Is Optimism Associated With Healthier Cardiovascular-Related Behavior?

Meta-Analyses of 3 Health Behaviors

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Abstract: **Optimistic people have reduced risk for cardiovascular disease and cardiovascular-related mortality compared with their less optimistic peers. One explanation for this is that optimistic people may be more likely to engage in healthy behavior like exercising frequently, eating fruits and vegetables, and avoiding cigarette smoking. However, researchers have not formally determined the extent or direction of optimism's association with health behaviors. Moreover, it is unclear whether optimism temporally precedes health behaviors or whether the relationship is because of shared common causes. We conducted random effects meta-analyses examining optimism's association with 3 health behaviors relevant for the prevention of cardiovascular disease. PubMed and PsycINFO databases were searched for studies published through November 2017 reporting on optimism's relationship with physical activity, diet, and cigarette smoking. We identified 34 effect sizes for physical activity (n=90 845), 15 effect sizes for diet (n=47 931), and 15 effect sizes for cigarette smoking (n=15 052). Findings suggested that more optimistic individuals tended to engage in healthier behaviors compared with less optimistic individuals, but effect sizes were modest ($r_{activity}$=0.07, P<0.0001; r_{diet}=0.12, P<0.0001; and $r_{smoking}$=0.07, P=0.001). Most evidence was cross-sectional (≥53% of effect sizes) and did not consider sociodemographic characteristics (<53% of effect sizes) or psychological distress (<27% of effect sizes) as potential confounders. Optimism is associated with healthier behaviors that protect against cardiovascular disease, although most evidence was relatively low quality. Additional longitudinal and experimental research is required to determine whether optimism causally contributes to healthy behaviors and whether optimism could be an effective target for preventing cardiovascular disease. (*Circ Res*. 2018;122:1119-1134. DOI: 10.1161/CIRCRESAHA.117.310828.)**

Key Words: cigarette smoking ■ diet ■ fruits ■ optimism ■ physical activity ■ vegetables

Optimistic people tend to expect that they will encounter favorable outcomes, whereas less optimistic people tend to expect that they will encounter unfavorable outcomes.[1] These generalized expectations about what the future will bring have important consequences for health. Optimistic individuals generally enjoy healthier and longer lives than their less optimistic peers.[2,3] To date, the most rigorous evidence of optimism's association with better health comes from the cardiovascular domain. In prospective longitudinal studies with epidemiological cohorts and clinically assessed outcomes, optimism consistently predicts reduced risk of cardiovascular disease and cardiovascular-related mortality.[4–8] For example, in 1 study of British men and women, those who were more optimistic at baseline were 27% less likely to develop coronary heart disease over ≈5 years of follow-up compared with those who were less optimistic.[9] In another study of nearly 100 000 US women, findings were similar with the most optimistic women demonstrating 30% reduced risk of death because of coronary heart disease relative to the least optimistic.[10] Notably, associations between optimism and reduced risk of cardiovascular disease are evident in varied populations, including younger and older men and women from different countries. Associations are also maintained after statistically controlling for sociodemographic characteristics, known cardiovascular risk factors, and psychological distress (eg, symptoms of depression and anxiety), all of which may confound the relationship.

Besides optimism's potential direct effects on physiological processes, as well as its possible role buffering against the harmful consequences of stress, theorists posit that individuals with greater optimism enjoy better health outcomes because they engage in healthier behaviors such as exercising, eating fruits and vegetables, and avoiding cigarette smoking.[3,11–13] Most people desire to lead healthy lives, but the behaviors

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Selected study materials are publicly available at osf.io/rk8fx.

The online-only Data Supplement is available with this article at http://circres.ahajournals.org/lookup/suppl/doi:10.1161/CIRCRESAHA.117.310828/-/DC1.

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Nonstandard Abbreviations and Acronyms	
CI	confidence interval

that provide the foundation for a healthy life can be difficult to achieve. Optimism may serve as a psychological resource that promotes healthy behaviors and, ultimately, cardiovascular health. Because optimists think favorable outcomes are possible, they may be more likely to set goals and resolutely pursue goal-related tasks, persist in the face of challenge, seek information to deal with future health risks, act in ways that are consistent with reducing future dangers, and use effective coping strategies when they encounter stressors (eg, problem-focused coping).[1,14] On the other hand, some theorizing suggests that the positive thoughts associated with optimism might lead people to feel as if they do not need to engage in healthy behaviors that will bolster their health and prevent disease.[15] In other words, optimists may think that things will turn out well in the future regardless of what decisions or actions they make now.

Although some work has documented associations between optimism and health behaviors, researchers have not yet determined the direction (ie, whether optimism is linked with better health behaviors or worse health behaviors) or the magnitude of the association. Much work implies that higher levels of optimism lead to healthier behaviors. If this is true, another outstanding issue is whether optimism encourages or contributes to the likelihood of engaging in healthy behaviors or whether there seems to be a relationship because of some shared common cause (eg, socioeconomic status or chronic illness). If optimism is temporally and causally linked with healthier behaviors, then it may be a novel target for intervention in an area that is seeking innovative strategies. In recent years, 27.5% of older US adults—≈31 million people—had not engaged in physical activities outside of work in the previous month.[16] Moreover, only 13.1% of the adult US population met recommended levels for consuming fruits and even fewer—only 8.9%—met recommended levels for consuming vegetables.[17] There is clearly a need to identify modifiable factors that can encourage healthier behaviors.

A first step toward determining optimism's role in the promotion of healthier behavior is to assess the current state of knowledge on the association between optimism and health behaviors. To date, 2 other reviews have briefly described the association between psychological resources (eg, optimism, life satisfaction, and positive emotions) and health behaviors in the context of other cardiovascular-related outcomes (eg, cardiovascular events and biological markers).[3,18] Although those narrative reviews provided preliminary evidence suggesting that optimism and other psychological resources were related to health behaviors in cross-sectional studies, the specific role of optimism apart from other psychological constructs was unclear and longitudinal evidence that has been published in the past 5 years was not included. Thus, our objective in the current work was to conduct a research synthesis and meta-analysis to quantitatively determine the direction of optimism's association with healthy behaviors known to protect against cardiovascular disease, as well as the extent of the association.

To maintain a reasonable scope, we investigated 3 modifiable behaviors identified by the American Heart Association as major or contributing risk factors to cardiovascular disease: physical activity, dietary quality, and cigarette smoking.[19–22] We hypothesized that individuals with higher optimism levels would engage in healthier behaviors relative to their peers with lower optimism levels. Because of optimism's promise for primordial, primary, and secondary prevention of cardiovascular disease, we considered the relationship between optimism and health behaviors in both healthy individuals and in individuals who had been diagnosed with cardiovascular disease.[23] However, it is important to note that disease processes could alter optimism's association with health behaviors in patient populations.[18] In addition, we were especially interested in longitudinal studies—particularly, prospective longitudinal studies that accounted for baseline behavior—because such evidence can establish that optimism precedes behavior, which can help determine whether a causal association is plausible and thereby whether optimism is a viable target for intervention. Finally, given past work establishing that socioeconomic characteristics and indicators of psychological distress are linked with health behaviors and cardiovascular outcomes,[24–26] we also considered whether such potential confounding variables were taken into account in past research.

Methods

Systematic literature searches were conducted in PubMed and PsycINFO databases through November 2017. Search terms included optimism, health behaviors, and, more specifically, variations of physical activity (ie, exercise, fitness, and sedentary), eating behavior (ie, food, nutrition, and diet), and cigarette smoking (ie, tobacco). Results were limited to humans and the English language in both databases, as well as to nondissertation publications in PsycINFO (the exact search that was conducted for each database is given in the Online Data Supplement). The authors' personal libraries and the reference lists of obtained articles were searched for additional citations. Titles and abstracts were screened by a single researcher (J.K.B.), who then obtained the full text of an article if eligibility criteria were met or article relevance was not clear based on the title and abstract.

