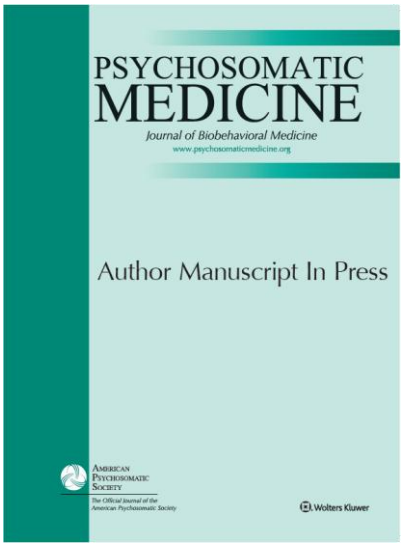

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The Impact of Subjective Well-Being on Mortality: A Meta-Analysis of Longitudinal Studies in the General Population

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Conflicts of Interest and Source of Funding

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ABSTRACT

Objective: To assess whether subjective well-being is a protective factor for mortality in the general population, and to analyze the differential impact of evaluative, experienced, and eudaimonic well-being.

Methods: Systematic review of articles in the PsycINFO, Web of Science, and PubMed databases. Data on the studies' characteristics, quality, and the effects of variables were extracted. A meta-analysis was conducted on the studies included in the systematic review.

Results: A total of 62 articles that investigated mortality in general populations, involving 1 259 949 participants, were found, and added to those considered in a previous published review (n=14). The meta-analysis showed that subjective well-being was a protective factor for mortality [pooled HR= 0.920; 95% CI = (0.905, 0.934)]. Although the impact of subjective well-being on survival was significant in both men and women, it was slightly more protective in men. The three aspects of subjective well-being were significant protective factors for mortality. The high level of heterogeneity and the evidences of publication bias may reduce the generalizability of these findings.

Conclusions: Our results suggest that subjective well-being is associated with a decreased risk of mortality. Longitudinal studies examining changing levels of well-being and their relationship to longevity would be required to establish a cause-effect relationship. Establishing such a causal relationship would strengthen the case for policy interventions to improve the population subjective well-being in order to produce longevity gains combined with optimizing quality of life.

Keywords: Subjective well-being, evaluative well-being, experienced well-being, eudaimonic well-being, mortality, longitudinal study, meta-analysis.

Acronyms:

WOS = Web of Science

HR = hazard ratio

RR = relative risk

CI = confidence interval

OR = odds ratio

ACROBAT-NSRI = The Cochrane Risk Of Bias Assessment Tool for Non-Randomized Studies of Interventions

ln = natural logarithms

BACKGROUND

Subjective well-being has been recognized as an important global health issue. The United Nations resolution on the Post-2015 Sustainable Development Agenda calls for, under the health goal, the ensuring of healthy lives and promotion of well-being for all, at all ages. More specifically, it has set a target (target 3.4) to promote mental health and well-being (1). Furthermore, the general goal of the World Health Organization Mental Health Action Plan 2013-2020 is to promote mental well-being and prevent mental disorders, and the Plan states that governments should put in place actions to protect and promote mental well-being at all stages of life (2).

Subjective well-being has been defined as a person's overall state, understood as a multidimensional concept including affective reactions as well as cognitive judgments (3). Three aspects of subjective well-being can be distinguished: evaluative well-being, i.e. the evaluation of life satisfaction; experienced well-being, referring to the positive and negative emotions that people experience in their lives (3); and eudaimonic well-being, which comprises the aspects of self-realization, sense of purpose and meaning in life (4). New approaches to the measurement of well-being have been developed in recent years, especially measurement of the experiential and eudaimonic aspects. Recent studies suggest that all three aspects predict lower future mortality (5). This might be due to the direct effects of positive feelings on behaviour and physiological systems that could help avoid diseases or death by changes in the immune and cardiovascular systems (e.g., through restful sleep, exercise, and a healthy diet), or the indirect effects of positive feelings that help people to cope with stressful events, which also could affect mortality (5-7).

There is a growing interest in studying the association between subjective well-being—understood as experiencing positive emotional states, being satisfied with life, and having a sense of meaning and purpose in life—and health. This is a two-way relationship, with subjective well-being influencing health, and health influencing subjective well-being (5, 8). Previous studies have shown that subjective well-being is linked to healthier lifestyles, might have a protective effect in health maintenance (9), and is associated with increased survival (10). Diener and Chan (11) have also shown that positive feelings predict longevity and health beyond negative feelings.

Many studies have concluded that depressive symptoms and depressive disorders are associated with a significantly increased risk of disability, stroke morbidity, and total mortality (12, 13). However, literature examining the link between dimensions of subjective well-being and health and mortality is scarce, even though recent years have seen an increase in interest. Taylor et al. (14) found that positive psychological beliefs—such as a sense of meaning, personal control and optimism—act as protective factors in AIDS patients and correlate positively with an increase in survival. Moreover, studies have shown that people with higher subjective well-being suffer lower levels of pain (15), seem to be protected against stroke and cardiovascular disease (7), and have a longer life expectancy (16).

Regarding healthy populations, research has shown that individuals' subjective well-being is associated with stability and family satisfaction, satisfaction with interpersonal relationships, job performance, and good health and longevity (17). Taylor et al. (14) proposed that subjective well-being is associated with better mental health

and a greater resistance to disease, and they may even increase the life expectancy of patients with chronic diseases.

Chida and Steptoe (18), in a review of prospective observational studies published until 2007 that analyzed the relationship between subjective well-being and mortality, found that positive psychological well-being had a favourable effect on survival in both healthy and clinical populations. Another review, by Veenhoven (19), also found that subjective well-being predicts longevity in healthy populations. However, a more recent large study of older women has found that subjective well-being has no direct effect on mortality after adjusting for self-rated health, treatment for several chronic conditions, and socio-demographic and lifestyle factors (20). Nevertheless, to our knowledge, no meta-analysis has been carried out to estimate the differential impact on mortality of the three components of subjective well-being (evaluative, experienced and eudaimonic).

The aim of the present review was to corroborate whether subjective well-being is a protective factor for mortality; to analyze the differential impact of evaluative, experienced, and eudaimonic well-being on mortality; and to examine whether the protective effect of subjective well-being is different for men and women in the general population.

METHODS

Data Sources and Searches

Following the methodology employed by Chida and Steptoe (18), we produced a protocol, using the recommended method for systematic reviews (21, 22) of

observational studies. We searched the following electronic databases: 1) PubMed, a database from the US National Library of Medicine (www.nlm.nih.gov/); 2) PsycINFO, a database of psychological literature (www.apa.org/psycinfo); and 3) Web of Science (WOS), a set of bibliographic databases and other resources covering all fields of academic knowledge. Moreover, we contacted the authors of some of the articles included to obtain unpublished data required for the review. Fourteen investigators from fourteen articles were contacted, of which twelve replied (85.71%), but only seven of the total of researchers contacted (50.0%) had access to and provided the data requested.The different search strategies were described in the Appendix.

The search was supplemented by a manual search to locate articles that had not been identified in the computerized searches. Articles extracted in previous systematic reviews were also included (18, 19). As ways of expanding on previous research by Chida and Steptoe (18), this systematic review also included the exploration of eudaimonic constructs, such as self-realization, purpose in life, and personal growth. Moreover, no language restriction was done in the search or in the inclusion of articles, so this review included studies published in any language.

Criteria for considering studies for the review:

The selection criteria for the studies were:

Study population: 1) human; 2) healthy.

Study design: 1) longitudinal observational study; 2) prospective cohort design; 3) follow-up study; 4) meta-analyses; 5) systematic reviews; 6) editorial; 7) letter; 8) column/opinion; 9) comment/reply.

Formal criteria: 1) full-length publication in any language in a peer-reviewed journal; 2) investigation of a potentially causal association of positive psychological factors with mortality.

The exclusion criteria for the studies were:

Study population: 1) clinical; 2) non-human population; 3) studies classifying measures of self-rated health or functional status as indicators of subjective well-being, because these factors incorporate physical health into the measure; 4) studies not directly evaluating positive psychological factors (thus, we did not regard a reversed indicator of negative affect as subjective well-being, e.g., hopelessness versus hopefulness; pessimism versus optimism; fatigue versus vitality/vigour); 5) studies investigating death by suicide, injury, or accident, because the present review principally focused on disease-related death.

Study design: 1) psychometric studies (development or validation of questionnaires or scales); 2) studies of phase-I/II clinical trials; 3) primary prevention studies; 4) ecologic studies; 5) cross-sectional studies; 6) case report/case series; 7) retrospective case-control studies; 8) papers with shorter follow-up, smaller sample size, or poorer study quality of a cohort overlapped across studies.

Publication type: 1) theses; 2) books or book sections.

Data Collection Procedures and Quality Assessment

The data collection process comprised three subsequent steps. Firstly, the prospective and longitudinal studies investigating the effect of subjective well-being on

mortality in healthy population were identified; studies that did not meet all the inclusion criteria, according to the information provided in their title and abstract, were excluded. One of the investigators checked the abstracts of the retrieved studies for inclusion. The references were then transferred to a software package for managing bibliographies, and the duplicates were removed. Each paper was coded as either included or excluded, with a secondary code reporting the reason for rejection. A random sample of 20% of retrieved abstracts was double-checked by a second researcher. Initial disagreements were resolved by a discussion between the two reviewers; if necessary, they were settled by consulting a third reviewer. Secondly, we reviewed the criteria for inclusion of studies through the complete reading of the retrieved publications. Finally, the information extracted was analyzed. Throughout this work the term "articles" will be used for papers found in the first systematic review while the word "studies" will be employed for papers included in the meta-analysis where the analysis and the effect sizes are provided separately for men and women or for different nationalities or types of subjective well-being (evaluative/experienced/eudaimonic). Moreover, if more than one type of mortality was assessed in a single article, all-cause mortality was chosen in case this category was reported; otherwise, the other causes of mortality were selected. In the case of several models controlling for different covariates, the most complete adjustment for potential confounders was selected. Finally, if the article reported mortality in different periods of time, the longest period was selected. When the study classified the participants into several groups according to their subjective well-being level (resulting in a categorical well-being variable), the hazard ratio (HR) or relative risk (RR) was extracted, comparing the highest with the lowest (reference group) subjective well-being category.

Studies were classified by the aspect of subjective well-being (evaluative, experienced, or eudaimonic) measured. Evaluative well-being studies were considered those evaluating individuals' thoughts about their lives, whereas experienced well-being studies were considered those assessing the positive emotions that people experience in their lives (23). Those that focused on judgments about the meaning and purpose of life were classified as measuring eudaimonic well-being (24).

The quality of the studies was assessed with a protocol based on The Cochrane Risk Of Bias Assessment Tool for Non-Randomized Studies of Interventions (ACROBAT-NSRI) (25). This scale examines bias in seven domains through three stages: pre-intervention, at-intervention and post-intervention. The final output offers five levels of risk of bias: low risk, moderate risk, serious risk, critical risk, and no information on which to base a judgement. We omitted three items for not being applicable: bias in measurement of interventions, bias due to departures from intended interventions, and bias due to missing data (since the dependant variable was mortality and most studies ascertained it through death registries, they did not have missing data, and the potential bias originated by cause of death was evaluated in the item of bias in measurement of outcomes). For the remaining items, we marked an article with low risk of bias if it adjusted for confounders considered to be important; in this case, because of their strong association with mortality, we opted for age, sex, health status (considering chronic diseases as a possible indicator), socioeconomic status (considering education and occupation as proxy variables), presence of depressive or anxiety symptoms, and smoking. For bias in selection of participants into the study, we observed whether it counted with consecutive or random recruitment of participants or representative

populations. We also checked bias in measurement of outcomes (complete assessment of vital status or death register) and of explanatory variables (ascertainment of subjective well-being by validated instruments or clinical examination). Finally, we took into account bias in selection of the reported result. At the end of these steps, we reached an overall judgement about risk of bias for each study included in the revision following Cochrane criteria (25). If the manuscript was referring to a previous study explained in another article, we searched the original study to check these data.

Statistical Analysis

The kappa coefficient (26) was employed as the statistical measure of inter-rater agreement; 95% confidence interval (CI) for the kappa statistic was calculated using an analytical method (27). The kappa value can be interpreted as follows (28): ≤0.20, poor; 0.21-0.40, fair; 0.41-0.60, moderate; 0.61-0.80, good; and 0.81-1.00, very good.

The meta-analysis was carried out over the final number of studies included in the systematic review and the studies considered in the meta-analysis carried out by Chida and Steptoe (18) that were conducted in healthy populations. Descriptive characteristics in these studies were reported.

