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ORIGINAL ARTICLE

# Optimism and Physical Health: A Meta-analytic Review

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**Abstract**
***Background*** Prior research links optimism to physical health, but the strength of the association has not been systematically evaluated.
***Purpose*** The purpose of this study is to conduct a meta-analytic review to determine the strength of the association between optimism and physical health.
***Methods*** The findings from 83 studies, with 108 effect sizes (ESs), were included in the analyses, using random-effects models.
***Results*** Overall, the mean ES characterizing the relationship between optimism and physical health outcomes was 0.17, $p<.001$. ESs were larger for studies using subjective (versus objective) measures of physical health. Subsidiary analyses were also conducted grouping studies into those that focused solely on mortality, survival, cardiovascular outcomes, physiological markers (including immune function), immune function only, cancer outcomes, outcomes related to pregnancy, physical symptoms, or pain. In each case, optimism was a significant predictor of health outcomes or markers, all $p<.001$.
***Conclusions*** Optimism is a significant predictor of positive physical health outcomes.

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## Introduction

Interest in the relationship between personality characteristics and physical health has increased substantially over the past several decades. Within this larger framework, a number of studies have explored the link between dispositional optimism (the generalized expectation that good things will happen) and physical well-being. Many of these studies have shown optimism to be protective. For example, research shows that optimistic people, compared to those more pessimistic in outlook, report less pain [1–4], better physical functioning [5–8], experience fewer physical symptoms [6, 8–12], and are less likely to be rehospitalized following coronary artery bypass surgery [13].

Although research on optimism and health has flourished, there has been no systematic review, qualitative or quantitative, of this specific literature. Thus, the nature of the association between optimism and physical health has not been explicitly assessed. This is an important oversight inasmuch as not all studies report significant associations (e.g., [14]). The purpose of the present paper is to provide a quantitative, meta-analytic review of the research exploring links between dispositional optimism and physical health.

Two other recent reviews are relevant here. First, Pressman and Cohen [15] provided a qualitative review of the literature linking positive affect to health. Although positive affect and optimism are related constructs, they are not the same [15, 16]. Thus, the focus of the review by

Pressman and Cohen [15] and the present review are distinct. Additionally, their review was qualitative; whereas, the present review is quantitative. The second review, by Chida and Steptoe [17], examined quantitatively the association between positive psychological well-being and mortality. The review by Chida and Steptoe [17] differs from the present review in that they defined positive psychological well-being quite broadly, including variables such as vitality, life satisfaction, and positive affect, in addition to optimism. Inasmuch as subanalyses were not conducted on specific predictors, it is difficult to tell whether optimism alone predicts health outcomes. Additionally, Chida and Steptoe [17] focused on only one outcome, mortality; whereas, the present review focuses on multiple outcomes.

As stated, the primary aim of this paper is to assess the extent to which optimism is linked to physical health outcomes (broadly defined). In addition, the meta-analysis was used to gather information about two other areas of interest. First, we wanted to examine moderators of the relation between optimism and physical health. The strength of the association between optimism and health varies across studies. The meta-analysis was used to identify and evaluate potential reasons for these differences.

One way to distinguish between the effect sizes (ES) of different studies is to take into account the manner in which physical health is assessed. The term "physical health" is quite broad and includes outcomes that reflect disease endpoints that are "softer" or "harder" in nature. For example, softer endpoints would include self-reports of symptoms or a clinical judgment about disease state; whereas, a harder endpoint might be mortality. Self-reported outcomes are very subjective in nature and rely completely on the respondent as a source of information. As such, these reports are influenced by a host of factors (e.g., memory biases) other than the underlying disease state. They also share important method variance with the manner in which optimism is assessed (i.e., via self-report). In contrast, harder disease endpoints primarily reflect outcomes that are biological in nature or outcomes that can be objectively determined (such as immune parameters or mortality). The present analysis assessed whether optimism is more strongly related to subjective than objective physical health outcomes.

The studies reviewed differ in many ways, in addition to the type of endpoint that is assessed. The design of the study could also affect the ES. A significant finding in a cross-sectional study may or may not hold in a study using a prospective design that examines changes in the outcome across time. One could argue that different types of designs also offer research evidence that is more or less convincing, in that some study designs (e.g., prospective studies) generally offer better evidence than do others (e.g., cross-sectional studies). Conducting separate analyses aggregating studies based on study design could be a useful way to identify variations in the ES of associations between optimism and physical health.

Studies also differ on the type of participants that were sampled. Some studies sampled participants that were healthy throughout the study, while other studies sampled participants that were either acutely or chronically ill at the beginning of the study or were categorized according to some specific health condition, such as pregnancy. Still, other research sampled participants that were healthy at the beginning of the study, and these participants may or may not have been healthy at the end of the study (e.g., epidemiological studies of mortality due to certain diseases).

Additional analyses were conducted distinguishing between studies that used healthy participants versus those that used "patient" samples, to discern whether sample type makes a difference in the relationship between optimism and physical health. We define healthy participants as those who had no known disease or health problem throughout the entire duration of the study and patient participants as those who were categorized according to a specific health condition by the end of the study (including research on survival and mortality).

Moreover, the studies included in the database were quite diverse, in terms of the types of outcome measures that were used. Because of this, we also performed subanalyses on clusters of studies that examined similar outcomes. For example, we separated studies that measured physiological markers (such as intima-media thickness, blood pressure, glycosylated hemoglobin, and immune markers) from studies that measured disease endpoints or survival and mortality. We also conducted subanalyses on several subjective outcomes of interest. In summary, subsidiary analyses were conducted on studies grouped according to whether they focused on mortality, survival, cardiovascular outcomes, physiological markers (including immune function), immune function only, cancer outcomes, outcomes related to pregnancy, physical symptoms, or pain.

A final difference among studies concerns the manner in which optimism was measured. Many of the studies used the Life Orientation Test (LOT, [18]) or the revised LOT (LOT-R, [19]) to assess the positivity of the generalized outcome expectancies that people hold. Peterson and Seligman [20] have approached optimism in terms of explanatory style, and the Attributional Style Questionnaire (ASQ, [21]) and the Expanded Attributional Style Questionnaire (EASQ, [22]) have been developed to assess optimism from this perspective. Still, other measures have

also been used. The differences in the measures used to assess optimism may also account for some of the variability among the studies. Analyses were conducted to explore this possibility.

As noted, the meta-analysis had a further aim, in addition to evaluating the significance of several moderator variables of interest. Specifically, it was used to gather information relevant to an issue that has emerged within the literature on optimism, but which also has implications for the link between optimism and physical health. That is, Scheier and Carver [18] initially conceptualized dispositional optimism as being a single bipolar trait, with optimism at one end and pessimism at the other. Most people working in the field still continue to construe optimism and pessimism in this fashion and analyze their studies accordingly. However, a number of researchers [23] have explored the possibility that optimism and pessimism are somewhat distinct constructs. This view is consistent with the fact that scales of generalized optimism are often shown to comprise two separate components [18, 19, 23, 24]—one measuring the person's expectancies for positive outcomes (i.e., his or her optimism) and one measuring the person's expectancies for negative outcomes (i.e., his or her pessimism).