Papers were excluded if they

1. defined optimism in terms of comparative optimism, unrealistic optimism, or hope (all of which have distinct and more specific definitions than the generalized perspective inherent to dispositional optimism),[27–29] or if dispositional optimism was combined with other indicators of psychological resources;
2. were literature reviews, book reviews, editorials, qualitative analyses, or other types of publications without empirical data;
3. described studies with pregnant women or patient populations other than those with cardiovascular disease (eg, cancer, diabetes mellitus, and human immunodeficiency virus, although studies with older adults were included even if participants had chronic conditions, which were typically controlled for in analyses);
4. described studies with children and adolescents under the age of 18 (1 article reported findings from 12 different samples, some of which included children[30]; however, because details were not provided about each specific sample, it was unclear which of the reported findings corresponded to adults versus children so none of the findings were included);
5. described studies in which the optimism and behavior association was auxiliary or not the primary association of interest as specified by a hypothesis, prediction, or aim;
6. examined outcomes related to smoking cessation activities rather than smoking status;

7. did not report the relevant effect size or an effect size could not be calculated from the reported data; and
8. included participants that overlapped with other studies that were in the meta-analysis (eg, 2 relevant studies were both based on data from the Women's Health Initiative and could have included the same participants in each set of analyses[31,32]; we chose to include the study with the largest sample size).

Following established recommendations,[33] 2 primary coders (J.K.B., H.K.) coded each study for its characteristics because this can impact the presence of bias in effect sizes. When disagreement occurred, 2 other coders (Y.C., L.L.V.) evaluated the study and discussions were held until everyone agreed. Consistent with past work,[34,35] coding was based on 6 dimensions:

1. size of study (very small [n<100]; small [n=100–199]; medium [n=200–999]; and large [n≥1000]);
2. study design (cross-sectional [studies <2 weeks in duration]; longitudinal without considering change over time; and prospective longitudinal considering change over time [eg, maintain, decline, improve, or accounting for baseline levels of behavior]);
3. statistical control for ≥2 baseline sociodemographic factors (eg, age, sex, race, education, or income) because of their potential to confound the optimism–behavior association (no; yes);
4. statistical control for baseline psychological distress (eg, depression, anxiety, or stress) to ensure that optimism's effects were independent of known relationships between distress and health behaviors (no; yes);
5. assessment of optimism with a scale comprised >1 item that has published reliability or validity information (eg, Life Orientation Test[36]; no; yes); and
6. assessment of health behaviors with an objectively based measurement (eg, actigraphy) or an instrument that has published reliability or validity information (no; yes). Note that smoking was often assessed with a single item that asked about being a former, current, or never smoker. Such single items are widely used and are considered a valid way to assess smoking status,[37] so we did not evaluate cigarette smoking studies for the use of a validated measure.

Recommended meta-analytic procedures were followed, including the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.[38]

Statistical Analyses

Comprehensive Meta-Analysis (version 3.0) was used for analyses. The Pearson correlation coefficient was selected as the common indicator of effect size. If studies reported other effect sizes (eg, odds ratios) or statistics (eg, *t* tests and regression analyses), then transformations were used.[39] All statistics were converted into Fisher *z* scores for analysis and then transformed into the Pearson correlation coefficient for purposes of presentation. When an effect size was not reported but a relationship was described as not statistically significant, the effect size was conservatively coded as zero. Similarly, when exact *P* values were not reported but a *P* value below a threshold was reported (eg, $P<0.001$), the conservative approach of using the closest referenced *P* value was used (eg, $P=0.001$) even though in reality the *P* value could have been much smaller.

Effect sizes were obtained and meta-analyzed separately for each health behavior (physical activity, dietary quality, and cigarette smoking). When multiple outcomes for one health behavior were presented, a post hoc decision was made to assess the most relevant behavioral outcome. For example, in the case of physical activity, frequency of physical activity was prioritized over variety or specific types of physical activity (eg, walking and weight lifting). In the case of dietary quality, vegetable consumption was prioritized over fruit consumption because vegetable consumption tends to be lower than fruit consumption[17] and research suggests that vegetables may have a more protective effect on health than fruits.[40]

Effect sizes were meta-analyzed using random effects models. Random effects models were chosen rather than fixed effects models because the studies included in this meta-analysis were thought to be sampled from a distribution of effect sizes rather than having identical underlying characteristics.[39] Because random effects models allow for effect sizes to differ based on study, heterogeneity among studies was assessed with the DerSimonian and Laird estimator of τ, which estimates the SD of the true effect sizes, and I^2, which estimates the proportion of variability that could reflect true differences in effect sizes (rather than merely random error).[39] In addition, Duval and Tweedie's[41,42] widely used Trim and Fill procedure was used to estimate an effect size that was not influenced by publication bias. This method may be limited because of its assumption that publication bias operates solely based on effect sizes rather than on *P* values,[43] so we additionally applied a likelihood-based correction procedure by Andrews and Kasy,[44] which more flexibly allows for publication bias, *P* hacking, and selective reporting.

Several sensitivity analyses were conducted post hoc. First, effect sizes were compared for healthy versus patient populations. Second, cross-sectional studies were excluded to see how effect sizes compared when considering only longitudinal or prospective longitudinal studies. Third, studies without validated measures of optimism were excluded. Finally, studies with effect sizes equal to zero—which occurred when study authors did not provide a specific effect size and results were merely described as not statistically significant (6.7%-20.0% of effect sizes)—were excluded because although associations may not have met conventional thresholds for statistical significance, the true effect size could have been something other than zero.

Results

The Online Data Supplement shows the screening process after searching PubMed and PsycINFO, which yielded 938 records after 248 duplicates were removed. From 938 possible records, 38 were ultimately included. Primary reasons for excluding a record included no empirical data, no assessment of dispositional optimism, or no behavioral outcome. A few studies did not provide the necessary statistical information to be included.

Thirty records (ie, articles) provided effect sizes on physical activity, 13 records provided effect sizes on dietary quality, and 14 records provided effect sizes on cigarette smoking. Because some records provided >1 effect size—for example, associations might have been reported for independent samples (eg, men and women) or multiple studies—the number of records does not correspond exactly to the number of effect sizes that were meta-analyzed for each health behavior (all possible effect sizes from independent samples were included in the meta-analysis). Moreover, some articles reported findings for >1 health behavior, so they were included in >1 of the meta-analyses. Tables 1 through 3 provide details of all of the studies that were included, separated by health behavior.

Physical Activity

Thirty-four effect sizes were analyzed with 90 845 total participants. One very large study accounted for 68% of all participants.[73] As shown in Table 4, the majority of effect sizes were drawn from cross-sectional study designs (64.7%), with 5 longitudinal effect sizes (14.7%) and 7 prospective longitudinal effect sizes that took into account change in behavior over time (20.6%). Only 12 effect sizes adjusted for sociodemographic characteristics (35.3%), and only 5 adjusted for psychological distress (15.7%). Most studies used a validated measure of optimism (94.1%), but fewer studies used a validated measure of physical activity (38.2%). Finally, most effect sizes included both men and women (73.5%) and reported results from adults across the lifespan (10 had younger participants [ie, 18–40 years], 3 had middle-aged participants [ie,

Table 1. Summary of Studies on the Association Between Optimism and Physical Activity

