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Article *in* The Journals of Gerontology Series B Psychological Sciences and Social Sciences · May 2020

DOI: 10.1093/geronb/gbaa069

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A Systematic Review and Meta-Analysis of Subjective Age and the Association with Cognition, Subjective Wellbeing, and Depression

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Abstract

Objectives: A systematic review and meta-analysis was conducted to quantify the degree to which subjective age is associated with cognition, subjective wellbeing, and depression.

Methods: A systematic search was performed in three electronic social scientific databases, PsycINFO, Scopus, and Web of Science in May 2018. A manual forward and backward citation search of articles meeting the criteria for inclusion, including a mean participant age of 40+ years, was conducted November, 2019. Twenty-four independent data sets were included in the meta-analysis.

Results: Overall, a younger subjective age was related to enhanced subjective wellbeing and cognitive performance, and reduced depressive symptoms (r = 0.18). This association was stronger among collectivist (r = .24) than individualist (r = .16) cultures. Mean chronological age across samples (ranging from 55 to 83 years), type of subjective age scoring, and gender did not influence the strength of the overall association. Further analysis revealed that subjective age was individually associated with depressive symptoms (r = .20), subjective wellbeing (r = .17), and cognition (r = .14), and none had a stronger association with subjective age than the other.

Discussion: The results indicate a small yet significant association between subjective age and important developmental outcomes.

Keywords: subjective aging, felt age, cognition, wellbeing, depression

Introduction

Subjective age refers to the extent to which people feel younger or older than their chronological age, and accounts for the idiosyncratic experience of aging (Kotter-Grühn, Kornadt, & Stephan, 2015). Subjective age is most commonly measured by asking how old someone feels, also known as *felt age* (Bergland, Nicolaisen, & Thorsen, 2014). A tendency to report a younger felt age has been referred to as the “subjective age bias” (Weiss & Lang, 2012), and has been widely replicated in research involving older adults (Montepare & Lachman, 1989; Rubin & Berntsen, 2006; Ward, 2010). Like chronological age, subjective age contributes to a range of developmental outcomes (Stephan, Sutin, & Terracciano, 2015). People who feel younger are usually better off than those who feel their actual age or older (Kornadt, Hess, Voss, & Rothermund, 2018). For instance, one of the only meta-analyses on subjective age, to the best of our knowledge, explored the longitudinal effect of subjective age on future health and longevity among adults (average age 57-85 years; Westerhof et al., 2014). It showed that feeling younger is associated with improved physical health and longevity. In addition to its relation to health and survival, a younger subjective age has been associated with important developmental processes, such as enhanced subjective wellbeing (e.g., Westerhof & Barrett, 2005), better performance on tests of cognition (Stephan, Caudroit, Jaconelli, & Terracciano, 2014), and experiencing fewer depressive symptoms (e.g., Spuling, Miche, Wurm, & Wahl, 2013). The aim of the current meta-analysis is to examine the association between subjective age and these constructs.

Subjective age theories

In order to understand the mechanisms underpinning developmental outcomes, it is important to consider that people experience age in idiosyncratic ways (Kotter- Grühn, Kornadt, & Stephan, 2015). As such, there exist various theoretical frameworks to explain why individuals experience age identities that are distinct from their chronological age. From a psychosocial perspective, resilience theory describes age-group dissociation (i.e., a youthful bias) as a self-protective strategy (Pinquart, 2002). According to this view, negative, but not positive or neutral, information about aging increases salience of age for the self-concept.

Moreover, older adults cope with this negative self-view via social comparison processes in which they contrast themselves with same-age peers and assimilate with middle-aged adults (Weiss & Freund, 2012; Weiss & Lang, 2012). In contrast, labelling theory suggests that negative age stereotypes are integrated into self-evaluations and are associated with worse self-perceptions among older adults (Pinquart, 2002). According to stereotype embodiment theory, age stereotypes become self-relevant through excessive exposure in the surrounding social and cultural environment (Levy, 2009). These internalized beliefs exert influence along psychological, behavioral, and physiological pathways, generating self-expectations that can result in self-fulfilling prophecies. Positive perceptions of aging (i.e., a youthful bias) are predicted to result in improved cognitive and physical functioning, while negative perceptions are expected to impair functioning.

In addition to these psychosocial accounts, research has also endorsed a biomedical perspective, which explores the interplay between biology and subjective aging across the lifespan (Stephan, Sutin, Kornadt, & Terracciano, 2019; Thyagarajan et al., 2019). Evidence suggests that a younger subjective age is associated with lower adiposity and lower physiological dysfunction (Stephan et al., 2015). The reverse may also be true in that subjective age depends, in part, on perceptions of fitness and biological age (Stephan et al., 2015). The finding that subjective age predicts health behaviors and survival over time also supports subjective age as a biomedical marker of aging (Westerhof et al., 2014).

It is important to note that the psychosocial and biomedical perspectives are not mutually exclusive, and subjective age can be explained from a combined biopsychosocial approach (Stephan et al., 2015). That is, subjective age captures biological and health-related factors that may influence, or be influenced by, cognition and emotional wellbeing (Stephan, Sutin, Luchetti, & Terracciano, 2017).

Associations with wellbeing, depression, and cognition

Consistent with these theoretical accounts, research has found that feeling younger than your chronological age is associated with higher levels of subjective wellbeing (Westerhof & Barrett, 2005), a greater sense of life satisfaction (e.g., Ambrosi-Randić, Nekic, & Junakovic, 2018; Brothers, Miche, Wahl, & Diehl, 2017), and more positive affect (e.g., Mock & Eibach, 2011; Westerhof & Barrett, 2005). A younger subjective age is also associated with higher levels of life satisfaction, having a sense of meaning in life, greater optimism, and more successful aging (Ambrosi-Randić et al., 2018). Similarly, feeling younger correlates with experiencing fewer depressive symptoms (Spuling et al., 2013), a decreased likelihood of experiencing a major depressive episode (Keyes & Westerhof, 2012), and reduced symptoms of depression (Shrira, Bodner, & Palgi, 2014).

