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Optimism and Diet Quality in the Women's Health Initiative

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Keywords

diet quality; psychosocial factors; Alternate Healthy Eating Index; psychological attitudes; diet; dietary behavior

INTRODUCTION

Psychological attitudes are significantly related to health outcomes, and a growing body of evidence has demonstrated the salutary role of positive psychological factors on health.¹ These include factors such as subjective wellbeing,²⁻⁴ positive affect,^{5,6} emotional vitality,^{7,8} and dispositional optimism,^{9,10} all of which have been associated with favorable biological markers and lower incidence and severity of coronary heart disease^{3,11,12} in diverse populations.

Among myriad psychological factors associated with good health, dispositional optimism (or positive expectancies for the future)¹³ has emerged as a key trait for healthy behavior. Optimistic people have been shown to engage and persist in health behaviors such as regular physical activity, moderate alcohol consumption, and smoking avoidance,^{12,14} and are more likely to adhere to medical advice.^{15,16}

In the largest study to date on dispositional optimism and health, optimism prospectively and independently predicted lower incident coronary heart disease risk and all-cause mortality in 100,000 postmenopausal women participating in the Women's Health Initiative (WHI).¹² In this study, health behaviors such as not smoking and being physically active explained part of this observed relationship. Dietary information was not included in that study, but a more recent study of middle-aged US men and women found that optimists had higher serum concentrations of antioxidants and that this was explained in part by their healthier diet.¹⁷ The findings raise intriguing questions about whether optimism can be used as a marker to predict which individuals may make healthy behavior changes, or whether optimism can enhance the effects of behavior change programs designed to impact chronic disease risk factors. In another WHI study, optimism was as a novel predictor of adherence to a low-fat eating pattern following a one-year dietary intervention.¹⁶ This intervention focused primarily on decreasing fat intake, although participants were also advised to consider other changes in diet including increasing intake of vegetables, fruits, and fiber.¹⁸ It remains unclear how optimism relates to changes in dietary behavior over time.

Optimists exhibit adaptive coping styles and robust self-regulation, both of which are critical to achieving successful behavior change.¹⁹ An improved understanding of the relationships between dispositional optimism, dietary intake and changes in diet can help explain how this trait may be used to prospectively influence nutrition and health.

The purpose of this study was to investigate the potential role of optimism as a predictor of diet quality and changes in diet quality in postmenopausal women, ages 50 to 79, enrolled in the WHI Observational Study (OS) and the WHI Clinical Trial (CT). Study objectives were threefold: first, to characterize relationships between optimism, diet quality, and lifestyle and demographic factors in women enrolled in the WHI OS and CTs; second, to evaluate

whether optimism was associated with change in diet quality over one year in women enrolled in the WHI Diet Modification Clinical Trial (DM-CT); and, finally, to investigate potential interactions between baseline optimism and lifestyle and demographic factors on diet quality change in intervention (DM-CT) participants.

METHODS

Study Design and Sample

The WHI is a large clinical investigation of strategies for the prevention and control of common causes of morbidity and mortality, including cancer, cardiovascular disease (CVD), and osteoporotic fractures among postmenopausal women, between 50 and 79 years old. Briefly, the WHI consisted of a set of overlapping, randomized CTs (hormone therapy, diet modification, and calcium/vitamin D, which collectively enrolled 68,132 women, and an Observational Study (OS) that enrolled 93,676 women into a prospective epidemiological cohort. Eligibility criteria also included ability and willingness to provide written informed consent and planning to reside in the area for a minimum three years after enrollment. Recruitment methods have been described in more detail elsewhere.²⁰ Eligible women could enroll in one, two, or all three of the CTs; women ineligible or unwilling to join the CTs were invited to participate in the OS. Written informed consent was obtained from all study participants prior to study enrollment, and each of the trials were approved by the Institutional Review Boards of the 40 participating institutions.

