

The Influence of Subjective Aging on Health and Longevity: A Meta-Analysis of Longitudinal Data

Gerben J. Westerhof
University of Twente

Martina Miche
Heidelberg University

Allyson F. Brothers
Colorado State University

Anne E. Barrett
Florida State University

Manfred Diehl
Colorado State University

Joann M. Montepare
Lasell College

Hans-Werner Wahl
Heidelberg University

Susanne Wurm
University of Erlangen-Nuremberg

Evidence is accumulating on the effects of subjective aging—that is, how individuals perceive their own aging process—on health and survival in later life. The goal of this article is to synthesize findings of existing longitudinal studies through a meta-analysis. A systematic search in PsycInfo, Web of Science, Scopus, and Pubmed resulted in 19 longitudinal studies reporting effects of subjective aging on health, health behaviors, and longevity. The authors combine the outcomes reported in these studies using a random effects meta-analysis, assuming that there would be differences in effect sizes across studies. The meta-analysis resulted in an overall significant effect of subjective aging (likelihood ratio = 1.429; 95% confidence interval = 1.273–1.604; $p < .001$). The analyses revealed heterogeneity, with stronger effects for studies with a shorter period of follow-up, for studies of health versus survival, for studies with younger participants (average age of the studies varies between 57 and 85 years with a median of 63 years), and for studies in welfare systems where state provisions of welfare are minimal. However, effects did not vary either across different operationalizations of subjective aging or by study quality. Subjective aging has a small significant effect on health, health behaviors, and survival. Further theoretical conceptualizations and empirical studies are needed to determine how subjective aging contributes to health and survival.

Keywords: age identity, attitudes toward own aging, health, longevity, meta-analysis

Subjective aging refers to how individuals perceive their own aging process. It is seen as the result of an intricate process involving personal experiences, social interactions, intergroup stereotypes, cultural values, and societal structures (Diehl et al., 2014; Westerhof & Tulle, 2007). For a long time, gerontologists have argued that subjective aging, in turn, contributes to functioning in

later life (Havighurst & Albrecht, 1953; Kuypers & Bengtson, 1973; Peters, 1971). Earlier studies mainly had a cross-sectional design (Barak & Stern, 1986). Markides and Pappas (1982) were the first to find with longitudinal data that feeling younger than one's chronological age predicts greater longevity. Studies around the turn of the century (e.g., Maier & Smith, 1999; Levy, Slade,

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Gerben J. Westerhof, Department of Psychology, Health, and Technology University of Twente; Martina Miche, Department of Psychological Aging Research, Heidelberg University; Allyson F. Brothers, Department of Human Development & Family Studies, Colorado State University; Anne E. Barrett, Department of Sociology, Florida State University; Manfred Diehl, Department of Human Development & Family Studies, Colorado State University; Joann M. Montepare, RoseMary B. Fuss Center for Research on Aging and Intergenerational Studies, Lasell College; Hans-Werner Wahl, Department of Psychological Aging Research, Heidelberg University; Susanne Wurm, Institute of Psychogerontology, University of Erlangen-Nuremberg.

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Correspondence concerning this article should be addressed to Gerben J. Westerhof, University of Twente, Department of Psychology, Health, and Technology, PO Box 217, 7500AE Enschede, the Netherlands. E-mail: g.j.westerhof@utwente.nl

Kunkel, & Kasl, 2002) gave a strong impetus to the field and, over the past decade and a half, an increasing number of longitudinal studies have shown that subjective aging affects health and survival. The goal of this article is to synthesize the evidence from the latter type of longitudinal studies through a meta-analysis.

Our main research question is whether subjective aging predicts health and longevity over time. The basic idea is that a person's perceptions of his or her own aging process function as self-fulfilling prophecies influencing further development in later life (Kuypers & Bengtson, 1973; Levy, 2009; Wurm, Warner, Ziegelmüller, Wolff, & Schütz, 2013). Subjective aging may influence health through both cognitive and behavioral pathways. Maintaining a positive perception of one's own aging process is generally considered an adaptive cognitive strategy in later life because it maintains a consistent and positive self-concept in a culture generally devaluing old age (Westerhof & Barrett, 2005). It thereby contributes to well-being (Mock & Eibach, 2011; Wurm, Tomasik, & Tesch-Römer, 2008), which, in turn, has been found to be related to health and longevity over time (Chida & Steptoe, 2008; Lamers, Bolier, Westerhof, Smit, & Bohlmeijer, 2012). Subjective aging also may influence further development through behavioral pathways, such as coping efforts and health-related activities. Longitudinal studies have found some evidence that people with younger and more positive self-perceptions of aging are more inclined to engage in task-oriented as opposed to avoidance-oriented coping strategies (Boehmer, 2007) or preventive health behaviors (Levy & Myers, 2004). Both cognitive and behavioral processes may result in consistent individual differences in health (e.g., Boehmer, 2006; Levy, Slade, & Kasl, 2002; Moser, Spagnoli, & Santos-Eggimann, 2011; Wurm, Tesch-Römer, & Tomasik, 2007) and may in the long run even contribute to survival (e.g., Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009; Levy, Slade, Kunkel & Kasl, 2002; Maier & Smith, 1999; Markides & Pappas, 1982). Building on these theoretical considerations and empirical findings from longitudinal studies, our main hypothesis is that subjective aging has an overall effect on health and longevity over time.

