

# Are Optimism and Cynical Hostility Associated with Smoking Cessation in Older Women?

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## Abstract

**Background** Optimism and cynical hostility independently predict morbidity and mortality in Women's Health Initiative (WHI) participants and are associated with current smoking. However, their association with smoking cessation in older women is unknown.

**Purpose** The purpose of this study is to test whether optimism (positive future expectations) or cynical hostility (mistrust of others) predicts smoking cessation in older women.

**Methods** Self-reported smoking status was assessed at years 1, 3, and 6 after study entry for WHI baseline smokers who were not missing optimism or cynical hostility scores ( $n = 10,242$ ). Questionnaires at study entry assessed optimism (Life Orientation Test-Revised) and cynical hostility (Cook-Medley, cynical hostility subscale). Generalized linear mixed models adjusted for sociodemographics, lifestyle factors, and medical and psychosocial characteristics including depressive symptoms.

**Results** After full covariate adjustment, optimism was not related to smoking cessation. Each 1-point increase in baseline cynical hostility score was associated with 5% lower odds of cessation over 6 years (OR = 0.95, CI = 0.92–0.98,  $p = 0.0017$ ).  
**Conclusions** In aging postmenopausal women, greater cynical hostility predicts lower smoking cessation over time. Future studies should examine whether individuals with this trait may benefit from more intensive cessation resources or whether attempting to mitigate cynical hostility itself may aid smoking cessation.

**Keywords** Smoking · Optimism · Pessimism · Cynical hostility · Smoking cessation

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[4]. Over 8% of US women over 65 are smokers [6], and the mortality risk from cigarette smoking in women has risen precipitously and now approaches that of men [7]. Fortunately, elderly smokers who quit enjoy substantial health improvements within 1–2 years of cessation, including improved physical functioning and quality of life [8] and reduced risk of cardiac death and coronary events [9, 10]. While two-thirds of smokers report intentions to quit [11], fewer than 5% succeed without help [12, 13]. Older female smokers appear less likely than their male peers to be able to quit smoking [14]. This may be true in part because women experience less social pressure to quit smoking [15], although they are equally likely to attempt quitting or receive cessation advice from physicians [16] and to have access to smoking cessation interventions [17]. Understanding factors that predict continued smoking in elderly women is critical to protecting the health of these vulnerable smokers.

Two major psychological attitudes in particular are important to the health of older women and may inform the understanding of their smoking behavior: optimism (positive future expectations [18]) and cynical hostility (mistrust of most people [19]). Optimism and cynical hostility independently predict incident coronary heart disease (CHD) and mortality among postmenopausal women of the Women's Health Initiative (WHI) [20]. In the WHI, higher optimism is associated with lower rates, and cynical hostility with higher rates, of subthreshold depression [21], and cynical hostility is also

associated with higher rates of metabolic syndrome and diabetes [22]. Considered trait-like, these attitudes predict health outcomes over the life span, which may be explained in large part by their associations with health behaviors [23–29] and also via myriad other mechanisms [30–37]. High trait optimism predicts positive dietary change and better adherence among women in the WHI [38–40] and is associated with lower rates of smoking in other elderly samples [41, 42]. In contrast, high cynical hostility predicts increased smoking initiation across races and genders [26] and greater withdrawal symptoms after quitting [43, 44]. However, the prospective relationship between optimism, cynical hostility, and longitudinal smoking cessation, independent of factors such as race and socioeconomic status (SES), health status, depression, and other health conditions, is unknown.

From a theoretical perspective, the Reserve Capacity Model predicts that holding more positive expectations about the future and other people's actions is likely to influence a variety of health behaviors including diet, physical activity, sleep, and substance abuse including smoking [32, 45–48]. Moreover, it is reasonable to posit that attitudes such as optimism and cynical hostility could be associated not only with the adoption of healthy behaviors but also with the cessation of unhealthy behaviors, such as smoking. Specifically, more optimistic people who attempt to quit smoking may be more likely to expect positive outcomes in the short and long term as a result of their efforts. This could reinforce cessation behavior even in the face of withdrawal symptoms and other common barriers to cessation. Furthermore, those who mistrust others may not be able to make the most of positive relationships in their social environment to support efforts to quit smoking [49].