The present analysis includes women with reliable dietary data (energy intake between 600 and 5000 kcal/d) and available optimism data. To characterize relationships between optimism, diet quality, and lifestyle and demographic factors in women enrolled in the WHI OS and CTs, the cross-sectional analysis of diet quality and optimism included 87,630 OS participants and 65,360 CT participants (Study Objective 1). To evaluate whether optimism was associated with change in diet quality over one year in women enrolled in the DM-CT, the analysis testing the association between optimism and diet quality score at baseline and year 1 included 13,645 DM-CT participants randomized to the diet intervention arm with available diet data at year 1 (Objective 2). Finally, to examine potential interactions between baseline optimism and lifestyle and demographic factors on diet quality change in DM-CT participants, the test for interaction between optimism and trial arm, smoking status, age, and race/ethnicity included women randomized to the DM-CT intervention arm ($n=13,645$) and the control arm ($n=20,242$) (Objective 3).

Measurement of Optimism

Optimism was assessed at baseline using the 6-item Life Orientation Test-Revised (e.g., “I’m always hopeful about my future” and “In unclear times, I usually expect the best”), with a Cronbach’s alpha of 0.78, test-retest reliability of 0.68 and adequate predictive and discriminant validity.¹³ A summary score was calculated from the 6 components, coded from 1=strongly disagree to 5=strongly agree. Scores ranged from 6 to 30 where a higher score indicated greater optimism.¹³

Diet Quality Assessment

Dietary intake was assessed using a food frequency questionnaire (FFQ) developed and validated by the Fred Hutchinson Cancer Research Center (Seattle, WA).²¹ This 122-item FFQ was designed for the WHI to include foods representative of the national food supply as well as capture regional and ethnic food selections. Respondents were asked to indicate the portion consumed and frequency of consumption over the previous 3-month period. Nutrient intake was derived using software developed at Fred Hutchinson and the Nutrition Data System for Research (NDS-R) food and nutrient database (University of Minnesota Nutrition Coordinating Center).²² All WHI participants completed the FFQ during the screening period, and DM-CT participants completed a second survey one year later.

The Alternate Healthy Eating Index (AHEI)²³ is a tool that when applied to dietary datasets, can be used to evaluate multiple and related aspects of dietary intake important to chronic disease prevention. The AHEI is a composite numerical measure^{24,25} previously used in this population to assess diet quality²⁶ and a robust predictor of chronic disease risk in older men and women including CVD^{24,26} and Type 2 diabetes.²⁷ It is comprised of 11 components, each scored from 0 (non-adherence) to 10 points (perfect adherence): vegetables, fruit, whole grains, sugar-sweetened beverages and fruit juice, nuts and legumes, red/processed meat, *trans* fat, long-chain (omega-3) fats, polyunsaturated fatty acids, sodium, and alcohol. Established scoring procedures were followed to obtain a total dietary score ranging from 0 to 110.^{23,24} Mean $\pm$ standard deviation AHEI score for all WHI participants in this study was 44.9 ± 10.2 .

Lifestyle and Demographic Data

Demographic data collected from participants at baseline included age, self-reported race/ethnicity, education (high school, any post-secondary, college), family income (< \$20k, \$20 to < 35k, \$35 to < 50k, \$50 to < 75k, \$75k), and weekly attendance at religious services (yes, no). Medical data included history of diabetes treatment (yes, no), current hypertension treatment (yes, no), high cholesterol-requiring medication (ever, never), current smoking (yes, no), physical activity (< 2.5, 2.5 MET-hr/wk), hormone therapy use (never, former, current), waist circumference (< 88, 88 cm), and body mass index (BMI) (< 30, 30 kg/m²).