Our second question addresses possible differences in effect sizes. We examine the following sources of variation: (a) differences in the operationalization of subjective aging, (b) differences in outcomes, (c) age differences, (d) cultural differences, and (e) differences in study quality.

We first examine whether different operationalizations of subjective aging have different effects on health and survival, focusing on the two that received most of the research attention (Diehl et al., 2014): age identity (also referred to in the literature as *subjective age*) and attitudes toward one's own aging (also referred to in the literature as *self-perceptions of aging*). *Age identity* refers to the inner experience of a person's age (Westerhof, 2008). It has most often been measured as the discrepancy between a person's felt and chronological age (e.g., Mock & Eibach, 2011). In contrast, attitudes toward one's own aging process refer to an overall evaluation of satisfaction with one's own aging (e.g., Levy, Slade, & Kasl, 2002)—most commonly measured with the Attitudes Toward Own Aging Scale of the Philadelphia Geriatric Center Morale Scale (Lawton, 1975). Building on the basic tenets of life span developmental theory about the multidimensional and multi-directional nature of aging (Baltes, 1987), some researchers also have studied attitudes toward own aging as a multifaceted phe-

nomenon. Steverink, Westerhof, Bode, and Dittmann-Kohli (2001), for example, developed the Personal Experiences of Aging Scale that has been used in longitudinal studies (e.g., Wurm et al., 2007). The only longitudinal study that incorporated both the age identity and the attitudes toward own aging approaches found similar results for both types of operationalizations (Kotter-Grühn et al., 2009). Seen from a theoretical perspective, the pathways through which these constructs exert their effects might differ at first glance. Age identity may mainly contribute to the cognitive pathway, as it has been argued that feeling youthful is a way to maintain self-esteem and well-being over time (Weiss & Lang, 2012; Westerhof & Barrett, 2005). More positive attitudes toward own aging may contribute to health in later life through both cognitive and behavioral pathways. A positive attitude toward aging may be not only a cognitive resource for well-being in later life (Wurm et al., 2008) but also an antecedent of coping and health behaviors that contribute to further development (Levy & Myers, 2004; Wurm, Tomasik, & Tesch-Römer, 2010; Wurm et al., 2013). However, narrowing down the effect of feeling younger to a cognitive pathway only may be a too simplistic view that ignores that such evaluations are typically also linked with behaviors, such as being physically or cognitively more engaged. Therefore, following Kotter-Grühn et al.'s (2009) findings as well as conceptual reasoning, we assume a similar effect size for age identity and attitudes toward own aging.

A second potential source of variation we examine is the target outcome. Subjective aging may have stronger effects on health, as it is a more direct result of the proposed cognitive and behavioral pathways. In contrast, the effects may be weaker for survival, as it is a more indirect result of these pathways. Furthermore, studies have differed widely in time of follow-up: Whereas Cheng, Yip, Jim, & Hui (2012) used a follow-up period of 3 months, Levy, Slade, Kunkel, & Kasl (2002) used data spanning 23 years. The effect of subjective aging on health and longevity may be weaker in studies of longer duration, as time and aging allow other factors to intrude on the processes involved, such as health-related attrition. Thus, we hypothesize that the effects of subjective aging are stronger for health than for survival and for shorter versus longer periods of follow-up.

We also consider the moderating effects of chronological age on the relation of subjective aging with health and survival. Longitudinal studies have tended to focus on one period of life—namely later life (e.g., Maier & Smith, 1999; average age 85 years) or the second half of life (e.g., Wurm et al., 2007; average age 57 years)—with few studies addressing whether subjective aging has similar effects across the adult life span. Findings from the German Aging Survey show that the effects do not differ between middle-aged and older adults (Spuling, Miche, Wurm, & Wahl, 2013). However, subjective aging may have a stronger effect on health in midlife or early in old age when many aging-related changes have yet to happen, compared to later old age when they have already been encountered.

No longitudinal studies have examined cross-national differences, even though findings from cross-sectional studies suggest that subjective aging needs to be conceptualized within the context of a national culture (Levy & Langer, 1994; Uotinen, 1998; Westerhof & Barrett, 2005). For example, Americans tend to feel younger than Germans, and the association between youthful identities and individual functioning is stronger in the United States

than in Germany (Westerhof, Barrett, & Steverink, 2003; Westerhof & Barrett, 2005). These patterns may stem from different welfare state regimes (Esping-Andersen, 1990; Bambra, 2007). The United States has a welfare regime where state provisions are minimal and there is a strong individual responsibility for security in later life. Germany has a welfare state that generates more state provisions, so that older individuals may have fewer worries about economic security and health. This type of welfare state also ties provisions to chronological age (e.g., obligatory retirement at age 65), perhaps making it more difficult to feel younger than one's chronological age. We predict that subjective aging has a stronger effect in welfare regimes providing less state support.