Author(s) of Study	Participants	Study Design	Optimism Assessment	Health Behavior Assessment	Covariates	Main Finding
Scheier et al[45]	45 men undergoing coronary bypass surgery (M_{age}=48.5)	Longitudinal (6 mo)	LOT	Vigorous physical activity	None	Optimists were more likely to have resumed vigorous physical activity 6 mo after surgery than pessimists
Hamid[46]	143 undergraduate students (M_{age}=21.8)	Cross-sectional	LOT	Whether a person exercised (single item on a 5-point scale)	None	Optimistic individuals were more likely to exercise than less optimistic people
Rabinowitz et al[47]	46 blue-collar workers (M_{age}=34.6)	Cross-sectional	LOT	Leisure-time exercise (single item)	None	Optimism was not significantly associated with exercising
Fontaine and Shaw[48]	154 men and women (M_{age}=22.9)	Prospective longitudinal across 8 wk	LOT-R	Attendance at an aerobics class	None	Optimism did not differ significantly between participants who attended aerobics class regularly vs the participants who dropped out
Jex et al,[49] Study 1	214 women (ages 19–74)	Cross-sectional	LOT	Exercise (measured by a 4-item scale)	None	Optimism was weakly but not significantly correlated with exercise
Jex et al,[49] Study 2	154 men and women who were employees at a university (M_{age}=41.2; ages 23–68)	Cross-sectional	LOT	Exercise adherence (measured by 21 items)	None	Optimism was weakly but not significantly correlated with exercise
Kavussanu and McAuley[50]	188 men and women (M_{age}=33)	Cross-sectional	Optimism	Exercise frequency	None	Optimism was positively associated with exercise frequency
Davidson and Prkachin[51]	56 college students (M_{age}=19)	Prospective longitudinal across 6 wk	LOT	Change in exercise across 6 wk (measured by the Wisconsin Lifestyle Assessment Questionnaire)	Initial exercise, unrealistic optimism	Optimism was not associated with change in exercise across 6 wk when controlling for initial exercise and unrealistic optimism
Greenberg[52]	101 men and women from a public housing project (M_{age}=35.41)	Cross-sectional	LOT	Exercise at least 3 days a week (yes or no)	None	Optimism was not significantly related to whether a person exercised or not
Kimble[53]	58 individuals undergoing percutaneous transluminal coronary angioplasty (M_{age}=62, ages 32–84)	Longitudinal across 2 wk post-discharge	LOT	Regular exercise	Previous percutaneous transluminal coronary angioplasty, treatment appraisal, heart disease threat	Optimism was not significantly associated with exercise
Segerstrom et al[54]	90 first-year law students (M_{age}=23.9)	Prospective longitudinal across ≈10 wk	LOT	Days of aerobic and anaerobic exercise (single item)	Baseline exercise	Optimism was not significantly correlated with exercise
Mulkana and Hailey[55]	118 college students (M_{age}=22.05)	Cross-sectional	LOT	Physical activity (from the Health-Promoting Lifestyle Profile)	None	Optimism was positively associated with physical activity
Glazer et al[56]	46 individuals with coronary heart disease participating in cardiac rehabilitation (M_{age}=58)	Longitudinal across 12 wk	LOT	No. of exercise sessions attended	Age, sex, depression, neuroticism	Optimism was not significantly associated with the number of exercise sessions individuals attended when controlling for depression and neuroticism
Holahan and Suzuki[57]	162 men and women from the Terman Study (M_{age}=86.36)	Cross-sectional	Single item	Exercise (single item: Which of the following activities do you engage in?)	None	Optimism was positively associated with exercise

(*Continued*)

Table 1. Continued

Author(s) of Study	Participants	Study Design	Optimism Assessment	Health Behavior Assessment	Covariates	Main Finding
Schroder and Schwarzer[58]	381 German heart surgery patients (M_{age}=61.2)	Longitudinal across 6 mo	LOT	Hours spent in physical activity	None	Optimism was associated with more physical activity
Steptoe et al[59]	128 men and women (M_{age}=70.5)	Cross-sectional	LOT-R	No. of moderate and vigorous physical activity sessions	Age, sex, number of chronic illnesses, medication count, education, area deprivation, BMI	Optimism was associated with vigorous physical activity in women
Venne et al[60]	187 college students (M_{age}=23.52)	Cross-sectional	LOT-R	Athletic participation vs no athletic participation	None	College seniors who were athletes were more optimistic than college seniors who were not athletes
Baker[61]	39 college students (M_{age}=20.1)	Cross-sectional	LOT	Exercise	None	Greater optimism was associated with an increased likelihood of exercising
Giltay et al[12]	773 elderly Dutch men (M_{age}=72.1)	Cross-sectional	4 items with established reliability	Total minutes spent in physical activity per week (validated measure)	Age, education, living arrangement, self-rated health, CVD, diabetes mellitus, cancer, BMI	Greater optimism was associated with more physical activity
Ruthig et al[62]	231 older men and women from the Successful Aging Study (119 participants ages 79–84; 112 participants ages 85–98)	Cross-sectional	LOT	Physical activity (2 items)	Sex, income, marital status, education level, chronic health conditions, falls, perceived control	Greater optimism was associated with more physical activity
Bailis et al[63]	164 older men and women (M_{age}=85; ages 79–98)	Cross-sectional	LOT	Accelerometer (objective measure of physical activity)	None	Optimism was not significantly associated with objective physical activity
Geers et al,[64] Study 1	136 undergraduate students	Longitudinal (optimism measured 3 wk before physical activity)	LOT-R	Frequency of aerobic exercise in the past 3 wk (2 items)	Illness, health center visits, sports team participation, exercising because of doctor's recommendation, engages in regular aerobic exercise, engages in weight training, friends exercise, number of classes taken, number of hours worked, value of exercise	Optimism was not significantly associated with aerobic exercise
Rius-Ottenheim et al[65]	600 older participants with history of myocardial infarction (ages 60–80)	Cross-sectional	LOT-R	Physical activity (from the Physical Activity Scale for the Elderly)	Age, sex	Optimism and physical activity were significantly associated when controlling for age and sex
Pavey et al[66]	9545 young women (ages 20.6–28.5) and 11 009 middle-aged women (ages 49.5–56.0)	Cross-sectional	LOT-R	Physical activity (from the Active Australia Survey)	None	More physical activity was associated with higher levels of optimism in both younger and middle-aged women
Ramsay et al[67]	365 Chinese students (M_{age}=20.6; ages 18–32)	Cross-sectional	LOT-R	Exercise (from the Physical Activity Rating for Children and Youth)	None	Optimism was not significantly associated with exercise

(*Continued*)

Table 1. Continued

Author(s) of Study	Participants	Study Design	Optimism Assessment	Health Behavior Assessment	Covariates	Main Finding
Ronaldson et al[68]	369 patients with acute coronary syndrome (M_{age}=60.82)	Prospective longitudinal across 12 mo	LOT-R	Physical activity	Age, sex, ethnicity, social deprivation, history of depression, risk of postdischarge death, baseline behavior	Optimism was not associated with changes in physical activity
Serlachius et al[69]	1113 Finnish men and women ages 24–39 at baseline	Prospective longitudinal across 6 y	LOT-R, optimism subscale	Regularly taking part in moderate or vigorous physical activity (≥150 min/wk moderate or ≥75 min/wk vigorous physical activity or a combination thereof)	Age, sex, baseline medication use, baseline physical activity, pessimism	The optimism subscale was not significantly associated with moderate and vigorous physical activity
Huffman et al[70]	153 men and women hospitalized for an acute coronary syndrome (M_{age}=61.5)	Prospective longitudinal across 6 mo	LOT-R	Physical activity assessed via accelerometer	Age, sex, living alone, previous acute coronary syndrome, peak troponin T, comorbidities, depression, anxiety, baseline physical activity	Optimism was significantly associated with more physical activity (ie, steps)
Kim et al[71]	1708 immigrants to the United States who were part of the Health and Retirement Study (M_{age}=67.88; ages 46–107)	Cross-sectional	3 items from the LOT-R	Leisure-time physical activity involvement	None	Optimism was significantly associated with leisure-time physical activity
Smagula et al[72]	613 men (M_{age}=81.4)	Cross-sectional	LOT-R	Physical activity (from the Physical Activity Scale for the Elderly)	Age, education, living alone, alcohol intake, smoking status, conscientiousness, goal disengagement, goal re-engagement	More optimistic men were more likely to be physically active than less optimistic men in unadjusted analyses, but when covariates were included in models optimism was no longer significantly associated with physical activity
Progovac et al[73]	61 756 postmenopausal women (M_{age}=62.4)	Prospective longitudinal across 6 y	LOT-R	Vigorous physical activity from a reliable and validated scale[74]	Age, race/ethnicity, income, education, past physical activity, health conditions, depressive symptoms, smoking, alcohol intake	The most optimistic women were more likely to report vigorous physical activity than the least optimistic women