Statistical Analyses

Baseline characteristics were compared across quintiles of AHEI scores or tertiles of optimism scores using linear (continuous variables), logistic (binary variables), or multinomial logistic (categorical variables) regression models with each variable of interest as a function of AHEI score quintiles or optimism tertiles (study objective 1). The association between optimism score (tertiles as a categorical variable) and baseline AHEI score (continuous variable), and change in AHEI score between baseline and year 1 in the DM-CT (continuous variable), were tested using multivariate linear regression, adjusted for potential confounders (see footnotes, Tables 1, 2). Optimism tertiles were subsequently modeled as an ordinal variable to test for trends (objective 2). The potential interaction between optimism and trial arm on AHEI change was tested using a likelihood ratio test. Likewise, potential interactions between optimism and race/ethnicity, age, and smoking on

AHEI change for women in the intervention arm were tested using likelihood ratio tests (objective 3). All analyses were conducted using Stata 12.1 (StataCorp, College Station, TX).

RESULTS AND DISCUSSION

Associations Between Optimism, Diet Quality, and Lifestyle and Demographic Factors

Among WHI OS and CT participants, higher baseline AHEI scores were associated with older age, non-Hispanic White race, higher education, higher income, being married or in a marriage-like relationship, use of hormone therapy, higher physical activity, being a past or never-smoker, and lower energy intake (Table 1). AHEI scores were inversely associated with BMI, waist circumference, history of diabetes or hypertension, depression, and attendance at religious services. The inverse relationship between religious services attendance and diet quality was a unique finding in this analysis. The role of religiosity in health has been investigated in many studies with mostly positive associations;²⁸ however, little is known about diet quality and religiosity. A review of twenty studies that examined religion and diet found that 60% of the studies reported a better diet in those who were more religious/spiritual.²⁸

When examining baseline characteristics by baseline optimism scores, high optimism was associated with younger age, lower waist circumference and BMI, and increased physical activity (Table 2). Further, women in the highest tertile of optimism were more likely to have higher income and be non-Hispanic White, college-educated, married or in a marriage-like relationship, a past or never smoker, current hormone therapy users, and without history of depression, hypertension, high cholesterol, or diabetes.

Association of Optimism with Diet Quality and Diet Quality Change by Intervention Trial Arm

Women in the DM-CT intervention and control arms both showed significant positive associations between optimism and AHEI at baseline, and between optimism and change in AHEI between baseline and 1 year (Table 3). Magnitude of change (mean $\pm$ SD change of 1.5 ± 8.4 points, data not shown) was similar to other dietary intervention studies using this index to assess change.²⁹ Although the absolute magnitude of AHEI score improvement was greater among intervention arm women (mean AHEI scores of 42.0, 43.3, and 44.3 for optimism tertiles 1–3, respectively, P -trend < 0.001) (Table 3), the association between optimism and diet quality was stronger in the control arm (P interaction = 0.014). Among control participants, the most optimistic women demonstrated a three-fold increase in AHEI score compared with least optimistic women over one year. This finding is consistent with results from a clinical trial of treatment for depression among men and women who had undergone coronary artery bypass surgery, in which the effect of optimism in promoting recovery from depression was seen only among control participants.¹⁵ This suggests optimistic attitudes may be particularly important to promote healthy change in the absence of formal behavioral intervention. Progovac and colleagues found that optimism and cynical hostility predicted longitudinal smoking behavior among WHI women who were smoking at baseline.¹⁴ As in the case of smoking behavior, understanding the extent to which optimism

is associated with longitudinal dietary intake is important when designing tailored behavioral approaches to optimize nutrient intake in older populations.

Association of Optimism with Diet Quality Change by Race/Ethnicity, Age, and Smoking Status

Overall, intervention arm participants demonstrated a positive change in AHEI score from baseline to year 1 (mean $\pm$ SD change of 1.5 ± 8.4 points). This trend appeared to hold across categories of age, smoking status, and certain racial/ethnic groups. While Asian women showed an inverse relationship between optimism and baseline AHEI scores (mean AHEI scores of 47.6, 46.5, and 43.0 for optimism tertiles 1–3, respectively, P -trend = 0.005), positive change in AHEI score from baseline to year 1 was similar to other groups. Black and Hispanic women experienced larger improvements in AHEI scores than other racial/ethnic groups. Similar positive changes were observed for younger (age 50–59) versus older women (age 70–79) and never versus current smokers (Table 3). There were no statistically significant interactions between optimism and race/ethnicity, age, or smoking status on change in AHEI.