HR (and in some cases RR) and 95% CI were obtained as effect size measures, and were combined for the meta-analysis. We used the results of the original studies from multivariate models with the most complete adjustment for potential confounders. Studies that reported Odds Ratios (OR) were included in a separated meta-analysis, since hazard ratios obtained from Cox regression are different from and cannot be used

interchangeably with the odds ratios obtained from logistic regression (29). In each case, HRs were transformed by taking their natural logarithms (ln). Standard errors were calculated from ln (HR) and corresponding CIs. Random effects modelling was employed to meta-analyze the data because the effect of a wide range of subjective well-being measures was compared, since this can provide more conservative results than a fixed effects model (30). Random effects models take into account the amount of variance caused by differences between studies, as well as differences among participants within studies. The inverse variance weighted method (31) was used to obtain an overall effect size and 95% CI.; in this approach, the weight given to each study is the inverse of the variance of the effect estimate. Thus larger studies are given more weight than smaller studies, which have larger standard errors. The choice of this type of weight minimizes the imprecision of the pooled effect estimate. In order to assess the differential effect of subjective well-being on mortality by gender and the differential effect of evaluative, experienced, and eudaimonic well-being, two similar meta-analyses were conducted on: 1) studies that were carried out exclusively in men or women; and 2) studies that assessed evaluative, experienced, and eudaimonic well-being. Instruments that assessed simultaneously different aspects of well-being (evaluative, experienced or eudaimonic), were not taken into account in the subgroup analysis by type of subjective well-being, since it was not possible to distinguish the type of well-being assessed.

Heterogeneity between studies was assessed by means of Cochran's Q test at a significance level of $p < 0.10$ (32) and quantified by the I^2 statistic, with values of 50% or more indicating a substantial level of heterogeneity (33). Cochran's Q tests whether

the between-study variability in effect size exceeds that expected from corresponding within-study variability, while the I^2 statistic quantifies the proportion of the total variation due to that heterogeneity. A random-effects meta-regression was used to explore sources of heterogeneity and to identify study characteristics that influenced the association between subjective well-being and mortality. The following characteristics were employed in the meta-regression: sample size (in thousands), gender of the sample (male, female or both), follow-up duration (in years), year of publication (centering the variable in 2008, when Chida and Steptoe's meta-analysis (18) was published), and quality of the study (low vs. moderate or serious risk of bias).

Potential publication bias was assessed by the application of Egger's linear regression test (34) and Begg's rank correlation test (35). Egger's test examines whether the association between estimated intervention effects and a measure of study size (such as the standard error of the intervention effect) is greater than might be expected to occur by chance; Begg's rank correlation test assesses the correlation between test accuracy estimates and their variances. A funnel plot was constructed by plotting the effect measure against the inverse of its standard error and including the fitted regression line from the Egger's test for small study effects. An asymmetric plot indicates a likely publication bias, and $p < 0.05$ is considered representative of statistically significant publication bias.

As a sensitivity analysis, the magnitude of the effect associated with subjective well-being on mortality was assessed separately in studies with low risk of bias and studies with moderate or serious risk of bias.

Meta-analysis was conducted in Stata version 11 (36), using the *metan*, *metabias* and *metareg* commands.

RESULTS

Figure 1 shows results obtained from the three search strategies (PubMed, PsycINFO and WOS). After excluding duplicates, 6 028 articles were identified as potentially relevant, and screened for retrieval. A total of 113 articles were retrieved for a more detailed evaluation, and 62 were included in the final systematic review.

Table S1 and Table S2 (Supplemental Digital Content, http://links.lww.com/PSYMED/A353), respectively detail the articles that were included (n = 62) and excluded (n = 51), in the systematic review. The articles were included as separate studies if they mentioned more than one subjective well-being components or conducted different analyses based on gender or nationality. A total of 87 studies were identified in the systematic review. Six studies that provided Odds Ratios (OR) instead of HR or RR (codes 16, 18 39, 52 and 56a-b, according to the notation in Table S1), were analyzed separately. Seven studies were excluded from the meta-analysis (codes 9a-b, 47b, 57, 60-62), after consultation with the authors, because effect sizes were not provided.

Finally, 74 studies derived from the 62 articles identified in the systematic review were included in the meta-analysis, 70 of them reporting HR and only 4 reporting RR (48a-b-c and 59). HR and RR were considered interchangeable effect size measures and were combined in order to carry out the meta-analysis. Table S3 (Supplemental Digital

Content, http://links.lww.com/PSYMED/A353) shows the characteristics of the 16 studies collected by Chida and Steptoe (18), conducted in healthy populations until 2007; these 16 studies were derived from 14 articles and were also included in the meta-analysis, resulting in a total of 90 studies. For the analysis by type of well-being, 13 studies were excluded because they used measures that mixed different aspects of well-being in the same instrument (codes 8, 17a, 21, 22, 26a-b, 27a, 29a, 34 and 59 in Table S1 and 67a-b and 74 in Table S3).

Study Characteristics and Quality Corresponding to the Studies Included in the Present Meta-Analysis

The percentage of agreement between the two independent researchers regarding whether to include or exclude each article was 99.0%. Kappa coefficient was 0.71 [95% CI = (0.55, 0.87)], indicating a good agreement.

The main descriptive characteristics of the studies finally included in the meta-analysis are shown in Table 1. Results from the 90 studies were analyzed in the present meta-analysis, involving participants from different continents (America, Asia, Europe and Oceania). More than half of the studies examined the effects in both genders together (55.6%), whereas the rest reported the effects only in men (21.1%) or in women (23.3%).

The relationship between subjective well-being and risk of mortality was evaluated in 1,309,527 participants. In 52 of the 90 studies (52.0%), the follow-up period was longer than ten years. All-cause mortality was the most common measure of

mortality, followed by cardiovascular disease, fatal coronary heart disease and other causes. The proportion of studies showing a significant protective effect of subjective well-being on mortality was 57.8%, representing more than half of studies. Only one study (1.1%) found a negative association between subjective well-being and mortality; specifically, the one that measured anticipation of future life satisfaction, and found that people who predicted that they would have a greater life degree of satisfaction in the future than they actually had when they were assessed at that future point in time presented an increased risk of dying by about 10% for every 1 SD increase in overestimating one's future life satisfaction (37).

Eudaimonic and evaluative well-being were the aspects most frequently assessed, each representing approximately a third of all studies. Overall, eudaimonic well-being was assessed in 40.0% of the cases, followed by evaluative well-being, assessed in 30.0% of the studies, whereas experienced well-being was assessed in 15.6% of the cases.

Table S4 (Supplemental Digital Content, http://links.lww.com/PSYMED/A353) shows the quality of each article included in the meta-analysis (without dividing in separate studies by type of subjective well-being, gender or nationality), assessed using the ACROBAT-NSRI tool of Cochrane methods group. More than half of these studies were qualified with moderate risk of bias (63.3%). A small percentage obtained a serious risk of bias (10.0%), while the remaining 24 studies (26.7%) presented a low risk of bias.

Study Results and Meta-Analysis

The results of the pooled analyses, encompassing studies included by Chida and Steptoe (18), are shown in Figure 2 and displayed as a square with a horizontal line, representing the estimated effect and its confidence interval. Individual study symbols are proportional in size to study weights, i.e., the area of the square reflects the weight that the study contributed to the meta-analysis. The pooled HR relative to the effect of subjective well-being on mortality was 0.920 [95% CI = (0.905, 0.934); $p < 0.001$]. Cochran's Q test was significant ($\chi^2(89) = 620.0$, $p < 0.001$), and the level of heterogeneity found was high ($I^2 = 85.6\%$), indicating that the use of a random effects model is more appropriate than the use of fixed effects.

An additional meta-analysis was conducted on the five studies that reported ORs and 95% CI for ORs (codes 16, 18, 39, 56a-b, according to the notation in Table S1; code 52 was not included because 95% CI or standard error for OR estimate were not available). The results found were similar to the findings obtained in the meta-analysis conducted over the HRs. The pooled OR associated with the effect of subjective well-being on mortality was 0.790 [95% CI = (0.657, 0.950); $p = 0.012$], being well-being a protective factor for mortality. Cochran's Q test was significant ($\chi^2(4) = 22.35$, $p < 0.001$), and the level of heterogeneity found was high ($I^2 = 82.1\%$), providing evidences for the use of a random effects model in this case.

According to the results obtained in the meta-regression, year of publication was the only characteristic with a significant effect on the relationship between subjective

well-being and mortality [coef. =1.017, 95% CI = (1.003, 1.031); p = 0.019], indicating a relationship between publication in recent years and effect size.

Begg's rank correlation test indicated no publication bias (p = 0.25); however, Egger's linear regression suggests strong evidence for publication bias and small-study effects: the estimated intercept for the fitted regression model was -3.23 with a standard error of 0.41, giving a p-value lower than 0.001. Publication bias is illustrated in Figure 3, where the funnel plot appears asymmetric. In general terms, and according to the fitted regression line, studies with smaller sample sizes (those with larger standard errors) tended to have lower HR, indicating that these studies found that subjective well-being is a preventive factor for mortality.

Subjective well-being was a significant protective factor for mortality in both genders, after conducting the meta-analyses over the studies that included only men or women in their samples (Figure 4). The pooled HR in men was 0.839 [95% CI = (0.779, 0.904); $p < 0.001$], whereas in women it was 0.897 [95% CI = (0.850, 0.948); $p < 0.001$], indicating that subjective well-being was a slightly more important protective factor in men than in women. Cochran's Q test was significant in studies conducted in men ($\chi^2(18) = 89.20$, $p < 0.001$) and women ($\chi^2(20) = 70.94$, $p < 0.001$). The level of heterogeneity was high in both cases, but higher in the studies conducted in men (I^2 = 79.8%) than in the studies conducted in women (I^2 = 71.8%).

Regarding the type of subjective well-being (Figure 5), the three aspects were found to be significant protective factors: for eudaimonic well-being, the pooled HR

was 0.929 [95% CI = (0.913, 0.946); $p < 0.001$]; for evaluative and experienced well-being, pooled HRs were 0.882 [95% CI = (0.827, 0.940); $p < 0.001$] and 0.917 [95% CI = (0.857, 0.982); $p = 0.013$], respectively. These estimates did not significantly differ, as shown by the overlap of the corresponding 95% confidence intervals. Cochran's Q test was significant in studies assessing evaluative (χ^2 (26) = 166.42, $p < 0.001$), experienced (χ^2 (13) = 46.77, $p < 0.001$), and eudaimonic (χ^2 (35) = 264.07, $p < 0.001$) well-being, with I^2 values of 84.4%, 72.2%, and 86.7%, respectively.

Considering only the studies with low risk of bias ($n = 24$), the effect of subjective well-being on mortality remained protective: pooled HR = 0.881 [95% CI = (0.829, 0.936); $p < 0.001$], whereas the pooled HR for the studies with moderate or serious risk of bias ($n = 66$) was 0.928 [95% CI = (0.913, 0.944); $p < 0.001$]. In both cases, a strong relationship between higher subjective well-being and lower mortality was observed. Cochran's Q test was significant in both cases [(χ^2 (23) = 76.19, $p < 0.001$; and (χ^2 (65) = 496.66, $p < 0.001$, respectively], while I^2 values were 69.8% and 86.9%.

DISCUSSION

Our results provide further evidence that subjective well-being is associated with a decreased risk of mortality. However, unlike other accumulated evidence in previous studies, which showed a significant association either in men only (38-45), or in women only (46, 47), we found a protective relation in both, although it was slightly higher in men. These protective results in both men and women were reported by only four of the articles included in this meta-analysis (48-51).

Positive hedonic states, life evaluation, and eudaimonic well-being were all associated with increased survival. Evaluative well-being was found to be more associated with a decreased risk of mortality than the other aspects, although the estimates associated with the three components of subjective well-being did not significantly differ. On the other hand, more studies that evaluate experienced well-being are needed in order to draw definite conclusions, since there is only a small number of studies (in comparison with the other two components) assessing the component of experienced well-being. Even though some of the articles considered in this review evaluated two components of subjective well-being (52-54), none of them incorporated the three aspects. Therefore, studies that incorporate all three aspects within the same study are also needed in order to ascertain their differential relationship regarding mortality and how they operate together, taking into account that they are highly associated (55).

In the present study, the number of articles found in the last decade was higher than before, which shows the increase in interest in this area over recent years especially in the field of eudaimonic well-being (56). This is in line with recent findings about the state of the art in European well-being research in the mental health field (57). The rising interest in well-being is not only seen at the scientific level, but also at the social and political levels. Several international economic commissions have recommended that economic measurement systems should shift emphasis from measuring economic production to measuring people's well-being (58, 59), and many countries are starting to systematically evaluate the well-being of their populations and are using this information to guide their public policies (10).