Studies are ordered by publication date with the oldest studies appearing in the table first. Unless otherwise specified, men and women were both included and analyses used all items from the LOT or LOT-R. In addition, the study design refers to whether the effect size included in the meta-analysis was from cross-sectional, longitudinal, or prospective longitudinal data. Studies may have been longitudinal, but if the longitudinal relationship had baseline behavior predicting optimism over time, then only the baseline correlation was included and the effect size would have been considered cross-sectional. BMI indicates body mass index; CVD, cardiovascular disease; LOT, Life Orientation Test; and LOT-R, Life Orientation Test Revised.

41–60 years], 14 had older participants [ie, >60 years], and 7 had a range of ages).

Effect sizes from each study are shown in Figure 1. The overall effect size shown in the bottom row of Figure 1 was relatively small according to conventional guidelines,[82] r=0.07; 95% confidence interval (CI), 0.05–0.09. The SD of the effect sizes (τ=0.04) suggests that 95% of the true effects fall within the range of −0.004 to 0.14. The level of heterogeneity among studies was moderate (I^2=58.43). The Trim and Fill procedure, which accounts for the possibility of publication bias, yielded a slightly smaller estimate of the overall effect size (r=0.06; 95% CI, 0.03–0.08). The Online Data Supplement shows both the observed effect sizes and the imputed effect sizes. The likelihood-based correction procedure estimated somewhat more publication bias, which resulted in an attenuated point estimate (r=0.03; 95% CI, −0.01 to 0.08).

Sensitivity analyses showed that when considering associations from effect sizes based only on healthy populations (ie, excluding the 7 effects sizes from patient populations), the overall effect size was comparable to what we reported above

Table 2. Summary of Studies on the Association Between Optimism and Dietary Quality

Author(s) of Study	Participants	Study Design	Optimism Assessment	Health Behavior Assessment	Covariates	Main Finding
Hamid[46]	143 undergraduate students (M_{age}=21.8)	Cross-sectional	LOT	Whether a person monitored their nutrition (single item)	None	Optimistic individuals were more likely to monitor their nutrition than less optimistic people
Rabinowitz et al[47]	46 blue-collar workers (M_{age}=34.6)	Cross-sectional	LOT	Extent to which a person ate well (single item)	None	Optimism was not significantly associated with eating well
Shepperd et al[75]	20 individuals in an 18-wk cardiac rehabilitation program	Longitudinal across 18 wk	LOT	Degree to which participant met goal to reduce saturated fat in diet	Age, rehabilitation goal	Optimistic individuals were more successful at meeting their goal to reduce saturated fat in their diet than less optimistic individuals
Kimble[53]	58 individuals undergoing percutaneous transluminal coronary angioplasty (M_{age}=62; ages 32–84)	Longitudinal across 2 wk post-discharge	LOT	Low-fat and low-sodium diet	Previous percutaneous transluminal coronary angioplasty, treatment appraisal, heart disease threat	Optimism was not significantly associated with diet
Mulkana and Hailey[55]	118 college students (M_{age}=22.05)	Cross-sectional	LOT	Consuming healthy foods (9 nutrition-related items from the Health-Promoting Lifestyle Profile)	None	Optimism was positively associated with better nutrition
Holahan and Suzuki[57]	162 men and women from the Terman Study (M_{age}=86.36)	Cross-sectional	Single item	Good nutrition (single item)	None	Optimism was positively associated with good nutrition
Kelloniemi et al[76]	8690 Finnish men and women (M_{age}=31)	Cross-sectional	LOT-R	Fresh vegetables or salad (validated food frequency questionnaire)	Smoking status, marital status, education, working history, residential area	Optimistic individuals reported eating more vegetables than less optimistic individuals
Schroder and Schwarzer[58]	381 German heart surgery patients (M_{age}=61.2)	Longitudinal across 6 mo	LOT	Heart disease preventative diet	None	Optimism was associated with healthier food consumption
Giltay et al[12]	773 elderly Dutch men (M_{age}=72.1)	Cross-sectional	4 items with established reliability	Consumption of vegetables (validated food frequency questionnaire)	Age, education, living arrangement, self-rated health, CVD, diabetes mellitus, cancer, BMI, total energy intake	Greater optimism was associated with more vegetable intake
Hingle et al[32]	13 645 women in a clinical trial and 20 242 in an observational study as part of the Women's Health Initiative	Prospective longitudinal across 1 y	LOT-R	Healthy eating (comprised vegetables, fruits, whole grains, sugar-sweetened beverages and fruit juice, nuts and legumes, red/processed meat, trans fat, long-chain fats, polyunsaturated fatty acids, sodium, and alcohol from the Alternate Healthy Eating Index)	Baseline healthy eating, age, race/ethnicity, education, family income, religious service attendance, diabetes treatment, hypertension, high cholesterol, smoking status, physical activity, use of hormone replacement therapy, waist circumference, BMI, depression	Greater optimism was associated with improvements in healthy eating across 1 y for women in both the clinical trial and observational study
Ronaldson et al[68]	369 patients with acute coronary syndrome (M_{age}=60.82)	Prospective longitudinal across 12 mo	LOT-R	Fruit and vegetable consumption	Age, sex, ethnicity, social deprivation, history of depression, risk of postdischarge death, baseline behavior	Optimism was positively associated with consuming more fruits and vegetables

(*Continued*)

Table 2. Continued

Author(s) of Study	Participants	Study Design	Optimism Assessment	Health Behavior Assessment	Covariates	Main Finding
Serlachius et al[69]	1113 Finnish men and women ages 24–39 at baseline	Prospective longitudinal across 6 y	LOT-R, optimism subscale	Healthy diet (having >4 ideal diet indicators, including ≥450 g of fruits or vegetables per day, 2 servings of fish per week, three 1-oz servings of whole grains per day, <1500 mg of sodium per day, and ≤450 kcal of sugar-sweetened beverages per week from a food frequency questionnaire)	Age, sex, baseline medication use, baseline diet, pessimism	The optimism subscale was significantly associated with a healthy diet 6 y later
Rius-Ottenheim et al[77]	2171 men and women with a history of myocardial infarction (M_{age}=72.2)	Cross-sectional	4 items whose reliability was established by the Central Bureau of Statistics	Dutch Healthy Nutrient and Food Score included 11 nutrient-dense food groups: vegetables, fruit, whole grains, protein-rich plant foods (ie, legumes), potatoes, lean meat, fish, eggs, low-fat milk and yogurt, oils and soft margarines, and noncaloric drinks	Age, sex	Optimism was associated with consuming healthy foods

Studies are ordered by publication date with the oldest studies appearing in the table first. Unless otherwise specified, men and women were both included and analyses used all items from the LOT or LOT-R. In addition, the study design refers to whether the effect size included in the meta-analysis was from cross-sectional, longitudinal, or prospective longitudinal data. Studies may have been longitudinal, but if the longitudinal relationship had baseline behavior predicting optimism over time, then only the baseline correlation was included and the effect size would have been considered cross-sectional. BMI indicates body mass index; CVD, cardiovascular disease; LOT, Life Orientation Test; and LOT-R, Life Orientation Test Revised.