Typically, chronological age is considered to be the primary predictor of cognitive decline (e.g., Singh-Manoux et al., 2012). However, subjective age is also associated with psychosocial, behavioral, and health-related processes that can go on to influence cognitive performance over time (Stephan et al., 2014). For instance, a younger subjective age may help to eschew the negative implications of aging in order to facilitate the maintenance of a youthful and active lifestyle to combat against cognitive decline (Choi, Kim, Lee, Shin, Park, & Cho, 2017; Stephan, Sutin, Caudroit, & Terracciano, 2016). The Health and Retirement Study (HRS) shows that rate of memory decline is 20 to 70% steeper among individuals who feel older than their age (Stephan et al., 2016). Similarly, a younger subjective age is related to decreased likelihood of future cognitive impairment across a composite of memory recall, working memory span, and processing speed tests (Stephan et al., 2017). In both cases the association was partly explained by reduced depressive symptoms. Importantly, subjective age may predict wellbeing, depression, and cognition, or the reverse may be true. Wellbeing, depression, and cognition may predict subjective age.

Potential moderators

Various factors could potentially moderate the association between subjective age and the developmental outcomes, including culture, type of subjective age scoring, chronological age, and gender. Although respondents from 18 different countries typically reported younger subjective ages (for a review see Barak, 2009), interpretation of what it means to be old may vary according to the extent to which a culture is youth-oriented and individualistic (Gendron, Inker, & Welleford, 2017; Westerhof & Barret, 2005). In general, collectivist cultures are less youth-oriented than individualist cultures (Hess et al., 2017), suggesting that subjective age may be more strongly associated with wellbeing, depression, and cognition in individualist cultures.

The reporting of subjective age scoring tends to differ from study to study. This includes raw scores, discrepancy scores (chronological age minus subjective age) that take into account actual age, and proportional discrepancy scores (chronological age minus subjective age, divided by chronological age). When testing wide age ranges, it is recommended that researchers use proportional discrepancy scores to control for the various effects of chronological age, and the fact that discrepancy scores likely have different meanings at different ages (Kotter-Grühn, Kornadt et al., 2015). Indeed, both the type of scoring and chronological age may account for some variance in the current meta-analysis. For example, Westerhof et al. (2014) found that the effect of a younger subjective age on improved health and survival was stronger for younger samples (average age of samples ranged from 57 to 85-years-old).

A meta-analysis has also found that, among adults with a mean age ≥ 55 years, self-esteem, happiness, and subjective health were higher in men than women, while a subset of studies showed that women reported younger subjective ages compared with men (Pinquart & Sörensen, 2001). Since then, studies have provided further evidence that being female is correlated with a younger subjective age (e.g., Choi et al., 2017; Hülür, Hertzog, Pearman, &

Gerstorf, 2015; Westerhof & Barrett, 2005), while others have found that subjective age is not associated with gender (e.g., Pearman, Hertzog, & Gerstorf, 2014; Rippon & Steptoe, 2018; Segel-Karapas & Palgi, 2017; Stephan et al., 2014). The current meta-analysis will extend these studies by examining gender (i.e., proportion female) as a potential moderator of the overall association between subjective age and the developmental outcomes.

There have not been enough studies to date that directly compare the strength of association between subjective age and various outcomes. The current meta-analysis will therefore also explore whether the association with subjective age may differ depending on the type of outcome (wellbeing, depression, and cognition).

The current meta-analysis

The current meta-analysis assessed the 'felt age' item, which reflects how old participants feel in years as either a raw score, or adjusting for chronological age. This item was used because the scores provide a continuous measure that allows for more sophisticated analyses (Rubin & Berntsen, 2006). It also appears to be the most commonly used measure of subjective age. Although we examined only the single 'felt age' item under the broad term of 'subjective age', to maintain consistency with current research, we refer to 'felt age' as 'subjective age' in the current meta-analysis. The outcomes assessed include subjective wellbeing, depression, and cognition. Subjective wellbeing includes measures such as life satisfaction, positive affect, and negative affect, as defined by Diener and Ryan (2009). Depression includes items assessing depressive symptoms, depressed mood, or possible depression. Measures of cognition include a variety of tests that assess cognitive processes or performance on a cognitive test (e.g., memory, attention, processing speed). Due to the limited longitudinal data available, only cross-sectional data were analysed. However, baseline measures of longitudinal studies were also included. Samples with a mean age of 40 years or greater were included based on Rubin and Berntsen's (2006) finding that after the age of 40, people consistently tend to report feeling about 20% younger than their actual age. Potential moderators of the association of subjective age with the developmental outcomes that were tested include outcome (cognition, wellbeing, and depression), culture (individualist vs. collectivist), subjective age scoring (discrepancy vs. proportional discrepancy), mean chronological age, and gender.

Method

This study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009).

Information sources and search

A systematic search was performed in three electronic social scientific databases, PsycINFO, Scopus, and Web of Science, up to May 15, 2018, with a manual forward and backward citation search of the final set of articles completed November 6, 2019. The initial search assessed title, abstract, and keywords using the following search terms taken from Westerhof and colleagues' (2014) meta-analysis: "subjective age", "subjective aging/ageing", "felt age", "perceived age", "age identity", "aging/ageing satisfaction", "self-perceptions of aging/ageing", "view on aging/ageing", and "age-related cognition". An additional search term "desired age" was also included to broaden the results as it tends to be assessed in conjunction with felt age (e.g., Ambrosi-Randić et al., 2018; Bellingtier, Neupert, & Kotter-Grühn, 2017). Note that although various subjective age terms were included in the search, the current meta-analysis only analysed 'felt age' data. This was important considering that the measures operate differently. For example, desired age sometimes asks people to report an older age that they would like to reach (e.g., Ambrosi-Randić et al., 2018), or an ideal younger age that may reflect reduced (rather than increased) wellbeing (e.g., Bellingtier et al., 2017). The search was conducted in peer-reviewed journals with no limitation on publication year. Thirteen corresponding authors from the studies identified for inclusion following the search of electronic databases, and who had published in the last five years, were contacted to request any unpublished data relevant to the current meta-analysis.