Variation in effect sizes also may stem from differences in study quality. Studies of lower quality may overestimate relationships because they lack reliability, external validity, or controls for confounding variables (Wong, Cheung, & Hart, 2008). Lower quality may be indicated, for example, by less reliable measures, convenience rather than probability samples, low response rates, or lack of control variables. We hypothesize that studies of lower quality find stronger effects of subjective aging.

To conclude, our main hypothesis is that subjective aging contributes to health and survival over time: More positive aging attitudes and more youthful identities predict better health and greater longevity. We hypothesize (a) similar effects for measures of attitudes about own aging and measures of age identity; (b) stronger effects for measures of health compared with survival; (c) stronger effects for shorter than longer periods of follow-up; (d) stronger effects for younger than older adults in their second half of life; (e) stronger effects for countries with less rather than more state support in welfare regimes; and (f) stronger effects for studies with lower rather than higher quality.

Methods

Search Strategy and Selection of Studies

A systematic search was performed in four electronic databases, PsycInfo, Web of Science, Scopus, and Pubmed, up to June 16, 2013. The main search strategy was based on two key components: subjective aging and longitudinal studies. The databases were searched for articles with both components in either the title, abstract, or keywords. Terms referring to subjective aging included the following: subjective age, subjective aging, felt age, perceived age, age identity, aging satisfaction, self-perceptions of aging, view on aging, and aging-related cognitions. Terms referring to longitudinal studies included the following: longitudinal, panel, or prospective. We searched for studies in peer-reviewed journals, applying no limitations on publication year or language. Furthermore, we cross-checked the reference lists of the included articles for additional eligible studies.

The first three authors (Gerben J. Westerhof, Martina Miche, and Allyson Brothers) independently rated potentially eligible studies in two phases. Selection was based on title and abstract in the first phase and on the full-text paper in the second phase. If one of the three reviewers evaluated a study as potentially eligible in the first phase, it was further evaluated in the second phase. In the second phase, disagreements between the reviewers were resolved by consensus.

Studies were included if they reported the effects of subjective aging on health or survival. Studies focusing on health behaviors were also included. Studies were excluded when any of the following conditions were met: (a) The study did not address subjective aging (e.g., perceived age by others, stereotypes about older persons); (b) the study did not address health or survival (e.g., well-being, cognitive aging dispositions); (c) the study design was not longitudinal (e.g., experimental study, cross-sectional study); or (d) subjective aging was not treated as an independent variable (e.g., studies addressing change in subjective aging).

The flow diagram of the study selection is shown in Figure 1. Searching databases resulted in 77 unique records, and cross-checking the reference lists of included studies resulted in 55 additional articles. Of these 132 articles, 76 were excluded in the first phase, based on title and abstract (see Figure 1 for rationales). Of the remaining 56 articles, 37 were excluded in the second phase, based on full-texts (see Figure 1 for rationales). This process resulted in a total of 19 articles included in the meta-analysis; 16 of these were identified through the electronic search and three through the reference lists of these included articles.

Table 1 provides an overview of the 19 studies included. The median year of publication was 2008 (range 1982–2013). The median sample size was 620, varying from 83 to 3038. The median of the average age was 63 years (57–85 years). Seven studies assessed age identity, all using single items. Thirteen studies focused on attitudes toward own aging, with nine using the subscale of the Philadelphia Geriatric Center Morale Scale (Lawton, 1975), three using the Personal Experiences of Aging Scale (Steverink et al., 2001), and one using the Images of Aging Scale as adapted to self-ratings (Levy, Kasl, & Gill, 2004). Studies were conducted in the United States, Europe, Australia, and Hong Kong. Seven studies reported on survival, and 12 studies examined one or more measures of health. These measures included health behaviors, physical exercise, self-rated health, perceived disability, recovery satisfaction, health-related quality of life, physical illnesses, medical events, functional health, falls, or hospitalizations. The median follow-up time was 6 years, varying between 3 months and 23 years.

Study quality was assessed with a protocol based on the quality checklists used by Wong et al. (2008) and by Lamers et al. (2012). Using the criteria that fit our study aims yielded a list with six quality criteria coded as 0 (*not applicable*) or 1 (*applicable*): probability sampling ($n = 8$); response rate 60% or above ($n = 4$); retention rate of 60% or above ($n = 10$); multi-item scale with Cronbach's alpha .70 or higher ($n = 13$); control for any confounding variables, such as gender, chronological age, education, and loneliness ($n = 17$); and control for baseline values of outcome variables ($n = 7$; not coded for studies on survival). The information to rate study quality was extracted by the second (Martina Miche) and third author (Allyson Brothers) and double-checked by the first author (Gerben J. Westerhof). The overall quality of the study was assessed by counting the number of applicable items and dividing them by six (for studies on health) or five (for studies on survival), resulting in a quality score between 0 and 1. The quality of the studies ranged from .17 to .83. Following Wong et al. (2008) we classified the studies in three groups: score $\leq .33$ ($n = 5$), score between .34 and .66 ($n = 5$), and score of .67 or higher ($n = 9$).