The present meta-analysis has several strengths, such as the large number of studies analyzed and the updating of the previous data regarding the impact of subjective well-being on mortality in healthy populations. The differential relationship of the type of subjective well-being has also been evaluated, providing new knowledge about the different associations of each aspect of well-being on mortality. In addition, as ways of expanding the previous research conducted by Chida and Steptoe (18), this meta-analysis also included studies written in any language, and the exploration of eudaimonic constructs (such as self-realization, purpose in life, and personal growth), as well as a more in-depth quality analysis. Furthermore, good agreement was found between the reviewers who conducted the meta-analysis.

Nevertheless, our results must be interpreted taking into account some limitations. We found evidence of publication bias according to Egger's linear regression test, indicating that studies with higher standard errors found a stronger relationship between subjective well-being and survival. Furthermore, the present review found that the methodological quality of the included studies was generally poor. Almost two thirds of the studies had a moderate risk of bias, which indicates that cautions must be taken when interpreting the results. Since the low quality of the studies increases the likelihood of overestimating effect size (60), a sensitivity analysis that considered studies with a low risk of bias and studies with a moderate or serious risk of bias separately was carried out; in both cases a strong relationship between higher subjective well-being and lower mortality was obtained. Nevertheless, in light of the low quality, more rigorous studies are warranted. Due to the levels of heterogeneity found throughout the different meta-analyses conducted, the conclusions based on the results

obtained should be interpreted cautiously. The I^2 statistic values obtained indicate that the variability across studies is due to heterogeneity rather than chance. Some reasons for the high level of heterogeneity found can be related to the different instruments for assessing well-being that have been considered across the studies, the different covariates used in each study to control their effect in the association between subjective well-being and mortality, and the year of publication of the studies (as found in the random-effect meta-regression conducted). Random effect models have been used in the different meta-analyses conducted in the present review to allow for heterogeneity across studies and produce wider confidence intervals than those obtained with fixed effect models. The random effects model is more conservative than the fixed effect model (61) and assumes that each sample comes from a different population and that the effects in these populations may also differ (62). However, despite of the use of this statistical framework, the presence of heterogeneity across the different studies considered in this meta-analysis should be contemplated as a potential limitation of the present work. Additionally, as we were focused on articles published in peer reviewed journals, we did not include grey literature or doctoral theses. The inclusion of these sources does not guarantee the reduction of the publication bias (63) and could have restricted the validity of the results of the meta-analysis.

Another limitation of the present review is that in some of the studies identified there was some information missing, such as confidence intervals for the HRs and in some cases we were not able to retrieve that data despite having tried to contact the authors. We also found four articles using a different measure of effect size (odds-ratio) which could not be pooled in the same meta-analysis with HR (64). We conducted a

separated analysis on the studies derived from these articles and we obtained findings in the same direction than those obtained using HRs, supporting the evidences for a longitudinal relationship between subjective well-being and mortality. Finally, an additional limitation is that the age effect has not been analyzed in detail because even though the majority of studies included older people, they reported results only for the total sample undifferentiated by age. Future studies should report the results for age groups, due to the age-related well-being paradox identified in previous research (65). This requires attention to sampling designs so that studies include sufficient numbers of people in different age strata, particularly in the oldest groups.

Common limitations of many of the studies included in the present review are the lack of control for health status or important covariates such as depression or anxiety, the absence of information about how mortality was ascertained or the evaluation of well-being by a single question that has not been previously validated. Moreover, some of these covariates are very difficult to measure accurately, such as daily fruit and vegetable intake (in the absence of detailed food diaries or similar elaborate approaches), or past participation in health screening; therefore, residual confounding remains an issue. It should also be emphasized that our review was focused on observational studies, so causal conclusions cannot be drawn. The associations between subjective well-being and survival could be due to unmeasured confounding factors. In addition, in all studies subjective well-being was assessed on a single occasion, and the stability of positive states was not examined. Future research should preferably employ fully adjusted models, give complete information about death records and use validated instrument to assess well-being in order to be able to draw more accurate conclusions.

CONCLUSIONS

Our results suggest that subjective well-being might be associated with a decreased risk of mortality. Longitudinal studies examining changing levels of subjective well-being and their relationship to longevity, while controlling for other risks, would be required to establish a cause-effect relationship. Establishing such a causal relationship would strengthen the case for policy interventions to improve the population subjective well-being in order to produce longevity gains combined with optimizing quality of life, since public health policies rarely attempt to improve subjective well-being. Strategies to reduce mortality and improve health may not necessarily need to target health directly, in other words, it would be possible to affect health by making people experience more positive emotions in their daily lives, e.g., encouraging people to engage in active leisure activities that are associated with a higher level of positive affect (66). Because of the importance and malleability of subjective well-being, further research should focus on designing and evaluating the impact of interventions intended to improve the subjective well-being of the population, an important step related to living longer.

APPENDIX

Search strategies in PubMed, PsycINFO and WOS databases:

PubMed: ((“mortality” OR “survival*”) AND (“positive life orientation” OR “at ease” OR “calm” OR “cheerful” OR “elated” OR “energetic” OR “enjoy” OR “enthusiastic” OR “excite*” OR “fondness” OR “happi*” OR “happy” OR “joy” OR “jovial*” OR “lively” OR “love” OR “hopeful” OR “optimis*” OR “pep” OR “pleas*” OR “positive affect” OR “positive emotion” OR “relaxed” OR “satisf*” OR “surgency”

OR “vigor” OR “well-being” OR “self-realization” OR “personal growth” OR “purpose in life”) AND (“longitudinal” OR “prospective” OR “cohort” OR “predict*”)). AND: Publication date: 1950/01/01 to 2015/04/30. AND: Humans.

PsycINFO: ((“mortality” OR “survival*”) AND (“positive life orientation” OR “at ease” OR “calm” OR “cheerful” OR “elated” OR “energetic” OR “enjoy” OR “enthusiastic” OR “excite*” OR “fondness” OR “happi*” OR “happy” OR “joy” OR “jovial*” OR “lively” OR “love” OR “hopeful” OR “optimis*” OR “pep” OR “pleas*” OR “positive affect” OR “positive emotion” OR “relaxed” OR “satisf*” OR “surgency” OR “vigor” OR “well-being” OR “self-realization” OR “personal growth” OR “purpose in life”) AND (“longitudinal” OR “prospective” OR “cohort” OR “predict*”)). AND: Publication date: January/01/1872 to April/30/2015 AND: Column-Opinion / Comment-Reply / Editorial / Erratum-correction / Journal / Journal Article / Letter / Peer Reviewed Journal / Peer Reviewed Status Unknown. AND: Follow-up Study / Prospective Study / Longitudinal Study / Meta-Analysis / Systematic Review. AND: Human.

WOS: ((“mortality” OR “survival*”) AND (“positive life orientation” OR “at ease” OR “calm” OR “cheerful” OR “elated” OR “energetic” OR “enjoy” OR “enthusiastic” OR “excite*” OR “fondness” OR “happi*” OR “happy” OR “joy” OR “jovial*” OR “lively” OR “love” OR “hopeful” OR “optimis*” OR “pep” OR “pleas*” OR “positive affect” OR “positive emotion” OR “relaxed” OR “satisf*” OR “surgency” OR “vigor” OR “well-being” OR “self-realization” OR “personal growth” OR “purpose in life”) AND (“longitudinal” OR “prospective” OR “cohort” OR “predict*”)). AND:

Period of time: 1900-2015. AND: Index: SCI-Expanded, SSCI, A&HCI. AND: Principal collection of WOS (without Conference Proceedings; Current Chemical Reactions; Index Chemicus) AND: Included: (Article AND Review AND Editorial material AND Letter).

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FIGURE CAPTIONS

Figure 1. Results obtained from the three search strategies and flow diagram of the systematic review.

Figure 2. Meta-analysis of the effect of well-being on mortality.

Note: Forest plot displaying an inverse-variance weighted random-effect meta-analysis.

Figure 3. Funnel plot of the ln effect size against its SE including the fitted regression line.

Note:

SE = Standard Error

ln= natural logarithm

Figure 4. Meta-analysis of the effect of well-being on mortality by gender.

Note: Forest plot displaying an inverse-variance weighted random-effect meta-analysis.

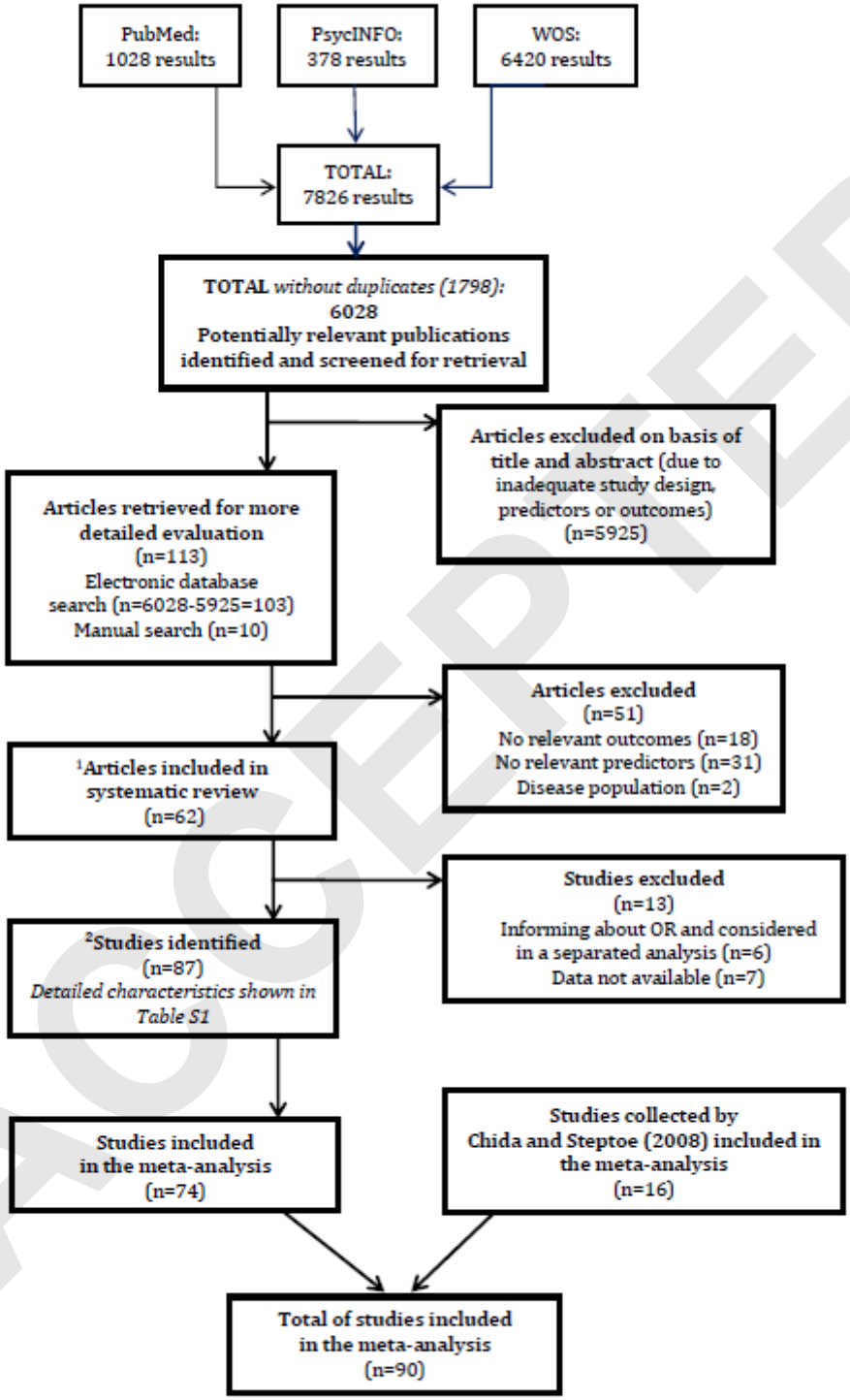
Figure 5. Meta-analysis of the effect of evaluative, experienced and eudaimonic well-being on mortality.

Note: Forest plot displaying an inverse-variance weighted random-effect meta-analysis.

List of Supplemental Digital Content:

Supplemental Digital Content. Table S1, Table S2, Table S3, Table S4 and references of supplemental tables. doc

Figure 1



Throughout this work: [1]Articles: papers found in the first systematic review. [2]Studies: if more than one variable of subjective well-being was assessed in a single article, or if the sample was divided by gender or nationality, the samples were included as separated studies.