This analysis seeks to address the gap in understanding of how optimism and cynical hostility may influence longitudinal smoking behavior in postmenopausal women. We hypothesized that (1) lower optimism would be associated with lower likelihood of smoking cessation (i.e., after baseline) independent of factors known to influence attitudes, smoking, or both and that (2) higher cynical hostility would also independently be associated with lower smoking cessation. Taken together, these analyses aimed to provide a better understanding of the role of optimism and cynical hostility in determining longitudinal smoking behavior in aging postmenopausal women.

## Methods

### Study Population

The Women's Health Initiative recruited 161,808 postmenopausal women ages 50–79 from diverse racial/ethnic, geographic, and socioeconomic backgrounds into one of two longitudinal study branches between 1994 and 1998: the clinical trial (CT;  $n = 68,132$ ) or the observational study (OS;

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$n = 93,676$ ) [50]. Exclusion criteria relevant to the current study included substance abuse (except alcohol or cigarettes); mental illness including severe depression, dementia, or life expectancy <3 years; participation in other randomized trials; and plans to relocate within 3 years. Further restrictions have been described elsewhere [50]. The current analysis includes women who smoked at study entry from either the OS or CT and who had complete data for optimism, pessimism, and cynical hostility ( $n = 10,242$ , see Fig. 1 for the diagram of cohort creation). Full-scale optimism and its subscales, optimism and pessimism, and cynical hostility were assessed at study entry in the WHI, while smoking was self-reported at years 1, 3, and 6 after study entry.

### Optimism, Pessimism, and Cynical Hostility

Optimism and cynical hostility were selected for inclusion in the WHI by the Behavioral Committee, with input from experts in the field, because of their importance for women's health and potential to be captured using brief and reliable tests [51]. Optimism and cynical hostility are moderately heritable [52, 53], associated with environmental exposures [54, 55], and remain fairly stable after young adulthood [56, 57]. They are considered trait-like, with high test-retest correlations (0.71 over 10 years for optimism [30] and 0.56 for hostility over 4 years [58]).

Optimism, characterized by positive expectations for the future, includes items such as “In uncertain times I usually expect the best.” Pessimism is characterized by negative future expectations, captured by items such as “I rarely count on good things happening to me” [56]. Both were measured by the Life

Orientation Test-Revised (LOT-R [18]), a widely-used and validated six-item scale, producing scores from 6 to 30, with higher scores signaling greater optimism and lower scores indicating greater pessimism. Two subscales of three questions each measure optimism and pessimism separately (scores ranging from 3 to 15). Higher scores on the subscales indicate a higher degree of each attitude (optimism or pessimism), while lower scores reflect neutral expectations for future events.

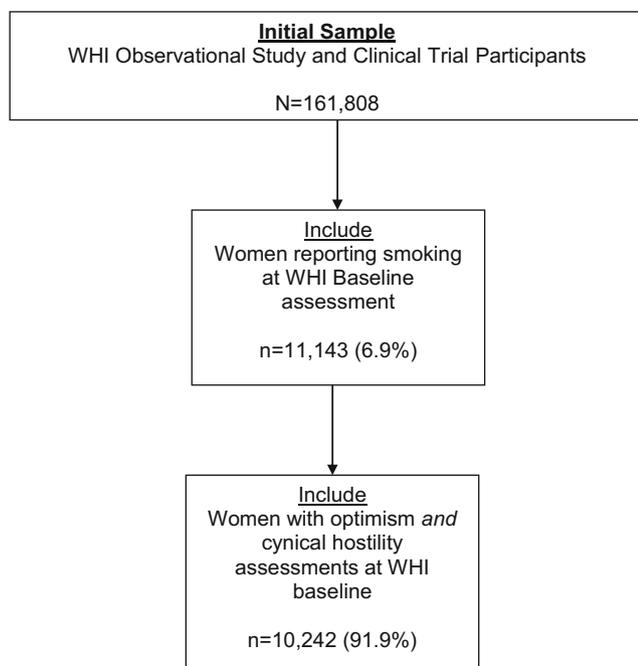
Cynical hostility (deep mistrust of others) was measured with the cynicism subscale of the Cook-Medley Questionnaire [19, 20] consisting of 13 true/false items such as “It is safer to trust nobody.” Scores range from 0 to 13; higher scores indicate greater cynical hostility.