Eligibility criteria

Studies were included if they: (1) included a continuous measure of the felt age item and at least one of the outcome variables, (2) included a sample where the mean age was at least 40 years-old, (3) included a healthy, community-dwelling sample, (4) assessed the association between felt age and at least one outcome variable (subjective wellbeing, depression, or cognition), and (4) included Pearson's *r* and sample size, or authors provided these data or a dataset on request. Studies were excluded if they were not written in English.

Data extraction

Pearson's *r* and sample size were extracted for the associations between subjective age and every outcome measure in each study. The first author (FAD) extracted all data or contacted the corresponding and/or first author for missing data. Two attempts were made to contact authors and comparisons were excluded when data were not made available (i.e., Baum & Boxley, 1983; Bodner, Ayalon, Avidor, & Palgi, 2017; Choi, DiNitto, & Kim, 2014; Kotter-Grühn, Neupert, & Stephan, 2015; Mirucka, Bielecka, & Kisielewska, 2016; Mock & Eibach, 2011; Palgi, Ayalon, Avidor, & Bodner, 2017; Staats, Heaphey, Miller, Partlo, Romine, & Stubbs, 1993; Teuscher, 2009). The first author re-extracted all data a second time to ensure 100% reliability across the two independent data files.

Subjective age was calculated differently in various studies. As shown in Table 1, some researchers calculated a discrepancy score between subjective age and chronological age (i.e., chronological age minus subjective age), whereas others calculated a proportional discrepancy score (i.e., chronological age minus subjective age, divided by chronological age). Some researchers reported subjective age as a raw score in years. All data were coded so that a higher score indicates a younger subjective age. That is, a greater difference between chronological and a younger subjective age, or a larger proportional discrepancy score. Raw scores were reversed so that a higher (rather than lower) score indicated a younger subjective age. Thus, a positive effect reflects a positive association between subjective age (i.e., a younger subjective age) and better development outcomes. A negative effect indicates the opposite.

Studies were excluded based on how the subjective age item was operationalized. For example, one included a composite score of subjective age, which combined results of feel-age, do-age, look-age, and interest-age (i.e., Stephan, Caudroit, & Chalabaev, 2011). Another study did not provide a continuous score for subjective age (i.e., Ayalon, Palgi, Avidor, & Bodner, 2016). Two studies were excluded that measured changes in subjective age as a result of testing or feedback and did not provide baseline correlations between subjective age and an outcome measure (i.e., Geraci, De Forrest, Hughes, Saenz, & Tirso, 2017; Hughes, Geraci, & De Forrest, 2013).

Two articles included independent data from three different samples (i.e., Stephan, Sutin, Bayard, & Terracciano, 2017; Stephan, Sutin, & Terracciano, 2018): one from the HRS, one from the Midlife in United States survey (MIDUS), and one from the National Health and Aging Trends Survey (NHATS), each. Seven studies reported data from the HRS data set, nine studies reported data from the MIDUS data set, and three reported data from the NHATS data set. In order to avoid overestimation effects, we created a composite score for each of these three datasets. This meant that there was only one overall HRS effect size estimate, only one overall MIDUS effect size estimate, and only one overall NHATS effect size estimate. One study by Westerhof and Barrett (2005) examined two longitudinal samples in conjunction, one from the MIDUS, and one from the German Aging Survey. Correlations were aggregated across the two samples; hence the current meta-analysis will treat this study as independent. For longitudinal studies (e.g., Segel-Karpas & Palgi, 2017; Stephan et al., 2014; Stephan et al., 2016), the initial baseline measurements were used in the meta-analysis to maintain consistency with cross-sectional findings. One exception was a longitudinal study for which we included the average correlation across eight days as these were the only data available (i.e., Bellingtier et al., 2017).

Data analyses

A random-effects model was used to account for variances that occur due to chance, sampling error, or heterogeneity, thereby allowing the findings to generalise beyond the studies included in the meta-analysis (Borenstein, Hedges, Higgins, & Rothstein, 2011; Field & Gillet, 2010). Heterogeneity among the effect sizes was examined using the I^2 statistic. Heterogeneity is defined as low (I^2 = 25%), moderate (I^2 = 50%), or high (I^2 = 75%). If I^2 is near zero, this would mean that almost all the observed variance is spurious, whereas an I^2 near 100% assumes that most of the observed variance is real (Higgins, Thompson, Deeks, & Altman, 2003). A positive correlation indicates that better scores on the measures of cognition, depression, and subjective wellbeing are associated with a younger subjective age, whereas negative correlations represent the opposite.

Analyses were carried out using the software Comprehensive Meta-Analysis Version 3.3.07 (CMA; Borenstein et al., 2011). We first calculated a composite effect for each independent study to determine the overall correlation between subjective age and measures of cognition, depression, and subjective wellbeing. These composite effects were calculated assuming a conservative correlation of 1.0 between measures. The correlation coefficients were converted into Fisher's *Z*, so that all correlations could become a standardised metric to compare across various studies (Borenstein et al., 2011; Field & Gillett, 2010). We initially performed an analysis to estimate the overall correlation between subjective age and all of the combined outcome measures of interest.

The next step was to test whether any heterogeneity in the overall correlation could be explained by type of outcome, culture, or subjective age scoring. If an independent data set included more than one measure of the same outcome (e.g., a measure of positive affect and life satisfaction to represent subjective wellbeing), we first computed a composite effect size accounting for a conservative correlation of 1.0 between these measures. Where a single study contributed to more than one outcome variable (e.g., a depressive symptom measure and a measure of cognitive performance), we divided *N* by the number of outcomes in order to reduce the impact on the overall effect size (Higgins & Green, 2011). Moderator analyses in CMA were conducted to examine whether the mean correlations between subjective age and the developmental outcomes differed as a function of type of outcome, culture, and subjective age scoring. Meta-regression examined the influence of mean chronological age and gender on the association of subjective age with the combined developmental outcomes.