If optimism and pessimism are viewed as two separate constructs, it becomes possible to ask which one has a greater impact on physical health. Perhaps effects found in the more numerous "bipolar" studies really are only due to the toxic effects of pessimism or only to the protective effects of optimism (see, e.g., Robinson-Whelen et al. [25]). Alternatively, perhaps both are equally important. The questions being asked here are reminiscent conceptually of the question that has arisen in the literature on affect, pertaining to whether it is better to construe positive and negative affect as bipolar ends of the same dimension or better to construe them as two independent, albeit correlated, dimensions (e.g., [26]). The questions are also related conceptually to the ones asked in earlier research involving the Type A Behavior Pattern and the attempt to identify which of the Type A components was most predictive of heart disease (e.g., Matthews et al. [27]). To provide evidence on this issue, studies providing separate assessments of optimism and pessimism were analyzed separately for optimism effects and pessimism effects, to determine if the two components were differentially related to health outcomes.

## Method

### Literature Search and Selection of Studies

In order to identify studies to include in our review, we performed computerized literature searches of the MedLINE and PsycINFO databases. These searches were performed through April 2009 using combinations of the following keywords: *optimism*, *explanatory style*, *Life Orientation Test*, *Life Orientation Test-Revised*, *Attributional Style Questionnaire*, *Expanded Attributional Style Questionnaire*, *immunity*, *HIV/AIDS*, *rheumatoid arthritis*, *lupus*, *autoimmune*, *multiple sclerosis*, *pain*, *pregnancy*, *infertility*, *neoplasms*, *cancer*, *cardiovascular*, *coronary*, *cardiac*, *heart*, *hypertension*, *ischemic heart disease*, *atherosclerosis*, *endocarditis*, *cardiomyopathy*, *heart failure*, *cerebrovascular disease*, *anemia*, *stroke*, *diabetes mellitus*, *renal disease*, *disease*, *osteoarthritis*, *tuberculosis*, *respiratory*, *asthma*, *Huntington's disease*, *Alzheimer's*, *influenza*, *pneumonia*, *peptic ulcer*, *sleep*, *illness*, *physical health*, *survival*, *mortality*, and *chronic disease*. We then used the ancestry method to locate studies that had not been identified in the computerized searches. Finally, we hand-searched through the three journals in which we found the majority of the articles published that included measures of optimism and physical health: *Journal of Personality and Social Psychology*, *Health Psychology*, and *Journal of Behavioral Medicine*. We did not locate any additional studies through our hand-search. We limited the search to only those studies that were published in English-language peer-reviewed journals. Unpublished data such as doctoral dissertations and conference abstracts were not included.

This search identified 132 studies that were considered for inclusion in the meta-analysis. Studies were then searched to determine whether they met the following additional inclusion criteria: (1) the study had to have a measure (or measures) of dispositional optimism (thus, studies were omitted if the expectancies measured were not generalized in nature, but rather limited to a particular domain or disease outcome, e.g., expectancies about how quickly life would normalize following coronary artery bypass graft surgery); (2) the study had to include a measure (or measures) of a physical health outcome; (3) the study had to have some type of ES statistic (such as a correlation coefficient) or statistics that could be transformed to an ES (e.g., *t* tests); and (4) the sample size had to be reported. We included studies with subjective and/or objective health outcomes. Subjective health outcomes include physical symptom reports, pain reports, and physician ratings of health status. Objective health outcomes include objective health records, survival, immune parameters, and various other biological outcomes. Since we were interested in the relationship between optimism and physical health, we did not include studies that only assessed mental health parameters (e.g., distress or anxiety). Using these criteria, 84 studies were included in our analyses, with a total of 108 ESs.

## Coding

Each study was coded for the following participant characteristics: type of sample (e.g., healthy participants, and cancer patients), mean age of the participants, gender percentages, and racial and ethnic category percentages. The following methodological characteristics were coded: date the study was published, design of the study, optimism measure(s) used, outcome measure(s) investigated, and the nature of covariates included in the analyses (if any).

A brief explanation of our coding of the study designs is warranted here. Although many of the studies were described by their authors as prospective studies, we categorized many of these author-identified prospective studies as longitudinal studies for the purposes of the meta-analysis. Many of the authors described their studies as prospective when they measured optimism and physical health across time without controlling for baseline physical health measures. Following Cohen et al. [28], we consider a prospective study to be a form of longitudinal study that assesses the associations between a predictor at one point in time and an outcome at a later point, controlling for the association between predictor and outcome at baseline. For the purpose of this meta-analysis, studies were only coded as prospective if they included (a) data presented in the article indicating that the sample was equivalent in health at the beginning of the study, or (b) baseline physical health was controlled for in the ES calculation between optimism and the later physical health outcome, or (c) the sample started out as healthy at the beginning of the study and developed subsequent illness or disease. In many instances, we could not extract the previously described prospective ES information from the information presented in the papers; rather, the data were often reported as measuring the relevant variables across time without controlling for baseline physical health. Readers should be aware that we used our coding scheme to classify studies in the tables that are presented, and that our coding scheme may be at odds with the coding scheme used by the authors.

## Calculation of Effect Sizes

We calculated ESs based on statistics published in the original reports. ESs are presented as correlation coefficients ($r$) in the table. Not all studies presented correlations between optimism and health outcomes, thus, other statistical information was converted to correlation coefficients. Student $t$ and $F$ values were transformed into correlations using formulas provided by Lipsey and Wilson [29]. If no statistics to calculate an ES were presented, we searched the article for a relevant $p$ value, from which, we calculated a $t$ statistic and an $r_{\text{equivalent}}$ [30] using the formula: $r_{\text{equivalent}}=\sqrt{\frac{t^2}{t^2+(N-2)}}$. Four studies reported odds ratios, which were converted into correlation coefficients using the formula: $r = (\text{odds ratio} - 1)/(\text{odds ratio} + 1)$ [31]. Two studies reported only that their findings regarding optimism and health outcome were nonsignificant and did not provide further information for calculating an ES. The results from these studies were assigned an $r$ of zero. This is a conservative approach as there is seldom zero correlation between two constructs. If the article did not include an ES or information to calculate an ES, the author of the study was contacted directly for the ES information. We contacted 24 authors (three authors were contacted about more than one manuscript and several ES possibilities). Twenty of the authors contacted replied that they would attempt to address our request, two were unable to provide ES information due to no longer having access to the data, 15 provided us with the ES information we requested, and three failed to respond following several reminders after their initial agreement to provide the information.

## Meta-analytic Procedures

We converted all test statistics into Fisher $z$ scores before conducting the analyses. Mean ESs were transformed back into $r$s for presentation after all analyses were conducted. Each study contributed only one ES per analysis in order to maintain the assumption of statistical independence [32]. When a study contained more than one ES, such as longitudinal studies with multiple follow-up points on the same outcome, we computed the average ES to avoid violating the assumption of statistical independence. We used a Statistical Package for the Social Sciences macro, MEANES [29], to conduct the meta-analyses.

Several different sets of analyses were conducted. In order to aggregate across studies, the sign of the ESs were changed as needed to make them consistent across studies. Such transformations were necessitated because some of the health outcomes measured (e.g., pain) were negative in nature and some of the outcomes measured (e.g., survival time) were positive in nature. The first planned analyses were conducted on the overall relationship between optimism and physical health, aggregating across all studies. We expected that optimism would be significantly related to physical health and that the ESs in this analysis would be heterogeneous.

The second set of analyses categorized studies in terms of the kind of physical health outcome examined (i.e., whether the outcome studied was objective or subjective in nature). We expected that optimism would be more strongly related

to subjective measures of physical health than objective measures, which reflected harder disease endpoints.

Third, we conducted analyses aggregating studies based on the study design (cross-sectional, longitudinal, or prospective), as we expected that study design would moderate the relationship between optimism and physical health.

