Original Investigation

Depressive Symptoms and Smoking in Middle-Aged and Older Women

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Abstract

Introduction: Smoking research and intervention efforts have neglected older women. Depressive symptoms, which are common in middle-aged and older women, are related to the maintenance of adult smoking.

Methods: This study investigated the relation of a composite measure of current depressive symptoms, derived from a short form of the Center for Epidemiological Studies Depression Scale, and history of depressive symptoms, derived from two items from the Diagnostic Interview Schedule, to smoking outcomes in the Women’s Health Initiative Observational Study (N = 90,627). Participants were postmenopausal with an average age of 63.6 years at baseline. Participants were recruited from urban, suburban, and rural areas surrounding 40 clinical centers in the United States. Analyses controlled for age, educational level, and ethnicity.

Results: In multinomial logistic regression analyses, depressive symptoms were related cross-sectionally to current light (odds ratio [OR] = 1.19, 95% CI = 1.14–1.23) and heavier (OR = 1.28, 95% CI = 1.23–1.32) smoking at baseline compared with non-smokers. In prospective multiple logistic regression analyses, baseline depressive symptoms were negatively predictive of smoking cessation at a 1-year follow-up (OR = .85, 95% CI = .77–.93) and at participants’ final assessments in the study (OR = .92, 95% CI = .85–.98). Light smokers had more than 2 times higher odds of smoking cessation than did heavier smokers.

Conclusions: The present findings demonstrate a consistent link between depressive symptoms and negative smoking-related behaviors among middle-aged and older women at both light and heavier smoking levels.

Introduction

Smoking research and intervention efforts have substantially neglected older adults, with older women particularly underserved.

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to attempt to quit smoking (U.S. DHHS, 2000), they are equally or more likely to be as successful as younger smokers when they do attempt to quit smoking (Burns, 2000; Ossip-Klein, Carosella, & Krusch, 1997; Sorlie & Kannel, 1990; Whitson, Hellin, & Burchett, 2006).

There has been a recent trend toward increased light smoking associated with tobacco control efforts, such as workplace smoking bans and cigarette taxes (Burns, Major, & Shanks, 2003; Pierce, White, & Messer, 2009), but there is limited research especially focused on light smoking (Businelle et al., 2009; CDC, 1994; Fagan & Rigotti, 2009; Falba, Jofre-Bonet, Busch, Duchovny, & Sindelar, 2004; Godtfredsen, Prescott, & Osler, 2005; Godtfredsen, Prescott, Vestbo, & Osler, 2006; Hatuskami et al., 2006; Reitzel et al., 2009; Shiffman, 2009; Wilson, Parsons, & Wakefield, 1999). Although little information is available concerning level of smoking in older women, a study of women smokers aged 70 years and older (Donze et al., 2007), 53% smoked 10 or fewer cigarettes/day. The study of light smoking is important because cigarette smoking is unsafe at all levels (Coggins, Murrelle, Carchman, & Heidbreder, 2009; Schane, Ling, & Glantz, 2010).

**Depressive Symptoms and Smoking**

Individuals with psychiatric disorders carry a disproportionate burden in cigarette consumption and nicotine dependence (Grant, Hasin, Chou, Stinson, & Dawson, 2004; Lasser et al., 2000). Mood disorders, in particular, have been shown to be risk factors for smoking prevalence (Husky, Mazure, Paliwal, & Mckee, 2008; Kendler et al., 1993; Lasser et al., 2000; Murphy et al., 2003), nicotine dependence (Breslau, Kilbey, & Andreski, 1993; Grant et al., 2004), and reduced smoking cessation (Curtin et al., 2000). There is also evidence that current depressive symptoms are associated with smoking prevalence (Anda et al., 1990) and reduced smoking cessation (McClave et al., 2009; Niaura et al., 2001). Some studies have found a stronger relation of current depressive symptoms (Anda et al., 1990) to reduced smoking cessation for women compared with men in adulthood. However, the relation of depressive symptoms to smoking is complex (Hayes, Dunsiger, & Borrelli, 2010), particularly among older smokers (Sachs-Ericsson et al., 2009; van Gool et al., 2003), and the National Institute of Mental Health has called for additional longitudinal research on depressive symptoms and smoking (Ziedonis et al., 2008).