Publication Bias and Outliers

The trim and fill method (Duval & Tweedie, 2000) was used to identify potential publication bias. No studies needed to be trimmed out or imputed to improve symmetry. We also used the *p*-curve web application (https://p-curve.com/app) to conduct *p*-curve tests to identify whether the selective reporting of results is responsible for significant effects in the published literature (Simonsohn, Nelson, & Simmons, 2014). The *p*-curve analysis assumes that each unit entered is statistically independent from the other. If studies reported multiple effect sizes, Simonsohn et al. (2014) recommended adhering to a prespecified selection rule for the first and second analyses. We therefore randomly selected one effect size from each study for the primary analysis and then randomly selected a different effect size for the robustness analysis in the second analysis. The results of the primary *p*-curve analysis are presented in Figure 1. The results of the half *p*-curve test, $Z = -33.55$, $p < .0001$, and the full *p*-curve test, $Z = -33.2$, $p < .0001$, suggest that the *p*-curve is significantly right-skewed, indicating that these studies were not likely to have been selectively reporting statistically significant findings. These results were further verified with the robustness analysis (half *p*-curve: $Z = -31.21$, $p < .0001$; full *p*-curve: $Z = -30.94$, $p < .0001$). Both the primary and secondary (robustness) analyses estimated that after correcting for selective reporting, the included studies had an estimated power of 99%.

There were no outliers, as classified by effect sizes with a standardised residual *z*-score greater than 3 (Viechtbauer & Cheung, 2010), that were identified in the current meta-analysis.

Results

Study selection and characteristics

A flow diagram depicts the screening process (see Figure S1 in supplementary material). The initial literature search resulted in 714 articles from PsycINFO, 931 from Scopus, and 801 from Web of Science. After merging the databases, 1367 duplicates and 88 non-English articles were removed, leaving a total of 991 articles to review. A further 898 studies were removed based on the first phase screening of the title and abstract, followed by a further 75 in the full-text assessment based on eligibility criteria. The forward and backward citation search identified an additional seventeen articles for inclusion. The resulting 35 articles included 40 data sets, seven of which were combined into a composite measure for the HRS, nine which were combined to represent the MIDUS, and three were combined to represent the NHATS. Thus, a total of 24 independent data sets were analysed in the meta-analysis. Included studies are indicated by an asterix in the reference section.

The number of participants, mean age, origin of sample, subjective age scoring, and measures that were used in each study are provided in Table S1 (see supplementary material). It should be noted that each study that used data from either the HRS, MIDUS, or NHATS used their own inclusion criteria for their study sample and may have used data from different waves of each survey. In this meta-analysis, we dealt with these data by calculating an average of both sample size and mean chronological age collapsed across all studies included within each of the HRS, MIDUS and NHATS. Thus, the HRS contributed 7,099 adults, while the MIDUS contributed 2,608 adults, and the NHATS contributed 4,766 adults. The remaining studies contributed 30,856 adults. The total number of adults included in the meta-analysis was 45,329.

Overall association between subjective age and the combined outcomes

Overall, the correlation between subjective age and the combined measures of subjective wellbeing, depression, and cognition, was positive and significant, $k = 24$, $r = 0.18$, 95% CI = [.15, .21]. Thus, a younger subjective age was associated with enhanced subjective wellbeing and cognitive performance and reduced depressive symptoms (see Figure 2). However, there was high heterogeneity among the studies that contributed to this effect, $I^2 =$ 89.47.

A power analysis revealed that the large average sample size (n =1,889) across the 24 independent data sets had 100% power to detect a small effect ($d = 0.2$), regardless of having low or high heterogeneity (Valentine, Pigott, & Rothstein, 2010).

Moderator Analyses.

The following analyses examined whether type of outcome (cognition vs. depression vs. wellbeing), culture (individualist vs. collectivist), or subjective age scoring (discrepancy vs. proportional discrepancy) moderated the association between subjective age and the developmental outcomes. Consistent with Bailey and Leon (2019), each level of a moderator required at least five effect sizes to be included in a moderator analysis.

Type of Outcome. The average correlations (r) between subjective age and cognition ($k = 10$), subjective age and depression ($k = 13$), and subjective age and wellbeing ($k = 10$) were 0.14, 95% CI = [.08, .19], 0.20, 95% CI = [.15, .24], and 0.17, 95% CI = [.12, .22], respectively. However, the test of whether the correlations differed by outcome was not significant, $Q(2) = 3.04$, $p = 0.219$ (see Figure 3).

Culture. The average correlations (*r*) between subjective age and the combined developmental outcomes for collectivist countries ($k = 6$) and individualist countries ($k = 15$) were 0.24, 95% CI = [.18, .30], and 0.16, 95% CI = [.11, .20], respectively (see Figure 4). The test of whether the overall effect differed depending on culture was significant, $Q(1) = 4.72$, $p = .030$, indicating that the overall effect was stronger in collectivist cultures than individualist cultures. Note that three Israeli samples were excluded from this analysis because Israel includes a unique mix of both individualist and collectivist culture.

Subjective Age Scoring. The HRS and MIDUS data sets were excluded from this analysis as different studies within this dataset calculated subjective age differently. There were only two studies using raw scores and both were therefore excluded. The average correlations (*r*) between subjective age and the combined developmental outcomes for discrepancy scores ($k = 6$), and proportional discrepancy scores ($k = 14$) were 0.18, 95% CI = [.11, .25], and 0.17, 95% CI = [.13, .22], respectively. However, the test of whether the correlations differed by type of scoring was not significant, $Q(1) = 0.06$, $p = .800$.

Meta-Regression Analyses

The following analyses examined whether some of the variation in effect size could be explained by the mean chronological age or proportion of females in each independent sample.