We then conducted analyses aggregating studies based on sample type (healthy versus patient). We also conducted separate analyses for studies that looked only at mortality, survival, cardiovascular outcomes, physiological markers (including immune function), immune function only, cancer outcomes, physical symptoms, pain, or only at outcomes related to pregnancy.

We also performed analyses aggregating studies based on the type of optimism measure used. Different measures of optimism have emerged from somewhat different theoretical perspectives [33], and it is possible that these differences in measurement instruments may moderate the relationship between optimism and physical health. Specifically, we separated analyses based on whether the studies used (a) LOT or LOT-R, (b) ASQ or EASQ, or (c) one-item measures of optimism.

Finally, we conducted analyses comparing ESs for those studies providing separate assessments of optimism and pessimism. These analyses were conducted as it remains unclear whether heightened optimism is protective, heightened pessimism is risk-enhancing, or if both factors are important in understanding links to physical well-being.

Each ES was weighted by sample size before conducting analyses, as studies that have a larger sample size provide a more accurate estimate of the true population parameter [29]. We calculated both an unweighted mean ES and a sample size-weighted mean ES for each analysis. There were no differences between the mean ESs for the analyses, thus, we only present the weighted mean ES in the results. Analyses were conducted using a random-effects model [29, 34, 35], as our goal was to be able to generalize the findings beyond the studies included in the meta-analysis. Random-effects models calculate means and confidence intervals that generalize to all studies in a research area, as opposed to fixed effects models which cannot be generalized to the entire domain of studies [34]. The random-effects model enables generalization beyond the observed studies because the model assumes that population parameters vary between studies and attempts to estimate this variance. This estimated variance is combined with the subject-level sampling error and is used to compute standard errors and confidence intervals. With more variance, the confidence intervals calculated using a random-effects model will be larger than those calculated using a fixed effects model. Using a random-effects model, though, provides a conservative test of significance of combined effects sizes; whereas, inappropriately applying a fixed effects model when it is not appropriate can yield erroneously narrow confidence intervals [34, 35].

Primary analyses used unadjusted ESs to estimate the association between optimism and health. We used unadjusted ESs because that was the only information available for the majority of effects. Although adjusted ESs were sometimes available, the primary analyses used only unadjusted ESs, in order to use the same metric for all effects that were included. Subsidiary analyses were also conducted, however, to determine whether ESs were also significant when only including effects that were adjusted for covariates. To do this, effects were placed into one of three categories: those that did not adjust for covariates, those that were adjusted for demographic and/or health risk covariates, and those that were adjusted for one or more psychosocial covariates such as depression or negative affectivity (62.9%, 19%, and 18.1% of the total effects available for analysis, respectively). The overall analysis was then repeated, breaking effects down into these three categories. Similar subsidiary analyses were conducted stratifying effects according to whether they reflected a subjective health outcome or an objective health outcome.

### Additional Analyses

We conducted *t* tests and *F* tests that paralleled the aforementioned meta-analyses. First, we compared ESs between objective and subjective measures of physical health to investigate whether the type of health outcome studied results in different ESs. Comparisons also were conducted after aggregating the studies by design (cross-sectional, longitudinal, and prospective). Similarly, we compared healthy versus patient samples to discern whether type of participant sampled in the studies might result in significantly different ESs. We also compared ESs between studies using different measures of optimism and studies that measured optimism and pessimism separately. Finally, we conducted *F* tests to determine if ES varied as a function of whether the effect was adjusted for covariates or not.

## Results

The Appendix provides a descriptive summary of each study utilized in the meta-analysis including the total number of participants, sample type, optimism measure used, physical health outcome investigated, and ES. These

data are split according to whether the physical health outcome assessed was objective or subjective in nature. Some studies are listed more than once, as they reported multiple correlations between optimism and physical health measures. The majority of the studies consisted of longitudinal (35% of the sample) and prospective designs (28% of the sample). The remainder of studies included was cross-sectional (35% of the sample). Some of the longitudinal and prospective studies also included cross-sectional data. Forty-four of the ESs (38%) involve correlations between optimism and objective physical health outcomes, and 73 of the ESs (62%) involve correlations between optimism and subjective physical health outcomes. The majority of studies (78%) used the LOT [36] or LOT-R [30] to measure optimism. When judging and interpreting ESs, 0.10 is considered a small effect, 0.30 is considered a medium effect, and 0.50 is considered a large effect [37].

## Overall Analysis of Effect Sizes for Optimism and Physical Health

The first analysis included the ES of all studies with the goal of providing an overall mean ES of the relationship between optimism and physical health. This analysis revealed a mean ES of 0.17 ($K$=108; $N$=30,133; 95% CI=0.15 to 0.20). Thus, optimism was significantly related to physical health outcomes based on all the studies examined ($p$<.001). Not surprisingly, the analysis showed that the test of homogeneity ($Q$=343.49, $p$=.000) was also significant, suggesting that the ESs in the overall analysis are heterogeneous. Accordingly, the planned moderator analyses were conducted in order to identify the source of some of this heterogeneity.

## Moderators of the Relationship Between Optimism and Physical Health

### *Objective and Subjective Measures of Physical Health*

The mean ES for optimism and subjective measures of physical health outcomes was 0.21 ($K$=65; $N$=11,772; 95% CI=0.18 to 0.25), and the mean ES for optimism and objective measures of physical health outcomes was 0.11 ($K$=43; $N$=18,361; 95% CI=0.09 to 0.14). Thus, ESs for both subjective and objective health outcomes were significantly different from zero (both $p$<.001). The $t$ test conducted to compare ESs for subjective and objective health outcomes revealed that the mean ES for objective measures was significantly smaller than the mean ES for subjective measures ($t$ (106)=−2.89, $p$=.005). Thus, the type of health outcome assessed moderates the relationship between optimism and good health.

### *Study Design*

We conducted analyses for optimism and health after stratifying by study design. The mean ES for optimism and health outcomes was 0.22 ($K$=37; $N$=8,443; 95% CI=0.18 to 0.26) for cross-sectional designs, 0.18 ($K$=38; $N$=5,692; 95% CI=0.13 to 0.22) for longitudinal designs, and 0.12 ($K$=33; $N$=15,998; 95% CI=0.09 to 0.15) for prospective designs. Each of the mean ESs was significantly different from zero (all $p$<.001). We tested the significance of the differences between ESs using analysis of variance. This analysis did not reveal any significant differences [$F$ (2, 105)=1.73, $p$=.18].

Inspection of the mean ESs, however, reveals that the differences are ordered in the expected direction, with the ES for prospective studies being the lowest. Consequently, a secondary analysis was conducted. For this analysis, cross-sectional and longitudinal studies were combined, because they suffer conceptually from the same set of limitations and compared to studies that used prospective designs. The mean ES for optimism and health outcomes for cross-sectional and longitudinal studies combined was 0.20 ($K$=75; $N$=14,135; 95% CI=0.17 to 0.23). The mean ES for cross-sectional and longitudinal studies combined was not significantly larger than the mean ES (0.12) for prospective studies ($t$ (106)=1.70, $p$=.09, 95% CI=−0.01 to 0.11), although the difference approached significance.

### *Type of Sample*

For this set of analyses, we separated the analyses based on the type of participant sampled in the studies (i.e., healthy versus patient) to discern whether sample type was a moderator. For the studies using healthy samples, the mean ES for the relationship between optimism and health was 0.15 ($K$=39; $N$=22,369; 95% CI=0.12 to 0.18). For studies using patient samples, the mean ES for the relationship between optimism and health was 0.19 ($K$=69; $N$=7,864; 95% CI=0.16 to 0.23). Both ESs were significantly different from zero (both $p$<.001). The follow-up $t$ test indicated that the mean ES for healthy samples was not significantly different than the mean ES for patient samples [$t$ (106)=−1.09, $p$=.27], indicating that sample type is not a moderator of the relationship between optimism and health.