Understanding the relationship between depressive symptoms and smoking is especially relevant to middle-aged and older women. Throughout adulthood, women show higher levels of depressive disorders than men (Kessler, 2006). The association between age and depressive disorders is curvilinear, with a drop in depressive disorders during middle age and a subsequent rise; however, the drop is less pronounced for women than for men (Mirowsky & Ross, 2003). Moreover, women are more prone to engage in negative affect–related smoking (Brandon & Baker, 1991; Livson & Leino, 1988) and to show stronger relations of life stressors to smoking maintenance or relapse (Mckee, Maciejewski, Falba, & Mazure, 2003).

**The Present Study**

The present study examined the relation of depressive symptoms to smoking in more than 90,000 middle-aged and older women using data from the WHI Observational Study. The WHI Observational Study was framed to examine the role of lifestyle factors in the prevention of heart disease, some cancers, and osteoporosis in women who were postmenopausal (Hays et al., 2003). Participants were recruited from areas surrounding clinical centers in the United States from urban, suburban, and rural areas. The WHI Observational Study presents a unique opportunity to examine the link between depressive symptoms and smoking in a sample of postmenopausal women ranging in age from 50 to 79 years at baseline, with depressive symptoms indexed at baseline and smoking examined across an ensuing 8-year period.

Based on increasing concern about the prevalence and adverse health consequences of light smoking (Fagan & Rigotti, 2009; Schane, Ling, & Glantz, 2010; Shiffman, 2009), we examined the association of depressive symptoms to both light and heavier smoking. Extending previous research on the role of depressive symptoms in smoking in mixed-age samples (Anda et al., 1990, McClave et al., 2009; Niaura et al., 2001), two hypotheses were advanced: (a) we hypothesized that depressive symptoms would be associated cross-sectionally with both current light and heavier smoking at baseline among middle-aged and older women and (b) we hypothesized that among baseline smokers, depressive symptoms at baseline would be associated prospectively with smoking cessation at a one-year follow-up and at participants’ last assessments. In exploratory analyses, we examined (a) the potential role of light versus heavier smoking in moderating (i.e., either strengthening or weakening) the strength of the relationship between depressive symptoms and smoking and (b) the role of depressive symptoms in prospectively predicting smoking uptake among nonsmokers at baseline, including relapse among former smokers.

**Methods**

### Sample Selection and Characteristics

The WHI Observational Study included 93,676 participants between the ages of 50 and 79 years who were postmenopausal at enrollment between 1993 and 1998 (Hays et al., 2003). The original purpose of the WHI Observational Study was to explore the predictors and natural history of important causes of morbidity and mortality in postmenopausal women related to heart disease, cancers, and osteoporosis, with participants followed for up to 8 years. Postmenopausal was defined as not having a menstrual period for at least six months if age was greater than or equal to 55 and having no menstrual period for at least twelve months if aged 50–54 years. The WHI Observational Study is an observational study tracking a large sample of postmenopausal women and is not part of the WHI clinical trials. The participants in the WHI Observational Study were not asked to take medications or to change their health habits.

Inclusion criteria included the ability and willingness to provide written informed consent and plans to stay in the same area for at least three years. Potential participants were excluded if they had medical conditions that predicted survival of less than three years or if they had conditions such as alcohol or drug dependency, mental illness, including severe depression or dementia, which might affect retention. Participants were recruited from urban, suburban, and rural areas surrounding 40 clinical centers, mainly at major academic health centers, located...
in 24 states and the District of Columbia in the United States (for a complete list of the WHI clinical centers, see Rossouw et al., 1995). Geographic distribution of participant enrollment in the WHI Observational Study was 22.7% from the Northeast, 26.1% from the South, 22.0% from the Midwest, and 29.2% from the West. The inclusion of participants from racial/minority groups proportionate to their age group representation in the U.S. population was a priority (Hays et al., 2003). Ten clinical centers emphasized minority recruitment and enrolled an average of 40% minorities, while other clinics recruited an average of 10% minorities. Main details of the WHI design have been published previously (Hays et al., 2003; Langer et al., 2003; WHI Study Group, 1998).