Mean Chronological Age. In a regression model that included the intercept and Mean Chronological Age as the predictors ($k = 23$; these data were missing for Uotinen et al. (2003)), mean chronological age across samples ($M = 67.41$ years, $SD = 7.64$, range 53.01 to 83.33 years) did not have any impact on the model, $Q = 0.08$, $p = 0.773$.

Gender. In a regression model that included the intercept and Proportion Female as the predictors (k = 24), proportion female (M = 0.58, SD = 0.10, range 0.38 to 0.91) did not have any impact on the model, Q = 0.56, p = 0.455.

Discussion

The current systematic review and meta-analysis shows a small but significant correlation between a younger subjective age and better outcomes averaged across the measures of subjective wellbeing, cognitive performance, and depression. Further analysis shows that each of the three outcomes is significantly correlated with subjective age, and none more strongly than the other. The overall relationship between subjective age and the combined measures of subjective wellbeing, cognition, and depression, across the 24 independent datasets, was moderated by culture, but not type of outcome, subjective age scoring, mean chronological age, or gender.

Subjective age and developmental outcomes

The current meta-analysis identified small but significant associations between subjective age and 10 independent data sets measuring subjective wellbeing, 13 independent data sets measuring depression, and 10 independent data sets assessing cognition. These three separate associations were of equivalent magnitude. According to the psychosocial perspective of subjective aging and resilience theory, older adults confronted with negative age stereotypes assimilate with younger, middle-aged adults as a self-protective strategy (Pinquart, 2002). According to Levy's (2009) stereotype embodiment theory, this rejection of negative age stereotypes should be associated with improved cognitive and physical functioning. The current data suggest that this occurs just as readily for subjective wellbeing and depression as for cognition. Alternatively, the similar associations between subjective age and the various outcomes may be explained at least in part by the biopsychosocial perspective of subjective aging. Older adults who are more physically healthy are likely to both feel younger and have improved cognition and wellbeing (Stephan et al., 2015; Stephan, Sutin, Luchetti et al., 2017). Similarly, feeling younger may improve wellbeing and cognition, which then improves health and longevity (Stephan et al., 2014; Westerhof et al., 2014).

While the current meta-analysis examined only cross-sectional data, the findings are consistent with existing longitudinal studies showing that feeling increasingly younger over a four-year period leads to better physical and mental health (Bodner et al., 2017). The current results suggest that promoting youthful age identities may encourage better mental health in terms of reduced depressive symptoms and improved subjective wellbeing and better cognitive performance in later life. This would be consistent with preliminary studies showing that subjective age is malleable (e.g., Geraci et al., 2017; Hughes et al., 2013; Kotter-Grühn, Neupert et al., 2015). It is also important to again highlight that these effects may be bi-directional, such that a younger subjective age may improve cognition and well-being, or vice versa.

The finding that subjective age was associated with the combined outcomes more strongly among collectivist than individualist cultures was not expected. It was predicted that older adults from individualist cultures would demonstrate the stronger association due to being more youth-oriented (Hess et al., 2017). However, the current data align with a meta-analysis showing that, relative to Western (i.e., individualist) cultures, Eastern (i.e., collectivist) cultures hold significantly greater negative attitudes towards aging overall (North & Fiske, 2015). The authors suggested that this might be because, relative to Western countries, Eastern countries have experienced more rapid population aging in the past couple of decades. This in turn may have placed pressure on societal resources and increased burden on younger generations to care for older adults. Hence, more negative attitudes towards older adults in collectivist cultures may have increased the salience of age for older adults' self-concept, leading to attempts to eschew the negative implications of aging by adopting a younger subjective age (Pinquart, 2002).

The other potential moderators examined in the current meta-analysis did not influence the association between subjective age and the combined outcomes. For example, there was no evidence that the scoring of subjective age (discrepancy vs. proportional discrepancy) influenced the association. There may be differences when comparing raw scores to discrepancy scores, as the former does not take into account chronological age. However, only two studies included in the current meta-analysis used raw scores to index subjective age and thus could not contribute to analyses.

A previous meta-analysis of longitudinal data showed that samples with a younger mean chronological age (ranging from 57-85 years) demonstrated a stronger effect of subjective age on health and longevity (Westerhof et al., 2014). In the current meta-analysis, the association between a younger subjective age and better wellbeing and cognitive outcomes remained the same regardless of mean chronological age (ranging from 53- 83 years). These contradictory findings in the two meta-analyses may reflect methodological differences such as the longitudinal versus cross-sectional designs, and the differing outcome measures. Nevertheless, the current finding aligns with the idea that subjective age represents a unique and informative marker of development that is distinct from chronological age (see Kotter-Grühn, Kornadt et al., 2015).

Previous research has presented a mixed picture as to whether subjective age differs for older men and women (e.g., Pinquart & Sörensen, 2001; Stephan et al., 2014). The current data suggest that gender (i.e., proportion female ranging from 0.38 to 0.91 across samples) was not a moderator of the association between subjective age and the developmental outcomes. This suggests that, at least in relation to the outcomes measured, feeling 'old' may not present as more of a threat to older women than men, as suggested by Pinquart and Sörensen (2001).

Limitations and future directions

Meta-analyses risk yielding published papers that only demonstrate 'positive' results with significant findings (Walker et al., 2008). These studies are likely to overestimate true effects. This potential limitation was offset in the current meta-analysis by making a call for unpublished data and by conducting statistical tests that helped to rule out publication bias and p-hacking. A further potential limitation of the current study is that measurements included within each type of outcome were not all consistent. For example, the meta-analysis included broad and varied measures of cognition. Due to an insufficient number of studies assessing individual domains of cognition, it was not possible to perform analyses to determine whether subjective age was more strongly associated with certain cognitive domains than others. Similarly, we could not assess whether culture, type of subjective age scoring, chronological age, or gender might moderate the association between subjective age and individual (rather than combined) outcomes. These questions should be addressed in future research.