Figure 2

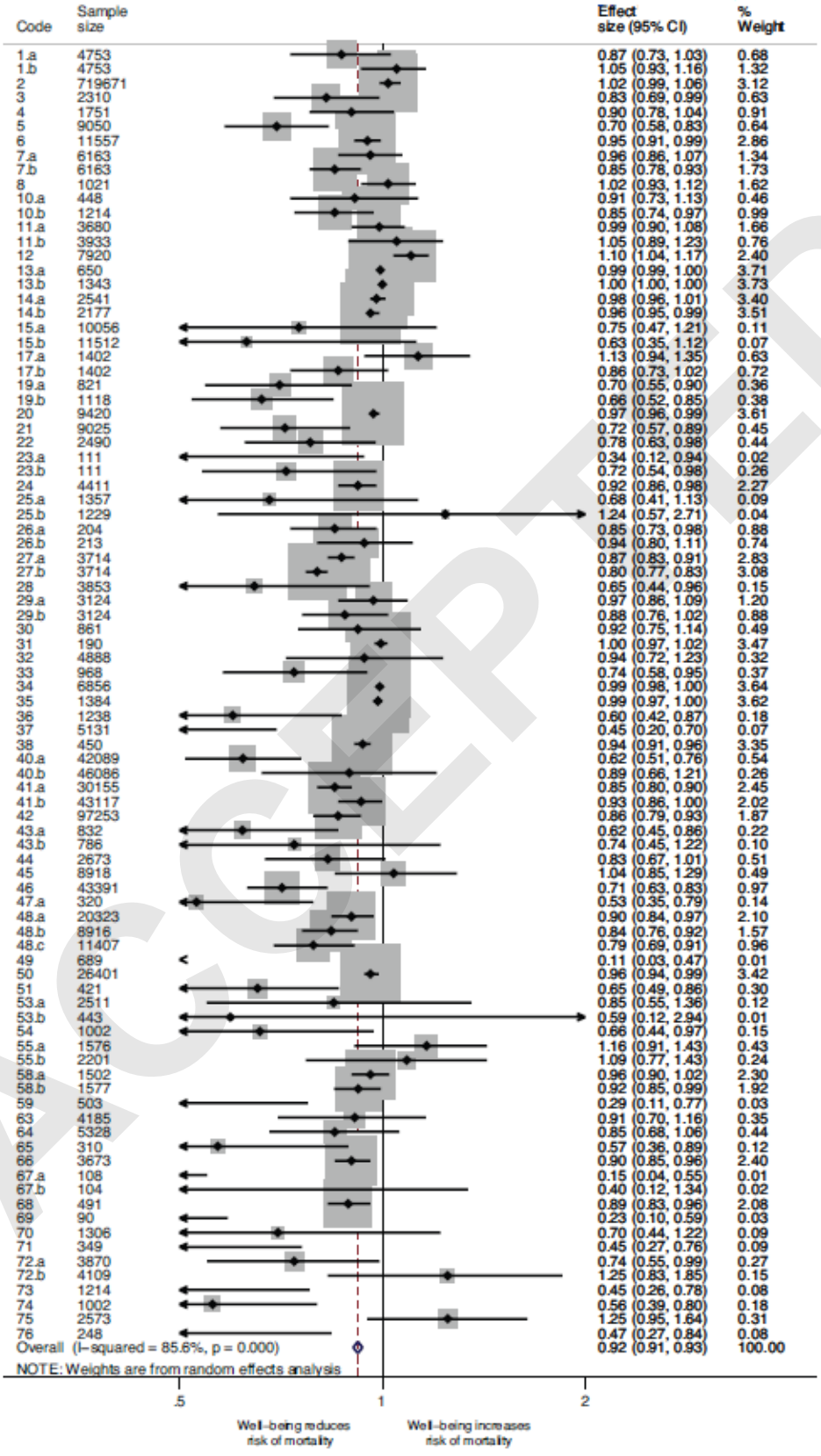


Figure 3

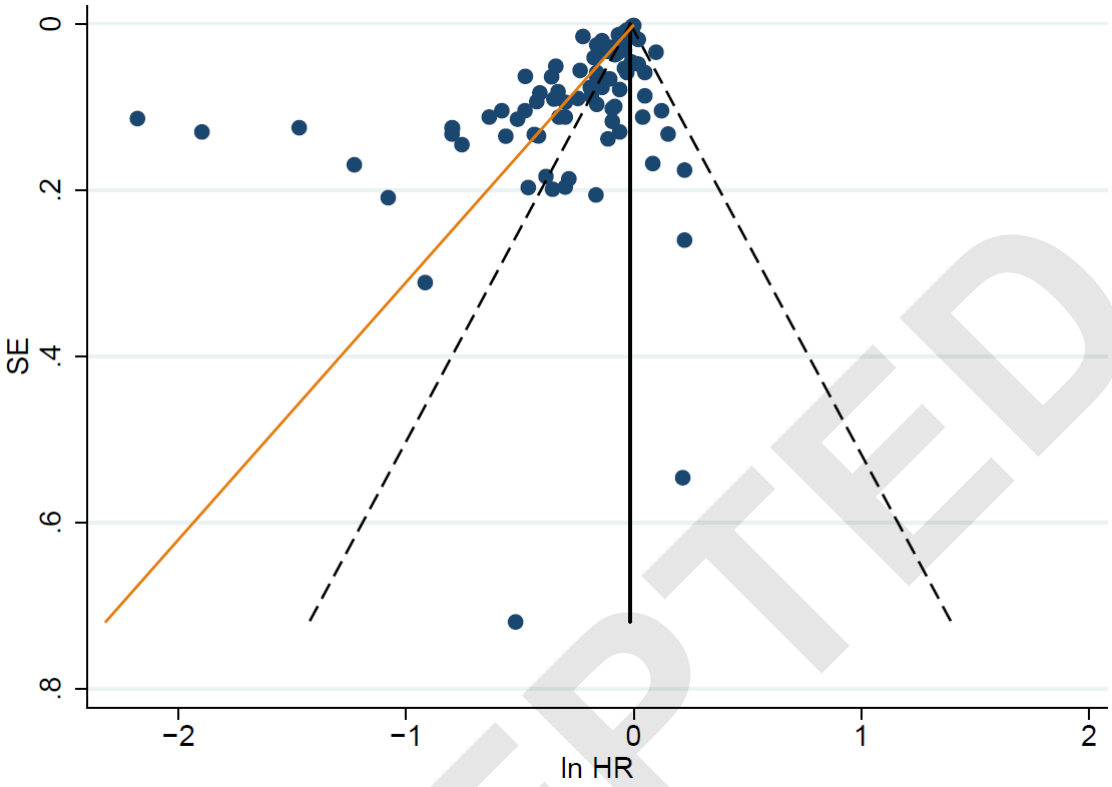


Figure 4

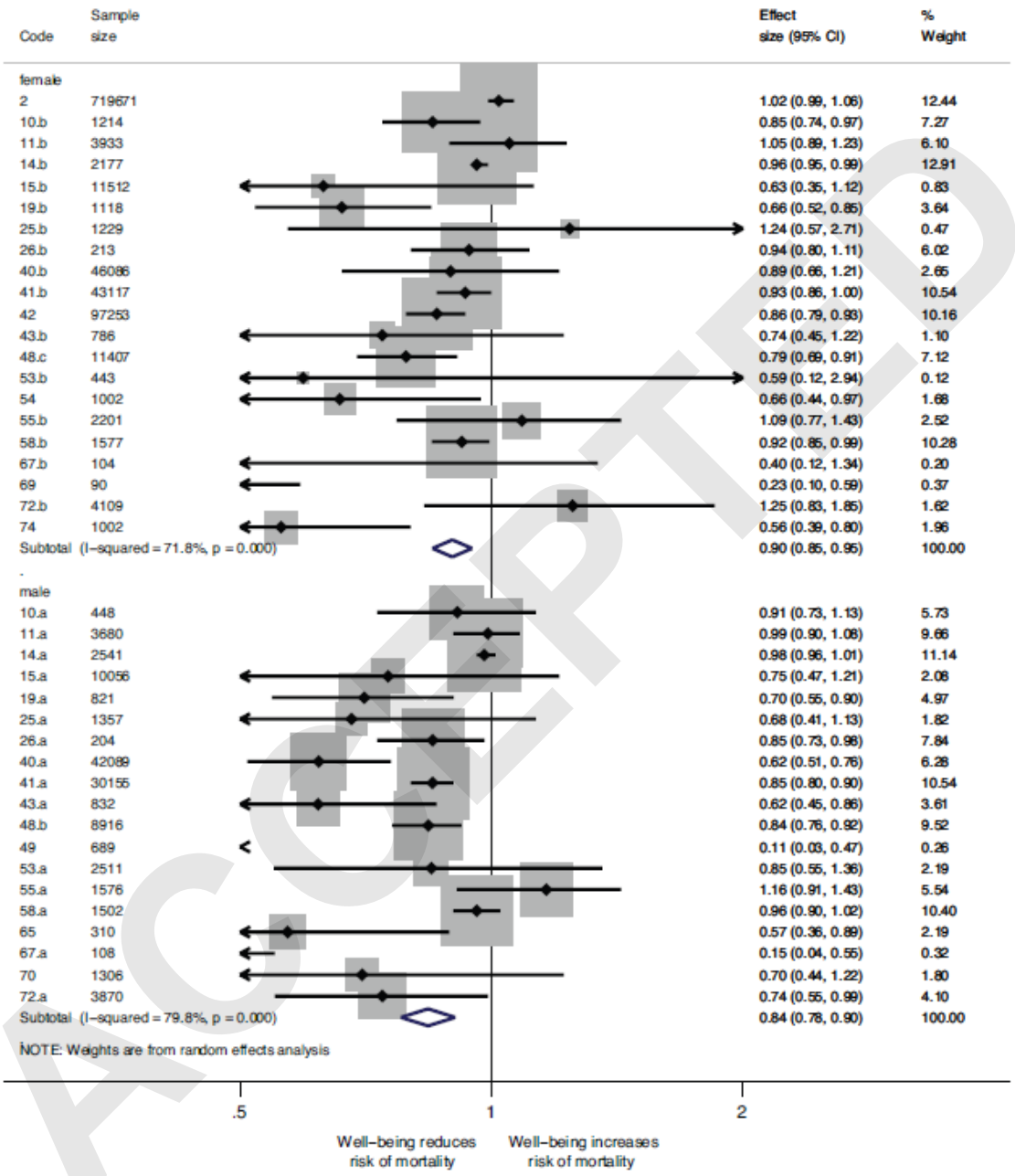


Figure 5

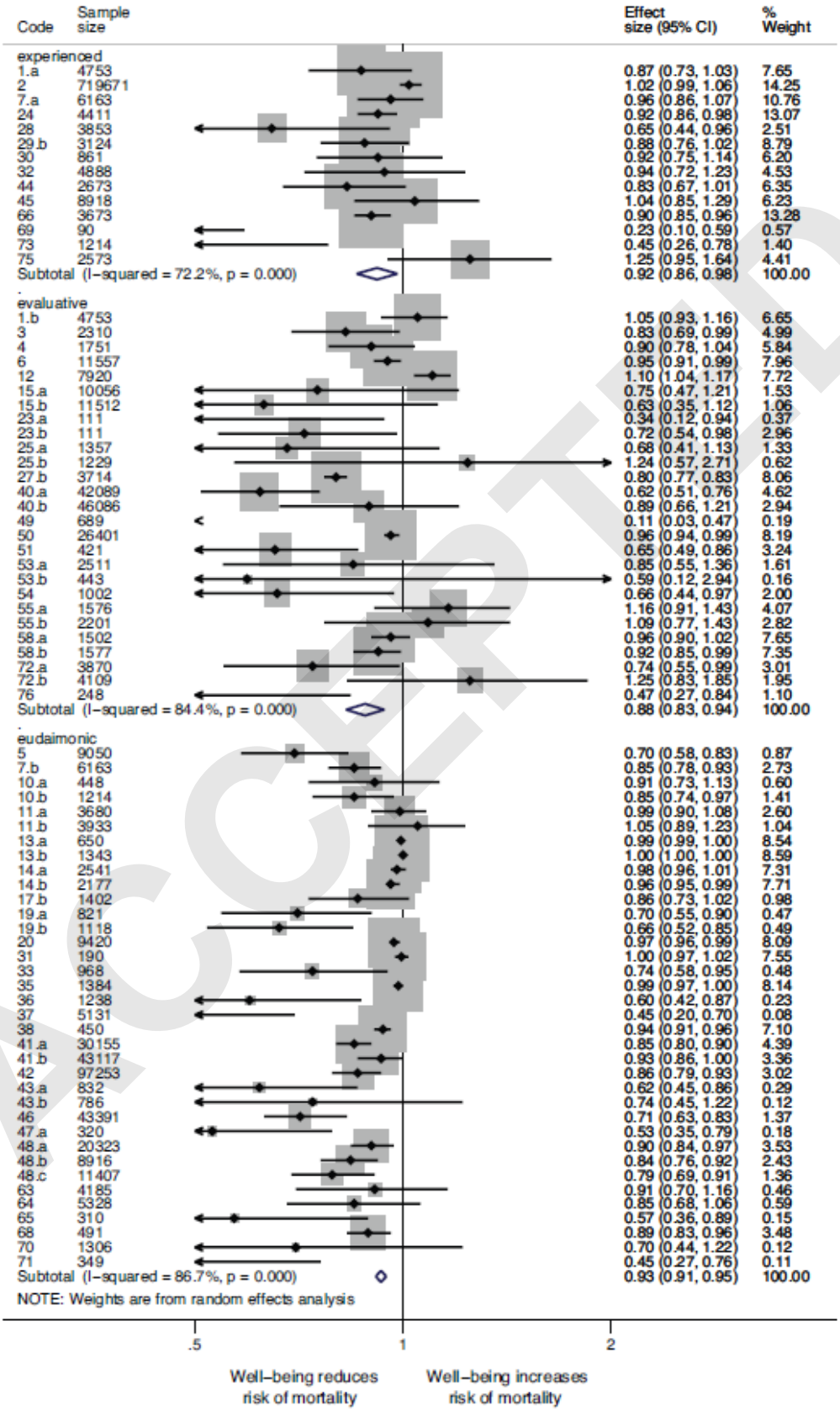


Table 1. Descriptive characteristics of the studies included in the meta-analysis.