The present sample includes the 90,627 (97%) of baseline participants in the WHI Observational Study who provided complete data on the measures used here. At baseline, the participants in the present sample were an average age of 63.6 (SD = 7.36) years, with smokers 2 years younger than nonsmokers. Most participants (62%) were married. The sample was predominantly White (83.9%), with the remainder of the sample American Indian/Alaskan Native (0.4%), Asian/Pacific Islander (2.9%), Black (8.0%), Hispanic (3.7%), and unknown (1.1%). Both White and Black ethnicity categories specified not-of-Hispanic origin. Five percent of participants had less than a high-school education, 16% had a high-school (or vocational school) education, 37% had some education beyond high school but had not completed college, and 42% had completed college.

**Measures**

Sociodemographic factors and depressive symptoms were assessed at baseline, and smoking status was assessed at baseline, an initial 1-year follow-up, and six additional annual follow-ups across Years 3 through 8.

**Sociodemographic Factors**

Sociodemographic factors used as control variables included age (in years), educational level, and ethnicity. Educational level was operationalized as less than a high-school (or vocational school) education, high-school (or vocational school) education, some education beyond high school (or vocational school) but not having completed college, and completed college.

**Depressive Symptoms**

A measure of depressive symptoms at baseline was indexed as a composite of a history of depressive symptoms and current depressive symptoms. History of depressive symptoms was derived from two items from the Diagnostic Interview Schedule (DIS; Robbins, Helzer, Croughan, & Ratliff, 1981). Participants were asked at baseline (a) if in the past year, they had 2 weeks or more during which they felt sad, blue, or depressed or lost pleasure in things that they usually cared about or enjoyed and (b) if they had 2 years or more in their life when they felt depressed or sad most days. History of depressive symptoms was operationalized as responding “yes” to both items (score = 1) versus “no” to either item (score = 0), following the approach of previous WHI investigators (Wassertheil-Smoller et al., 2004) in indexing history of depressive symptoms in the WHI Observational Sample.

Current depressive symptoms, assessed by symptoms in the past week, were indexed at baseline by a shortened six-item version of the Center for Epidemiological Studies Depression Scale (CES-D; Burnam, Wells, Leake, & Landsverk, 1988; Wassertheil-Smoller et al., 2004). The CES-D is a currently and widely used self-report measure of depressive symptoms in epidemiological studies (Santor, Gregus, & Welch, 2006). The items in the six-item scale are felt depressed, sleep was restless, enjoyed life (reversed scored), had crying spells, felt sad, and felt that people disliked you. Participants were asked how often they experienced each depressive symptom during the past week, with items scaled from 0 (rarely or none of the time) to 3 (most or all of the time). Current depressive symptoms are a sum of the six items. The six-item version of the CES-D correlated .88 with the full 20-item CES-D in a similar population of older women (Borhani et al., 1991).

Following Burnam et al. (1988) and Wassertheil-Smoller et al. (2004), a continuous measure of depressive symptoms was created as the average of history of depressive symptoms and current depressive symptoms when both of these measures were available. Standard scores were used for both measures to equate their scales. In the full sample 313 (0.3%), participants were excluded who did not provide data on both measures; among baseline smokers, 20 (0.04%) participants were excluded who did not provide data on both measures. The correlation between the measures of history of depressive symptoms and current depressive symptoms was .44 in the full sample and .51 among baseline smokers.

**Smoking Outcomes**

Three smoking outcomes were assessed: smoking status at baseline and, among baseline smokers, smoking cessation at one year and smoking cessation at participants’ last assessments. Smoking status at baseline (nonsmoker, light smoker, and heavier smoker) was indexed in two steps. First, participants were asked if, “During your entire life, have you smoked at least 100 cigarettes?” Participants who reported that they did not currently smoke cigarettes were coded as nonsmokers. Next, participants who reported having smoked at least 100 cigarettes in their entire life and who reported that they currently smoked cigarettes were coded as either light or heavier smokers based on their responses to a question that asked, “On the average, how many cigarettes do you usually smoke each day?” Response choices were less than 1, 1–4, 5–14, 15–24, 25–34, 35–44, and 45 or more. For the present study, following definitions of light smoking used in other studies (CDC, 1994; Falba, Jofre-Bonet, Busch, Duchovny, & Sindelar, 2004; Godtfredsen et al., 2005, 2006; Hatsukami et al., 2006; Wilson, Parsons, & Wakefield, 1999), light smoking was operationalized as less than 15 cigarettes/day. Heavier smoking was operationalized as 15 or more cigarettes/day (Hatsukami et al., 2006). Among baseline smokers, smoking cessation at one year was operationalized as reporting no smoking at the one-year follow-up (score = 1) versus continuing to smoke at the one-year follow-up (score = 0). Among baseline smokers, smoking cessation at participants’ last assessments (restricted to assessments beyond the one-year follow-up) was operationalized as not smoking at both of participants’ last two assessments (score = 1) versus continuing to smoke at either of participants’ last two assessments (score = 0).