Separate analyses were also performed for studies that looked only at the following: mortality, survival, cardiovascular outcomes, physiological markers (including immune function), immune function only, cancer outcomes,

physical symptoms, pain, or outcomes related to pregnancy. For purposes of these analyses, we kept the studies with prospective designs separate from the studies with cross-sectional and longitudinal designs but combined the latter two groups. These analyses showed that optimism was linked to the vast majority of health outcomes that were assessed including mortality and survival (see Table 1). Only four analyses failed to find an ES greater than zero, and two of these four were close to being significant (i.e., those involving cross-sectional and longitudinal studies of immune function ($p$=.07), and those involving prospective studies of cancer outcomes ($p$=.053)). The link between optimism and health seemed most tenuous for prospective studies of pain ($p$=.18).

### *Type of Optimism Measure*

Analyses were conducted for studies using different measures of optimism: the LOT or LOT-R, ASQ or EASQ, and one-item measures of optimism. The mean ES for optimism and health using the LOT or LOT-R as the measure of optimism was 0.17 *(*$K$=94, $N$=22,413, 95% CI=0.14 to 0.19). The mean ES was 0.28 ($K$=5; $N$=471; 95% CI=0.05 to 0.47) for those studies using the ASQ or EASQ and 0.31 ($K$=4; $N$=4,137; 95% CI=0.16 to 0.44) for those using one-item measures of optimism. All ESs were significantly different from zero (all $p$<.01). The means ESs for the different types of optimism measures were not significantly different from each other ($F$ (6, 96)=1.25, $p$=.29), indicating that type of optimism measure is not a moderator of the relationship between optimism and health outcomes.

### *Optimism Versus Pessimism*

Analyses were done on those studies that assessed optimism and pessimism separately, in order to assess the strength of association of each element to health outcomes. The mean ES between the optimism component by itself and health was 0.14 ($K$=16; $N$=11,243; 95% CI=0.08 to 0.20). The mean ES between the pessimism component and health was 0.18 ($K$=17; $n$=7,666; 95% CI=0.12 to 0.24). The mean ES for each component was significantly different from zero (both $p$<.001). Although the mean ES for the pessimism component was larger than the mean ES for the optimism component, a follow-up $t$ test revealed no significant difference between the two means.

### *Unadjusted Versus Adjusted Effect Sizes*

To determine whether ESs differed depending on whether the effects were adjusted for covariates or not, effects were grouped into one of three categories: those that were unadjusted for covariates, those that were adjusted for demographic and/or health risk covariates, and those that

**Table 1** Mean effect sizes for specific health outcomes

| Health outcome | *K* studies | *N* subjects | Weighted mean ES | 95% CI | Significance level (*p*) |
|---|---|---|---|---|---|
| Mortality | 2 | 1,901 | 0.09 | 0.04 to 0.13 | <.001 |
| Survival | 6 | 1,772 | 0.10 | 0.03 to 0.17 | <.001 |
| Cardiovasulcar (cross-sectional and longitudinal studies only) | 8 | 589 | 0.25 | 0.12 to 0.37 | .0002 |
| Cardiovascular (prospective studies only) | 4 | 761 | 0.15 | 0.03 to 0.27 | .01 |
| Physiological markers (cross-sectional and longitudinal studies only) | 8 | 845 | 0.11 | 0.04 to 0.18 | .001 |
| Physiological markers (prospective studies only) | 10 | 961 | 0.17 | 0.07 to 0.27 | .001 |
| Immune function (cross-sectional and longitudinal studies only) | 4 | 312 | 0.12 | −0.01 to 0.24 | .07 |
| Immune function (prospective studies only) | 7 | 251 | 0.21 | 0.05 to 0.36 | .01 |
| Cancer (cross-sectional and longitudinal studies only) | 14 | 2,102 | 0.27 | 0.16 to 0.36 | <.001 |
| Cancer (prospective studies only) | 4 | 756 | 0.07 | −0.001 to 0.14 | .053 |
| Physical symptoms (cross-sectional and longitudinal studies only) | 16 | 2,148 | 0.25 | 0.19 to 0.30 | <.001 |
| Physical symptoms (prospective studies only) | 1 | 242 | 0.16[a] | – | – |
| Pain (cross-sectional and longitudinal studies only) | 12 | 1,925 | 0.25 | 0.15 to 0.35 | <.001 |
| Pain (prospective studies only) | 3 | 178 | 0.10 | −0.05 to 0.25 | .18 |
| Pregnancy outcomes (cross-sectional and longitudinal studies only) | 2 | 359 | 0.10 | −0.02 to 0.20 | .10 |
| Pregnancy outcomes (prospective studies only) | 1 | 982 | 0.09[a] | – | – |

[a] There is only one study in this category. Thus, a meta-analysis was not conducted. The single effect size is provided for the one study in this category

were adjusted for psychosocial covariates. In terms of the overall analysis, the mean ES between optimism and health for unadjusted effects was 0.18 ($K$=66; $N$=8,493; 95% CI=0.13 to 0.19). The mean ES for effects adjusted for demographic and/or health risk covariates was 0.16 ($K$=20; $N$=8,312; 95% CI=0.11 to 0.22). The mean ES for effects adjusted for psychosocial covariates was 0.20 ($K$=19; $N$=7,767; 95% CI=0.13 to 0.26). All ESs were significantly different from zero (all $p<.001$). The mean ESs did not differ significantly from each other ($F$ (2, 102)=1.25, $p$=.29).

Two further analyses were also performed—one including effects that involved subjective outcomes and one including effects that involved objective outcomes. With respect to effects involving subjective outcomes, the mean ES between optimism and health for unadjusted effects was 0.20 ($K$=42; $N$=5,255; 95% CI=0.17 to 0.23). The mean ES for effects adjusted for demographic and/or health risk covariates was 0.18 ($K$=10; $N$=809; 95% CI=0.05 to 0.30). The mean ES for effects adjusted for psychosocial covariates was 0.24 ($K$=11; $N$=5,574; 95% CI=0.14 to 0.32). Each of these ESs was significantly different from zero (all $p\leq.005$). The mean ESs did not differ significantly from each other ($F$ (2, 60)=1.15, $p$=.32).

With respect to effects involving objective outcomes, the mean ES between optimism and health for unadjusted effects was 0.08 ($K$=24; $N$=8,493 95% CI=0.06 to 0.10). The mean ES for effects adjusted for demographic and/or health risk covariates was 0.24 ($K$=10; $N$=7,503; 95% CI=0.14 to 0.34). The mean ES for effects adjusted for psychosocial covariates was 0.14 ($K$=8; $N$=2,193; 95% CI=0.06 to 0.22). All ESs were significantly different from zero (all $p<.001$). The mean ESs did not differ significantly from each other ($F$ (2, 39)=2.39, $p$=.11).

Because of the special interest in the relationship between optimism and negative affectivity that has arisen in the literature (e.g., [38]), one final analysis was conducted. For this analysis, effects were included only if the effect was adjusted for some variant of negative affectivity (i.e., for measures of neuroticism, negative affectivity, or depression). This analysis produced a mean ES of 0.20 ($K$=10; $N$=1,848; 95% CI=0.06 to 0.32). This ES was significantly different from zero ($p<.005$).