Strengths of this study include a large sample of ethnically diverse, postmenopausal women who are well characterized in relation to demographic, clinical, and lifestyle variables, validated (and repeated) measures of dietary intake and optimism assessment. The inclusion of a large intervention cohort provides an opportunity to evaluate the role of optimism in change in dietary quality among women participating in a dietary intervention. The inclusion of an established predictor of chronic disease risk in older men and women (AHEI) is another strength.^{24,26}

This study also has several limitations. Although there is currently no gold standard diet quality assessment approach, we applied published methods,^{23,24} previously used and validated in the WHI population.²⁶ We were not able to report the precise mechanisms by which dispositional optimism prospectively influences dietary change. It is known that optimistic (vs. pessimistic) women of the WHI reported greater adherence to dietary advice, so adherence is likely to have played a role, but the WHI did not collect longitudinal information on adherence. Other factors such as coping styles may also explain the observed results. For example, optimists are known to cope better than pessimists in response to stress and, thus, theoretically, may not be as vulnerable to stress eating and other unhealthy eating behaviors leading to improved diet quality over time. The WHI did not collect data that would shed light on the biological mechanisms underlying differential stress responses among individual women. We were also not able to explain the observed differences among racial/ethnic subgroups with regard to the relationship between optimism and diet quality; lack of association among Asian women may relate to cultural differences that were not assessed during the WHI.

An unresolved question is whether a threshold exists at which a particular psychological characteristic should be addressed in order for dietary or other health behavior changes to occur (e.g., tailoring of intervention for participants with high vs. low optimism). Future work should determine whether interventions that incorporate psychosocial components enhance dietary change and increase intervention adherence. Future studies might also test

whether interventions can modify specific traits or whether modification of traits should be considered during recruitment (e.g., inclusion/exclusion criteria) or during an intervention (e.g., stratification based on psychological traits). For example, among school-aged children, an intervention to modify dispositional optimism and pessimism was shown to lower the incidence of depression over three years.³⁰ In adult populations, interventions to enhance and sustain greater psychological wellbeing and optimistic attitudes have shown promise.³¹ This area requires further study to understand the extent to which attitudes may be modified in adults and under different circumstances.

CONCLUSIONS

These data support a relationship between optimism and dietary quality score in postmenopausal women at baseline and greater positive diet quality score changes after a one-year dietary intervention. These associations should be tested more robustly as an *a priori* hypothesis before conclusions can be made regarding a women's level of optimism and capacity to improve diet quality within the context of a dietary intervention.

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Table 1

Baseline characteristics of Women's Health Initiative (WHI) participants, by Alternate Healthy Eating Index (AHEI)-2010 quintiles¹