(*r*=0.07; 95% CI, 0.04–0.09). However, the effect was slightly higher for patient studies only (*r*=0.09; 95% CI, 0.03–0.15). When considering effect sizes from just the longitudinal and prospective longitudinal studies (ie, excluding effect sizes from cross-sectional studies), the overall effect size was quite a bit smaller although still statistically significant (*r*=0.03; 95% CI, 0.002–0.06). Excluding the 2 effect sizes from analysis that did not use a reliable or validated measure of optimism yielded a slightly smaller overall effect size (*r*=0.06; 95% CI, 0.04–0.09), but excluding studies with null effects yielded a slightly larger overall effect size (*r*=0.08; 95% CI, 0.05–0.10).

Dietary Quality

Fifteen effect sizes concerning dietary quality were analyzed. There were 47 931 total participants across all studies. More than half of the effect sizes came from studies that were cross-sectional (53.3%), whereas the remaining effect sizes came from longitudinal or prospective longitudinal studies (Table 4). Seven effect sizes from articles published in 2005 or earlier did not statistically control for sociodemographic characteristics (46.7%), although effect sizes from more recent studies did control for at least several (53.3%). Even fewer effect sizes adjusted for psychological distress (26.7%). Nearly all studies used a validated measure of optimism (93.3%), but only approximately half used a validated measure of dietary quality. Ten effect sizes were derived from both men and women (66.7%), whereas 2 were derived from men only (13.3%) and 3 were derived from women only (20.0%). Five effect sizes were derived from younger individuals (33.3%; ie, 18–40 years), whereas the rest reflected older individuals (33.3%; ie, >60 years) or included a range of ages (33.3%).

Effect sizes from each study are shown in Figure 2. As depicted in the bottom row of Figure 2, the overall effect size was *r*=0.12; 95% CI, 0.08–0.16. The SD of the effect sizes (τ=0.06) indicates that 95% of the true effects fall within the range of −0.002 to 0.24. The level of heterogeneity among studies was high (I^2=87.34). Notably, the Trim and Fill procedure to account for publication bias did not yield a substantially different effect size estimate or CI (*r*=0.12; 95% CI, 0.08–0.16). That is, only 1 extremely small study had to be removed and replaced (see funnel plot in the Online Data Supplement). The likelihood-based correction procedure estimated more severe publication bias, such that the corrected point estimate was in the opposite direction, albeit with a wide CI (*r*=−0.11; 95% CI=−0.30 to 0.09).

Sensitivity analyses indicated that findings from healthy populations were comparable to those that included both healthy and patient populations (*r*=0.12; 95% CI, 0.07–0.17). With just 5 effect sizes from patient populations, the combined effect size was slightly attenuated (*r*=0.11; 95% CI, 0.04–0.17). When the 8 effect sizes from the cross-sectional studies were removed, the combined effect size from the longitudinal and prospective longitudinal studies was smaller (*r*=0.05; 95% CI, 0.02–0.09). After removing the single study that did not assess optimism with a validated measure, the overall effect size remained mostly unchanged (*r*=0.11; 95%

Table 3. Summary of the Studies on the Association Between Optimism and Cigarette Smoking

Author(s) of Study	Participants	Study Design	Optimism Assessment	Health Behavior Assessment	Covariates	Main Finding
Greenberg[52]	101 men and women from a public housing project (M_{age}=35.41)	Cross-sectional	LOT	Smoking status	None	Optimism was not significantly related to current cigarette smoking
Kimble[53]	58 individuals undergoing percutaneous transluminal coronary angioplasty (M_{age}=62; ages 32–84)	Longitudinal across 2 wk post-discharge	LOT	Smoking status	Previous percutaneous transluminal coronary angioplasty, treatment appraisal, heart disease threat	Optimism was not significantly associated with smoking status
Segerstrom et al[54]	90 first-year law students (M_{age}=23.9)	Prospective longitudinal (controlled for baseline smoking status during ≈8 wk of follow-up)	LOT	Smoking status	Baseline smoking status	Optimism was not significantly correlated with smoking status
Kendler et al[78]	759 white women who were same-sex twins (M_{age}=30.1)	Longitudinal (M_{months}=61.3; SD_{months}=5.1)	LOT	Nicotine dependence (8-item Fagerstrom Tolerance Questionnaire)	None	Optimism was associated with reduced risk of nicotine dependence
Kubzansky et al[79]	429 college students (M_{age}=19)	Cross-sectional	LOT	Use of tobacco (from a subscale of the Health and Daily Living Form)	Sex, age	Optimism was not significantly associated with cigarette smoking
Kelloniemi et al[76]	8690 Finnish men and women (M_{age}=31)	Cross-sectional	LOT-R	Smoking status	None	The least optimistic were more likely to smoke; nonsmokers were the most optimistic
Schroder and Schwarzer[58]	120 German heart surgery patients who were initially smokers	Longitudinal across 6 mo	LOT	Smoking status	None	Optimism was not significantly associated with smoking status among those who were smokers at baseline
Steptoe et al[59]	128 men and women (M_{age}=70.5)	Cross-sectional	LOT-R	Smoking status	Age, sex, chronic illness, medication, education, area deprivation	Optimism was associated with a reduced likelihood of smoking
Baker[61]	39 students (M_{age}=20.1)	Cross-sectional	LOT	Smoked any cigarettes, pipes, or cigars	None	Greater optimism was associated with a reduced likelihood of smoking
Giltay et al[12]	773 elderly Dutch men (M_{age}=72.1)	Cross-sectional	4 items whose reliability was established by the Central Bureau of Statistics	Smoking status	Age, education, living arrangement, self-rated health, CVD, diabetes mellitus, cancer, BMI	Greater optimism was marginally associated with not smoking
Khallad[80]	167 American and 260 Jordanian college students	Cross-sectional	LOT-R	Smoking status	None	Optimism was not significantly associated with smoking status for either group
Liu et al[81]	1956 Chinese men who were coal miners	Cross-sectional	Subscale of the Psychological Capital Questionnaire (in Chinese)	Current smokers vs nonsmokers	Age, marital status, education, job rank, occupational category, occupational stress, self-efficacy, hope, resilience	Optimism was associated with a reduced risk of being a current smoker

(*Continued*)

Table 3. Continued

Author(s) of Study	Participants	Study Design	Optimism Assessment	Health Behavior Assessment	Covariates	Main Finding
Ronaldson et al[68]	369 patients with acute coronary syndrome (M_{age}=60.82)	Prospective longitudinal across 12 mo	LOT-R	Smoking status (current smoker vs nonsmoker)	Age, sex, ethnicity, social deprivation, history of depression, risk of postdischarge death, and baseline behavior	Optimism was associated with reduced likelihood of smoking after 12 mo
Serlachius et al[69]	1113 Finnish men and women ages 24–39 at baseline	Prospective longitudinal across 6 y	LOT-R, optimism subscale	Not smoking (either never having smoked or quit smoking >12 mo ago)	Age, sex, baseline medication use, baseline smoking status, pessimism	The optimism subscale was not significantly associated with being a nonsmoker during follow-up

Studies are ordered by publication date with the oldest studies appearing in the table first. Unless otherwise specified, men and women were both included and analyses used all items from the LOT or LOT-R. In addition, the study design refers to whether the effect size included in the meta-analysis was from cross-sectional, longitudinal, or prospective longitudinal data. Studies may have been longitudinal, but if the longitudinal relationship had baseline behavior predicting optimism over time, then only the baseline correlation was included and the effect size would have been considered cross-sectional. BMI indicates body mass index; CVD, cardiovascular disease; LOT, Life Orientation Test; and LOT-R, Life Orientation Test Revised.

