 74:382–388. <https://doi.org/10.1093/geronb/gbx124>
- Stewart TL, Chipperfield JG, Perry RP, Weiner B (2012) Attributing illness to ‘old age’: consequences of a self-directed stereotype for health and mortality. *Psychol Health* 27:881–897. <https://doi.org/10.1080/08870446.2011.630735>
- Warmoth K, Tarrant M, Abraham C, Lang IA (2016) Older adults’ perceptions of ageing and their health and functioning: a systematic review of observational studies. *Psychol Health Med* 21:531–550. <https://doi.org/10.1080/13548506.2015.1096946>
- Westerhof GJ, Wurm S (2015) Longitudinal research on subjective aging, health, and longevity: current evidence and new directions for research. *Ann Rev Gerontol Geriat* 35:145–165. <https://doi.org/10.1891/0198-8794.35.145>
- Westerhof GJ et al (2014) The influence of subjective aging on health and longevity: a meta-analysis of longitudinal data. *Psychol Aging* 29:793–802. <https://doi.org/10.1037/a0038016>
- Wolff JK, Warner LM, Ziegelmann JP, Wurm S (2014) What do targeting positive views on ageing add to a physical activity intervention in older adults? Results from a randomised controlled trial. *Psychol Health* 29:915–932. <https://doi.org/10.1080/08870446.2014.896464>
- Wurm S, Tesch-Römer C, Tomasik MJ (2007) Longitudinal findings on aging-related cognitions, control beliefs, and health in later life. *J Gerontol B* 62:P156–P164. <https://doi.org/10.1093/geronb/62.3.P156>
- Wurm S, Warner LM, Ziegelmann JP, Wolff JK, Schüz B (2013) How do negative self-perceptions of aging become a self-fulfilling prophecy? *Psychol Aging* 28:1088–1097. <https://doi.org/10.1037/a0032845>
- Wurm S, Diehl M, Kornadt AE, Westerhof GJ, Wahl H-W (2017) How do views on aging affect health outcomes in adulthood and late life? Explanations for an established connection. *Dev Rev* 46:27–43. <https://doi.org/10.1016/j.dr.2017.08.002>

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.