Characteristics	**n=90** *(16 from Chida & Steptoe)*
Gender: n (%)	
Both	50 (55.6)
Males	19 (21.1)
Females	21 (23.3)
Sample size: n (mean ± SE)	1 309 527 (14 550.3 ± 8 053.1)
Both	246 312 (4 926.2 ± 1 051.7)
Males	112 971 (5 945.8 ± 2 560.1)
Females	950 244 (45 249.7 ± 34 110.6)
Follow-up period ≥10Y: n (%)	52 (57.8)
Subjective well-being: n (%)	
Evaluative well-being	27 (30.0)
Experienced well-being	14 (15.6)
Eudaimonic well-being	36 (40.0)
Mortality: n (%)	
All-cause mortality	70 (77.8)
Cardiovascular mortality	8 (8.9)
Fatal coronary heart disease	2 (2.2)
Other	10 (11.1)
Effect of subjective well-being on mortality: n (%)	
Protective (significant)	52 (57.8)
Null (not significant)	37 (41.1)
Harmful (significant)	1 (1.1)

Note: SE = Standard error; SD = Standard deviation; ≥10Y= Longer than ten years.

Table S1. Characteristics of the studies identified in the present systematic review.

Code	First author	Year	Cohort (Nation)	Follow -up	Well-being variable (instrument)	Covariates	Mortality	Results	Effect Size HR (95% CI)
1.a	Martín-María, N. (54)	2016	4753 mf (Spain)	3 Y	Positive affect (DRM)-Ex	Ag, Sx, Ex, BMI, S, Al, SES, HS, CD, Dep, DFV	All-cause (medical record)	±	0.870 (0.730, 1.030)
1.b	Martín-María, N. (54)	2016	4753 mf (Spain)	3 Y	Life evaluation-Ev	Ag, Sx, Ex, BMI, S, Al, SES, HS, CD, Dep, DFV	All-cause (medical record)	±	1.050 (0.930, 1.160)
2	Liu, B. (20)	2016	719671 f (United Kingdom)	10 Y	Happiness-Ex	Ag, Sx, Eth, Ex, BMI, S, Al, SES, MS, PH, CD, Dep, Anx	All-cause (medical record)	±	1.02 (0.990, 1.064)
3	Lee, M. C. (67)	2015	2310 mf (Taiwan)	8 Y	Income satisfaction-Ev	Ag, Sx, Eth, Edu, Empl, SES, MS	All-cause (medical record)	-	0.826 (0.690, 0.990)
4	St John P. D. (68)	2015	1751 mf (Canada)	5 Y	Life satisfaction (Terrible-Delightful scale)-Ev	Ag, Sx, Eth, Edu, PH, ADL	All-cause (medical record)	±	0.900 (0.780, 1.040)
5	Steptoe, A. (5)	2015	9050 mf (United Kingdom)	8.5 Y (mean)	Purpose in life (CASP)-Eu	Ag, Sx, Eth, Edu, Ex, Empl, S, Al, CD, Dep, SES, MS	All-cause (medical record)	-	0.697 (0.583, 0.833)
6	Guven, C. (69)	2014	11557 mf (Germany)	23 Y	Life satisfaction-Ev	Ag, Sx, Empl, SES, HS	All-cause (medical record)	-	0.950 (0.908, 0.994)
7.a	Hill, P.L. (52)	2014	6163 mf (USA)	14 Y	Positive affect (Mroczek and Kolarz)-Ex	Ag, Sx, Eth, Edu, SN	All-cause (medical record)	-	0.960 (0.860, 1.070)
7.b	Hill, P.L. (52)	2014	6163 mf (USA)	14 Y	Purpose in life (3 items Ryff scale of PWB)-Eu	Ag, Sx, Eth, Edu, SN	All-cause (medical record)	-	0.850 (0.780, 0.930)
8	Kern, M. L. (70)	2014	1021 mf (USA)	87 Y	Subjective well-being	Ag, Sx, Edu, Al, Depanx, SN	All-cause (medical record)	±	1.020 (0,930, 1.120)
9.a	Edjolo, A. (71)	2013	1054 m (France)	20 Y	Life satisfaction-Ev	Ag, Sx, Edu, Ex, BMI, S, Al, HS, PH, FB	All-cause (medical record)	±	Data not reported
9.b	Edjolo, A. (71)	2013	1504 f (France)	20 Y	Life satisfaction-Ev	Ag, Sx, Edu, Ex, BMI, S, Al, HS, PH, FB	All-cause (medical record)	±	Data not reported
10.a	Engberg, H. (46)	2013	448 m (Denmark)	12 Y	Dispositional optimism-Eu	Ag, Sx, CD, ADL	All-cause (medical record)	±	0.910 (0.730, 1.130)
10.b	Engberg, H. (46)	2013	1214 f (Denmark)	12 Y	Dispositional optimism-Eu	Ag, Sx, CD, ADL	All-cause (medical record)	-	0.850 (0.740, 0.970)
11.a	Haukkala, A. (72)	2013	3680 m (Finland)	17 Y	Sense of coherence (SOC)-Eu	Ag, Sx, Edu, MS, BMI, S, Al, CD, Dep	All-cause (medical record)	±	0.990 (0.900, 1.080)

11.b	Haukkala, A. (72)	2013	3933 f (Finland)	17 Y	Sense of coherence (SOC)-Eu	Ag, Sx, Edu, MS, BMI, S, Al, CD, Dep	All-cause (medical record)	±	1.050 (0.890, 1.230)
12	Lang, F. R. (37)	2013	7920 mf (Germany)	17 Y	Anticipation of future life satisfaction-Ev	Ag, Sx, Edu, SES, PH	All-cause (medical record)	+	1.103 (1.038, 1.172)
13.a	Li, C. P. (73)	2013	650 mf (United Kingdom)	14 Y	Life satisfaction (LSI-Z)-Eu	Ag, Sx, MS, SES, S, PH, CD, Dep, SN, ADL	All-cause (unknown)	-	0.993 (0.987, 0.999)
13.b	Li, C. P. (73)	2013	1343 mf (Taiwan)	14 Y	Life satisfaction (LSI)-Eu	Ag, Sx, MS, SES, S, PH, CD, Dep, SN, ADL	All-cause (unknown)	±	1.000 (0.996, 1.004)
14.a	Lin, H. W. (47)	2013	2541 m (Taiwan)	12 Y	Life satisfaction (LSI-A)-Eu	Ag, Sx, Edu, PH, CD, ADL, Freed	All-cause (medical record)	±	0.980 (0.960, 1.010)
14.b	Lin, H. W. (47)	2013	2177 f (Taiwan)	12 Y	Life satisfaction (LSI-A)-Eu	Ag, Sx, Edu, PH, CD, ADL, Freed	All-cause (medical record)	-	0.960 (0.950, 0.990)
15.a	Miething, A. (74)	2013	10056 m (Germany)	5 Y	Income satisfaction-Ev	Ag, Sx, Edu, SES, Empl, PH	All-cause (medical record)	±	0.752 (0.474, 1.205)
15.b	Miething, A. (74)	2013	11512 f (Germany)	5 Y	Income satisfaction-Ev	Ag, Sx, Edu, SES, Empl, PH	All-cause (medical record)	±	0.629 (0.352, 1.124)
16	Newall, N. (75)	2013	228 mf (Canada)	20 Y	Happiness-Ex	Ag, Sx, MS, SES, HS, Dep, ADL	All-cause (medical record)	-	1,000 (0.880, 1.130)*
17.a	Wiest, M. (76)	2013	1402 mf (Germany)	8 Y	Life satisfaction (SWLS)	Ag, Sx, Eth, Edu, Ex, MS, PH, CB	All-cause (medical record)	±	1.130 (0.940, 1.350)
17.b	Wiest, M. (76)	2013	1402 mf (Germany)	8 Y	Control beliefs (Dispositional Hope Scale)-Eu	Ag, Sx, Eth, Edu, Ex, MS, PH, LS	All-cause (medical record)	±	0.860 (0.730, 1.020)
18	Daly, M. (77)	2012	5545 mf (USA)	9 Y	Positive affect-Ex	Ag, Sx, Edu, Dep, Depanx	All-cause (unknown)	±	0.640 (0.450, 0.830)*
19.a	Kimm, H. (48)	2012	821 m (South Korea)	11.8 Y (mean)	Life satisfaction (LSI-A)-Eu	Ag, Sx, Edu, BMI, S, Al, CD, ADL	All-cause (medical record)	-	0.704 (0.546-0.901)
19.b	Kimm, H. (48)	2012	1118 f (South Korea)	11.8 Y (mean)	Life satisfaction (LSI-A)-Eu	Ag, Sx, Edu, BMI, S, Al, CD, ADL	All-cause (medical record)	-	0.662 (0.521, 0.847)
20	Netuveli, G. (78)	2012	9415 mf (United Kingdom)	5 Y	Quality of life (CASP)-Eu	Ag, Sx, Empl, CD, PH, ADL, SES, HS	All-cause (medical record)	-	0.970 (0.960, 0.990)
21	Steptoe, A. (79)	2012	9025 mf (United Kingdom)	7.3 Y (mean)	Enjoyment of life (Pleasure subscale from CASP)	Ag, Sx, Eth, Edu, Ex, Empl, S, Al, CD, PD, Dep, SES, MS	All-cause (medical record)	-	0.717 (0.575, 0.895)
22	Tilvis, R. S. (80)	2012	2490 mf (Finland)	4.8 Y (mean)	Positive life orientation	Ag, Sx, Ex, Empl, PH, MS, SN	All-cause (medical record)	-	0.782 (0.625, 0.977)