Despite early advocacy for a multidimensional approach to the study of subjective aging (e.g., Kastenbaum, Derbin, Sabatini, & Artt, 1972), most studies have continued to employ a unidimensional approach in assessing how old a person feels. This might fail to capture complexities in the broader experience of subjective age because felt age might only be tapping into health and physical aging, rather than other domains that are relevant to the aging process (Kornadt, Hess, Voss, & Rothermund, 2018). This might also explain why the current meta-analysis only identified small correlations between subjective age and the outcome measures of wellbeing, depression, and cognition.

Most existing studies of subjective age are cross-sectional, which prevents causal interpretation of the observed relationships. Longitudinal studies are needed that provide not only descriptions of how subjective age changes over multiple life decades, but also estimates of variability around the patterns of social and psychological factors that produce these changes (Barrett & Montepare, 2015). Future studies should also begin assessing more diverse samples of older adults in order to test whether the current findings with cognitively healthy community-dwelling older adults extend more broadly.

Conclusion

Overall, the empirical literature reviewed in the current meta-analysis converges to support the conclusion that a younger subjective age is associated with better outcomes in relation to subjective wellbeing, cognitive performance, and depressive symptoms among adults aged 40 years or more. Notably, this association was shown to be stronger among collectivist than individualist cultures. Type of outcome, subjective age scoring, chronological age, and gender did not moderate the relationship between subjective age and the outcomes of interest. Consistent with the biopsychosocial perspective, the small yet significant overall effect size suggests subjective age may be a distal predictor of developmental outcomes (cognition, wellbeing, and depression) through more proximal pathways such as health and biology.

Funding

This work was supported by Australian Research Council's *Discovery Projects* funding scheme (project number DP200100876).

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Figures

Figure 1. Primary *p* curve analysis

Figure 2. Overall meta-analysis, $k = 24$.

Figure 3. Separate correlations between subjective age and cognition ($k = 10$), depression ($k = 13$), and subjective wellbeing ($k = 10$)

Figure 4. Moderation of the association between subjective age and the combined outcomes by collectivist versus individualist culture.

Figure 1

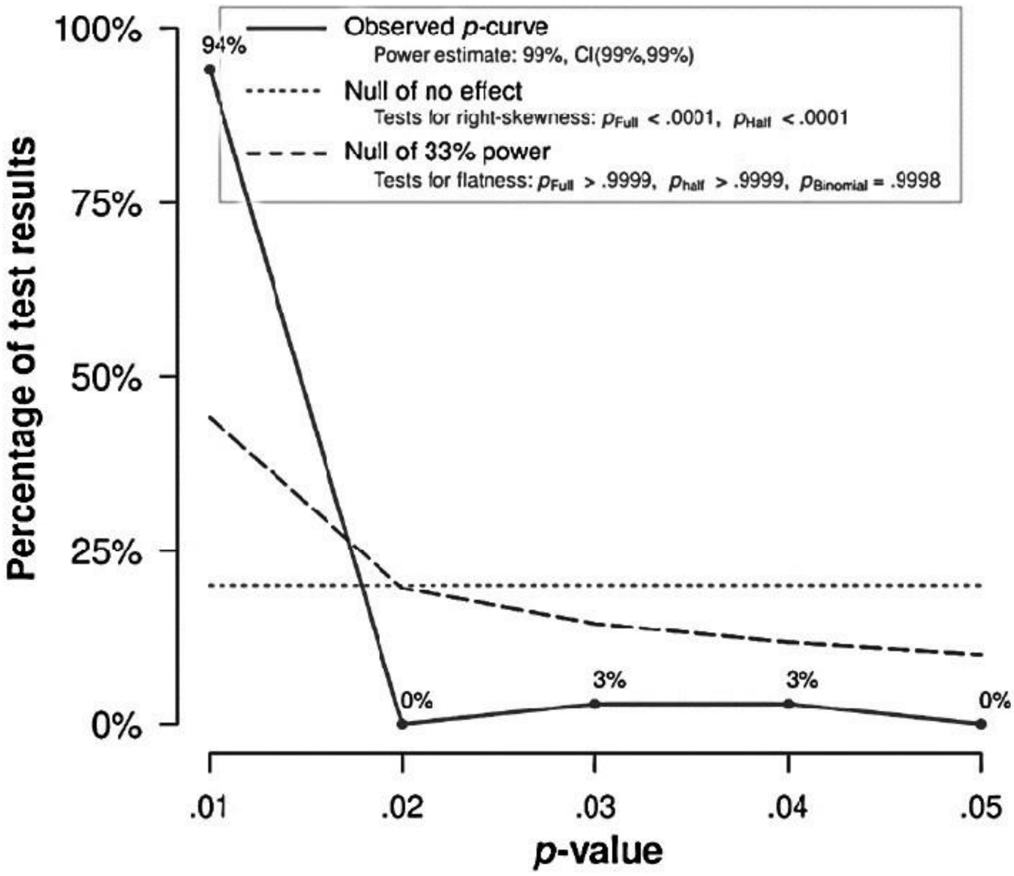

100%
75%
50%
25%
0%
Percentage of test results
94%
Observed p-curve
Power estimate: 99%, CI(99%,99%)
Null of no effect
Tests for right-skewness: pFull < .0001, pHalf < .0001
Null of 33% power
Tests for flatness: pFull > .9999, phalf > .9999, pBinomial = .9998
0%
3%
3%
0%
.01
.02
.03
.04
.05
p-value