### Smoking Measures

Women reporting smoking at study entry and with no missing data for optimism or cynical hostility ( $n = 10,242$ ) were included. Self-reported smoking status ( $y/n$ , a valid measure of smoking outside of clinical trials [59]) was assessed at years 1, 3, and 6 after study entry. Women reporting not smoking in a given year were considered to have achieved smoking cessation. Participants were asked whether they had smoked 100 cigarettes in their lifetime and, if so, were asked if they currently smoke and the number of cigarettes smoked per day in categories (<5, 5–14, 15–24, 25–34, 35–44, and >45). The number of cigarettes per day was dichotomized for analysis into lighter (<15,  $n = 5829$ ) and heavier smokers ( $\geq 15$ ,  $n = 4413$ ), based on the distribution of smoking rates in the sample [60].

### Covariate Measures

We included as covariates baseline factors which are known to be associated with smoking, smoking cessation, or smoking behavior and attitudes jointly. Factors associated with smoking were self-reported at study entry and were included as covariates, including age [61], race and ethnicity [62], cigarettes smoked per day (<15,  $\geq 15$ , which is associated with the level of nicotine withdrawal and difficulty quitting smoking [60]), education (<HS,  $\geq$ HS) [62], annual family income (<35k annually,  $\geq 35$ k annually) [63], weekly exercise (METS/week) [62], and alcohol consumption ( $y/n$ ) [62]. A region of the USA [64] (Northeast, South, Midwest, or West) was included due to association with both trait attitudes [20, 65] and smoking. Other covariates included health insurance ( $y/n$ ), WHI social support construct (continuous score; nine items selected from the Medical Outcomes Study) [51, 66], regular source of medical care ( $y/n$ ), and a history ( $y/n$ ) of seven health conditions at study entry: diabetes, high cholesterol, hypertension, CVD, cancer, obesity (BMI  $\geq 30$ ), or baseline elevated depressive symptoms. Depressive symptoms were measured using the Burnam Screening Algorithm [67], a questionnaire that includes six items from the Center for Epidemiologic



**Fig. 1** Flowchart of cohort creation

Studies Depression Scale (CES-D) [68] and two from the Diagnostic Interview Scale (DIS) [69], with a cutoff of  $\geq 0.06$  indicating depressive symptoms [67, 70]. Health conditions were included because over 90% of individuals who attempt to quit smoking do so for health reasons [71], and the increased physician visits due to these health conditions may increase exposure to smoking cessation advice from a physician [72]. Both income and education were included, as neither on their own sufficiently characterized socioeconomic status [73]. Social support at the start of a quit attempt is positively associated with smoking cessation and negatively associated with relapse [74]. This analysis controlled for baseline elevated depressive symptoms, which are associated with higher smoking rate [75] and predict increases in depressed affect during tobacco withdrawal [76]. The role of overt mental illness, including major depression, could not be examined because this was among the exclusion criteria for study entry [50].

## Statistical Methods

### Characteristics at Study Entry

Participant characteristics at study entry were compared across quartiles of scores for optimism and cynical hostility, including covariates and potential confounders outlined above. Chi-squared tests (categorical variables) and ANOVA tests (continuous variables) assessed associations with quartiles of optimism and cynical hostility.