23.a	Carstensen, L. L. (53)	2011	111 mf (USA)	15 Y	Positive emotional experience-Ex	Ag, Sx, Eth	All-cause (medical record)	-	0.340 (0.120, 0.940)
23.b	Carstensen, L. L. (53)	2011	111 mf (USA)	15 Y	Happiness (SHS)-Ev	Ag, Sx, Eth	All-cause (medical record)	-	0.720 (0.540, 0.980)
24	Krijthe B. P. (81)	2011	4411 mf (Denmark)	7.2 Y (mean)	Positive affect (CES-D)-Ex	Ag, Sx, Edu, Ex, Empl, BMI, S, Al, CD, ADL, Dep, MS, SES, HS	All-cause (medical record)	-	0.920 (0.860, 0.980)
25.a	Lacruz, M. E. (40)	2011	1357 m (Germany)	12 Y	Life satisfaction-Ev	Ag, Sx, HS, PH, Dep, Som, DI, DA, SN	All-cause (medical record)	±	0.680 (0.410, 1.130)
25.b	Lacruz, M. E. (40)	2011	1229 f (Germany)	12 Y	Life satisfaction-Ev	Ag, Sx, HS, PH, Dep, Som, DI, DA, SN	All-cause (medical record)	±	1.240 (0.570, 2.710)
26.a	Nilsson, G. (41)	2011	204 m (Sweden)	10 Y	Subjective well-being (PGWB)	Sx, S, BMI, CD, LA	All-cause (medical record)	-	0.850 (0.730, 0.980)
26.b	Nilsson, G. (41)	2011	213 f (Sweden)	10 Y	Subjective well-being (PGWB)	Sx, S, BMI, CD, LA	All-cause (medical record)	±	0.940 (0.800, 1.110)
27.a	Sadler, M. E. (82)	2011	3714 mf (Denmark)	9 Y	Positive affect (CAMDEX)	Ag, Sx, Ex, CD, Dem, Dep, HS	All-cause (medical record)	-	0.870 (0.830, 0.910)
27.b	Sadler, M. E. (82)	2011	3714 mf (Denmark)	9 Y	Life satisfaction-Ev	Ag, Sx, Ex, CD, Dem, Dep, HS	All-cause (medical record)	-	0.800 (0.770, 0.830)
28	Steptoe, A. (83)	2011	3853 mf (United Kingdom)	5 Y	Positive affect-Ex	Ag, Sx, Edu, Ex, MS, SES, Empl, S, Al, PH, CD, Dep	All-cause (medical record)	-	0.646 (0.436, 0.958)
29.a	Wiest, M. (84)	2011	3124 mf (Germany)	14 Y	Life satisfaction (SWLS)	Ag, Sx, Eth, Edu, Ex, CD, PH, MS, S	All-cause (medical record)	±	0.970 (0.860, 1.090)
29.b	Wiest, M. (84)	2011	3124 mf (Germany)	14 Y	Positive affect (PANAS)-Ex	Ag, Sx, Eth, Edu, Ex, CD, PH, MS, S	All-cause (medical record)	±	0.880 (0.760, 1.020)
30	Koopmans, T. A. (85)	2010	861 mf (The Netherlands)	15 Y	Happiness (2 items from optimism subscale from SSWO)-Ex	Ag, Sx, Edu, Ex, MS, SES, S, CD	All-cause (medical record)	±	0.920 (0.750, 1.140)
31	Lundman, B. (86)	2010	190 mf (Sweden)	4 Y	Sense of coherence (SOC)-Eu	Ag, Sx	All-cause (medical record)	±	0.995 (0.973, 1.018)
32	Ortega, F. B. (87)	2010	4888 mf (USA)	15 Y	Positive affect (CES-D)-Ex	Ag, Sx, Ex, BMI, S, Al, US, WNICF	All-cause (medical record)	±	0.940 (0.720, 1.230)
33	Shirom, A. (88)	2010	968 mf (Israel)	20 Y	Vigor (PMS)-Eu	Ag, Sx, Edu, Ex, SES, BMI, S, Al, CD, Depanx	All-cause (medical record)	-	0.740 (0.580, 0.950)
34	Xu, J. (89)	2010	6856 mf (USA)	28 Y	Subjective well-being	Ag, Sx, Edu, Ex, PH, CD, SN	All-cause (medical record)	±	0.991 (0.978, 1.004)

35	Bowling, A. (90)	2009	1384 mf (United Kingdom)	20 Y	Subjective well-being (LSI-A)-Eu	Ag, Sx, SES, ADL, SN, HS	All-cause (medical record)	-	0.985 (0.970, 0.999)
36	Boyle, P. A. (91)	2009	1238 mf (USA)	2.7 Y (mean)	Purpose in life (Ryff and Keyes)-Eu	Ag, Sx, Eth, Edu, CD	All-cause (medical record)	-	0.600 (0.420, 0.870)
37	Collins, A. L. (92)	2009	5131 mf (Taiwan)	10 Y	Life satisfaction (LSI-A)-Eu	Ag, Sx, Edu, S, Al, CD, PH, ADL, Dem, MS	All-cause (medical record)	-	0.451 (0.205, 0.697)
38	Fry, P. S. (93)	2009	450 mf (Canada)	6.5 Y (mean)	Dispositional optimism (LOT)-Eu	Ag, Sx, Edu, Ex, ADL, SN, PH	All-cause (relative record)	-	0.935 (0.909, 0.961)
39	Krause, N. (94)	2009	1361 mf (USA)	5 Y	Meaning in life (Krause)-Eu	Ag, Sx, Edu PH, MS	All-cause (medical record)	±	0.967 (0.926, 1.007)*
40.a	Shirai, K. (39)	2009	42089 m (Japan)	12 Y	Enjoyed life-Ev	Ag, Sx, Ex, Empl, BMI, S, Al, PS, CD, PHSDP, TAC	Cardiovascular disease (medical record)	-	0.621 (0.510, 0.758)
40.b	Shirai, K. (39)	2009	46086 f (Japan)	12 Y	Enjoyed life-Ev	Ag, Sx, Ex, Empl, BMI, S, Al, PS, CD, PHSDP, TAC	Cardiovascular disease (medical record)	±	0.893 (0.662, 1,205)
41.a	Tanno, K. (49)	2009	30155 m (Japan)	12.5 Y (mean)	*Ikigai*-Eu	Ag, Sx, Edu, Empl, BMI, S, Al, CD, PS, MS, SD	All-cause (medical record)	-	0.850 (0.800, 0.900)
41.b	Tanno, K. (49)	2009	43117 f (Japan)	12.5 Y (mean)	*Ikigai*-Eu	Ag, Sx, Edu, Empl, BMI, S, Al, CD, PS, MS, SD	All-cause (medical record)	-	0.930 (0.860, 0.999)
42	Tindle, H. A. (95)	2009	97253 f (USA)	8 (mean)	Dispositional optimism (LOT-R)-Eu	Ag, Sx, Eth, Ex, Edu, Empl, SES, BMI, S, Al, CD, Dep	All-cause (medical record)	-	0.860 (0.790-0.930)
43.a	Koizumi, M. (38)	2008	832 m (Japan)	13.3 Y (mean)	Purpose in life-Eu	Ag, Sx, S, CD, PS, HS	All-cause (medical record)	-	0.620 (0.450, 0.860)
43.b	Koizumi, M. (38)	2008	786 f (Japan)	13.3 Y (mean)	Purpose in life-Eu	Ag, Sx, S, CD, PS, HS	All-cause (medical record)	±	0.740 (0.450, 1.220)
44	Moskowitz, J. T. (96)	2008	2673 mf (USA)	10 Y	Positive affect (CES-D)-Ex	Ag, Sx, Eth, Edu, Ex, BMI, S, PH, PS	All-cause (medical record)	±	0.830 (0.670, 1.010)
45	Nabi, H. (97)	2008	8918 mf (United Kingdom)	12.5 Y (mean)	Positive affect (Bradburn affect balance scale)-Ex	Ag, Sx, Eth, Ex, Empl, BMI, S, Al, CD, DFV, JS	Fatal coronary heart disease (medical record)	±	1.040 (0.850, 1.290)
46	Sone, T. (98)	2008	43391 mf (Japan)	7 Y	*Ikigai* Sense of Life Worth Living-Eu	Ag, Sx, Edu, Empl, BMI, S, Al, CD, PH, PS, MS, SD	All-cause (medical record)	-	0.710 (0.630-0.830)
47.a	Lyyra, T. M. (99)	2006	320mf (Sweden)	10 Y	Zest (LSI-Z)-Eu	Age, Sx, Edu, CD, Dep, ADL, LA	All-cause (medical record)	-	0.530 (0.350, 0.790)
47.b	Lyyra, T. M. (99)	2006	320mf (Sweden)	10 Y	Congruence (LSI-Z)-Eu	Age, Sx, Edu, CD, Dep, ADL,	All-cause	±	Data not

						LA	(medical record)		reported
48.a	Surtees, P. G. (50)	2006	20323 mf (United Kingdom)	6 Y	Sense of coherence (3-item SOC)-Eu	Ag, Sx, CD, SOM	All-cause (medical record)	-	0.900 (0.840, 0.970)
48.b	Surtees, P. G. (50)	2006	8916 m (United Kingdom)	6 Y	Sense of mastery (7-item version HLEQ)-Eu	Ag, Sx, S, SES, CD, DI, DA, SOC	All-cause (medical record)	-	0.840 (0.760, 0.920)
48.c	Surtees, P. G. (50)	2006	11407 f (United Kingdom)	6 Y	Sense of mastery (7-item version HLEQ)-Eu	Ag, Sx, S, SES, CD, DI, DA, SOC	All-cause (medical record)	-	0.790 (0.690, 0.910)
49	Kao, S. (44)	2005	689 m (Taiwan)	2 Y	Life satisfaction-Ev	Ag, CD, PH, ADL, HS, H	All-cause (medical record)	-	0.113 (0.027, 0.474)
50	Frijters, P. (100)	2005	26401 mf (Germany)	8.5 Y (mean)	Life satisfaction-Ev	Ag, Sx, Edu, Empl, SES, MS, HS	All-cause (medical record)	-	0.960 (0.940, 0.988)
51	Meinow, B. (101)	2004	421 mf (Sweden)	15 Y	Life satisfaction-Ev	Ag, Sx	All-cause (medical record)	-	0.653 (0.495, 0.862)
52	Menec, V. H. (102)	2003	2291 mf (Canada)	6 Y	Life satisfaction (LSI-A)-Eu	Ag, Sx, Edu, PH, CD, ADL, HS, LA	All-cause (medical record)	±	1* CI not reported
53.a	Heslop, P. (103)	2002	2511 m (Scotland)	21 Y	Job satisfaction-Ev	Ag, Sx, Emp, CD	Cardiovascular disease (medical record)	±	0.847 (0.549, 1.356)
53.b	Heslop, P. (103)	2002	443 f (Scotland)	21 Y	Job satisfaction-Ev	Ag, Sx, Emp, CD	Cardiovascular disease (medical record)	±	0.595 (0.121, 2.941)
54	Ostir, G. V. (104)	2002	1002 f (USA)	3 Y	Satisfaction with support given (SWGSS)-Ev	Ag, Eth, Edu, MS, CD, ADL	All-cause (medical record)	-	0.658 (0.442, 0.971)
55.a	Fuhrer, R. (105)	1999	1576 m (France)	5 Y	Satisfaction with social support-Ev	Ag, Sx, Edu, S, Al, Dep, ADL, Dem, SN, H	All-cause (medical record)	±	1.163 (0.909, 1.429)
55.b	Fuhrer, R. (105)	1999	2201 f (France)	5 Y	Satisfaction with social support-Ev	Ag, Sx, Edu, S, Al, Dep, ADL, Dem, SN, H	All-cause (medical record)	±	1.087 (0.770, 1.429)
56.a	Gustafsson, T. M. (51)	1998	192 m (Sweden)	6 Y	Life satisfaction-Ev	Ag, Sx, PH, CD, HS, SN	All-cause (medical record)	-	0.585 (0.407, 0.826)*
56.b	Gustafsson, T. M. (51)	1998	229 f (Sweden)	6 Y	Life satisfaction-Ev	Ag, Sx, PH, CD, HS, SN	All-cause (medical record)	-	0.571 (0.397, 0.826)*
57	Blakeslee, T. R. (106)	1996	3055 mf (Germany)	21 Y	Pleasure and well-being (PWI)	S, Al, TAC, PS	All-cause (medical record)	-	Data not reported
58.a	Fujita T. (107)	1990	1502 m (Japan)	2 Y	Life satisfaction-Ev	Ag, Sx, ADL	All-cause (medical record)	±	0.960 (0.900, 1.024)
58.b	Fujita T. (107)	1990	1577 f (Japan)	2 Y	Life satisfaction-Ev	Ag, Sx, ADL	All-cause	-	0.921

							(medical record)		(0.848, 0.994)
59	Bowling, A. (108)	1987	503 mf (United Kingdom)	6 Y	Happiness	Ag, Sx, M	All-cause (medical record)	-	0.293 (0.110, 0.775)
60	Mossey, J. M. (109)	1982	3128 mf (Canada)	6 Y	Life satisfaction (LSI-A)-Eu	Ag, Sx, SES, HS	All-cause (medical record)	±	Data not reported
61	Palmore, E. B. (110)	1982	270 mf (USA)	25 Y	Life satisfaction-Ev	Ag, Sx, Eth	All-cause (medical record)	±	Data not reported
62	Noelker, L. (111)	1978	125 mf (USA)	2 Y	Life satisfaction (Botwinick & Storandt)-Ev		All-cause (medical record)	-	Data not reported

Sample: Y= year(s); m= males; f= females; mf= both.

Measures: CES-D= Center for Epidemiological Studies-Depression scale; SSWO= Dutch Scale of Subjective Well-being for Older Persons; PMS= Profile of Mood States; LSI-A/ Z= Life Satisfaction Index-A scale/ Z scale; SOC= Sense Of Coherence; LOT-R= Life Orientation Test-Revised; CAMDEX= Cambridge examination for mental disorders of the elderly; PGWB= Psychological General Well-Being questionnaire; SWLS= Satisfaction With Life Scale; PANAS= Positive And Negative Affect Scale; CASP= Control, Autonomy, Self-realization and Pleasure Scale; HLEQ= Health and Life Experiences Questionnaire; PWI= Pleasure and Wellbeing Inventory; SWSGS= Satisfaction With Support Given Scale.