Figure 2

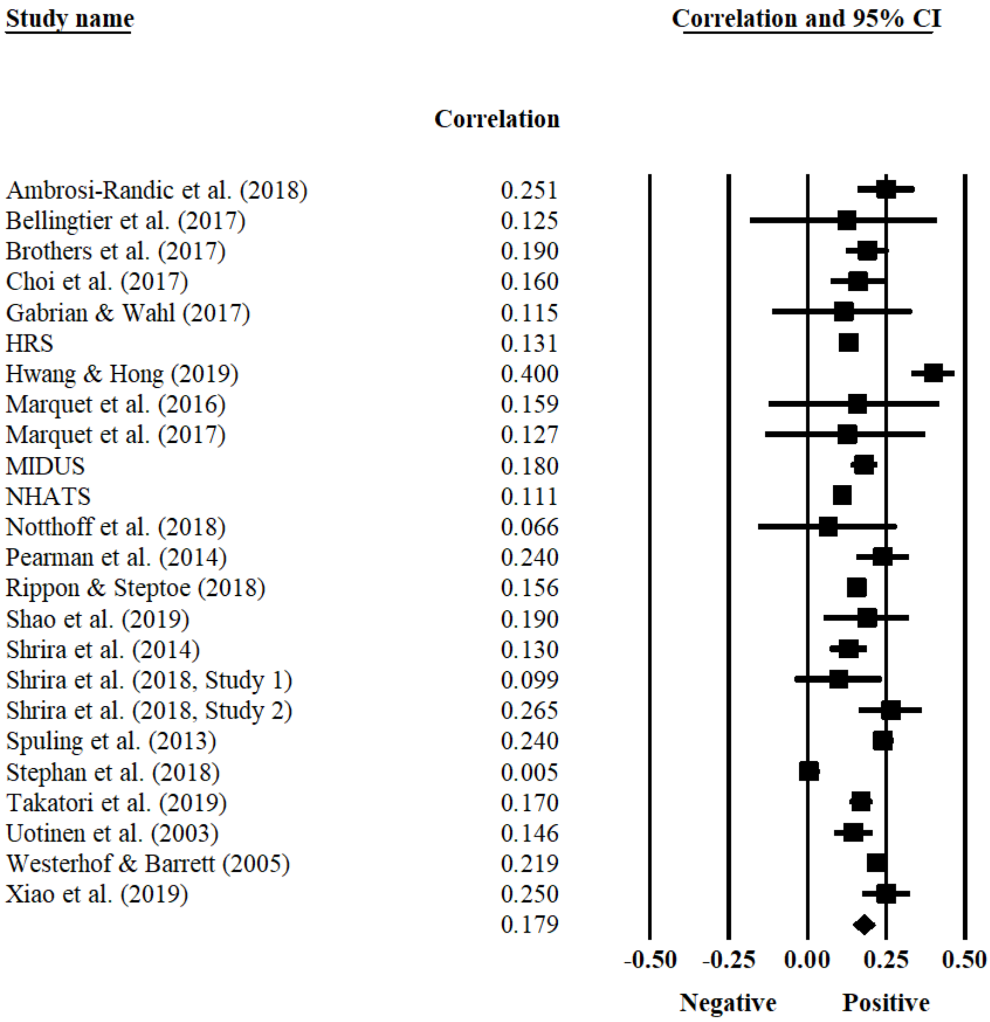

Study name
Correlation and 95% CI
Correlation
Ambrosi-Randic et al. (2018) 0.251
Bellingtier et al. (2017) 0.125
Brothers et al. (2017) 0.190
Choi et al. (2017) 0.160
Gabrian & Wahl (2017) 0.115
HRS 0.131
Hwang & Hong (2019) 0.400
Marquet et al. (2016) 0.159
Marquet et al. (2017) 0.127
MIDUS 0.180
NHATS 0.111
Notthoff et al. (2018) 0.066
Pearman et al. (2014) 0.240
Rippon & Steptoe (2018) 0.156
Shao et al. (2019) 0.190
Shrira et al. (2014) 0.130
Shrira et al. (2018, Study 1) 0.099
Shrira et al. (2018, Study 2) 0.265
Spuling et al. (2013) 0.240
Stephan et al. (2018) 0.005
Takatori et al. (2019) 0.170
Uotinen et al. (2003) 0.146
Westerhof & Barrett (2005) 0.219
Xiao et al. (2019) 0.250
0.179
-0.50
-0.25
0.00
0.25
0.50
Negative
Positive

Figure 3

Study	Outcome Measure	Correlation
Choi et al. (2017)	Cognition	0.140
Gabrian & Wahl (2017)	Cognition	0.115
HRS	Cognition	0.104
Marquet et al. (2017)	Cognition	0.134
MIDUS	Cognition	0.183
NHATS	Cognition	0.070
Notthoff et al. (2018)	Cognition	0.170
Pearman et al. (2014)	Cognition	0.290
Rippon & Steptoe (2018)	Cognition	0.080
Shao et al. (2019)	Cognition	0.190
		0.136
Choi et al. (2017)	Depression	0.180
HRS	Depression	0.162
Hwang & Hong (2019)	Depression	0.400
Marquet et al. (2016)	Depression	0.159
Marquet et al. (2017)	Depression	0.121
MIDUS	Depression	0.106
NHATS	Depression	0.124
Notthoff et al. (2018)	Depression	0.040
Pearman et al. (2014)	Depression	0.190
Rippon & Steptoe (2018)	Depression	0.230
Spuling et al. (2013)	Depression	0.240
Takatori et al. (2019)	Depression	0.170
Xiao et al. (2019)	Depression	0.250
		0.198
Ambrosi-Randic et al. (2018)	Wellbeing	0.250
Bellingtier et al. (2017)	Wellbeing	0.125
Brothers et al. (2017)	Wellbeing	0.190
HRS	Wellbeing	0.020
MIDUS	Wellbeing	0.226
Shrira et al. (2014)	Wellbeing	0.130
Shrira et al. (2018, Study 1)	Wellbeing	0.098
Shrira et al. (2018, Study 2)	Wellbeing	0.266
Uotinen et al. (2003)	Wellbeing	0.146
Westerhof & Barrett (2005)	Wellbeing	0.219
		0.170
		0.171