**Data Analysis Strategy**

Multinomial logistic regression analyses were used to partition the outcome variables (Kleinbaum & Kline, 2010) to analyze the cross-sectional relation of baseline depressive symptoms to smoking status at baseline and participants’ smoking cessation at one year and participants’ last assessments.
Depressive symptoms and smoking

smoking status (nonsmokers vs. light and heavier smokers). Multiple logistic regression analyses were used to analyze the relation of baseline depressive symptoms to smoking cessation one year later and at the participants’ final two assessments. All analyses controlled for age (in years), educational level (less than a high-school education was the reference group), and ethnicity (White was the reference group). To simplify the presentation, all analyses used the composite measure of a history of depressive symptoms and current depressive symptoms. In fact, the underlying pattern of findings is the same for history of depressive symptoms and current depressive symptoms, and all results are significant ($\alpha < .05$) for both history of depressive symptoms and current depressive symptoms if they are examined separately.

Results

Descriptive Statistics

At baseline, 11,170 of 90,627 participants (12.3%) reported a history of depressive symptoms, and mean current depressive symptoms from the CES-D were 2.37 ($SD = 2.58$). At baseline, the first quartile on the composite measure of depressive symptoms included no participants with a history of depressive symptoms and no participants with high (score of 5 or more; Wassertheil-Smoller et al., 2004) current depressive symptoms. In contrast, the fourth quartile on depressive symptoms included 11,170 (56.6%) participants with a history of depressive symptoms and 14,490 (73.5%) participants with high current depressive symptoms.

Current smoking was reported by 5,691 participants (6.3%) at baseline, 3,010 of whom (52.9%) reported light smoking of less than 15 cigarettes/day. Among current smokers at baseline, 1,155 participants (20.3%) reported a history of depressive symptoms, and mean current depressive symptoms were 2.86 ($SD = 3.00$). Among current smokers at baseline, the first quartile on the composite measure of depressive symptoms included no participants with a history of depressive symptoms and no participants with high current depressive symptoms. In contrast, the fourth quartile on depressive symptoms included 1,155 (84.2%) participants with a history of depressive symptoms and 899 (65.6%) participants with high current depressive symptoms.

The 5,691 baseline smokers began smoking at a median age of 15–19 years and had been regular smokers for a median of 30–39 years. Among these baseline smokers, smoking cessation was reported by 852 of 5,178 participants (16.5%) providing data at the one-year follow-up and by 1,801 of 4,984 participants (36.1%) across participants’ last two assessments (i.e., participants who provided data for two assessments beyond the one-year follow-up). Tables 1 and 2 show baseline smoking and smoking cessation, respectively, for each control variable (to facilitate interpretation, age is presented in 10-year categories in the table).

Baseline Smoking Status

We began by examining the cross-sectional association between depressive symptoms and current smoking status at baseline in the full sample ($N = 90,627$). We used multinomial logistic regression in order to contrast light and heavier smokers with nonsmokers, which was the reference category. Results are presented in Table 3. Controlling for age, educational level, and ethnicity, depressive symptoms were significantly positively associated with both current light and heavier smoking. Compared with nonsmokers, each one-unit increase in depressive symptoms (range = 5.00) was linked to a 19% increase in the odds of being a current light smoker and to a 28% increase in the odds of being a current heavier smoker. The association between depressive symptoms and current smoking status at baseline remained significant with comparable effect sizes when this analysis was repeated restricting current nonsmokers to either former smokers ($n = 38,828$) or never-smokers ($n = 46,108$). There were no significant interactions between depressive symptoms and either age (for light smoking, odds ratio [OR] = 0.999, $p = .58$; for heavier smoking, OR = 0.998, $p = .46$), educational level ($\chi^2$ change [6 df] for the model including educational level = 4.76, $p = .57$), or ethnicity ($\chi^2$ change [10 df] for the model including ethnicity = 5.61, $p = .85$) in predicting smoking status at baseline. That is, the relationship between depressive symptoms and smoking status at baseline did not vary by age, educational level, or ethnicity.