### Longitudinal Analysis

Hierarchical (sequential) multiple regression analysis was performed in seven modeling steps using generalized linear mixed models (SAS 9.4 PROC GLIMMIX using random intercept, METHOD = Quad, qpoints = 21). Hierarchical

models were used to assess the role of attitudes independent of potential confounders such as demographic characteristics, smoking rate, health behaviors and conditions, and other psychosocial factors. Covariates were added in batches in order to clarify the mechanisms linking psychological attitudes to smoking. Table 1 provides a brief description of each model.

The main analysis (models 1–7) examined each attitude (optimism, optimism/pessimism subscales, and cynical hostility) as independent predictors of smoking cessation. Covariates were added successively in seven modeling steps (Table 1, models 1–7) beginning with attitude, age, and time (model 1) and adding additional variables in batches: sociodemographic factors including race/ethnicity, education, income, region, and insurance status (model 2); cigarettes per day (model 3); health behaviors including physical activity and alcohol consumption (model 4); presence of seven health conditions including diabetes, high cholesterol, hypertension, CVD, cancer, depressive symptoms, and obesity (model 5); social support and regular source of medical care (model 6); and finally the other attitude of interest (model 7, optimism full scale controlled for cynical hostility, optimism subscales modeled individually and controlled for cynical hostility, cynical hostility controlled for optimism full scale). Models were checked for multicollinearity.

## Results

### Characteristics at Study Entry

Compared to the entire WHI observational cohort, our sample of baseline female smokers was slightly younger

**Table 1** Hierarchical modeling steps for main analysis

Outcome = smoking cessation ( <i>y/n</i> )	Category of variables added	Variables added in models for optimism	Variables added in models for cynical hostility
Model 1	Basic predictors	Optimism, age, time	Cynical hostility, age, time
Model 2	Demographics	Model 1 + race/ethnicity, education, income, region, insurance	Model 1 + race/ethnicity, education, income, region, insurance
Model 3	Smoking level	Model 2 + cigarettes per day	Model 2 + cigarettes per day
Model 4	Health behaviors	Model 3 + physical activity, alcohol consumption	Model 3 + physical activity, alcohol consumption
Model 5	Health conditions	Model 4 + diabetes, high cholesterol, hypertension, cardiovascular disease or cancer, depressive symptoms, obesity	Model 4 + diabetes, high cholesterol, hypertension, cardiovascular disease or cancer, depressive symptoms, obesity
Model 6	Other characteristics	Model 5 + social support, regular source of medical care	Model 5 + social support, regular source of medical care
Model 7	Other attitude	Model 6 + cynical hostility	Model 6 + optimism

on average (61.1 vs. 63.6), less educated (with 6.8 vs. 5.2% not finishing high school), lower income (with 47.7 vs. 39.4% having household income under \$35,000 annually), more likely to be from racial/ethnic minority groups (79.7 vs. 83.3% white), and slightly less likely to be obese (24.3 vs. 25.1%) [50]. The least (vs. most) optimistic women were more likely to be lower-income racial and ethnic minorities without a high school education, regular healthcare provider, or health insurance. They reported lower levels of physical activity and social support and were more likely to abstain from alcohol, smoke 15 or more cigarettes per day, and report diabetes, high cholesterol, hypertension, CVD, elevated depressive symptoms, and obesity (Table 2, all  $p < 0.05$ ,  $p$  values not shown). The most (vs. least)

cynically hostile women closely resembled the least optimistic women at study entry and, additionally, were more likely to report cancer ( $p = 0.0082$ ).

### Longitudinal Analysis

Of the 10,242 baseline smokers observed from study entry (before year 1 follow-up), 15.8% reported not smoking by year 1 follow-up, 28.1% reported not smoking at year 3, and 39.2% reported not smoking at year 6. Correlations between attitudes at baseline and the final WHI survey of the main study (years 8–9; this varied by respondent) attitude scores were assessed on the subset of women for whom these were available ( $n = 3704$ ). The Pearson correlation coefficient for total

**Table 2** Characteristics of WHI smokers at study entry, by quartiles of optimism and cynical hostility (as percent of sample)