Characteristic	Quintile					P trend ²
	1 12.7–36.1 (n = 30,598)	2 36.1–41.7 (n = 30,598)	3 41.7–46.9 (n = 30,598)	4 46.9–53.4 (n = 30,598)	5 53.4–92.0 (n = 30,598)	
AHEI, median (interquartile range)	31.4 (29.2–34.3)	39.0 (37.6–40.4)	44.3 (43.0–45.6)	50.0 (48.3–51.5)	59.8 (55.6–62.6)	
Age (y), mean ± SD	62.3 ± 7.2	63.1 ± 7.2	63.2 ± 7.2	63.6 ± 7.2	63.7 ± 7.2	<0.001
Waist circumference (cm), mean ± SD	90.3 ± 14.6	88.2 ± 14.0	86.5 ± 13.3	85.0 ± 13.3	82.3 ± 12.4	<0.001
BMI (kg/m ²), mean ± SD	29.6 ± 6.4	28.7 ± 6.1	28.0 ± 5.8	27.4 ± 5.6	26.2 ± 5.2	<0.001
Energy intake (kcal), mean ± SD	1764 ± 654	1646 ± 647	1631 ± 658	1607 ± 640	1571 ± 595	<0.001
Physical activity (MET-hr/wk), mean ± SD	8.4 ± 11.3	10.4 ± 12.2	11.9 ± 12.7	14.0 ± 14.0	17.7 ± 15.9	<0.001
Race/ethnicity, %						<0.001
American Indian or Alaskan Native	0.57	0.47	0.45	0.33	0.26	
Asian or Pacific Islander	1.09	2.02	2.64	3.18	3.73	
Black or African American	12.5	9.28	7.61	6.53	5.71	
Hispanic/Latina	5.40	4.22	3.67	2.83	2.07	
Non-Hispanic white	79.4	83.0	84.5	86.0	87.0	
Other	0.98	1.05	1.15	1.13	1.22	
Education, %						<0.001
High school diploma	31.3	25.8	21.8	17.7	12.7	
Any post-secondary education	40.6	40.1	38.2	37.4	33.4	
College graduate	28.2	34.1	40.0	45.0	53.9	
Marital status, %						<0.001
Never married	4.20	4.09	4.43	4.42	4.96	
Divorced or separated	16.5	15.1	14.8	15.6	16.9	
Widowed	17.9	17.7	17.2	16.5	15.5	
Married	60.1	61.7	62.1	61.7	60.6	
Marriage-like relationship	1.38	1.48	1.50	1.75	2.11	
Family income, %						<0.001
< \$20,000	21.9	18.7	15.5	13.4	10.9	
\$20,000 to < \$35,000	27.8	26.0	24.9	22.8	20.0	
\$35,000 to < \$50,000	21.0	21.0	20.9	20.9	19.5	

Characteristic	Quintile					P trend ²
	1 12.7–36.1 (n = 30,598)	2 36.1–41.7 (n = 30,598)	3 41.7–46.9 (n = 30,598)	4 46.9–53.4 (n = 30,598)	5 53.4–92.0 (n = 30,598)	
\$50,000 to < \$75,000	17.4	19.4	20.0	21.3	22.5	
\$75,000	11.9	15.1	18.7	21.6	27.1	
Smoking, %						< 0.001
Never	54.0	53.3	51.5	49.0	46.3	
Past	35.8	38.8	41.8	45.4	49.7	
Current	10.2	7.95	6.72	5.63	4.03	
Religious service/church attendance, %						< 0.001
Not at all in the past month	30.6	30.7	32.2	34.6	40.5	
Once in the past month	8.24	8.64	8.77	9.40	10.2	
2–3 times in the past month	12.1	12.1	12.5	12.4	12.4	
Once a week	32.2	32.4	31.2	29.8	25.4	
2–6 times a week	15.6	14.9	14.1	12.6	10.4	
Every day	1.21	1.24	1.29	1.29	1.12	
History of diabetes mellitus treatment, %	4.37	4.63	4.48	4.18	3.69	< 0.001
Hormone therapy use, %						< 0.001
Never	37.0	34.7	32.8	31.3	29.6	
Past	24.7	23.4	23.3	22.5	21.7	
Current	38.3	41.9	43.9	46.2	48.6	
Hypertension, %						< 0.001
Never hypertensive	61.4	63.6	65.8	68.3	72.3	
Currently untreated hypertensive	8.40	8.26	8.24	7.81	7.74	
Currently treated hypertensive	30.2	28.2	26.0	23.9	20.0	
High cholesterol requiring pills, %	13.4	14.1	14.3	14.4	13.3	0.913
Depression score (short CES-D/DIS)						< 0.001
Low (< 0.009)	71.4	74.3	75.3	76.6	77.9	
Medium (0.009–0.06)	14.6	14.3	14.2	13.8	13.5	
High (> 0.06)	14.0	11.5	10.5	9.64	8.61	