CI, 0.07–0.15). Finally, removing 1 effect size from analyses that was equal to zero did not measurably change the overall effect (r=0.12; 95% CI, 0.08–0.16).

Cigarette Smoking

Fifteen effect sizes were analyzed for the association between optimism and smoking status. Most studies were relatively small with 1 study[76] comprising more than half of the 15 052 total participants. Moreover, as shown in Table 4, most effect sizes were from cross-sectional studies (60.0%), with 3 longitudinal studies (20.0%) and 3 prospective longitudinal studies that accounted for changes in behavior during the follow-up period (20.0%). Although all effect sizes were based on a validated method of assessing optimism, less than half of the effect sizes controlled for ≥2 sociodemographic characteristics and only 20.0% controlled for psychological distress (Table 4). All but 3 effect sizes were based on data from both men and women (80.0%), and most participants were from younger cohorts (53.3%; ie, 18–40 years).

Each effect size is shown in Figure 3. The overall effect size was r=0.07; 95% CI, 0.03–0.10. The SD of the effect sizes (τ=0.05) suggests that 95% of the true effects fall within the range of −0.02 to 0.16. The level of heterogeneity among studies was moderate (I^2=46.44), indicating that the variance between studies is likely real and could possibly be explained by study characteristics. The overall effect size and CI were

Table 4. Summary of the Characteristics of the Effect Sizes for Each Health Behavior

Health Behavior	Study Size*	Study Design†	Statistical Control for ≥2 Sociodemographic Characteristics	Statistical Control for Psychological Distress	Validated Assessment of Optimism	Validated Assessment of Health Behavior‡
Physical activity	Very small: 9/34 (26.5%)	Correlational: 22/34 (64.7%)	12/34 (35.3%)	5/34 (15.7%)	32/34 (94.1%)	13/34 (38.2%)
	Small: 13/34 (38.2%)	Longitudinal: 5/34 (14.7%)				
	Medium: 7/34 (20.6%)	Prospective: 7/34 (20.6%)				
	Large: 5/34 (14.7%)					
Dietary Quality	Very small: 3/15 (20.0%)	Correlational: 8/15 (53.3%)	8/15 (53.3%)	4/15 (26.7%)	14/15 (93.3%)	8/15 (53.3%)
	Small: 3/15 (20.0%)	Longitudinal: 3/15 (20.0%)				
	Medium: 3/15 (20.0%)	Prospective: 4/15 (26.7%)				
	Large: 6/15 (40.0%)					
Cigarette Smoking	Very small: 3/15 (20.0%)	Correlational: 9/15 (60.0%)	6/15 (40.0%)	3/15 (20.0%)	15/15 (100%)	…
	Small: 4/15 (26.7%)	Longitudinal: 3/15 (20.0%)				
	Medium: 5/15 (33.3%)	Prospective: 3/15 (20.0%)				
	Large: 3/15 (20.0%)					

*Size of study was classified as very small (n<100), small (n=100–199), medium (n=200–999), and large (n≥1000).

†Designs were classified as cross-sectional (studies <2 wk in duration), longitudinal (studies ≥2 wk in duration) without considering change over time, and prospective longitudinal considering change over time (eg, maintain, decline, improve, or taking account of baseline behavior).

‡Cigarette smoking is frequently assessed with a single item that asks participants to indicate their smoking status. Although these are not multi-item scales, they are consistent with more objective assessments of smoking status.[37] As such, we did not evaluate cigarette smoking studies on this dimension.

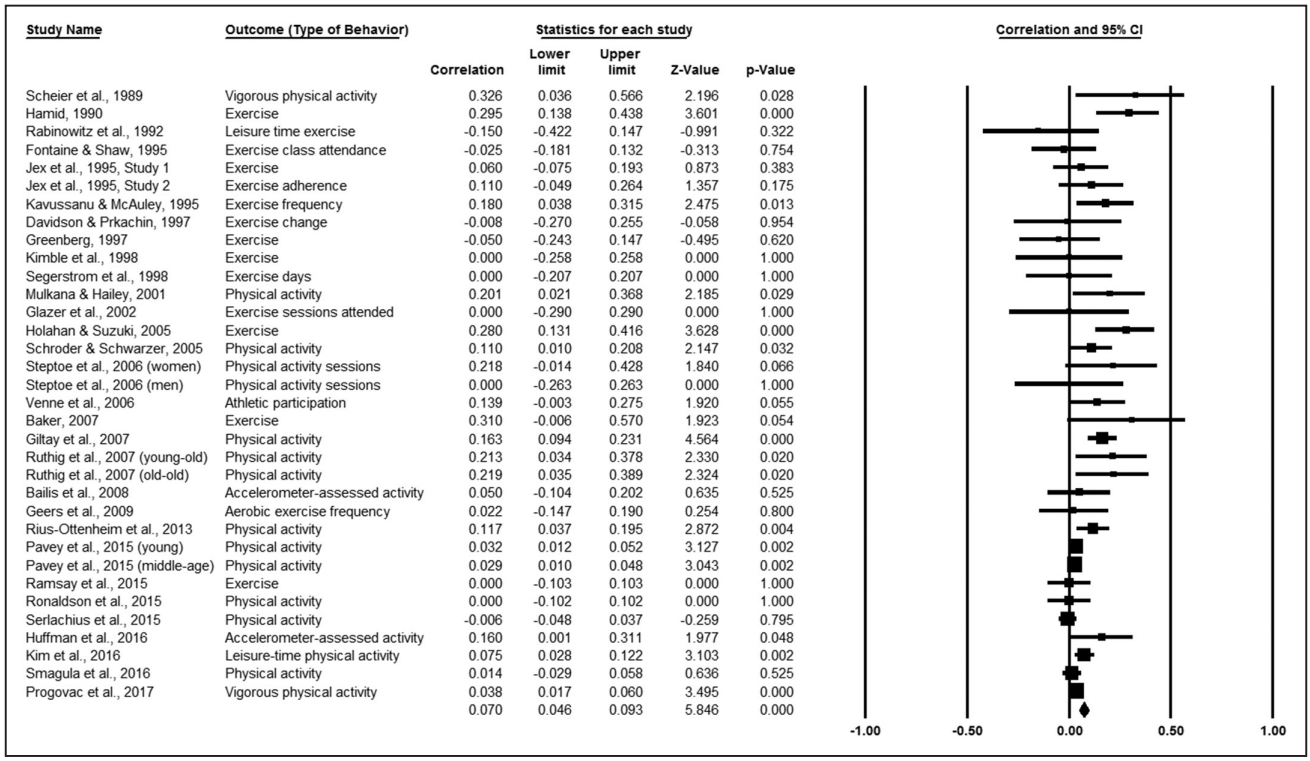

Figure 1. Forest plot of individual studies investigating the association between optimism and physical activity. The size of the square corresponds to the weight of the effect size in the analysis. CI indicates confidence interval.

identical after the Trim and Fill procedure, indicating that no studies were removed and replaced (see funnel plot in the Online Data Supplement). The likelihood-based correction procedure yielded similar results (r=0.04; 95% CI, 0.02–0.07).

In sensitivity analyses without 3 effect sizes from patient populations, the overall effect was mostly the same (r=0.07; 95% CI, 0.02–0.12). The 3 effect sizes from patient populations yielded an overall effect size that was somewhat attenuated (r=0.05; 95% CI, 0.01–0.09). After excluding effect sizes from cross-sectional designs, the overall effect was slightly smaller for longitudinal and prospective longitudinal studies (r=0.06; 95% CI, 0.03–0.09). Finally, after excluding 3 effect sizes that were equal to zero, the overall effect was mostly unchanged (r=0.07; 95% CI, 0.03–0.12).