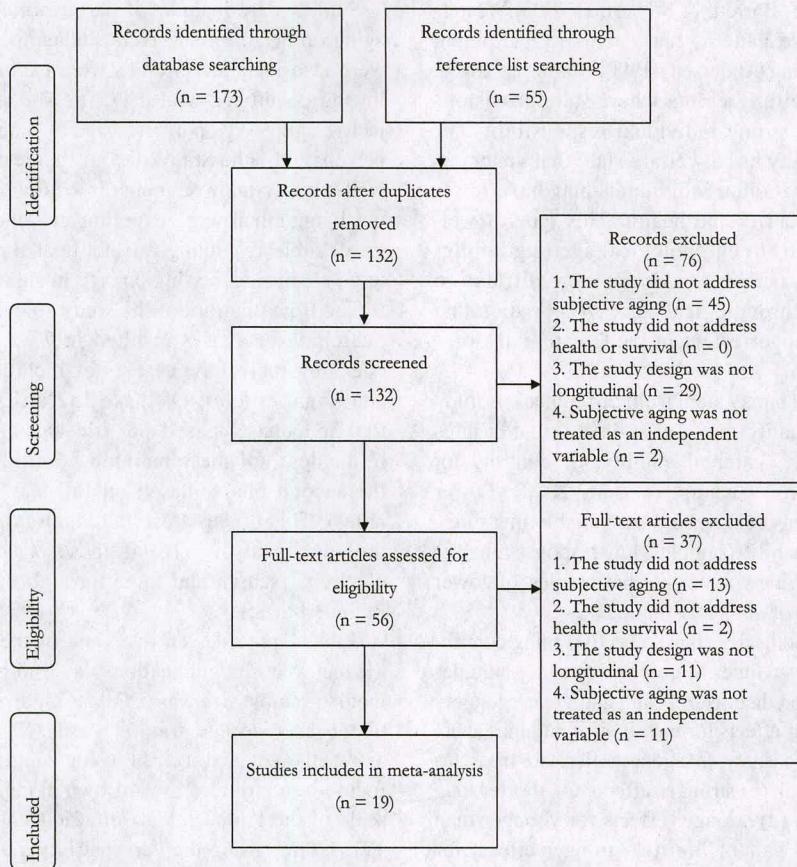


Figure 1. Flowchart.

Meta-Analysis

We used the software Comprehensive Meta-Analysis (CMA; Borenstein, Hedges, Higgins, & Rothstein, n.d.) to meta-analytically combine study outcomes. The articles reported hazard ratios ($n = 2$), risk ratios ($n = 4$), odds ratios ($n = 2$), likelihood ratios ($n = 1$), regression coefficients ($n = 7$), correlations ($n = 2$), or means ($n = 1$). Papers often presented bivariate relations of subjective aging to health and longevity, as well as more advanced analyses controlling for potential confounders (e.g., demographic, health-related, psychosocial functioning, and baseline health variables). We used the results of these more advanced analyses for the meta-analysis. When studies presented findings of unidirectional models (i.e., the effect of subjective aging on health), as well as bidirectional models (i.e., including the effects of both subjective aging on health and health on subjective aging), we used the results of the unidirectional models. When studies presented findings on the baseline measure of subjective aging as well as the change in subjective aging over time, we only included the results for the baseline measure. When articles had more than one outcome variable, we first did a meta-analysis for the particular article so as to include only one effect size per article. Furthermore, results from the same longitudinal study (e.g., Ohio Longitudinal Study of Aging and Retirement) were sometimes reported in different articles (see Table 1). To avoid overestimation of effects due to this multiple use of datasets, we did an additional meta-analysis across

studies rather than articles where we first meta-analytically combined the different articles to produce only one estimation per dataset. We extracted the hazard, risk, or odds ratio with confidence intervals (CIs). We used CMA to convert regression coefficients, correlations, and means to odds ratios. We refer to different ratios (hazard, risk, and odds ratios) as likelihood ratios (LR; Lamers et al., 2012). We inverted ratios so that LRs above 1 indicate a positive relationship of subjective aging to health and survival. We weighted the studies LRs by the inverse of the standard errors. We considered a LR statistically significant if the 95% CI did not include the value of 1, which refers to no effect.

We expected heterogeneity across the studies and therefore performed a random-effects meta-analysis. This analysis allows for the assumption that the studies are estimating different but related effects, thus relaxing the assumption that all studies are replicas of each other. In addition, the random-effects model adjusts the study weights according to the level of heterogeneity in order to compute the 95% CI around the pooled effect estimate (Deeks, Higgins, & Altman, 2008).