¹ Quintile 1 represents the least-healthy scores, whereas quintile 5 represents the most-healthy scores

² P values calculated from linear (continuous variables), logistic (binary variables), or multinomial logistic (categorical variables) regression models with the variable of interest as a function of AHEI quintile

Table 2Baseline characteristics of Women's Health Initiative (WHI) participants, by optimism score tertiles¹

Characteristic	Optimism score tertiles			P trend ²
	1: 6–22 (n = 57,998)	2: 23–25 (n = 55,557)	3: 26–30 (n = 39,435)	
Age (y), mean ± SD	63.3 ± 7.3	63.3 ± 7.1	62.8 ± 7.1	< 0.001
Waist circumference (cm), mean ± SD	87.6 ± 14.3	86.1 ± 13.6	85.2 ± 13.4	< 0.001
BMI (kg/m ²), mean ± SD	28.4 ± 6.2	27.8 ± 5.8	27.5 ± 5.7	< 0.001
Energy intake (kcal), mean ± SD	1644 ± 673	1641 ± 624	1649 ± 623	0.310
Physical activity (MET-hr/wk), mean ± SD	11.1 ± 13.1	12.7 ± 13.6	14.2 ± 14.6	< 0.001
Race/ethnicity, %				< 0.001
American Indian or Alaskan Native	0.54	0.33	0.35	
Asian or Pacific Islander	3.61	2.18	1.44	
Black or African American	8.88	7.64	8.49	
Hispanic/Latina	5.21	2.82	2.49	
Non-Hispanic white	80.4	86.0	86.4	
Other	1.35	1.00	0.89	
Education, %				< 0.001
High school diploma	29.3	19.8	13.9	
Any post-secondary education	38.5	38.8	35.7	
College graduate	32.2	41.3	50.4	
Marital status, %				< 0.001
Never married	4.79	4.25	4.12	
Divorced or separated	16.8	14.6	16.0	
Widowed	18.8	16.4	15.0	
Married	58.1	63.2	63.1	
Marriage-like relationship	1.59	1.57	1.83	
Family income, %				< 0.001
< \$20,000	22.2	13.5	10.7	
\$20,000 to < \$35,000	26.8	24.1	20.9	
\$35,000 to < \$50,000	19.7	21.8	20.4	
\$50,000 to < \$75,000	17.5	21.0	22.7	
\$75,000	13.8	19.6	25.3	
Smoking, %				< 0.001
Never	50.2	50.6	51.9	
Past	41.4	43.2	42.3	
Current	8.35	6.17	5.79	
Religious service/church attendance, %				< 0.001
Not at all in the past month	35.9	32.3	32.5	
Once in the past month	9.48	8.82	8.75	
2–3 times in the past month	12.5	12.4	11.9	
Once a week	29.5	31.1	30.0	
2–6 times a week	11.6	14.2	15.5	

Characteristic	Optimism score tertiles			<i>P</i> trend ²
	1: 6–22 (<i>n</i> = 57,998)	2: 23–25 (<i>n</i> = 55,557)	3: 26–30 (<i>n</i> = 39,435)	
Every day	1.10	1.22	1.42	
History of diabetes mellitus treatment, %	5.57	3.74	3.12	< 0.001
Hormone therapy use, %				< 0.001
Never	34.7	32.4	31.6	
Past	24.5	22.7	21.7	
Current	40.7	44.9	46.8	
Hypertension, %				< 0.001
Never hypertensive	62.9	66.7	70.6	
Currently untreated hypertensive	9.02	7.72	7.24	
Currently treated hypertensive	28.0	25.5	22.1	
High cholesterol requiring pills, %	15.5	13.6	12.0	< 0.001
Depression score (short CES-D/DIS)				< 0.001
Low (< 0.009)	63.6	79.7	85.3	
Medium (0.009–0.06)	17.3	13.2	10.7	
High (> 0.06)	19.2	7.07	3.98	