## Discussion

This quantitative review summarizes the findings from 84 studies that tested the relationship between optimism and physical health outcomes. In the aggregate, these studies strongly suggest that optimism is a significant predictor of physical health. The ES for the overall analysis was in the small to moderate range, using the framework developed by Cohen and Cohen [37]. This finding is important because not all of the prior research on optimism and physical health has produced significant relationships [14]. The results from the overall analysis help to document the positive role that optimism plays in physical well-being.

Also noteworthy is the fact that the strength of the relationship between optimism and health was moderated by the nature of the outcome that was assessed. That is, results revealed that the mean ES for studies using subjective measures to assess health outcomes was significantly higher than the mean ES for studies using objective measures. Indeed, the mean ES for subjective outcomes was nearly twice as high as the mean ES for objective measures.

As defined in the present study, subjective health measures were largely those that reflected self-reports of physical symptoms or pain (but included physician ratings of disease as well). Over the past several decades, self-report measures of health have come under increasing scrutiny, for at least a couple reasons. First, when psychosocial predictors and health outcomes are both assessed via self-reports, they share common method variance, and this shared method variance may lead to inflated associations. Second, numerous authors have argued that self-reports might be contaminated by certain psychosocial factors, most notably, neuroticism [39, 40]. The argument here is that nuisance factors like neuroticism relate to self-reports of disease not because of any real association with the underlying disease process but because of reporting biases and perceptional distortions. To the extent that characteristics like neuroticism are correlated with the psychosocial predictor variables of interest, inflated associations with health can result.

The fact that the mean ES for studies using subjective measures of health was higher than the mean ES for studies using objective measures of health is consistent with the concern about self-report measures. It is also important to realize, however, that even though the mean ES for studies using objective measures was lower, it was still statistically significant. Additionally, separate analyses conducted on studies focusing exclusively on survival, mortality, cardiovascular outcomes, physiological markers (including immune function), immune function only, cancer outcomes, and pregnancy outcomes all documented significant effects between optimism and health. Thus, optimism still predicts health outcomes, even when harder disease endpoints and direct markers of underlying physiologic state are used.

There was no moderator effect for study design in the present set of analyses. This finding is somewhat surprising. Because prospective designs explicitly take baseline health

into account, they focus on changes in health over time, and as such, provide a direct measure of the temporal association between variables. We anticipated that these differences between designs would result in smaller mean ESs for prospectively designed studies. This was not the case. Even so, we still believe that prospective studies are preferred. Prospective studies are the only ones that are able to eliminate an explanation based on reverse causality. Thus, the advantage held in this regard by prospective studies is far from trivial.

We also considered that ESs for the association between optimism and physical health might differ depending on the type of population that is sampled. This was not the case. Although the ES for studies using patient populations was larger than the ES for studies using healthy populations, the difference was small and nonsignificant.

Neither were there any differences between ES as a function of the type of optimism measure that was used. This suggests that choice of assessment instrument may not matter. We should note, however, that the majority of studies reported in the literature used either the LOT or LOT-R to assess optimism. This is likely due to the fact that these scales are easy for participants to complete. They also allow for the separate measurement of optimism and pessimism, depending on how the scale is scored. This is a capability that one-item scales do not have. Thus, there are reasons why these scales have been used so much. Continued use of the LOT-R (the newer preferred version) would allow for the greatest comparability with the prior research that has been done.

Primary analyses were based on unadjusted ESs. While informative, unadjusted effects do not rule out the possibility that the effects were due in fact to some unmeasured factor that is correlated with optimism. For example, perhaps persons who are healthier are more optimistic and that it is differences in health that are driving the effects, not differences in optimism. Similarly, the argument has been made [38] that optimism effects are really due to the confounding with neuroticism or negative affectivity. Analysis of ESs adjusted for relevant covariates could help mitigate some of these concerns.

Subsidiary analyses of major findings revealed that significant ESs were obtained even when ESs were adjusted for relevant demographic factors, health status and health risk factors, and relevant psychosocial factors. Indeed, there were no significant differences between adjusted and unadjusted ESs in any of the analyses that were conducted. Perhaps most noteworthy was the finding that a significant ES emerged for optimism even from those studies that specifically adjusted their effects for negative affectivity. This strongly suggests that the effects of optimism are independent of the effects of negative affectivity. More generally, it suggests that dispositional optimism is a significant predictor of variations in physical health and biologic markers of health, even when traditional risk factors and relevant psychosocial factors are taken into account. As such, dispositional optimism provides value added.

Our final issue has to do with the relative potency of optimism and pessimism, if the two components are viewed as separate rather than comprising the polar ends of a single unidimensional construct. Although the statistical test comparing the optimism and pessimism components was not significant, the mean ES for the pessimism component was larger than the mean ES for the optimism component. This fact, coupled with the small number of studies involved in the comparison, suggests that the question should remain open. It may well be the case that it is the presence or absence of pessimism that is important in determining physical health outcomes rather than the presence or absence of optimism. Scheier et al. [19] have explicitly suggested that primary analyses involving optimism and pessimism be conducted using an overall composite score, treating the variables as bipolar opposites. They also suggested that secondary analyses of data sets be done to explore whether one component was more or less toxic (or more or less protective) than the other. Given that this issue has yet to be definitively resolved, routinely conducting and reporting secondary analyses of data sets separating optimism and pessimism by component would still seem warranted.

## Limitations

Every data analytic plan or research strategy has its limitations, and meta-analysis is no exception. These limitations need to be borne in mind when evaluating the conclusions that can be drawn from the results presented. First, the search for studies has to end at some point in time; even the research literature that the review captures is dynamic. Additional studies will always be added to the literature. In this sense, all attempts to characterize the literature are necessarily out of date.

A second limitation of meta-analysis has to do with aggregating research findings based on multivariate relationships. There are two issues here. The first has to do with the paucity of studies that include covariates in analyses. In the majority of studies that we located, unadjusted effects were all that were reported, and less than 20% contained psychosocial covariates. Additionally, the information needed to construct inverse variance weights is often not available in the published manuscript [29]. It is difficult to

estimate the independent effect of some factor of interest when relevant covariates are not measured or are reported upon in a manner from which ESs cannot be extracted.

The second problem has to do with the difficulty interpreting ESs from multivariate analyses even when the data are available. That is, the field has not agreed upon set of demographic, health risk, or psychosocial factors to include in analyses. As a result, the ES statistics are contingent on very different covariates from study to study. This makes it difficult to know whether the effects of a target variable, e.g., optimism, are independent of specific covariates, e.g., age. In this case, an analysis was performed aggregating only studies that include a measure of affectivity, because the confounding of optimism and negative affectivity has been explicitly discussed in the literature [38]. However, it is not feasible to do this for every covariate measured. To do so would yield a set of results that would be exceedingly complex and likely too fragmented to understand fully. Thus, although analyses of ESs based on multivariate associations have benefits (i.e., they can tell you in general whether a target variable provides value added), they also have drawbacks.

A third limitation has to do with the fact that the current meta-analysis used correlations across studies to calculate ESs. Use of this technique precluded the possibility of including in the analysis studies that report interactions between optimism and some other psychosocial variable. Although there are very few studies that explore interactions of this type, including them in the meta-analysis might have yielded a more complex picture of the relationship between optimism and health.

## Looking to the Future

The present meta-analysis identified a number of studies that examined links between optimism and physical health outcomes and underlying biologic states. The nature of the studies included and the meta-analyses performed on the outcome of those studies can be used to help inform future research activity in this area. In general, it is clear from this review that optimism is related to physical health. It is also clear that the link between optimism and health is stronger for subjective health outcomes than for objective health outcomes. We do not need more studies to document these basic effects.