Percent of sample (unless otherwise indicated) <sup>a</sup>	All $n = 10,242$	Optimism				Cynical hostility			
		Most ( $\geq 26$ ) $n = 2223$	Mid-high (24–25) $n = 2108$	Mid-low (21–23) $n = 3323$	Least (6–20) $n = 2588$	Most ( $\geq 6$ ) $n = 3013$	Mid-high (4–5) $n = 2415$	Mid-low (2–3) $n = 2644$	Least (0–1) $n = 2170$
Age at screening (mean, SD)	61.1 (6.8)	61.1 (6.7)	61.3 (6.7)	61.1 (6.8)	60.8 (6.8)	60.9 (6.8)	61.1 (6.9)	61.2 (6.8)	61.1 (6.6)
US region									
Northeast	23.1	18.6	21.3	24.6	26.8	22.1	23.4	24.4	22.6
South	26.4	27.1	25.7	25.9	27.0	28.9	27.9	24.1	24.02
Midwest	22.9	22.8	24.8	23.7	20.3	22.4	21.6	22.7	25.2
West	27.6	31.6	28.3	25.9	25.9	26.6	27.1	28.8	28.2
Race/ethnicity									
Black (non-Hispanic)	13.3	12.8	12.0	14.4	13.2	20.2	14.6	9.3	7.2
White (non-Hispanic)	79.7	81.6	82.8	78.3	77.2	70.6	79.6	84.4	86.4
Other <sup>b</sup>	7.1	5.6	5.2	7.2	9.6	9.3	5.8	6.3	6.3
Education <HS	6.8	2.7	4.8	6.9	12.2	11.6	6.3	4.4	4.0
Income <\$35,000	47.7	37.9	43.8	49.0	58.2	56.7	47.9	44.4	39.3
No insurance	10.0	8.4	8.4	9.4	13.5	13.5	9.0	8.9	7.6
Cigs/day $\geq 15$	48.6	46.5	47.5	48.7	51.4	46.9	48.7	50.6	48.5
METs per week $\geq 25$	63.3	69.1	65.5	63.1	56.6	57.4	63.5	65.0	69.0
Any alcohol	76.3	81.2	78.1	76.1	70.7	70.7	77.5	78.1	80.4
Diabetes ever	5.8	4.6	4.7	6.2	7.3	7.8	5.8	4.5	4.7
High cholesterol	13.4	11.8	14.0	13.0	14.7	14.6	14.3	12.1	12.2
Hypertension	34.4	30.3	33.7	36.5	35.8	38.1	34.1	32.5	31.7
CVD	9.1	6.8	7.8	9.1	12.0	12.8	8.6	7.5	6.3
Cancer	9.8	9.5	10.6	9.5	9.7	10.8	10.2	9.8	7.8
Elevated depressive symptoms ( $y/n$ ) <sup>c</sup>	17.6	7.2	9.8	16.4	35.0	27.9	17.4	13.1	9.5
Obesity (BMI $\geq 30$ )	24.3	22.8	22.3	24.7	26.8	28.2	26.1	21.4	20.5
No regular care provider	11.2	10.3	10.1	10.4	13.7	14.0	10.6	9.9	9.4
Social support (mean, SD)	34.4 (8.4)	37.8 (7.1)	35.8 (7.4)	34.1 (8.0)	30.7 (9.1)	31.7 (9.2)	34.2 (8.0)	35.6 (7.8)	37.0 (7.3)

SD standard deviation, HS high school, METs metabolic equivalents, CVD cardiovascular disease, BMI body mass index

<sup>a</sup> Bivariate analyses were conducted using chi-squared tests (categorical variables) and ANOVA tests (continuous variables)

<sup>b</sup> Includes American Indian or Alaskan Native, Asian or Pacific Islander, Hispanic, and unknown

<sup>c</sup> Burnam algorithm with cutoffs of 0.06 indicating elevated depressive symptoms

LOT score (measured at baseline and the final WHI survey) was 0.605 ( $n = 3704$ ,  $p < 0.0001$ ) and for hostility was 0.619 ( $n = 3583$ ,  $p < 0.001$ ), which are within the 0.6–0.8 range reported in the literature for adults [77–79]. The Pearson correlation coefficient for elevated depression symptoms (measured at baseline and the final WHI survey) was lower at 0.338 ( $n = 3638$ ,  $p < 0.001$ ). All baseline psychological attitudes were moderately but statistically significantly correlated with each other, with the highest correlation found between the optimism and pessimism subscale scores (Pearson coefficient =  $-0.45$ ,  $p < 0.0001$ ) and pessimism subscale and hostility score (Pearson coefficient =  $0.37$ ,  $p < 0.0001$ ).