Prospective Analyses

Smoking Cessation at One Year

We then examined the prospective association between depressive symptoms at baseline and smoking cessation at the one-year follow-up among baseline smokers ($N = 5,178$; average age = 63) in a multiple logistic regression analysis. Results are presented Table 4. Controlling for age, educational level, and ethnicity, depressive symptoms at baseline were significantly negatively associated with smoking cessation at the one-year follow-up. Each one-unit increase in depressive symptoms (range = 4.24) was linked to a 15% decrease in the odds of smoking cessation.

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Table 1. Baseline Smoking by Demographic Characteristics for the Total Sample ($N = 90,627$)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Light smokers, % (95% CI)</th>
<th>Heavier smokers, % (95% CI)</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50–59</td>
<td>4.3 (4.1–4.5)</td>
<td>3.9 (3.7–4.1)</td>
<td>28,846</td>
</tr>
<tr>
<td>60–69</td>
<td>3.2 (3.0–3.4)</td>
<td>3.0 (2.8–3.2)</td>
<td>39,919</td>
</tr>
<tr>
<td>70–79</td>
<td>2.3 (2.1–2.5)</td>
<td>1.7 (1.5–1.9)</td>
<td>21,862</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
<td>5.3 (4.7–5.9)</td>
<td>4.8 (4.2–5.4)</td>
<td>4,576</td>
</tr>
<tr>
<td>High school</td>
<td>3.4 (3.1–3.7)</td>
<td>3.5 (3.2–3.8)</td>
<td>14,764</td>
</tr>
<tr>
<td>Some school after high school</td>
<td>3.7 (3.5–3.9)</td>
<td>3.5 (3.3–3.7)</td>
<td>33,106</td>
</tr>
<tr>
<td>College degree</td>
<td>2.7 (2.5–2.9)</td>
<td>2.0 (1.9–2.1)</td>
<td>38,181</td>
</tr>
<tr>
<td>Race or ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Indian/Alaskan Native</td>
<td>5.3 (3.2–7.7)</td>
<td>5.5 (3.3–7.9)</td>
<td>397</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>2.4 (1.8–3.0)</td>
<td>1.1 (0.6–1.4)</td>
<td>2,623</td>
</tr>
<tr>
<td>Black</td>
<td>8.0 (7.4–8.6)</td>
<td>3.2 (2.8–3.6)</td>
<td>7,248</td>
</tr>
<tr>
<td>Hispanic</td>
<td>5.5 (4.7–6.3)</td>
<td>1.2 (0.8–1.6)</td>
<td>3,320</td>
</tr>
<tr>
<td>White, not-of-Hispanic origin</td>
<td>2.8 (2.7–2.9)</td>
<td>3.1 (3.0–3.2)</td>
<td>76,028</td>
</tr>
<tr>
<td>Unknown</td>
<td>3.9 (2.7–5.1)</td>
<td>2.5 (1.5–3.4)</td>
<td>1,011</td>
</tr>
</tbody>
</table>
one year later. There were no significant interactions between depressive symptoms and either age (OR = 1.003, \( p = .65 \)), educational level (\( \chi^2 \) change [3 df] for the model including educational level = 7.10, \( p = .07 \)), or ethnicity (\( \chi^2 \) change [5 df] for the model including ethnicity = 5.38, \( p = .37 \)) in predicting smoking cessation at the one-year follow-up.

Smoking Cessation at Participants’ Last Assessments

In addition, we examined the prospective association between depressive symptoms at baseline and smoking cessation at participants’ last assessments among baseline smokers (\( N = 4,984 \); average age = 69) in a multiple logistic regression analysis. Among baseline smokers who were smoking at their last assessments, 162 individuals (5.4%) had quit at the one-year follow-up but later relapsed. Results are presented in Table 4.