Correlation and 95% CI

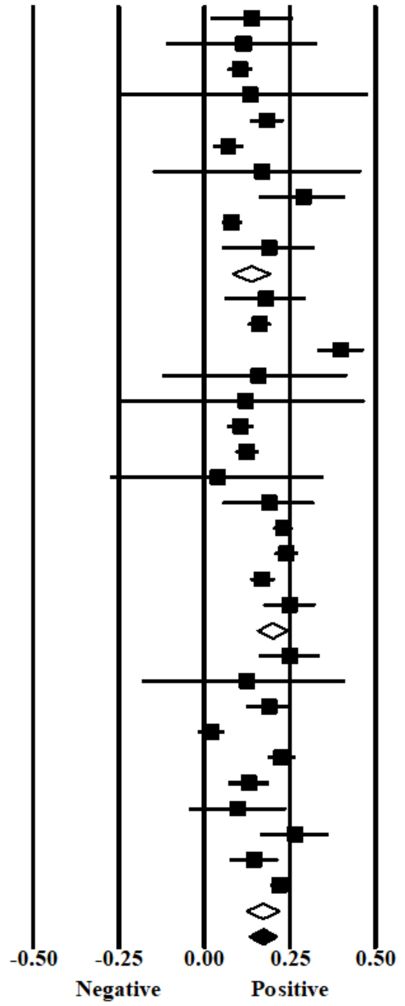
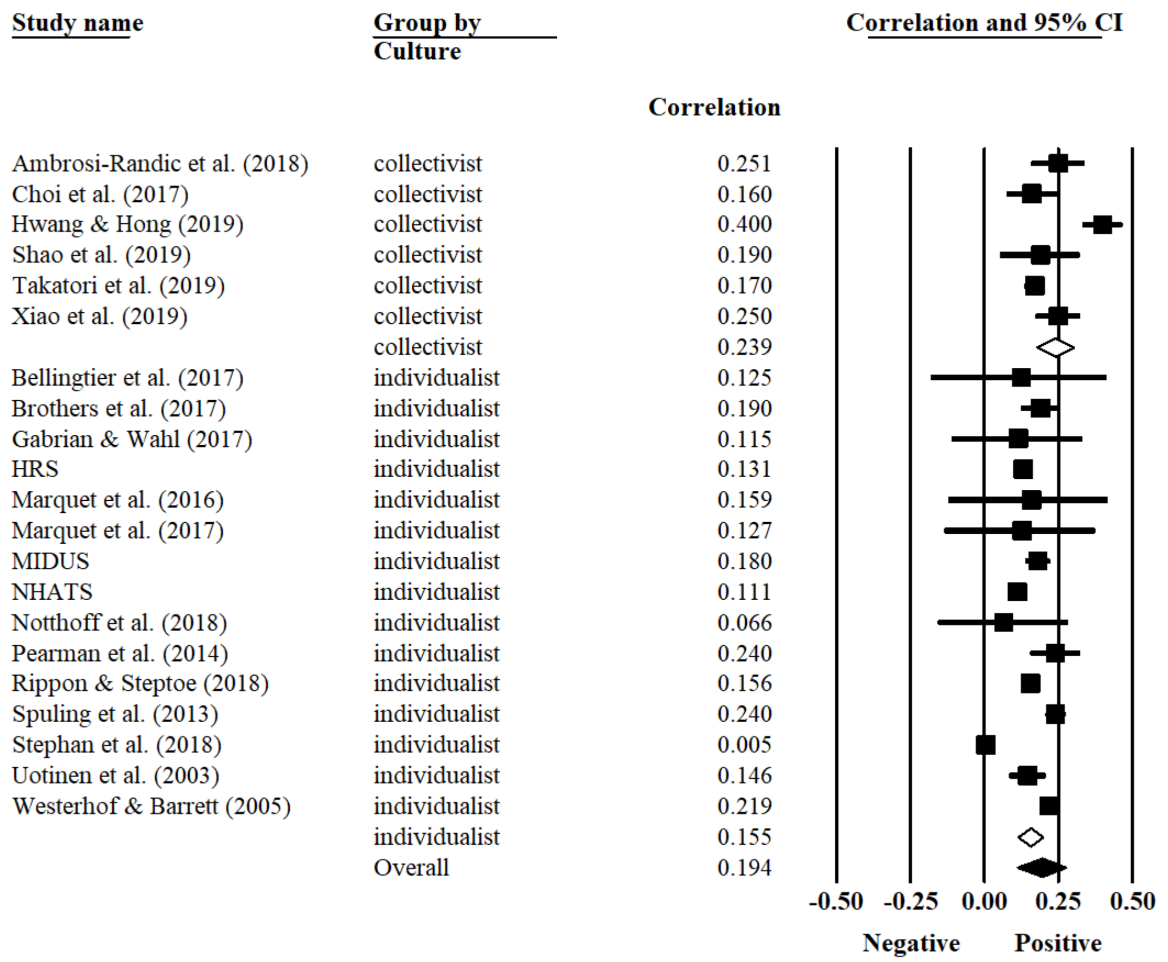


Figure 4


Study name
Group by Culture
Correlation and 95% CI
Correlation
Ambrosi-Randic et al. (2018) collectivist 0.251
Choi et al. (2017) collectivist 0.160
Hwang & Hong (2019) collectivist 0.400
Shao et al. (2019) collectivist 0.190
Takatori et al. (2019) collectivist 0.170
Xiao et al. (2019) collectivist 0.250
collectivist 0.239
Bellingtier et al. (2017) individualist 0.125
Brothers et al. (2017) individualist 0.190
Gabrian & Wahl (2017) individualist 0.115
HRS individualist 0.131
Marquet et al. (2016) individualist 0.159
Marquet et al. (2017) individualist 0.127
MIDUS individualist 0.180
NHATS individualist 0.111
Notthoff et al. (2018) individualist 0.066
Pearman et al. (2014) individualist 0.240
Rippon & Steptoe (2018) individualist 0.156
Spuling et al. (2013) individualist 0.240
Stephan et al. (2018) individualist 0.005
Uotinen et al. (2003) individualist 0.146
Westerhof & Barrett (2005) individualist 0.219
individualist 0.155
Overall 0.194
-0.50 -0.25 0.00 0.25 0.50
Negative
Positive