¹ Tertile 1 represents the least-optimistic scores, whereas tertile 3 represents the most-optimistic scores

² *P* values calculated from linear (continuous variables), logistic (binary variables), or multinomial logistic (categorical variables) regression models with the variable of interest as a function of optimism tertile

The proportion of missing data for each baseline characteristic was as follows: age (0%), waist circumference (0.4%), BMI (0.9%), energy intake (0%), physical activity (4.6%), race/ethnicity (0.2%), education (0.7%), marital status (0.4%), family income (6.4%), smoking (1.1%), religious service/church attendance (0.2%), history of diabetes mellitus treatment (0.1%), hormone therapy use (2.9%), hypertension (5.4%), and high cholesterol requiring pills (5.8%), depression score (2.3%).

Association between optimism and change in AHEI-2010 score between baseline and year 1 in the WHI Diet Modification Clinical Trial by trial arm, race/ethnicity, age, and smoking

Table 3

Subgroup	AHEI	Optimism score at baseline			P trend ^{1,2}
		Tertile 1 (low) scores 6–22	Tertile 2 (middle) scores 23–25	Tertile 3 (high) scores 26–30	
<u>Stratified by Trial Arm</u>					
Intervention (n = 13,645)					
	Baseline (mean ± SD)	42.1 ± 9.4	43.3 ± 9.4	44.3 ± 9.8	< 0.001
	Year 1 (mean ± SD)	43.8 ± 9.1	44.8 ± 9.0	45.7 ± 9.2	
	Change (95% CI) ²	1.36 (1.15–1.57)	1.52 (1.32–1.72)	1.77 (0.53–2.01)	0.014
Control (n = 20,242)					
	Baseline (mean ± SD)	42.2 ± 9.5	43.3 ± 9.5	44.1 ± 9.7	< 0.001
	Year 1 (mean ± SD)	42.7 ± 9.4	44.1 ± 9.6	44.9 ± 9.7	
	Change (95% CI) ²	0.32 (0.15–0.49)	0.82 (0.66–0.98)	1.01 (0.81–1.20)	< 0.001
Test for interaction ³ , P = 0.014					
<u>Stratified by race/ethnicity (Intervention arm only)</u>					
NHW (n = 11,380)					
	Baseline (mean ± SD)	42.2 ± 9.4	43.5 ± 9.4	44.7 ± 9.8	< 0.001
	Year 1 (mean ± SD)	43.8 ± 9.1	44.9 ± 9.0	45.9 ± 9.2	
	Change (95% CI) ²	1.26 (1.02–1.49)	1.38 (1.17–1.60)	1.62 (1.36–1.88)	0.045
Black (n = 1,311)					
	Baseline (mean ± SD)	40.1 ± 9.1	40.7 ± 9.1	41.8 ± 9.4	0.146
	Year 1 (mean ± SD)	42.4 ± 8.9	43.4 ± 9.1	44.4 ± 9.3	
	Change (95% CI) ²	2.10 (1.42–2.79)	2.58 (1.87–3.29)	2.98 (2.20–3.75)	0.105
Hispanic (n = 402)					
	Baseline (mean ± SD)	39.5 ± 8.7	42.6 ± 8.9	42.0 ± 9.5	0.142
	Year 1 (mean ± SD)	42.2 ± 8.1	45.0 ± 8.3	44.7 ± 7.5	
	Change (95% CI) ²	2.11 (1.06–3.16)	3.13 (1.85–4.40)	2.95 (1.33–4.58)	0.326
Asian (n = 345)					
	Baseline (mean ± SD)	47.6 ± 8.9	46.5 ± 10.1	43.0 ± 7.9	0.005