### Table 2. Smoking Cessation at One Year (\( n = 5,178 \)) and at Participants’ Last Assessments (\( n = 4,984 \)) by Demographic Characteristics for Baseline Smokers

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>One year</th>
<th>Last assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>50–59</td>
<td>17.1 (15.5–18.7)</td>
<td>35.5 (33.4–37.6)</td>
</tr>
<tr>
<td>60–69</td>
<td>16.3 (14.8–17.8)</td>
<td>36.6 (34.6–38.6)</td>
</tr>
<tr>
<td>70–79</td>
<td>15.2 (12.7–17.8)</td>
<td>36.6 (33.1–40.1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education</th>
<th>One year</th>
<th>Last assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than high school</td>
<td>16.5 (12.7–20.3)</td>
<td>30.3 (25.6–35.0)</td>
</tr>
<tr>
<td>High school</td>
<td>15.2 (12.9–17.5)</td>
<td>31.8 (28.7–34.9)</td>
</tr>
<tr>
<td>Some school after high school</td>
<td>16.3 (14.7–17.9)</td>
<td>36.5 (34.4–38.6)</td>
</tr>
<tr>
<td>College degree</td>
<td>17.3 (15.5–19.1)</td>
<td>39.3 (36.9–41.7)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race or ethnicity</th>
<th>One year</th>
<th>Last assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian/Alaskan Native</td>
<td>20.5 (7.8–33.2)</td>
<td>35.1 (19.7–50.5)</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>6.2 (1.0–11.4)</td>
<td>36.1 (25.8–46.4)</td>
</tr>
<tr>
<td>Black</td>
<td>15.3 (12.6–35.2)</td>
<td>31.7 (28.2–35.2)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>17.9 (12.3–23.5)</td>
<td>31.8 (24.9–38.7)</td>
</tr>
<tr>
<td>White, not-of-Hispanic origin</td>
<td>16.7 (15.6–17.8)</td>
<td>37.1 (35.6–38.6)</td>
</tr>
<tr>
<td>Unknown</td>
<td>18.5 (8.1–28.9)</td>
<td>33.3 (20.0–46.6)</td>
</tr>
</tbody>
</table>

Note. OR = odds ratio.

<table>
<thead>
<tr>
<th>Predictors</th>
<th>One-year follow-up</th>
<th>Last two assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light smoking</td>
<td>Heavier smoking</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td>95% CI</td>
<td>OR</td>
</tr>
<tr>
<td>0.85**</td>
<td>0.77–0.93</td>
<td>0.92*</td>
</tr>
<tr>
<td>0.99</td>
<td>0.98–1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>0.88</td>
<td>0.63–1.22</td>
<td>1.00</td>
</tr>
<tr>
<td>0.94</td>
<td>0.70–1.28</td>
<td>1.23</td>
</tr>
<tr>
<td>1.00</td>
<td>0.74–1.37</td>
<td>1.37*</td>
</tr>
<tr>
<td>1.34</td>
<td>0.61–2.95</td>
<td>1.01</td>
</tr>
</tbody>
</table>

Note. OR = odds ratio.

<table>
<thead>
<tr>
<th>Predictors</th>
<th>One-year follow-up</th>
<th>Last two assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressive symptoms</td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>0.85**</td>
<td>0.77–0.93</td>
<td></td>
</tr>
<tr>
<td>Age (in years)</td>
<td>0.99</td>
<td>0.98–1.00</td>
</tr>
<tr>
<td>High school</td>
<td>0.88</td>
<td>0.63–1.22</td>
</tr>
<tr>
<td>Some school after high school</td>
<td>0.94</td>
<td>0.70–1.28</td>
</tr>
<tr>
<td>College degree</td>
<td>1.00</td>
<td>0.74–1.37</td>
</tr>
<tr>
<td>American Indian/Alaskan Native</td>
<td>1.34</td>
<td>0.61–2.95</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>0.31*</td>
<td>0.13, 0.77</td>
</tr>
<tr>
<td>Black</td>
<td>.90</td>
<td>0.72, 1.14</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.14</td>
<td>0.76, 1.70</td>
</tr>
<tr>
<td>Unknown</td>
<td>1.17</td>
<td>0.58, 2.33</td>
</tr>
</tbody>
</table>

Note. OR = odds ratio.

Appendix.