The analysis proceeded in several steps. We first performed an analysis to estimate the overall effect across all studies. Next, we examined heterogeneity, which indicates the variation in outcomes between studies. We used both the Q-test, which indicates the probability of heterogeneity, and the I^2 index, which indicates the magnitude of the heterogeneity (0–30% is low; 30–75% is mod-

Table 1
Characteristics of Studies

| Authors | Year | Study | Country | N ^a | Average age | Predictive measure | Outcome measure(s) | Follow-up (years) | Quality assessment | LR (95% CI) | Conclusion |
|---------------------|------|--------|---------|----------------|-------------|--------------------|---|-------------------|--------------------|----------------------|------------|
| Markides & Pappas | 1982 | SATX | USA | 460 | 60+ | AI | Survival | 4 | .50 | 3.772* (2.281–6.238) | + |
| Maijer & Smith | 1999 | BASE | FRG | 513 | 85 | AAS | Survival | 4.5 | .67 | 1.220* (1.023–1.455) | + |
| Levy, Slade & Kasl | 2002 | OLSAR | USA | 433 | 62 | AAS | Functional health | 20 | .67 | 2.097* (1.478–2.976) | + |
| Levy et al. | 2002 | OLSAR | USA | 660 | 63 | AAS | Survival | 23 | .67 | 1.149* (1.060–1.245) | + |
| Levy & Myers | 2004 | OLSAR | USA | 241 | 57 | AAS | Health behaviors | 20 | .50 | 1.664* (1.049–2.640) | + |
| Levy & Myers | 2005 | OLSAR | USA | 620 | 63 | AAS | Respiratory survival | 23 | .67 | 1.439* (1.118–1.853) | + |
| Uutinen et al. | 2005 | EP | FIN | 1165 | 73 | AI | Survival | 13 | .33 | 1.235* (1.021–1.493) | + |
| Boehmer | 2006 | BLS | FRG | 143 | 64 | AI | Health-related quality of life ^b | 0.42 | .17 | 1.734 (0.944–3.184) | 0 |
| Boehmer | 2007 | BLS | FRG | 159 | 64 | AI | Perceived disability, Recovery satisfaction | 0.42 | .17 | 1.338 (0.756–2.368) | 0 |
| Wurm et al. | 2007 | DEAS | FRG | 1286 | 57 | PEAS | Physical illnesses ^b | 6 | .67 | 1.494* (1.224–1.824) | + |
| Wurm et al. | 2008 | DEAS | FRG | 1286 | 57 | PEAS | Subjective health | 6 | .67 | 1.440* (1.179–1.758) | + |
| Kotter-Gruhn et al. | 2009 | BASE | FRG | 496 | 85 | AI, AAS | Survival | 16 | .70 | 1.025* (1.005–1.046) | + |
| Wurm et al. | 2010 | DEAS | FRG | 1286 | 57 | PEAS | Physical exercise | 6 | .67 | 1.143 (0.937–1.395) | 0 |
| Moser et al. | 2011 | LC65 + | CHE | 883–1053 | 69 | AAS | Basic and instrumental ADL, falls, hospitalizations ^b | 1–3 | .67 | 1.465* (1.021–2.102) | + |
| Cheng et al. | 2012 | SSP | HKG | 83 | 58 | IAS | Medical events | 0.25 | .33 | 3.380* (1.292–8.843) | + |
| Sargent-Cox et al. | 2012 | ALSA | AUS | 1212 | 77 | AAS | Physical functioning | 16 | .50 | 2.656* (2.149–3.282) | + |
| Lim et al. | 2013 | ACPC | USA | 290 | 63 | AI | Survival | 1 | .33 | 1.230 (0.707–2.140) | 0 |
| Spulding et al. | 2013 | DEAS | FRG | 3038 | 61 | AI | Functional health, physical illnesses, subjective health ^b | 6 | .50 | 1.229* (1.080–1.398) | + |
| Sargent-Cox et al. | 2014 | ALSA | AUS | 1507 | 77 | AAS | Survival | 15 | .50 | 1.120* (1.020–1.230) | + |

Note. ACPC = adult cancer patients receiving chemotherapy; ALSA = Australian Longitudinal Study; BASE = Berlin Longitudinal Study on Quality of Life after Tumor Surgery; EP = Evergreen Project; DEAS = German Aging Survey; LC65+ = Lausanne Cohort Study; MIDUS = Survey on Midlife in the United States; OLSAR = Ohio Longitudinal Study of Aging and Retirement; SATX: Survey in San Antonio, Texas; SSP = study on chronically institutionalized schizophrenia patients; AUS = Australia; CHE = Switzerland; FRG = Germany; FIN = Finland; HKG = Hong Kong; USA = United States; AI = age identity; AAS = Personal Experience of Aging Scale; PEAS = Attitudes Toward own Aging Scale; LR = likelihood ratio; CI = confidence interval.

^a Number of subjects may vary slightly for studies reporting analyses for multiple outcomes. ^b Multiple outcome measures.