On the other hand, there are at least three issues or concerns that the present meta-analysis raised toward which future research might be directed. The first has to do with the continued effort to tease apart the effects of optimism from related constructs. It was noteworthy to us that so few studies included psychosocial covariates. Although the data suggested that optimism is linked to health, independent of other relevant psychosocial characteristics, the analyses were based on a limited set of studies. Thus, it will be important for future studies to include measures of related concepts and continue the effort to distinguish which effects are due to what. It will also be important to report findings in such a manner that ESs can be easily estimated.

We should explicitly note that this recommendation is not limited to research focusing on the effects of optimism. The same strategy should be employed whenever psychosocial predictors are being examined, particularly so when those psychosocial predictors involve characteristics of the person. Thus, studies that focus on depression, positive affect, or whatever variable should also include relevant psychosocial covariates, so that the effects of variables other than optimism can be distinguished as well. As already discussed, the importance of including covariates in research on optimism has been primed because of the discussion in the literature of the association between optimism and negative affectivity [38]. Although we have not systematically examined the literature, it would not be surprising to learn that even fewer studies of other psychosocial variables have included psychosocial covariates in their designs.

Second, very few studies have attempted to capture the underlying pathways by which optimism impacts disease and health. To identify such pathways, studies are needed that assess optimism, the suspected underlying pathways, and relevant disease endpoints and health outcomes. Relevant statistical analyses then have to be performed to determine whether those pathways provide a viable explanation for the optimism-disease link. Such studies are complicated and time consuming to enact, which no doubt explains why so few studies of this type exist. Still the relevant studies are conspicuously lacking from the available database and need to be conducted in the future.

Finally, attention still needs to be given to the relative toxicity of optimism versus pessimism. Although not statistically significant, ESs for the pessimism component were larger than the ESs for the optimism component. Very few studies have conducted analyses that enable the relative potency of these two components to be evaluated, and more studies are critically needed. The answer to the question of which component is more toxic has implications for not only how we understand the manner in which expectancies impact health but also on the kinds of interventions that are created to help people maintain better health.

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## Appendix

### Characteristics of the studies

| Study | *N* | Sample type | Optimism measure | Health measure | Study design | Effect size (*r*) |
|---|---|---|---|---|---|---|
| Studies with objective health measure | | | | | | |
| Allison et al. (2003) [41] | 101 | Head and neck cancer | FLOT | Survival at 1 year | PR | .06 |
| Brennan and Charnetski (2000) [42] | 112 | Undergraduates | ASQ | Immunoglobulin A | CS | −.02 |
| Brody et al. (2008) [43] | 200 | Diabetes mellitus | LOT (pessimism) | Glycosylated hemoglobin | CS | .10 |
| Cohen et al. (1999) [44] | 39 | Healthy women | LOT | Immune measure (mean of CD 4 counts of 3 months) | LO | .29 |
| Cohen et al. (1999) [44] | 39 | Healthy women | LOT | Immune measure (mean of CD 8 counts of 3 months) | LO | .02 |
| Cohen et al. (1999) [44] | 39 | Healthy women | LOT | Immune measure (mean of NK Cells counts of 3 months) | LO | −.03 |
| Contrada et al. (2004) [45] | 142 | Surgery | LOT-R | Post-surgical complications | LO | .10 |
| Costello et al. (2002) [2] | 20 | Temporomandibular disorder | LOT | Immune measure (IL-6) | PR | −.62 |
| De Moor et al. (2006) [46] | 90 | Cancer | LOT-R | Cancer antigen (CA 125) | LO | −.32 |
| de Ridder et al. (2004) [5] | 65 | Type I diabetes | LOT-R | Blood glucose | CS | −.15 |
| Friedman et al. (1993) [47] | 1,178 | Aging | TC | Death | LO | −.09 |
| Giltay et al. (2004) [48] | 940 | Aging | SWB | Survival | PR | .18 |
| Goetzmann et al. (2007) [49] | 76 | Transplant patients (lung, liver, or bone marrow) | LOT | Survival | PR | .005 |
| Helgeson and Fritz (1999) [50] | 298 | Percutaneous transluminal coronary angioplasty | LOT | New coronary events (death from coronary artery disease, myocardial infarction, progression, etc.) | PR | .03 |
| Kennedy and Hughes (2004) [51] | 50 | Healthy undergraduates | LOT-R | Systolic blood pressure reactivity | LO | .30 |
| Kennedy and Hughes (2004) [51] | 50 | Healthy undergraduates | LOT-R | Diastolic blood pressure reactivity | LO | −.08 |
| Kennedy and Hughes (2004) [51] | 50 | Healthy undergraduates | LOT-R | Heart rate reactivity | LO | 0 |
| Kivimaki et al. (2005) [52] | 5,007 | Healthy people | LOT-R | Increase in number of sick days | PR | −.04 |
| Kohut et al. (2002) [53] | 57 | Aging | LOT | Immune measure (IL-10) | LO | .24 |
| Lee et al. (1995) [54] | 89 | Male Air Force cadets | LOT | Immune measure (PHA) | LO | .04 |
| Lee et al. (1995) [54] | 89 | Male Air Force cadets | LOT | Immune measure (PMA) | LO | .11 |
| Lee et al. (1995) [54] | 89 | Male Air Force cadets | LOT | Immune measure (anti-CD3) | LO | −.02 |
| Lobel et al. (2000) [55] | 129 | Pregnancy | LOT | Birth weight | LO | .20 |
| Lobel et al. (2000) [55] | 129 | Pregnancy | LOT | Gestational age | LO | .13 |
| Maruta et al. (2000) [56] | 723 | Aging | MMPI (pessimism) | Death | PR | .09 |
| Matthews et al. (2004) [57] | 209 | Healthy middle-aged women | LOT (pessimism) | Increase in carotid intima-media thickness | PR | .19 |
| Matthews et al. (2008) [58] | 401 | Healthy middle-aged women | LOT | Metabolic syndrome | PR | −.03 |
| Motivala et al. (1999) [8] | 25 | Type I and II diabetes | LOT | Disease duration | CS | −.41 |