Table 3. Results of a Cross-Sectional Multinomial Logistic Regression Analysis Predicting Current Light and Heavier Smoking Status at Baseline in the Full Sample (\( N = 90,627 \))

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Light smoking</th>
<th>Heavier smoking</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td>95% CI</td>
<td>OR</td>
</tr>
<tr>
<td>1.19**</td>
<td>1.14–1.23</td>
<td>1.28**</td>
</tr>
<tr>
<td>0.97**</td>
<td>0.96–0.97</td>
<td>0.96**</td>
</tr>
<tr>
<td>0.82*</td>
<td>0.69–0.96</td>
<td>0.63**</td>
</tr>
<tr>
<td>0.85*</td>
<td>0.74–0.99</td>
<td>0.60**</td>
</tr>
<tr>
<td>0.62**</td>
<td>0.53–0.72</td>
<td>0.32**</td>
</tr>
<tr>
<td>1.58*</td>
<td>1.01–2.46</td>
<td>1.23</td>
</tr>
<tr>
<td>0.84</td>
<td>0.65–1.09</td>
<td>0.37**</td>
</tr>
<tr>
<td>2.68**</td>
<td>2.43–2.95</td>
<td>0.88</td>
</tr>
<tr>
<td>1.48**</td>
<td>1.26–1.74</td>
<td>0.24**</td>
</tr>
<tr>
<td>1.31</td>
<td>0.95–1.81</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Note. OR = odds ratio.

Table 4. Results of Prospective Multiple Logistic Regression Analyses Predicting Smoking Cessation at the One-Year Follow-Up (\( N = 5,178 \)) and Across Participants’ Last Two Assessments (\( N = 4,984 \)) Among Baseline Smokers

<table>
<thead>
<tr>
<th>Predictors</th>
<th>One-year follow-up</th>
<th>Last two assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td>95% CI</td>
<td>OR</td>
</tr>
<tr>
<td>0.85**</td>
<td>0.77–0.93</td>
<td>0.92*</td>
</tr>
<tr>
<td>0.99</td>
<td>0.98–1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>0.88</td>
<td>0.63–1.22</td>
<td>1.00</td>
</tr>
<tr>
<td>0.94</td>
<td>0.70–1.28</td>
<td>1.23</td>
</tr>
<tr>
<td>1.00</td>
<td>0.74–1.37</td>
<td>1.37*</td>
</tr>
<tr>
<td>1.34</td>
<td>0.61–2.95</td>
<td>1.01</td>
</tr>
</tbody>
</table>

Note. OR = odds ratio.

Appendix.

<table>
<thead>
<tr>
<th>Predictors</th>
<th>One-year follow-up</th>
<th>Last two assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressive symptoms</td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>0.85**</td>
<td>0.77–0.93</td>
<td></td>
</tr>
<tr>
<td>Age (in years)</td>
<td>0.99</td>
<td>0.98–1.00</td>
</tr>
<tr>
<td>High school</td>
<td>0.88</td>
<td>0.63–1.22</td>
</tr>
<tr>
<td>Some school after high school</td>
<td>0.94</td>
<td>0.70–1.28</td>
</tr>
<tr>
<td>College degree</td>
<td>1.00</td>
<td>0.74–1.37</td>
</tr>
<tr>
<td>American Indian/Alaskan Native</td>
<td>1.34</td>
<td>0.61–2.95</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>0.31*</td>
<td>0.13, 0.77</td>
</tr>
<tr>
<td>Black</td>
<td>.90</td>
<td>0.72, 1.14</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.14</td>
<td>0.76, 1.70</td>
</tr>
<tr>
<td>Unknown</td>
<td>1.17</td>
<td>0.58, 2.33</td>
</tr>
</tbody>
</table>

Note. OR = odds ratio.

Appendix.

*Less than a high-school education was the reference category.

*White was the reference category.

*p < .05, **p < .01.
for age, educational level, and ethnicity, depressive symptoms at baseline were significantly negatively associated with smoking cessation at participants’ last assessments when smokers were an average of 69 years of age. Each one-unit increase in depressive symptoms (range = 4.24) was linked to an 8% decrease in the odds of smoking cessation at participants’ last assessments. There were no significant interactions between depressive symptoms and either age (OR = 1.004, p = .42), educational level ($\chi^2$ change [3 df] for the model including educational level = 6.87, $p = .08$), or ethnicity ($\chi^2$ change [5 df] for the model including ethnicity = 4.86, $p = .43$) in predicting smoking cessation at participants’ last assessments. However, one noteworthy effect emerged in comparisons of each ethnic minority group’s smoking cessation at participants’ last assessments; Black women were less likely to report smoking cessation at participants’ last assessments compared with White women.