* p < .05.

erate; 75–100% is high; Deeks et al., 2008). Subgroup and metaregression analyses should be performed to identify factors that might account for the variation if heterogeneity is high. We did four subgroup analyses and two metaregression analyses to identify potential sources of variation in effect sizes across studies. In the subgroup analyses, we examined the effects of different aspects of subjective aging (age identity vs. attitudes toward own aging) and different outcome variables (health vs. survival), welfare regimes (less or more state support), and different quality scores. Although there has been dispute on the classification of different welfare states, a number of different classifications agree that the United States, Australia, and Hong Kong provide less state support, whereas Germany, Switzerland, and Finland generate more state support (Esping-Andersen, 1990; Bambra, 2007). We performed two separate analyses where we regressed the effect size per study on (a) the time of follow-up and (b) the average sample age. To this end, we used an unrestricted maximum likelihood mixed effects regression. Last, as it is not unusual to find publication bias, we examined publication bias with three indices to assess whether there was an overreporting of positive findings (Ferguson & Brannick, 2012). The funnel plot is a graph of effect size (LR) against standard error. When the studies are systematically distributed toward the left and right of the overall effect size, there is no publication bias. The Egger's test of intercept correlates the study precision (i.e., the inverse of the standard error) with the standardized effect (i.e., the effect size divided by its standard error). Duval and Tweedie's (2000) trim and fill analysis was conducted to estimate effect sizes after correcting the publication bias. We applied guidelines from the PRISMA statement on transparent reporting on meta-analyses, in particular regarding search strategy, eligibility criteria, quality assessment, and publication bias (Moher, Liberati, Tetzlaff, Altman, & the PRISMA Group, 2009).

Results

Overall Effect Size and Heterogeneity

An overview of the studies assessing the impact of subjective aging on health and survival is given in Table 1. The results of the meta-analysis are reported in Figure 2. The meta-analysis revealed an overall significant effect ($LR = 1.429$; 95% CI = 1.273–1.604; $p < .001$), indicating a small but positive effect of subjective aging (Chen, Cohen, & Chen, 2010). When results from the same longitudinal study (e.g., Ohio Longitudinal Study of Aging and Retirement) that were reported in different articles were meta-analytically combined, the overall effect remained again significant ($LR = 1.351$; 95% CI 1.180–1.546; $p < .001$). Although the effect was somewhat lower, the difference was not significant, given that the CIs overlapped with the first analysis. Thus, our main hypothesis was confirmed by these findings.

No studies reported negative effects of subjective aging on health, health behaviors, or longevity, 15 reported positive effects, and four reported no significant effects. In other words, when effects were found, they were in the expected direction, such that more positive subjective aging was associated with better health outcomes and greater longevity. The effects reported in the studies were heterogeneous and varied between 1.025 and 3.772. The variability of the

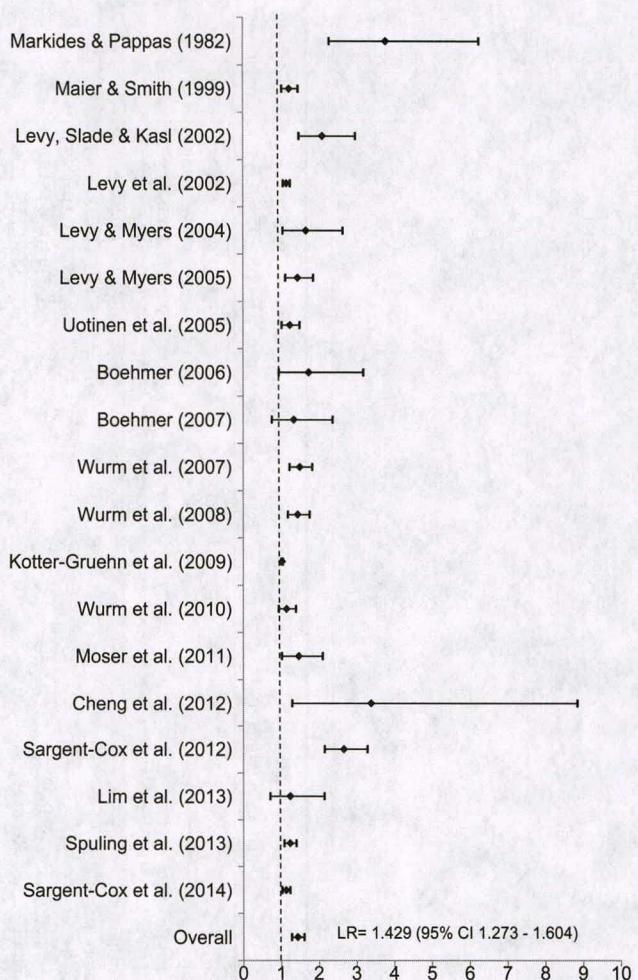


Figure 2. Forest plot of effect sizes (95% confidence interval). LR = likelihood ratio; CI = confidence interval.

effect sizes was significantly larger than would be expected from sampling error alone ($Q_{18} = 179.3$; $p < .001$; $I^2 = 90.0$).

We left two studies with the most extreme values out of the meta-analysis. Without the study of Markides and Pappas (1982) and that of Cheng et al. (2012) the effect size is not significantly different from the original effect size ($LR = 1.363$; 95% CI 1.221–1.522). Leaving out the studies did not result in a homogenous effect ($Q_{16} = 156.5$; $p < .001$; $I^2 = 89.8$).