Characteristics of the studies

| Study | *N* | Sample type | Optimism measure | Health measure | Study design | Effect size (*r*) |
|---|---|---|---|---|---|---|
| Nelson et al. (2003) [59] | 982 | Pregnancy | LOT-R | Pregnancy loss | PR | .09 |
| Raikkonen et al. (1999) [60] | 100 | Healthy people | LOT | Average systolic ambulatory blood pressure over 3 days | PR | .18 |
| Raikkonen et al. (1999) [60] | 100 | Healthy people | LOT | Average diastolic ambulatory blood pressure over 3 days | PR | .26 |
| Rini et al. (1999) [61] | 230 | Pregnancy | LOT | Birth weight | LO | .09 |
| Rini et al. (1999) [61] | 230 | Pregnancy | LOT | Gestational age | LO | .01 |
| Scheier et al. (1989) [36] | 51 | Coronary artery bypass surgery | LOT | Physical recovery | PR | .36 |
| Scheier et al. (1989) [36] | 51 | Coronary artery bypass surgery | LOT | Fewer post-operative complications | PR | .23 |
| Scheier et al. (1999) [13] | 263 | Coronary artery bypass surgery | LOT | Rehospitalization | PR | −.33 |
| Schofield et al. (2004) [14] | 179 | Lung cancer | LOT | Survival | PR | .03 |
| Schulz et al. (1996) [62] | 238 | Cancer | LOT (pessimism) | Mortality | PR | .14 |
| Schulz et al. (1996) [62] | 238 | Cancer | LOT (optimism) | Mortality | PR | .04 |
| Segerstrom (2001) [63] | 22 | Law students | LOT-R | Immune function (DTH skin test) | PR | .09 |
| Segerstrom et al. (2003) [64] | 30 | Medical and Law students | LOT-R | Immune function (DTH skin test) | PR | .12 |
| Segerstrom et al. (1998) [65] | 50 | Law students | LOT | Immune measure (CD4 helper T cells) | PR | .01 |
| Segerstrom et al. (1998) [65] | 50 | Law students | LOT | Immune measure (CD8-cytotoxic T cells) | PR | .25 |
| Segerstrom et al. (1998) [65] | 50 | Law students | LOT | Immune measure (CD19 B cells) | PR | .15 |
| Segerstrom et al. (1998) [65] | 50 | Law students | LOT | Immune measure (CD16+56 natural killer cells) | PR | −.01 |
| Tomakowsky et al. (2001) [66] | 78 | HIV/AIDS | LOT | Lower CD 4 counts | CS | −.05 |
| Tomakowsky et al. (2001) [66] | 78 | HIV/AIDS | EASQ | Lower CD 4 counts | CS | −.21 |
| Tomakowsky et al. (2001) [66] | 47 | HIV/AIDS | LOT | Decline in CD 4 counts at 2-year follow-up | PR | −.08 |
| Tomakowsky et al. (2001) [66] | 47 | HIV/AIDS | EASQ | Decline in CD 4 counts at 2-year follow-up | PR | −.43 |
| Von Ah and Kang (2007) [67] | 49 | Breast cancer | LOT-R | Disease stage at baseline | CS | −.06 |
| Von Ah and Kang (2007) [67] | 49 | Breast cancer | LOT-R | Lymph node status at baseline | CS | −.02 |
| Von Ah and Kang (2007) [67] | 49 | Breast cancer | LOT-R | Disease stage at post-treatment | CS | −.04 |
| Von Ah and Kang (2007) [67] | 49 | Breast cancer | LOT-R | Lymph node status at post-treatment | CS | .02 |
| Von Ah et al. (2007) [68] | 54 | Breast cancer | LOT-R | Immune measure (natural killer cells) | CS | .08 |
| Yi et al. (2008) [69] | 111 | Diabetes mellitus | LOT | Glycosylated hemoglobin | LO | −.11 |
| Studies with subjective health measure | | | | | | |
| Abend and Williamson (2002) [70] | 63 | Breast cancer | LOT | Patient report of cancer recurrence | CS | −.12 |
| Achat et al. (2000) [71] | 659 | Aging | LOT | Freedom from pain | LO | .06 |
| Affleck et al. (2001) [1] | 89 | Fibromyalgia | LOT | Mean daily pain | LO | −.04 |
| Affleck et al. (2001) [1] | 89 | Fibromyalgia | LOT | Mean daily fatigue | LO | −.13 |
| Allison et al. (2001) [72] | 88 | Head and neck cancer | FLOT | Freedom from pain | CS | .18 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Baker (2007) [73] | 39 | Undergraduates | LOT (optimism) | Physical symptoms | LO | −.18 |
| Baker (2007) [73] | 39 | Undergraduates | LOT (pessimism) | Physical symptoms | LO | .19 |
| Bennett and Elliot (2005) [74] | 72 | Post-cardiac event | ASQ | Physical symptoms | LO | −.54 |
| Bensten et al. (2008) [75] | 101 | Spinal fusion patients | One-item measure (pessimism) | Pain | CS | .57 |
| Brewer (2007) [76] | 91 | Knee surgery | LOT-R | Knee pain | LO | .07 |
| Chamberlain et al. (1992) [77] | 50 | Surgery | LOT | Knee pain | PR | −.14 |
| Chaney et al. (2004) [78] | 42 | Rheumatoid arthritis | ASQ | Pain | LO | .34 |
| Conway et al. (2008) [79] | 67 | Hypertension | LOT-R (optimism) | Physical symptoms | CS | −.25 |
| Conway et al. (2008) [79] | 67 | Hypertension | LOT-R (pessimism) | Physical symptoms | CS | .46 |
| Costello et al. (2002) [2] | 20 | Temporomandibular disorder | LOT | Pain | PR | −.02 |
| Curbow et al. (1993) [80] | 135 | Bone marrow transplants | LOT | Perceived health | CS | .25 |
| de Ridder et al. (2004) [5] | 50 | Multiple sclerosis | LOT-R | Physician rating of neurological disorder interfering with functioning | CS | −.11 |
| de Ridder et al. (2004) [5] | 50 | Multiple sclerosis | LOT-R | Physical functioning | PR | .06 |
| de Ridder et al. (2004) [5] | 65 | Type I diabetes | LOT-R | Physical functioning | PR | .24 |
| Ferreira and Sherman (2007) [81] | 72 | Osteoarthritis | LOT-R | Pain | CS | −.28 |
| Fitzgerald et al. (2000) [82] | 50 | Coronary artery bypass surgery | LOT | Reduction in post-CABG angina | LO | .29 |
| Fotiadou et al. (2008) [83] | 100 | Parents of cancer patients | LOT-R | Perceived health | CS | .26 |
| Fournier et al. (2002a) [6] | 269 | Chronic disease | LOT-R | Physical functioning at 6-month follow-up | LO | .24 |
| Fournier et al. (2002a) [6] | 269 | Chronic disease | LOT-R | Physical functioning at 1-year follow-up | LO | .24 |
| Fournier et al. (2002a) [6] | 269 | Chronic disease | LOT-R | Disease severity at 6-month follow-up | LO | −.22 |
| Fournier et al. (2002a) [6] | 269 | Chronic disease | LOT-R | Disease severity at 1-year follow-up | LO | −.21 |
| Fournier et al. (2002b) [7] | 104 | Type I diabetes | LOT-R | Patient report of physical functioning | CS | .15 |
| Fournier et al. (2002b) [7] | 95 | Rheumatoid arthritis | LOT-R | Patient report of physical functioning | CS | .25 |
| Fournier et al. (2002b) [7] | 98 | Multiple sclerosis | LOT-R | Patient report of physical functioning | CS | .33 |
| Fournier et al. (2002b) [7] | 104 | Type I diabetes | LOT-R | Physical symptoms | CS | −.26 |
| Fournier et al. (2002b) [7] | 95 | Rheumatoid arthritis | LOT-R | Physical symptoms | CS | −.36 |
| Fournier et al. (2002b) [7] | 98 | Multiple sclerosis | LOT-R | Physical symptoms | CS | −.29 |
| Fry (1995) [84] | 37 | Female executives | LOT | Physical symptoms | CS | −.44 |
| Glazer et al. (2002) [9] | 46 | Cardiac patients | LOT | Physical symptoms | CS | −.43 |
| Glazer et al. (2002) [9] | 46 | Cardiac patients | LOT | Physical symptoms at 3-month follow-up | LO | −.11 |
| Hamid (1990) [85] | 75 | Undergraduates | LOT | Influenza symptoms | LO | −.24 |
| Hooker et al. (1992) [86] | 51 | Alzheimer's caregivers | LOT | Perceived health | CS | .15 |
| Jackson et al. (2002) [87] | 99 | Undergraduates | EASQ (pessimism) | Physical illness | PR | .25 |
| King et al. (1998) [88] | 75 | Coronary artery bypass surgery | LOT | Angina | LO | 0 |
| Kurdek and Siesky (1990) [10] | 48 | HIV/AIDS | LOT | Physical symptoms | CS | −.06 |
| Lam et al. (2004) [89] | 367 | Breast cancer | CLOT | Physical symptoms | CS | −.25 |
| Lau and Knardahl (2008) [90] | 1,946 | Healthy adults | One-item measure (optimism) | Perceived health | CS | .27 |