*Optimism Full Scale and Subscales*

Each score of 1 point higher in optimism (continuous) predicted 3% increased odds of smoking cessation over time, after adjustment for age and time only (model 1; OR = 1.03, 95% CI = 1.01–1.06,  $p = 0.004$ ). However, this relationship was no longer significant after adding demographic covariates (model 2; OR = 1.01, 95% CI = 0.98–1.03,  $p = 0.6487$ ). The association between optimism and smoking cessation was also not significant in models 3–7 which adjusted for heavier vs. lighter smoking, health behaviors, health conditions, other social factors, and hostility (Table 3). Optimism

and pessimism subscale analyses did not differ relative to the full scale.

*Cynical Hostility*

A score of 1 point higher in cynical hostility (continuous) was associated with 6% lower odds of smoking cessation over time adjusting for age and time only (model 1; OR = 0.94, 95% CI = 0.92–0.97,  $p < 0.0001$ ). This relationship remained significant after adjusting for demographic factors (model 2; OR = 0.96, 95% CI = 0.93–0.98,  $p = 0.0027$ ) and additional covariates in models 3–7 (Table 3) and was only slightly attenuated after adjustment for all covariates (model 7; OR = 0.95, 95% CI = 0.92–0.98,  $p = 0.0017$ ).

**Discussion**

Consistent with our hypothesis, cynical hostility predicted lower odds of smoking cessation over 6 years of follow-up in WHI women, with each 1-point increase in cynical hostility corresponding to 5% lower odds of smoking cessation in fully adjusted models. These results confirm existing literature on the links between cynical hostility and smoking [43, 44] and extend it by demonstrating a longitudinal relationship between higher cynical hostility and lower smoking cessation in

**Table 3** Odds of smoking cessation over 6 years among WHI smokers at study entry, by optimism and cynical hostility, for hierarchical generalized linear mixed models

	Variables added (hierarchical modeling)	n	Optimism full scale		Cynical hostility	
			OR (95% CI)	p value <sup>a</sup>	OR (95% CI)	p value
Model 1	Attitude + basic predictors <sup>b</sup>	10,242	1.03 (1.01–1.06)	0.0040*	0.94 (0.92–0.97)	<0.0001*
Model 2	Model 1 + demographics <sup>c</sup>	9577	1.01 (0.98–1.03)	0.6487	0.96 (0.93–0.98)	0.0027*
Model 3	Model 2 + smoking (heavier vs. lighter) <sup>d</sup>	9577	1.00 (0.98–1.03)	0.9095	0.95 (0.92–0.98)	0.0011*
Model 4	Model 3 + health behaviors <sup>e</sup>	9055	1.00 (0.97–1.02)	0.7945	0.95 (0.93–0.98)	0.0023*
Model 5	Model 4 + health conditions <sup>f</sup>	8671	0.99 (0.97–1.02)	0.6101	0.96 (0.93–0.99)	0.0080*
Model 6	Model 5 + other social factors <sup>g</sup>	8450	0.99 (0.96–1.02)	0.3930	0.96 (0.93–0.99)	0.0055*
Model 7	Model 6 + other attitude <sup>h</sup> (optimism + hostility together)	8450	0.98 (0.96–1.01)	0.1963	0.95 (0.92–0.98)	0.0017*