Subgroup Analyses and Metaregression Analyses

To account for the heterogeneity in effects we performed four subgroup analyses and two metaregression analyses. Within each of the subgroup analyses, heterogeneity continued to exist. The results of the subgroup analyses are presented in Table 2. As expected, we did not find that attitudes toward one's own aging have a stronger effect than age identity.

The type of outcome did show the hypothesized significant differences in effects. The effect was stronger for health than survival, although significant for both outcomes. A metaregression of effect size on length of follow-up showed that studies with a shorter follow-up interval reported stronger effects than did studies

Table 2
Subgroup Analyses

| Subgroup | N | LR | 95% CI | Q | df | p |
|--|----|-------|-------------|-------|----|------|
| Operationalization of subjective aging | | | | | | |
| Age identity | 7 | 1.359 | 1.110–1.664 | 0.094 | 1 | .760 |
| Attitudes toward own aging | 13 | 1.412 | 1.234–1.615 | | | |
| Outcome measure | | | | | | |
| Health | 11 | 1.572 | 1.371–1.804 | 5.427 | 1 | .020 |
| Survival | 8 | 1.249 | 1.090–1.433 | | | |
| Welfare state regime | | | | | | |
| Less state support | 9 | 1.676 | 1.389–2.021 | 4.519 | 1 | .034 |
| More state support | 10 | 1.281 | 1.089–1.506 | | | |
| Study quality | | | | | | |
| Lower | 5 | 1.430 | 1.065–1.921 | 3.147 | 2 | .207 |
| Intermediate | 5 | 1.690 | 1.351–2.115 | | | |
| Higher | 9 | 1.320 | 1.128–1.544 | | | |

Note. LR = likelihood ratio; CI = confidence interval.

with longer follow-up intervals, as hypothesized (Slope = -.012; 95% CI = -.017 to -.006).

Also as hypothesized, a metaregression of effect size on average age of the study sample (range between 57 and 85 with a median of 63 years) showed that studies with younger samples showed stronger effects than did studies with older samples (Slope = -.010; 95% CI = -.012 to -.008).

The cross-national comparison did result in the hypothesized significant difference in welfare regimes. The overall effect was stronger in the regimes with less state support than in the regimes with more state support. However, the overall effects were significant for both regimes.

Last, we assessed whether study quality was related to the effect sizes. In contrast to our hypothesis, there was no significant difference in the effects of subjective aging on the outcome variables depending on study quality. Instead, the effects of subjective aging on health and longevity were significant in studies of low, intermediate, and high quality.

Publication Bias

To complete the meta-analysis, we also evaluated publication bias. The funnel plot indicated asymmetry, as the studies were concentrated on the right side of the plot. The Egger's test of intercept ($t_{19} = 5.731$; $p < .001$) proved to be significant, indicating a significant correlation between study precision and the standardized effect. The trim and fill analysis showed that looking for missing studies to the left of the mean resulted in an adjusted value with two trimmed studies of $LR = 1.369$ (95% CI = 1.220–1.536), similar to the original value ($LR = 1.429$; 95% CI = 1.273–1.604; $p < .001$). Even though the funnel plot and the Egger's test suggested publication bias, the trim and fill analysis suggests that it did not appear to impact the results.

Discussion

The goal of this article was to synthesize findings of longitudinal studies on the effects of subjective aging on health and longevity. We found an overall significant effect of subjective aging, indicating a small significant effect of subjective aging on health, health behaviors, and survival over time. To put the findings in

perspective, we can compare the results from the present meta-analysis to those of a number of other meta-analyses examining predictors of health and survival. The likelihood ratio for subjective aging on health was 1.57 (95% CI = 1.37–1.80), a ratio similar to one reported in a meta-analysis of longitudinal studies of the effect of well-being on health ($LR = 1.39$; 95% CI = 1.26–1.53; Howell, Kern, & Lyubomirsky, 2007). Similarly, the effect of subjective aging on longevity ($LR = 1.25$, 95% CI = 1.09–1.43) is comparable to the one reported in a meta-analysis of the effect of well-being on survival ($LR = 1.22$; 95% CI = 1.12–1.32; Chida & Steptoe, 2008), but smaller than the effect of not smoking on longevity ($LR = 1.83$; 95% CI = 1.65–2.03; Gellert, Schöttker, & Brenner, 2012). These effect sizes have been used to argue that public health policies should focus on enhancing well-being and decreasing smoking in order to promote the health of populations.

Our results suggest that promoting youthful identities and more positive attitudes toward own aging might be a highly relevant goal for public health initiatives. These may include social strategies, such as supporting more diverse and positive media messages about aging and old age (Westerhof & Tulle, 2007) as well as providing possibilities for intergenerational contact (Westerhof, 2011). These strategies may have a positive, though more indirect impact on subjective aging as they target stereotypes of both younger and older groups. Experimental studies have shown that subjective aging can also be more directly targeted, for example by providing feedback about positive social comparisons, raising awareness of positive age-related changes, or educating older people about positive aging (Kotter-Grühn, in press). An intervention study has shown that changing negative self-perceptions of aging may promote a healthier lifestyle (Sarkisian, Prohaska, Davis, & Weiner, 2007; Wolff, Warner, Ziegelmann, & Wurm, 2014). However, these studies are still in an early stage and long-term effects of such strategies remain to be assessed (Kotter-Grühn, in press), in particular because overly positive views on aging may be unrealistic and may in the end reinforce views of aging as becoming ill and dependent (e.g., Andrews, 1999).