Subgroup	AHEI	Optimism score at baseline			P trend ^{1,2}
		Tertile 1 (low) scores 6–22	Tertile 2 (middle) scores 23–25	Tertile 3 (high) scores 26–30	
Stratified by age (Intervention arm only)					
Age 50–59 y (n = 4,835)					
	Year 1 (mean ± SD)	48.8 ± 8.8	47.0 ± 8.8	45.2 ± 8.7	
	Change (95% CI) ²	1.65 (0.54–2.76)	0.31 (–0.99–1.62)	1.07 (–0.98–3.12)	0.357
Age 60–65 y (n = 4,898)					
	Baseline (mean ± SD)	41.5 ± 9.6	42.7 ± 9.5	43.6 ± 9.8	0.001
	Year 1 (mean ± SD)	43.7 ± 9.2	44.7 ± 9.2	45.5 ± 9.3	
	Change (95% CI) ²	2.04 (1.68–2.39)	1.99 (1.64–2.35)	2.13 (1.73–2.53)	0.747
Age 66–79 y (n = 3,912)					
	Baseline (mean ± SD)	42.2 ± 9.3	43.1 ± 9.2	44.3 ± 9.8	0.002
	Year 1 (mean ± SD)	43.6 ± 9.0	44.8 ± 8.9	45.8 ± 9.0	
	Change (95% CI) ²	1.08 (0.73–1.43)	1.65 (1.31–1.98)	1.92 (1.52–2.32)	0.002
Stratified by smoking (Intervention arm only)					
Never smoker (n = 7,082)					
	Baseline (mean ± SD)	41.5 ± 9.2	42.9 ± 9.4	43.4 ± 9.6	<0.001
	Year 1 (mean ± SD)	43.2 ± 8.9	44.5 ± 8.9	45.0 ± 9.0	
	Change (95% CI) ²	1.43 (1.14–1.72)	1.75 (1.47–2.02)	1.82 (1.50–2.15)	0.076
Past smoker (n = 5,686)					
	Baseline (mean ± SD)	43.1 ± 9.5	44.2 ± 9.4	45.5 ± 10.0	<0.001
	Year 1 (mean ± SD)	44.8 ± 9.2	45.4 ± 9.1	46.7 ± 9.3	
	Change (95% CI) ²	1.28 (0.95–1.62)	1.25 (0.93–1.56)	1.71 (1.34–2.09)	0.115
Current smoker (n = 877)					
	Baseline (mean ± SD)	40.4 ± 9.1	41.4 ± 8.9	44.3 ± 9.7	0.001
	Year 1 (mean ± SD)	42.3 ± 9.1	42.9 ± 8.7	45.0 ± 9.5	
	Change (95% CI) ²	1.34 (0.56–2.12)	1.43 (0.55–2.31)	1.80 (0.72–2.88)	0.527

² Adjusted predictions calculated from linear regression models adjusted for baseline AHEI, age (continuous), race/ethnicity (American Indian or Alaskan Native, Asian or Pacific Islander, black or African-American, Hispanic/Latina, non-Hispanic white, other), education (high school, any post-secondary, college), family income (< \$20k, \$20 to < 35k, \$35 to < 50k, \$50 to < 75k, \$75k), attended 1 + religious service per week (yes, no), history of diabetes treatment (yes, no), current hypertension treatment (yes, no), high cholesterol requiring pills (ever, never), current smoking (yes, no), physical activity (< 2.5, 2.5 MET-hr/wk), hormone replacement therapy use (never, former, current), waist circumference (< 88, 88–102, > 102 cm), BMI (< 30, 30–34.9, ≥ 35 kg/m²), and depression score (< 0.009, 0.009–0.06, > 0.06).

³ Likelihood ratio test for interaction between optimism (tertile) and trial arm on change in AHEI