Ev (Evaluative well-being); Ex (Experienced well-being); Eu (Eudaimonic).

Covariates: Ag (Age); Sx (Sex); Eth (Ethnicity); Edu (Education); Ex (Exercise); Empl (Employment); BMI (Body Mass Index); S (Smoking); Al (Alcohol use); CD (Chronic Diseases); PH (Perceived Health); PS (Perceived Stress); DFV (Daily Fruit and Vegetables); JS (Job Strain); Dep (Depressive symptoms); Anx (Anxiety symptoms); ADL (Activities Daily Life); SES (Socio Economic Status); Dem (Dementia); MS (Marital Status); PHSDP (Participation in Health Screening During the Past) TAC (Type A Characteristics); US (Unhealthy Status); WNICF (Well-being and Negative emotion Index for Cardiorespiratory Fitness); Depanx (Depressive and anxiety symptoms); SN (Social Network); HS (Health Status); Som (Somatic symptoms); Depsom (Depressive and somatic symptoms); DI (Disposition to Irritation); DA (Disposition to Anger); FB (Family Background); Freed (Freedom); SD (Sleep Duration); LA (Living Alone); CB (Control Beliefs); LS (Life Satisfaction); SOM (Sense Of Mastery); SOC (Sense Of Control); H (Hospitalization); M (use of Medicines).

Results: - = protective (significant); ± = null (not significant); + = harmful (significant).

Effect Size: HR= hazard ratio; 95% CI= 95% Confidence Interval. * : This value represents an odds ratio (OR).

Table S2. Articles excluded from the present systematic review after being read in full.

No.	Reference	Reason for exclusion
1	Andrews, G., Clark, M., & Luszcz, M. (2001). Successful aging in the Australian longitudinal study of aging: applying the MacArthur model cross–nationally. Journal of Social Issues, (58), 749-765.	No relevant predictors
2	Aro, S., & Hasan, J. (1987). Occupational class, psychosocial stress and morbidity. Annals of Clinical Research.	No relevant outcomes
3	Bailis, D. S., Chipperfield, J. G., & Perry, R. P. (2005). Optimistic social comparisons of older adults low in primary control: a prospective analysis of hospitalization and mortality. Health Psychology, 24(4), 393.	No relevant predictors
4	Barefoot, J. C., Maynard, K. E., Beckham, J. C., Brummett, B. H., Hooker, K., & Siegler, I. C. (1998). Trust, health, and longevity. Journal of behavioral medicine, 21(6), 517-526.	No relevant predictors
5	Burns, R. A., Byles, J., Magliano, D. J., Mitchell, P., & Anstey, K. J. (2014). The utility of estimating population-level trajectories of terminal wellbeing decline within a growth mixture modelling framework. Social psychiatry and psychiatric epidemiology, 50(3), 479-487.	No relevant outcomes
6	Burns, R. A., Mitchell, P., Shaw, J., & Anstey, K. J. (2014). Trajectories of terminal decline in the well-being of older women: the DYNOPTA project. Psychology and aging, 29(1), 44.	No relevant outcomes
7	Carmel, S., Baron-Epel, O., & Shemy, G. (2007). The will-to-live and survival at old age: Gender differences. Social science & medicine, 65(3), 518-523.	No relevant predictors
8	Carmel, S., Shrira, A., & Shmotkin, D. (2013). The will to live and death-related decline in life satisfaction. Psychology and aging, 28(4), 1115.	No relevant predictors
9	Chang, Y. H., Chen, R. C. Y., Wahlqvist, M. L., & Lee, M. S. (2012). Frequent shopping by men and women increases survival in the older Taiwanese population. Journal of epidemiology and community health, 66(7), e20-e20.	No relevant predictors
10	Cohen, S., & Pressman, S. D. (2006). Positive affect and health. Current Directions in Psychological Science, 15(3), 122-125.	No relevant outcomes
11	Cummins, R. A., Lau, A. A., Mellor, D., & Stokes, M. A. (2009). Encouraging governments to enhance the happiness of their nation: Step 1: Understand subjective wellbeing. Social Indicators Research, 91(1), 23-36.	No relevant outcomes
12	Eaker, E. D., Sullivan, L. M., Kelly-Hayes, M., D'Agostino Sr, R. B., & Benjamin, E. J. (2007). Marital status, marital strain, and risk of coronary heart disease or total mortality: the Framingham Offspring Study. Psychosomatic medicine, 69(6), 509-513.	No relevant predictors
13	Fooken, I. (1984). Überleben im hohen Alter—Ein Vergleich "kurz"- und "langlebiger" Probanden der Bonner gerontologischen Längsschnittstudie (BOLSA). Zeitschrift für Gerontologie, 17(6), 340-358.	No relevant outcomes
14	Froshaug, D. B., Dickinson, L. M., Fernald, D. H., & Green, L. A. (2009). Personal health behaviors are associated with physical and mental unhealthy days: a Prescription for Health (P4H) practice-based research networks study. The Journal of the American Board of Family Medicine, 22(4), 368-374.	No relevant predictors
15	Gerstorf, D., Ram, N., Estabrook, R., Schupp, J., Wagner, G. G., & Lindenberger, U. (2008). Life satisfaction shows terminal decline in old age: longitudinal evidence from the German Socio-Economic Panel Study (SOEP). Developmental psychology, 44(4), 1148.	No relevant outcomes
16	Gerstorf, D., Ram, N., Goebel, J., Schupp, J., Lindenberger, U., & Wagner, G. G. (2010). Where people live and die makes a difference: Individual and geographic disparities in well-being progression at the end of life. Psychology and aging, 25(3), 661.	No relevant outcomes
17	Gerstorf, D., Ram, N., Mayraz, G., Hidajat, M., Lindenberger, U., Wagner, G. G., & Schupp, J. (2010). Late-life decline in well-being across adulthood in Germany, the United Kingdom, and the United States: Something is seriously wrong at the end of life. Psychology and aging, 25(2), 477.	No relevant outcomes
18	Gerstorf, D., Ram, N., Röcke, C., Lindenberger, U., & Smith, J. (2008). Decline in life satisfaction in old age: longitudinal evidence for links to distance-to-death. Psychology and aging, 23(1), 154.	No relevant outcomes
19	Giltay, E. J., Geleijnse, J. M., Zitman, F. G., Buijsse, B., & Kromhout, D. (2007). Lifestyle and dietary correlates of dispositional optimism in men: The Zutphen Elderly Study. Journal of psychosomatic research, 63(5), 483-490.	No relevant outcomes
20	Giltay, E. J., Zitman, F. G., & Kromhout, D. (2008). Cardiovascular risk profile and subsequent disability and mental well-being: the Zutphen Elderly Study. The American Journal of Geriatric Psychiatry, 16(11), 874-882.	No relevant outcomes
21	Heikkinen, R. L. (1996). Depressed mood among the elderly in Jyvaskyla. A five-year follow-up. Scandinavian journal of social medicine. Supplementum, 53, 66-78.	No relevant outcomes
22	House, J. S., Strecher, V., Metzner, H. L., & Robbins, C. A. (1986). Occupational stress and health among men and women in the Tecumseh Community Health Study. Journal of health and social behavior, 62-77.	No relevant predictors
23	Kahana, E., Lawrence, R. H., Kahana, B., Kercher, K., Wisniewski, A., Stoller, E., ... & Stange, K. (2002). Long-term impact of preventive proactivity on quality of life of the old-old. Psychosomatic medicine, 64(3), 382-394.	No relevant outcomes
24	Iwasa, H. (2005). [Subjective well-being and all-cause mortality among middle-aged and elderly people living in an urban Japanese community]. Nihon Ronen Igakkai Zasshi. 42(6). 677-683.	No relevant predictors
25	Kaplan, R. M., Anderson, J. P., Patterson, T. L., McCutchan, J. A., Weinrich, J. D., Heaton, R. K., ... & Grant, I. (1995). Validity of the quality of well-being scale for persons with human immunodeficiency virus infection. Psychosomatic Medicine, 57(2), 138-147.	Clinical population

26	Khoman, E., Mitchell, J., & Weale, M. (2008). Incidence-based estimates of life expectancy of the healthy for the UK: coherence between transition probabilities and aggregate life-tables. Journal of the Royal Statistical Society: Series A (Statistics in Society), 171(1), 203-222.	No relevant predictors
27	Koivumaa-Honkanen, H., Honkanen, R., Koskenvuo, M., Viinamäki, H., & Kaprio, J. (2002). Life dissatisfaction as a predictor of fatal injury in a 20-year follow-up. Acta Psychiatrica Scandinavica, 105(6), 444-450.	No relevant outcomes
28	Kotter-Grühn, D., Kleinspehn-Ammerlahn, A., Gerstorf, D., & Smith, J. (2009). Self-perceptions of aging predict mortality and change with approaching death: 16-year longitudinal results from the Berlin Aging Study. Psychology and aging, 24(3), 654.	No relevant predictors
29	Lee, Y. (2000). The predictive value of self assessed general, physical, and mental health on functional decline and mortality in older adults. Journal of epidemiology and community health, 54(2), 123-129.	No relevant predictors
30	Maxson, P. J., Berg, S., & Mcclearn, G. (1996). Multidimensional Patterns of Aging in 70-Year-Olds Survival Differences. Journal of aging and health, 8(3), 320-333.	No relevant predictors
31	Mora, P. A., DiBonaventura, M. D., Idler, E., Leventhal, E. A., & Leventhal, H. (2008). Psychological factors influencing self-assessments of health: Toward an understanding of the mechanisms underlying how people rate their own health. Annals of Behavioral Medicine, 36(3), 292-303.	No relevant predictors
32	Netterstrom, B. (1994). [Self-evaluated job satisfaction and ischemic heart disease. A 10-year follow-up study of bus drivers in a big city]. Ugeskr Laeger. 156(36), 5110-4.	No relevant predictors
33	Nosraty, L., Enroth, L., Raitanen, J., Hervonen, A., & Jylhä, M. (2015). Do Successful Agers Live Longer? The Vitality 90+ Study. Journal of aging and health, 27(1), 35-53.	No relevant predictors
34	Oishi, S., & Schimmack, U. (2010). Residential mobility, well-being, and mortality. Journal of personality and social psychology, 98(6), 980.	No relevant predictors
35	Ostir, G. V., Markides, K. S., Peek, M. K., & Goodwin, J. S. (2001). The association between emotional well-being and the incidence of stroke in older adults. Psychosomatic medicine, 63(2), 210-215.	No relevant outcomes
36	Oswald, W. D., Hagen, B., Rupprecht, R., Gunzelmann, T., & Steinwachs, K. C. (2002). Maintaining and Preventing Independent Living in Old Age (SIMA)-Part XVIII: Risk Factors for a Loss of Independent Living, Dementia, and Mortality. Zeitschrift Fur Gerontopsychologie und Psychiatrie, 15(2), 61-84.	No relevant predictors
37	Palgi, Y., Shrira, A., Ben-Ezra, M., Spalter, T., Shmotkin, D., & Kavé, G. (2010). Delineating Terminal Change in Subjective Well-Being and Subjective Health Brief Report. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 65(1), 61-64.	No relevant outcomes
38	Persson, C., Östlund, U., Wennman-Larsen, A., Wengström, Y., & Gustavsson, P. (2008). Health-related quality of life in significant others of patients dying from lung cancer. Palliative Medicine, 22(3), 239-247.	Clinical population
39	Pitkala, K. H., Routasalo, P., Kautiainen, H., & Tilvis, R. S. (2009). Effects of psychosocial group rehabilitation on health, use of health care services, and mortality of older persons suffering from loneliness: a randomized, controlled trial. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 64(7), 792-800.	No relevant predictors
40	Romelsjö, A., Kaplan, G. A., Cohen, R. D., Allebeck, P., & Andreasson, S. (1992). Protective factors and social risk factors for hospitalization and mortality among young men. American Journal of Epidemiology, 135(6), 649-658.	No relevant predictors
41	Samuelsson, G., Hagberg, B., Dehlin, O., & Lindberg, B. (1994). Medical, social and psychological factors as predictors of survival—a follow-up from 67 to 87 years of age. Archives of gerontology and geriatrics, 18(1), 25-41.	No relevant predictors
42	Sargent-Cox, K. A., Anstey, K. J., & Luszcz, M. A. (2014). Longitudinal change of self-perceptions of aging and mortality. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 69(2), 168-173.	No relevant predictors
43	Schwartz, J. E., Friedman, H. S., Tucker, J. S., Tomlinson-Keasey, C., Wingard, D. L., & Criqui, M. H. (1995). Sociodemographic and psychosocial factors in childhood as predictors of adult mortality.*American journal of public health*, *85*(9), 1237-1245.	No relevant predictors
44	St. John, P. D., & Montgomery, P. R. (2009). Do depressive symptoms predict mortality in older people?. Aging & mental health, 13(5), 674-681.	No relevant predictors
45	Stålbrand, I. S., Svensson, T., Elmståhl, S., Horstmann, V., Hagberg, B., Dehlin, O., & Samuelsson, G. (2007). Subjective health and illness, coping and life satisfaction in an 80-year-old Swedish population-implications for mortality. International journal of behavioral medicine, 14(3), 173-180.	No relevant predictors
46	Surtees, P. G., Wainwright, N. W. J., Luben, R. N., Wareham, N. J., Bingham, S. A., & Khaw, K. T. (2008). Psychological distress, major depressive disorder, and risk of stroke. Neurology, 70(10), 788-794.	No relevant predictors
47	Tigani, X., Artemiadis, A. K., Alexopoulos, E. C., Chrousos, G. P., & Darviri, C. (2012). Self-rated health in centenarians: A nation-wide cross-sectional Greek study. Archives of gerontology and geriatrics, 54(3), e342-e348.	No relevant predictors
48	Vaillant, G. E., & Mukamal, K. (2001). Successful aging. American Journal of Psychiatry, 158(6), 839-847.	No relevant predictors
49	Yates, L. B., Djoussé, L., Kurth, T., Buring, J. E., & Gaziano, J. M. (2008). Exceptional longevity in men: modifiable factors associated with survival and function to age 90 years. Archives of Internal Medicine, 168(3), 284-290.	No relevant predictors
50	Yeung, W. J., & Xu, Z. (2012). Economic stress, quality of life, and mortality for the oldest-old in China. Social indicators research, 108(1), 131-152.	No relevant predictors
51	Zaslavsky, O., Rillamas-Sun, E., Woods, N. F., Cochrane, B. B., Stefanick, M. L., Tindle, H. & LaCroix, A. Z. (2014). Association of the selected dimensions of eudaimonic well-being with healthy survival to 85 years of age in older women. International Psychogeriatrics, 26(12), 2081-2091.	No relevant outcomes