We also addressed several possible sources of variation in the identified effect sizes. As expected, subjective aging had stronger effects on the more proximal outcome of health and over a shorter time period as well in younger adults in their second half of life

and welfare regimes with less state support. As expected, we did not find differences between studies focusing on age identity versus those studying attitudes toward one's own aging. This finding is consistent with our conceptual reasoning that there is no clear predictive superiority for either age identity or attitudes toward own aging as well as with the only study we found that included both indicators (Kotter-Grühn et al., 2009). The finding is remarkable, as age identity is generally measured by a single item on felt age. Interestingly, studies using single items to assess subjective health also reveal effects on mortality (Benyamin & Idler, 1999; Idler & Benyamin, 1997). Further, items tapping perceived health in comparison to other persons of one's own age have even stronger effects than do noncomparative items on self-perceived health (DeSalvo, Bloser, Reynolds, He, & Muntner, 2005). These findings suggest that subjective perceptions of one's own age and health provide summative judgments on how well one is doing in life.

Conclusions concerning these analyses are not definitive. The statistical power for subgroup and metaregression analyses is rather low—even though it is sufficient for the study in total (Cafri, Kromrey, & Brannick, 2010). Given the small number of studies, it is even more remarkable that we did find four out of six differences in effects to be significant. Another issue is possible confounding across these variables. However, the moderating variables are not significantly related to each other—with two exceptions. One exception was that studies on health had, on average, younger participants (mean 62 years) than did studies on survival (mean 72 years; $t_{17} = -2.7$; $p = .017$). It therefore remains unclear whether the stronger effects were due to the younger sample or the health outcome. The other exception was that studies conducted in nations with more collective welfare systems had a shorter period of follow-up (6.0 years) than did studies in welfare regimes with less state support (13.6 years; $t_{17} = -2.2$; $p = .039$). As the effect sizes were stronger for shorter intervals of follow-up and in regimes with less state support, this significant relationship between the subgroups might suppress rather than confound the differences in effect sizes.

Some caution also is in place in concluding whether subjective aging has a causal effect on health and survival. Other variables, such as personality traits, might account for not only subjective aging but also health and survival. Some studies have found evidence of significant relationships between personality traits and subjective aging (Hubley & Hultsch, 1994; Stephan, Demulier, & Terracciano, 2012; Wahl, Konieczny, & Diehl, 2013). Studies examining the longitudinal relationship of personality traits with mortality report similar effect sizes as our meta-analysis reveals (Ferguson & Bibby, 2012; Kern & Friedman, 2008; Lahey, 2009). Although no studies controlled for personality traits, eight studies did control for aspects of psychological functioning that are related to personality traits: depressive symptoms (Moser et al., 2011; Sargent-Cox et al., 2012, 2014; Uotinen et al., 2005), loneliness (Levy, Slade, Kunkel, & Kasl, 2002; Levy, Slade, & Kasl, 2002; Levy & Myers, 2005), and hope (Wurm et al., 2010). With the exception of Wurm et al. (2010), these studies still found significant longitudinal effects of subjective aging. Further studies need to take these variables into account as possible confounders. Nevertheless, our findings are in line with meta-analyses demonstrating the influence of age stereotypes in several domains of functioning (Horton, Baker, Pearce, & Deakin, 2008; Meisner, 2012).

Furthermore, it remains an interesting question how subjective aging might affect health and survival. Interestingly, controlling for health in studies of survival might even underestimate the effects, as the indirect effect of subjective aging on survival through health is excluded. Although some longitudinal studies found effects on possible cognitive and behavioral pathways, such as well-being, self-efficacy, and coping (Boehmer, 2006; Mock & Eibach, 2011), these studies did not directly address whether these pathways affected the relation of subjective aging with health and well-being. Only Levy, Slade, Kunkel, & Kasl (2002) found evidence for a partially mediating effect of will to live on this relationship. Further theoretical conceptualizations and empirical studies are needed to determine how subjective aging contributes to health and survival (Westerhof & Wurm, in press).

Despite some limitations, there are also a number of strengths. Even though heterogeneity continued to exist, we did find consistent evidence that subjective aging is related to health and longevity in a variety of countries, using several measures of subjective aging and a number of different outcome measures. The study quality did not moderate the strength of the overall effect size and most effect sizes included in the meta-analysis were controlled for possible confounders. Although there were a limited number of datasets involved, the effect size did not significantly change when we analyzed the findings per dataset. A possible publication bias did not impact the conclusion. We thus conclude that there is now solid evidence that subjective aging has a longitudinal relationship to health and longevity.

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