OR odds ratio, CI confidence interval

\* $p < 0.05$

<sup>a</sup>  $p$  values for each of seven models assessed using Wald-type tests in SAS 9.4 PROC GLIMMIX using random intercept, METHOD = Quad, qpoints = 21, with a logit link function, binomial distribution, and the *containment method* to compute denominator degrees of freedom. These models employ maximum likelihood estimation techniques and Gauss-Hermite quadrature likelihood approximation. The associated variance function is  $\mu(1 - \mu)/n$

<sup>b</sup> Includes age and time

<sup>c</sup> Includes race/ethnicity, education, income, region, and insurance

<sup>d</sup> Lighter smokers used less than 15 cigarettes per day, while heavier smokers used 15 or more cigarettes per day

<sup>e</sup> Includes physical activity and alcohol consumption

<sup>f</sup> Includes diabetes, high cholesterol, hypertension, cardiovascular disease (CVD), cancer, elevated depressive symptoms, and obesity

<sup>g</sup> Includes social support and having a regular medical care provider

<sup>h</sup> Models optimism and cynical hostility together

postmenopausal women. Results are also consistent with the framework of cynical hostility as a “trans-diagnostic vulnerability” for smoking [80]. This framework posits that maladaptive emotional states (common in individuals endorsing high levels of cynical hostility), which are broader than any single clinical diagnosis, may reinforce the rewarding properties of smoking for particularly vulnerable individuals.

The link between cynical hostility and smoking cessation patterns may be partially explained by how this attitude is associated with perceived stress and coping behaviors, as well as how cynical hostility may undermine ability to leverage social support [20, 49]. Women with hostile attitudes may not be as equipped to handle the stressors of quitting smoking or to fully leverage their support structures during the quit attempt. The current analysis controls for self-reported social support at study baseline, but social support was not measured repeatedly, and thus, any potential changes in social support cannot be accurately captured in this sample. Evidence for the trajectory of social relations in late life demonstrates that some types of social support decline with age (including contacts with friends, support satisfaction, anticipated support, and provided support) while emotional support tends to remain relatively stable, and other forms of support may actually increase [81]. Cynical hostility is also associated with other psychological traits which predict increased smoking behavior, such as high neuroticism and low agreeableness, from the five-factor model of personality [82]. Though distinct from cynical hostility, these factors are associated with both cynical hostility and smoking yet were not measured in the WHI.

Neither optimism nor the optimism and pessimism subscales significantly predicted odds of smoking cessation after adjustment for covariates beyond age, specifically demographic predictors and socioeconomic status variables. These findings are consistent with underlying theoretical framework positing that attitudes co-occur with, and may even emerge from, the stress induced by low SES [83]. In addition, SES and psychological attitudes are likely mutually reinforcing [84], such that certain attitudes (e.g., high degree of pessimism) may exacerbate the stressors associated with low SES, while optimistic attitudes may buffer them [85], a question that cannot be addressed by this cohort.

What do these findings offer in terms of addressing smoking behavior? Regardless of psychological attitudes, older women who are interested in quitting smoking are advised to seek evidence-based cessation aids including pharmacotherapy (e.g., nicotine replacement therapy) and counseling to maximize their chances of long-term abstinence from tobacco [86]. It is possible that women with a high degree of cynical hostility, compared to less hostile peers, may be less receptive to physician advice to quit smoking or less willing to engage in other proven treatments unless trust in the provider can be established. These questions cannot be answered by the WHI. In addition, the extent to which cynical hostility or other

psychological attitudes may be modified is unclear. While type A behavior patterns, which are related to hostility, have been addressed in the setting of a clinical trial [87], this question requires further study.