## Characteristics of the studies

| Study | *N* | Sample type | Optimism measure | Health measure | Study design | Effect size (*r*) |
|---|---|---|---|---|---|---|
| Lau and Knardahl (2008) [90] | 1,946 | Healthy adults | One-item measure (optimism) | Mean pain | CS | −.11 |
| Lyons and Chamberlain (1994) [11] | 158 | Undergraduates | LOT | Perceived health | CS | .28 |
| Lyons and Chamberlain (1994) [11] | 158 | Undergraduates | LOT | Upper respiratory illness (URI) symptoms | CS | −.23 |
| Lyons and Chamberlain (1994) [11] | 158 | Undergraduates | LOT | Physical symptoms | CS | −.17 |
| Lyons and Chamberlain (1994) [11] | 138 | Undergraduates | LOT at 2-week follow-up | Perceived health at 2-week follow-up | CS | .16 |
| Lyons and Chamberlain (1994) [11] | 138 | Undergraduates | LOT at 2-week follow-up | URI symptoms at 2-week follow-up | CS | −.01 |
| Lyons and Chamberlain (1994) [11] | 138 | Undergraduates | LOT at 2-week follow-up | Physical symptoms at 2-week follow-up | CS | −.08 |
| Lyons and Chamberlain (1998) [91] | 175 | Undergraduates | LOT | URI symptoms | CS | −.20 |
| Lyons and Chamberlain (1998) [91] | 175 | Undergraduates | LOT | Non-URI symptoms | CS | −.16 |
| Lyons and Chamberlain (1998) [91] | 131 | Undergraduates | LOT | URI symptoms | LO | −.32 |
| Lyons and Chamberlain (1998) [91] | 131 | Undergraduates | LOT | Non-URI symptoms | LO | −.21 |
| Mahler and Kulik (2000) [3] | 215 | Coronary artery bypass surgery | LOT | Pain at 2 week post coronary artery bypass surgery | LO | −.21 |
| Mahler and Kulik (2000) [3] | 215 | Coronary artery bypass surgery | LOT | Pain at 1 month post coronary artery bypass surgery | LO | −.17 |
| Mahler and Kulik (2000) [3] | 215 | Coronary artery bypass surgery | LOT | Pain at 3 months post coronary artery bypass surgery | LO | −.14 |
| Mahler and Kulik (2000) [3] | 215 | Coronary artery bypass surgery | LOT | Pain at 6 months post coronary artery bypass surgery | LO | −.17 |
| Mahler and Kulik (2000) [3] | 215 | Coronary artery bypass surgery | LOT | Pain at 12 months post coronary artery bypass surgery | LO | −.27 |
| Motivala et al. (1999) [8] | 25 | Type I and II diabetes | LOT | Physical symptoms | CS | −.47 |
| Northouse et al. (1999) [12] | 98 | Breast cancer | LOT | Physical symptoms | CS | −.48 |
| Pence (2007) [92] | 27 | Sickle cell patients | LOT-R | Mean pain | LO | .09 |
| Pritchard et al. (2007) [93] | 242 | Undergraduates | LOT | Physical symptoms | PR | −.16 |
| Pakenham and Rinaldis (2001) [94] | 114 | HIV/AIDS | LOT | Perceived health | CS | .07 |
| Ruthig et al. (2007) [95] | 231 | Aging | LOT | Perceived health | CS | .33 |
| Scheier et al. (1989) [36] | 51 | Coronary artery bypass surgery | LOT | Staff ratings of physical recovery | PR | .25 |
| Scheier et al. (1989) [36] | 51 | Coronary artery bypass surgery | LOT | Angina | PR | −.29 |
| Segerstrom (2007) [96] | 61 | Law students | LOT | Physical symptoms | LO | −.22 |
| Shen et al. (2004) [97] | 149 | Post-cardiac event | LOT-R | Physical health at 6-week follow-up | LO | .49 |
| Shepperd et al. (1996) [98] | 22 | Cardiac patients | LOT | Decrease in global coronary risk (self-report) | LO | .64 |
| Shnek et al. (2001) [99] | 86 | Cardiac patients | LOT | Chest pain | CS | −.29 |
| Smets et al. (1998) [100] | 250 | Cancer | LOT | Fatigue | CS | −.01 |
| Smets et al. (1998) [100] | 250 | Cancer | LOT | Fatigue at 2-week follow-up | LO | .03 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Smets et al. (1998) [100] | 250 | Cancer | LOT | Fatigue at 9-month follow-up | LO | .08 |
| Smith and Zautra (2004) [4] | 64 | Knee surgery | LOT-R | Pain | CS | .11 |
| Smith and Zautra (2004) [4] | 64 | Knee surgery | LOT-R | Pain | PR | −.02 |
| Tallman et al. (2007) [101] | 56 | Cancer | LOT | Physical functioning | LO | .42 |
| Tennen et al. (1992) [102] | 54 | Rheumatoid arthritis | LOT | Pain | CS | −.27 |
| Tennen et al. (1992) [102] | 54 | Rheumatoid arthritis | LOT | Disease activity | CS | −.09 |
| Treharne et al. (2007) [103] | 117 | Rheumatoid arthritis | LOT (optimism) | Pain | LO | .01 |
| Treharne et al. (2007) [103] | 117 | Rheumatoid arthritis | LOT (pessimism) | Pain | LO | .23 |
| Treharne et al. (2007) [103] | 117 | Rheumatoid arthritis | LOT (optimism) | Fatigue | LO | −.05 |
| Treharne et al. (2007) [103] | 117 | Rheumatoid arthritis | LOT (pessimism) | Fatigue | LO | .14 |
| Tomakowsky et al. (2001) [66] | 78 | HIV/AIDS | LOT | HIV symptoms | CS | −.30 |
| Tomakowsky et al. (2001) [66] | 78 | HIV/AIDS | EASQ | HIV symptoms | CS | −.28 |
| Treharne et al. (2005) [104] | 154 | Rheumatoid arthritis | LOT | Pain/fatigue | CS | −.13 |
| Treharne et al. (2001) [105] | 125 | Undergraduates | LOT | URI symptoms | LO | −.04 |
| Umstattd et al. (2007) [106] | 231 | Older women | LOT-R (optimism) | Physical functioning | CS | −.13 |
| Umstattd et al. (2007) [106] | 231 | Older women | LOT-R (pessimism) | Physical functioning | CS | .20 |
| Wong and Fielding (2007) [107] | 144 | Lung cancer patients | Single item optimism measure | Pain | LO | −.03 |
| Wyatt et al. (1999) [108] | 699 | Cancer | LOT | Physical symptoms | CS | −.21 |

*LOT* Life Orientation Test (Scheier and Carver [18]), *LOT-R* Life Orientation Test-Revised (Scheier et al. [19]), *FLOT* French life orientation test (Allison et al. [109]), *CLOT* Chinese life orientation test (Lai et al. [110]); *ASQ* Attributional Style Questionnaire (Peterson et al. [21]), *EASQ* Expanded Attributional Style Questionnaire (Peterson and Vallanova [22]), *TC* Terman cheerfulness (Friedman et al. [47]), *SWB* Dutch subjective well-being for older persons (Tempelman [111]), *CS* cross-sectional, *LO* longitudinal; *PR* prospective

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