Discussion

Engaging in healthy behaviors is related to better cardiovascular health and reduced risk of cardiovascular-related mortality.[83–85] However, attaining or maintaining healthy behavior across the lifespan is notoriously difficult.[86] One possible reason for the limited success of fostering healthy behavior is the failure to take into account the feelings, aspirations, or context of individuals. A novel approach to promoting cardiovascular health can draw from research on optimism, which has been

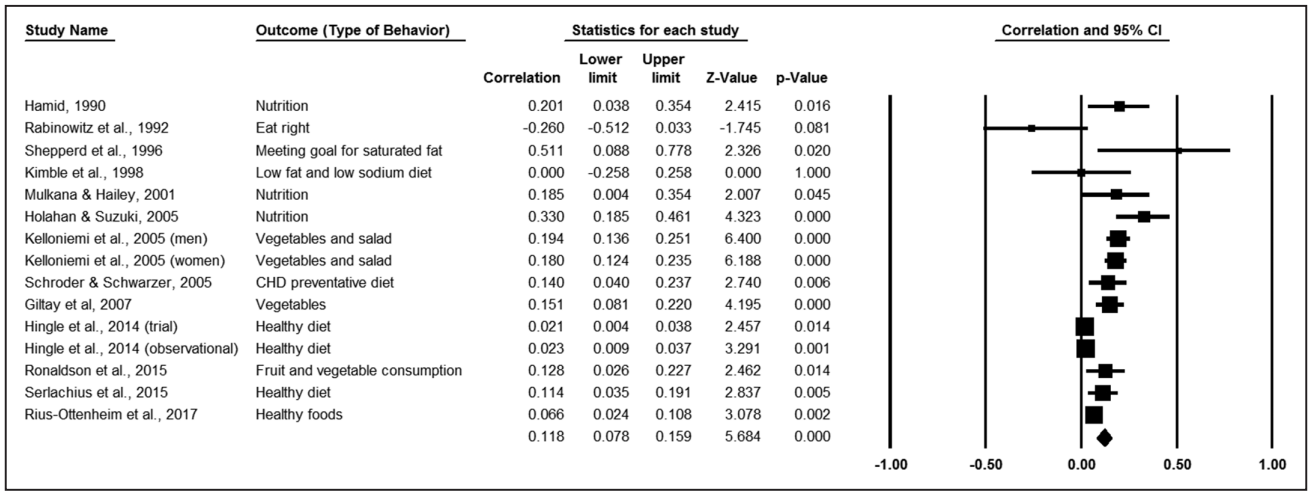

Figure 2. Forest plot of individual studies investigating the association between optimism and dietary quality. The size of the square corresponds to the weight of the effect size in the analysis. CI indicates confidence interval.

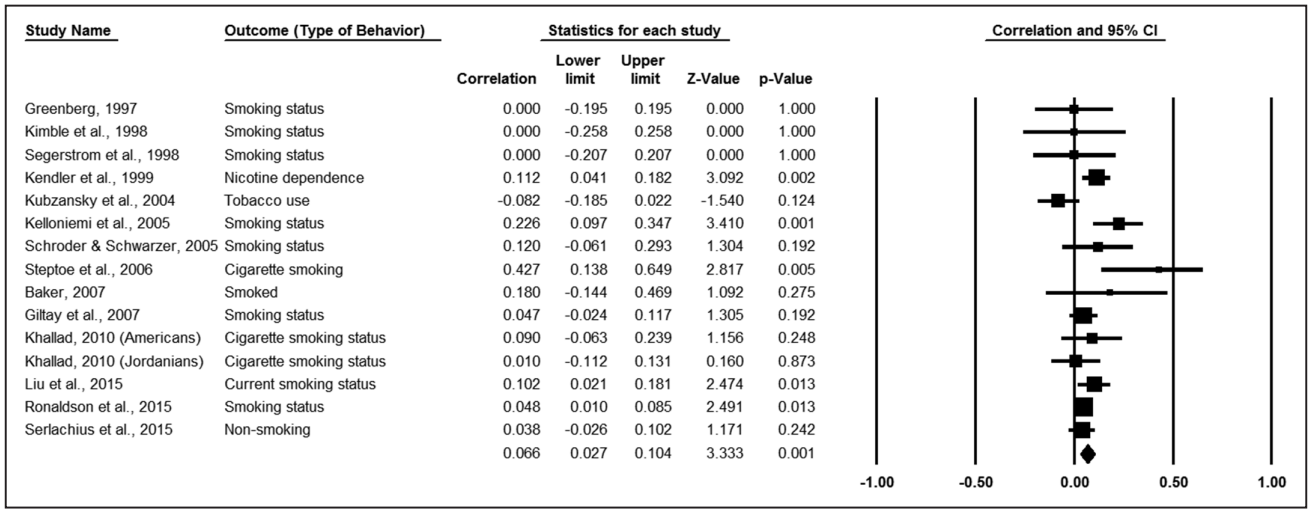

Figure 3. Forest plot of individual studies investigating the association between optimism and cigarette smoking. The size of the square corresponds to the weight of the effect size in the analysis. CI indicates confidence interval.

identified as a modifiable, upstream psychological resource that is related to improved cardiovascular outcomes.[23,87,88] However, research to date has been unclear as to the direction and extent of optimism's association with health behaviors. Evidence from the meta-analyses reported here suggests that optimism is modestly associated with greater physical activity, eating healthier food, and being less likely to smoke cigarettes in both healthy and patient populations. It does not seem that optimists ignore future health because of a rosy outlook; instead, they engage in healthier behaviors compared with their less optimistic peers. By including longitudinal study designs and studies that statistically controlled for potential confounders, our findings provide the most stringent test to date for an association between optimism and health behaviors.

The relatively small associations between optimism and cardiovascular-related behaviors are perhaps not surprising given that health behaviors are determined by factors at multiple levels (ie, individual, environmental, social, and policy factors). In addition, focusing on the association between optimism and health behaviors at a single point in time may underestimate optimism's association with health behaviors cumulatively over time,[89] or even in the context of sensitive developmental periods (eg, during adolescence when health-related behaviors are often established) or major life events (eg, after experiencing a heart attack). Although it is possible that the association between optimism and health behaviors may operate differently for healthy and patient populations, we did not find strong evidence of that and small associations persisted regardless of the population. Such modest associations can have a measurable impact at the population level, where small changes on a wide scale can impact the health of thousands of people.[90]

Up to 65% of effect sizes included in the meta-analyses used cross-sectional designs, which restricts conclusions about the timing of the relationship (for other limitations of existing evidence and recommendations for future research, see Table 5). When effect sizes from cross-sectional studies were excluded from the meta-analyses, effects were attenuated for all 3 health behaviors. That said, it is noteworthy that small but consistent effects were evident for each health behavior even when considering only the more rigorously designed studies. Thus, evidence is suggestive but not conclusive. A bidirectional relationship between optimism and health behaviors is likely, so additional evidence is needed that demonstrates optimism precedes and motivates health behaviors.

Further consideration of published longitudinal studies also provides insight for future directions. In the existing longitudinal evidence examining whether optimism precedes a given behavior, participants were often followed for short periods of time (eg, 8 weeks). Only a couple of studies followed participants for a year or more,[32,69] and few considered behavioral maintenance, uptake, or decline. Given the inherent difficulty of not only initiating but also sustaining healthy behaviors over time, longer perspectives that track participants for lengthy periods of time are crucial, especially because healthy behavior is often not maintained over time.[86] One recent study that prospectively investigated the association between a different psychological resource, psychological well-being, and physical activity found that people with higher versus lower baseline levels of psychological well-being were more likely to attain and maintain recommended levels of physical activity across more than a decade.[91] However, this type of evidence remains rare.