The findings of cynical hostility and persistent smoking raise several considerations with respect to the current health policy environment. Recently, Medicare has enacted a number of performance measures tied to financial incentives for primary care physicians and hospitals to encourage them to provide smoking cessation services. Among these value-based payment (VBP) programs are quality measures for tobacco use assessment and cessation intervention for Accountable Care Organizations (ACOs) in the Medicare Shared Savings Program (SSP) [88]. For ACOs in the SSP, quality measures for treatment of diabetic patients include tobacco non-use, suggesting that factors which determine smoking cessation may influence quality ratings and associated payments for these programs. Tracking smoking status for patients also helps medical providers meet the requirements for “meaningful use” with electronic health records (EHRs) and is a quality measure for other evolving incentive programs, particularly in psychiatric hospitals [89, 90]. Though SES is often used in risk adjustment, VBP programs vary their use of SES to adjust payments to providers, and critics argue that such programs may have the unintended consequence of increasing health disparities by penalizing providers with a greater share of vulnerable patients [91]. Given that rates of cynical hostility are higher for lower SES individuals and those of minority racial/ethnic status in prior work [92] and in the WHI [20], these providers could be caring for a greater proportion of individuals with high trait cynical hostility and could be penalized for quality measures focused around treatment of tobacco use.

### Limitations

This study has several limitations. The exposure variables of optimism, pessimism, and cynical hostility are measured via self-report. Despite known limitations to self-reported data, the questionnaires are validated and have ecological validity in their prediction of “hard” clinical outcomes in the WHI [20]. Intent to quit smoking, quit attempts, and use of quit aids were not measured in the WHI and limited our ability to determine the direct mechanism by which psychological attitudes may have influenced smoking cessation rates. While the WHI draws from a large, diverse, and representative sample of women in the USA, the sample may limit the generalizability of findings to all persons because it is focused on postmenopausal women only and because WHI women are typically healthier and more motivated to engage in healthy behavior than their peers in the general population. The WHI also excluded

women with baseline mental health conditions such as depression and substance use, which further sets this sample apart from the general population of smokers, who tend to suffer from these comorbid conditions [93]. These excluded individuals would be expected to exhibit the lowest rates of optimism and highest rates of cynical hostility; thus, the exclusion criteria of the WHI may have led to an underestimate of the true association between psychological attitudes and smoking outcomes.

One potential limitation is missing data for smoking status, which was assessed in mailed surveys. Missing data for smoking status at year 1 follow-up (28% missing), year 3 (17% missing), and year 6 (14% missing) were unlikely to be missing at random. Using pattern mixture modeling [94] to evaluate the impact of missingness on our results, we found that missing data for smoking status did not influence the observed results. Thus, these additional analyses improve our confidence in the validity of the reported findings.

## Conclusions

Higher cynical hostility predicted lower odds of smoking cessation over 6 years in postmenopausal women. Individuals with high cynical hostility, who are already at elevated risk of morbidity and mortality independent of their smoking, represent a group for whom smoking cessation is particularly challenging. Similar to smokers with depression or other mental health comorbidity, individuals with a high degree of cynical hostility may need more intensive treatment to successfully quit smoking, a fact which may have direct policy implications for new hospital and physician payment incentives focused on smoking cessation treatment to measure quality of care. Whether individuals with high cynical hostility may benefit from increased cessation resources to aid in quitting smoking and whether cynical hostility itself may be modifiable are questions which merit further study.

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## Compliance with Ethical Standards

**IRB Approval** For the Women's Health Initiative study, institutional review board approval was obtained at each clinical center and all participants were provided written informed consent.

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## Authors' Statement of Conflict of Interest and Adherence to Ethical Standards

**Authors** Ana M. Progovac acknowledges that she had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Ana M. Progovac, Yue-Fang Chang, Chung-Chou H. Chang, Karen A. Matthews, Julie M. Donohue, Michael F. Scheier, Elizabeth B. Habermann, Lewis Kuller, Joseph S. Goveas, Benjamin P. Chapman, Paul R. Duberstein, Catherine R. Messina, Kathryn E. Weaver, Nazmus Saquib, Robert B. Wallace, Robert C. Kaplan, Darren Calhoun, J. Carson Smith, and Hilary A. Tindle declare that they have no conflict of interest. All procedures, including the informed consent process, were conducted in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000.

**Human Subjects** The WHI received IRB approval and informed consent from all participants. Study documentation can be found here <https://www.whi.org/researchers/studydoc/SitePages/Protocol%20and%20Consents.aspx>.

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