Table S3. Characteristics of the studies found by Chida and Steptoe (18) included in the present meta-analysis.

Code	First author	Year	Cohort (Nation)	Follow-up	Well-being variable (instrument)	Covariates	Mortality	Results	Effect Size HR (95% CI)
63	Kubzansky, L. D. (112)	2007	4185 mf (USA)	19 Y (mean)	Vitality (GWS)-Eu	Ag, Sx, Ex, BMI, SES, S, Al, Dep	Cardiovascular disease (medical record)	±	0.91 (0.70, 1.16)
64	Brummett, B. H. (113)	2006	5328 mf (USA)	40 Y	Dispositional Optimism (PSM-R)-Eu	Sx	All-cause (medical record)	±	0.85 (0.68, 1.06)
65	Giltay, E. J. (43)	2006	310 m (The Netherlands)	15 Y	Dispositional Optimism-Eu	Ag, Edu, Ex, BMI, SES, S, Al, CD, PH, Dep	Cardiovascular disease (medical record)	-	0.57 (0.36, 0.89)
66	Blazer, D. G. (114)	2004	3673 mf (USA)	10,5 Y (mean)	Positive affect (CES-D)-Ex	Ag, Sx, Eth, MS, SES, Dep	All-cause (medical record)	-	0.90 (0.85, 0.96)
67.a	Giltay, E. J. (42)	2004	108 m (The Netherlands)	9.1 Y (mean)	Optimism (Optimism subscale from SSWO)	Ag, BMI, MS, SES, S, Al, Dep	Cardiovascular disease (medical record)	-	0.15 (0.04, 0.55)
67.b	Giltay, E. J. (42)	2004	104 f (The Netherlands)	9.1 Y (mean)	Optimism (Optimism subscale from SSWO)	Ag, BMI, MS, SES, S, Al, Dep	Cardiovascular disease (medical record)	±	0.40 (0.12, 1.34)
68	Pitkala, K. H. (115)	2004	491 mf (Finland)	10 Y	Positive life orientation-Eu	Ag, Sx, MS, Dep	All-cause (medical record)	-	0.89 (0.83, 0.96)
69	Danner, D. D. (45)	2001	90 f (USA)	22 Y	Positive affect-Ex	Ag, SES	All-cause (medical record)	-	0.23 (0.10, 0.59)
70	Kubzansky, L. D. (116)	2001	1306 m (USA)	10 Y (mean)	Dispositional Optimism (PSM-R)-Eu	Ag, BMI, SES, S, Al, Dep	Fatal Coronary Heart Disease (medical record)	±	0.70 (0.44, 1.22)
71	Stern, S.L. (117)	2001	749 mf (USA)	5.2 Y (mean)	Hopefulness (one item from GDS)-Eu	Ag, Sx, Eth, BMI, S, Al, SES, Dep	All-cause (medical record)	-	0.45 (0.27, 0.76)
72.a	Koivumaa-Honkanen, H. (118)	2000	3870 m (Finland)	19 Y	Life Satisfaction-Ev	Ag, Sx, Ex, S, Al, MS, SES, Dep	Disease-cause (medical record)	-	0.74 (0.55, 0.99)
72.b	Koivumaa-Honkanen, H. (118)	2000	4109 f (Finland)	19 Y	Life Satisfaction-Ev	Ag, Sx, Ex, S, Al, MS, SES, Dep	Disease-cause (medical record)	±	1.25 (0.83, 1.85)
73	Ostir, G. V. (119)	2000	1214 mf (USA)	2 Y	Positive affect (CES-D)-Ex	Ag, Sx, BMI, S, Al, MS, SES, Dep	All-cause (medical record)	-	0.45 (0.26, 0.78)

74	Penninx, B. (120)	2000	1002 f (USA)	3 Y	Vitality	Ag, Ex, MS, SES, Dep	All-cause (medical record)	-	0.56 (0.39, 0.80)
75	Vogt, T. (121)	1994	2573 mf (USA)	15 Y	Positive affect (ABS)-Ex	Ag, Sx, S, SES	All-cause (medical record)	±	1.25 (0.95, 1.64)
76	Parker, M. G. (122)	1992	248 mf (Sweden)	4 Y	Life Satisfaction-Ev	Ag, Sx	All-cause (unknown)	-	0.47 (0.27, 0.84)

Note: Data from Chida and Steptoe (2008).

Sample: Y= year(s); m= males; f= females; mf= both.

Measures: GWS= General Well-being Schedule; PSM-R= Revised Optimism-Pessimism Scale; CES-D= Center for Epidemiological Studies-Depression scale; SSWO= Dutch Scale of Subjective Well-being for Older Persons; GDS= Geriatric Depression Scale; ABS= Affect Balance Scale.

Ev (Evaluative well-being); Ex (Experienced well-being).

Covariates: Ag (Age); Sx (Sex); Eth (Ethnicity); Ex (Exercise); BMI (Body Mass Index); S (Smoking); Al (Alcohol use); CD (Chronic Diseases); PH (Perceived Health); PS (Perceived Stress); Dep (Depressive symptoms); SES (Socio Economic Status); MS (Marital Status).

Results: - = protective (significant); ± = null (not significant); + = harmful (significant).

Effect Size: HR= hazard ratio; 95% CI= 95% Confidence Interval.

Table S4. Quality assessment of the included articles in the present meta-analysis.

Study	Bias due to confounding	Bias in selection of participants into the study	Bias in measurement of mortality	Bias in measurement of well-being	Bias in selection of the reported result	OVERALL
Martín-María N. (54)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Liu, B. (20)	Low risk	Low risk	Low risk	Moderate risk	Low risk	**Moderate risk**
Lee, M. C. (67)	Moderate risk	Low risk	Low risk	Moderate risk	Low risk	**Moderate risk**
St John P. D. (68)	Moderate risk	Low risk	Low risk	Moderate risk	Low risk	**Moderate risk**
Steptoe, A. (5)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Guven, C. (69)	Moderate risk	Low risk	Moderate risk	Moderate risk	Moderate risk	**Moderate risk**
Hill, P.L. (52)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Kern, M. L. (70)	Moderate risk	Serious risk	Moderate risk	Serious risk	Low risk	**Serious risk**
Engberg, H. (46)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Haukkala, A. (72)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Lang, F. R. (37)	Moderate risk	Low risk	Moderate risk	Moderate risk	Moderate risk	**Moderate risk**
Li, C. P. (73)	Low risk	Low risk	Moderate risk	Low risk	Low risk	**Moderate risk**
Lin, H. W. (47)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Miething, A. (74)	Moderate risk	Low risk	Moderate risk	Moderate risk	Low risk	**Moderate risk**
Wiest, M. (76)	Moderate risk	Low risk	Moderate risk	Low risk	Low risk	**Moderate risk**
Kimm, H. (48)	Moderate risk	Moderate risk	Low risk	Low risk	Low risk	**Moderate risk**
Netuveli, G. (78)	Moderate risk	Low risk	Low risk	Low risk	Moderate risk	**Moderate risk**
Steptoe, A. (79)	Low risk	Low risk	Moderate risk	Low risk	Low risk	**Moderate risk**
Tilvis, R. S. (80)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Carstensen, L. L. (53)	Moderate risk	Moderate risk	Low risk	Low risk	Moderate risk	**Moderate risk**
Krijthe B. P. (81)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Lacruz, M. E. (40)	Moderate risk	Low risk	Low risk	Moderate risk	Low risk	**Moderate risk**
Nilsson, G. (41)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Sadler, M. E. (82)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Steptoe, A. (83)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Wiest, M. (84)	Moderate risk	Low risk	Moderate risk	Low risk	Low risk	**Moderate risk**
Koopmans, T. A. (85)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Lundman, B. (86)	Serious risk	Moderate risk	Low risk	Low risk	Moderate risk	**Serious risk**
Ortega, F. B. (87)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Shirom, A. (88)	Low risk	Moderate risk	Low risk	Low risk	Low risk	**Moderate risk**
Xu, J. (89)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**

Bowling, A. (90)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Boyle, P. A. (91)	Moderate risk	Low risk	Low risk	Low risk	Moderate risk	**Moderate risk**
Collins, A. L. (92)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Fry, P. S. (93)	Moderate risk	Low risk	Moderate risk	Low risk	Low risk	**Moderate risk**
Shirai, K. (39)	Moderate risk	Low risk	Low risk	Moderate risk	Low risk	**Moderate risk**
Tanno, K. (49)	Low risk	Low risk	Low risk	Moderate risk	Moderate risk	**Moderate risk**
Tindle, H. A. (95)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Koizumi, M. (38)	Moderate risk	Low risk	Low risk	Moderate risk	Low risk	**Moderate risk**
Moskowitz, J. T. (96)	Low risk	Low risk	Moderate risk	Low risk	Low risk	**Moderate risk**
Nabi, H. (97)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Sone, T. (98)	Low risk	Low risk	Low risk	Moderate risk	Low risk	**Moderate risk**
Lyyra, T. M. (99)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Surtees, P. G. (50)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Kao, S. (44)	Moderate risk	Low risk	Low risk	Moderate risk	Low risk	**Moderate risk**
Frijters, P. (100)	Moderate risk	Low risk	Low risk	Moderate risk	Low risk	**Moderate risk**
Meinow, B. (101)	Serious risk	Low risk	Low risk	Low risk	Low risk	**Serious risk**
Heslop, P. (103)	Moderate risk	Moderate risk	Low risk	Low risk	Low risk	**Moderate risk**
Ostir, G. V. (104)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Fuhrer, R. (105)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Fujita T. (107)	Moderate risk	Low risk	Low risk	Serious risk	Low risk	**Serious risk**
Bowling, A. (108)	Moderate risk	Low risk	Low risk	Serious risk	Low risk	**Serious risk**
Kubzansky, L. D. (112)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Brummett, B. H. (113)	Serious risk	Low risk	Low risk	Low risk	Low risk	**Serious risk**
Giltay, E. J. (43)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Blazer, D. G. (114)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Giltay, E. J. (42)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Pitkala, K. H. (115)	Moderate risk	Moderate risk	Low risk	Low risk	Moderate risk	**Moderate risk**
Danner, D. D. (45)	Serious risk	Moderate risk	Low risk	Serious risk	Low risk	**Serious risk**
Kubzansky, L. D. (116)	Low risk	Moderate risk	Low risk	Low risk	Low risk	**Moderate risk**
Stern, S.L. (117)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Koivumaa-Honkanen, H. (118)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Ostir, G. V. (119)	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Penninx, B. (120)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Vogt, T. (121)	Moderate risk	Low risk	Low risk	Low risk	Low risk	**Moderate risk**
Parker, M. G. (122)	Serious risk	Low risk	Serious risk	Serious risk	Low risk	**Serious risk**

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