Another challenge is that even when health behaviors are considered as outcomes in longitudinal studies, controlling for baseline behavior may leave little variance to be explained by other factors such as optimism, especially if changes in behavior are not expected (this may have been the case in some of the smoking studies, where it is unlikely that many older adults initiate smoking later in life). In fact, most studies begin at a relatively arbitrary point in time, often in middle adulthood, because they are focused on diseases that develop midlife and beyond (eg, Multi-Ethnic Study of Atherosclerosis). This is potentially problematic given that many of the behaviors of interest are initiated in adolescence or early adulthood. By the time a cohort study can examine the relationships of interest, any observable effects are likely to have been at play for some time. Thus, the time frame of studies and a focus on whether

Table 5. Limitations of Existing Research and Recommendations for Future Research

Limitation	Recommendation
Cross-sectional study designs	Use prospective longitudinal designs that assess optimism at baseline and take into account baseline levels of behavior or change in behavior across time
Short-term longitudinal studies	Examine associations across longer periods of time (eg, a year or several years)
Investigation of the optimism–behavior relationship at a relatively arbitrary point in time	Investigate the association during sensitive periods (eg, during adolescence) or in the context of major life events (eg, after a heart attack)
Few potential confounders considered in analytic models	Include a wide range of potential confounders in analyses including sociodemographic characteristics and psychological distress
Self-reported assessment of optimism and behaviors with inconsistent questionnaires for health behaviors	Use alternatives to self-report including peer-report, text analysis, biomarker assessment (eg, cotinine), or actigraphy; in addition, use standardized questionnaires to assess health behaviors
Small sample sizes	Use sample sizes that are sufficiently powered to detect modest effect sizes
Mostly white participants from Western countries	Conduct studies with individuals from a variety of cultural, racial, and ethnic backgrounds
Only linear relationships investigated and uncertainty whether different aspects of behavior (eg, sedentary behavior vs vigorous physical activity) differentially correlate with optimism	Examine whether optimism and health behaviors have nonlinear relationships; split up potentially independent behavioral outcomes and investigate separately; use quantile regression models to see if effects of optimism matter more at some parts of a behavioral distribution than others; model an interaction between the baseline level of a health behavior and change in optimism in longitudinal studies

optimism is associated with the maintenance, improvement, or decline of health behaviors are important directions for future research, especially during adolescence or early adulthood.

Another weakness of many studies is their inability to rule out the possibility that other variables might alter the association between optimism and health behaviors. Although some studies controlled for known potential confounders such as socioeconomic status, others did not. Given the small sizes of the associations, even modest levels of confounding could explain away the associations. Thus, future studies should take into account the third variables that might confound the optimism–behavior relationship or even formally assess the robustness of observed associations to unmeasured confounding.[92] Key factors to consider include education and the presence of underlying disease. In addition, given that optimism (or the lack thereof) is often correlated with indicators of psychological distress such as depression, anxiety, and stress, it is critical to ensure that effects of optimism are not simply signaling the absence of distress.

An additional drawback relates to the measurement of optimism and health behaviors in existing studies. Because both optimism and health behaviors are typically self-reported, the magnitude of their association may be inflated because of common methodology (although this is somewhat mitigated when optimism is assessed before behavior). Future research could use alternatives to self-report that may be more precise. For example, analyzing written text could provide measurements of optimism, whereas cotinine levels or actigraphs could provide objective assessments of cigarette smoking and physical activity, respectively. In general, more consistent and standardized approaches to measuring health behaviors would also be useful.

Furthermore, examining nonlinear associations between optimism and health behaviors may be fruitful, especially for behaviors such as alcohol consumption where some but not too much of the behavior is associated with health.[93] Moreover, health behaviors are often assessed with bipolar scales—for example, physical activity may be measured with a scale ranging from inactivity (ie, sedentary behavior) to vigorous activity. However, being inactive may have different correlates than vigorously engaging in exercise does (eg, sedentary behaviors are associated with increased risk of disease independently of physical activity).[94–96] Optimism could also be more strongly associated with one end of the spectrum (eg, vigorous activity), whereas psychological distress could be associated with the other end (eg, inactivity). We are not aware of any studies that have explicitly tested this hypothesis, but it may be useful to investigate the full spectrum of each behavior moving forward.

Findings indicated that there was substantial heterogeneity across the included studies that reflected true variation (not merely error), so further attention to differences in study characteristics is warranted, especially when additional longitudinal studies are conducted. The majority of evidence to date is based on relatively small sample sizes, which may not have enough statistical power to detect associations. Studies with diverse samples in terms of age, race, cultural background, socioeconomic status, and health status will allow generalization to more people and help identify potential moderators of the association between optimism and health behaviors. Most studies included in the meta-analyses comprised white individuals from Western countries. Yet optimism's association with health behaviors may be moderated by characteristics that only the use of diverse samples can reveal. Moreover, optimism itself may be an important modifier and may interact with other factors, such as socioeconomic status, to predict health behaviors.

Finally, the commonly used Trim and Fill approach to determining the extent of publication bias suggested that overall effect sizes were mostly unchanged. However, results from the likelihood-based correction procedure suggested that only a modest association was evident for cigarette smoking and that associations for physical activity and dietary quality were no longer statistically significant. Thus, findings should be interpreted in light of the possibility of publication bias, while recognizing that any narrative review or search of the literature would be subject to similar effects.

Concluding Remarks

Meta-analytic findings indicate that more optimistic individuals are apt to engage in healthier behaviors that are relevant

for the delay of cardiovascular disease. We cannot yet draw firm conclusions as to whether modifying levels of optimism would lead to behavior change because of the predominance of cross-sectional evidence and the probable bidirectional association between optimism and health behaviors. That is, people with greater optimism are more likely to engage in healthy activities and healthy activities, in turn, are likely to foster greater optimism. However, the consistency of findings across different health behaviors, as well as across cross-sectional and longitudinal studies, suggests that optimism may increase the likelihood of engaging in healthy behavior. Additional longitudinal, prospective longitudinal (taking into account changes in behavior over time), and experimental investigations that isolate the effects of optimism and rule out alternative explanations can indicate more conclusively whether initially optimistic people have a reduced risk of cardiovascular disease because of their greater willingness to engage in health behaviors.

If future evidence can establish that optimism precedes and influences health behaviors, then new approaches to behavior change could be developed. Given the limited success of current efforts to promote behavior change, optimism may provide a novel strategy with which to design innovative behavioral interventions that foster psychological resources, rather than primarily seeking to repair psychological deficits.[18] Such an approach is congruent with recent calls for primordial prevention where a major goal is to prevent the development of risk factors and promote protective factors.[97] Indeed, an emphasis on optimism and other psychological resources may be especially promising because effects could impact multiple behaviors simultaneously, rather than just a single behavior at a time.

Empirical evidence suggests that small improvements in optimism can be made through a variety of strategies, including via relatively brief writing exercises, meditative approaches, and even more intensive cognitive-behavioral therapy practices.[88] Preliminary work has also investigated the feasibility of conducting 8-week long interventions to increase optimism and related constructs in cardiac patients.[98–100] It remains unclear whether improvements in optimism could translate into behavioral or health benefits in the short term or, even more challenging, over the long term. However, findings indicating that optimism is modifiable combined with findings that optimism is associated with healthier behavior suggest that optimism may be a promising target for intervention. Given that optimism is important in its own right and that it may serve as a resource in relation to behavior and other health outcomes, a greater focus on both upstream factors that foster optimism and its downstream effects is warranted.

Sources of Funding

Support for this research was provided by the Robert Wood Johnson Foundation through the grants Exploring the Concept of Positive Health and Positive Health & Comprehensive Soldier Fitness. The funding agency had no role in the design, execution, analysis, or interpretation of this research.

Disclosures

None.

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