**Additional Analyses**

**Light Versus Heavier smoking**

In multiple logistic regression analyses, we explored the role of light (score = 1) versus heavier (score = 0) smoking at baseline in subsequent smoking cessation. Controlling for age, educational level, and ethnicity as well as for baseline depressive symptoms, light smokers were significantly more likely to report smoking cessation both at one-year (OR = 2.41, $p < .01$, CI = 2.05–2.83) and at participants’ last assessments (OR = 2.05, $p < .01$, CI = 1.81–2.32) compared with heavier smokers. At both points, light smokers had more than two times higher odds of smoking cessation than did heavier smokers. There was not a significant ($p > .05$) interaction between depressive symptoms and light versus heavier smoking in predicting smoking cessation either at the one-year follow-up or at the participants’ last assessments.

**Smoking Uptake**

In a multiple logistic regression analysis, we also explored the role of depressive symptoms in prospectively predicting smoking uptake among the 83,431 nonsmokers at baseline who provided follow-up information. Smoking uptake at some time during the follow-up period was reported by 1,049 baseline nonsmokers (1.3%). Controlling for age, educational level, and ethnicity, baseline depressive symptoms were significantly positively related to smoking uptake among former smokers (OR = 1.29, $p < .01$, CI = 1.22–1.37). Each one-unit increase in depressive symptoms (range = 5.00) was linked to a 29% increase in the odds of smoking uptake. Because 88% of smoking uptake occurred among former smokers, we repeated this analysis restricted to the 38,179 former smokers who were nonsmokers at baseline and who provided follow-up information. Smoking relapse at some time during the follow-up period was reported by 920 (2.4%) baseline nonsmokers who were former smokers. Results were essentially the same as those with the full sample of baseline nonsmokers. Controlling for age, educational level, and ethnicity, baseline depressive symptoms were significantly positively related to smoking relapse among former smokers (OR = 1.28, $p < .01$, CI = 1.20–1.36).

**Discussion**

The present findings demonstrate a consistent link between depressive symptoms and negative smoking-related behaviors among middle-aged and older women in the WHI Observational Study. Extending previous research on the role of depressive symptoms in smoking in mixed-age samples (Anda et al., 1990), depressive symptoms were related cross-sectionally to both current light and heavier smoking at baseline. In addition, extending previous research on depressive symptoms and reduced smoking cessation in mixed-age samples (McClave et al., 2009; Niaura et al., 2001), baseline depressive symptoms were negatively predictive of smoking cessation both at a one-year follow-up when smokers were an average of 63 years of age and at participants’ final assessments in the study when smokers were an average of 69 years of age. Furthermore, in exploratory analyses, baseline depressive symptoms were significantly positively related to smoking uptake. In general, the effect sizes across these analyses are meaningful in light of the close link between cigarette smoking and both morbidity and mortality (CDC, 2008).

Consistent with earlier research reporting that a majority of older women smokers were light smokers (Donze et al., 2007), we found that over half of the smokers in the WHI Observational Study were light smokers smoking fewer than 15 cigarettes/day. This result is consistent with research documenting a trend toward light smoking (Burns, Major, & Shanks, 2003; Pierce et al., 2009). The finding of high prevalence of light smoking in middle-aged and older women is important because adult cessation trials tend to exclude light smokers (Fagan & Rigotti, 2009; Shiffman, 2009), and most research on depression and smoking cessation has neglected light smoking (Shiffman, 2009). We found that light smokers had more than two times higher odds of smoking cessation than did heavier smokers, both at one year and at participants’ last assessments. Light smokers in general and light smokers among older women tend to underestimate the health risks of light smoking (Ayanian & Cleary, 1999; Donze et al., 2007), suggesting the importance of educational interventions focused on light smokers.

We found that Black, Native American, and Hispanic women were significantly more likely to be current light smokers compared with White women. This finding is consistent with earlier work indicating that light smoking is particularly common among ethnic minorities (Tong, Nyuden, Vittinghoff, & Perex-Table, 2009; Trinidad et al., 2009). In addition, we found that Black women were less likely to have quit smoking at their last assessments compared with White women, even though Black women were more likely to be light smokers. Although Black women start smoking later than White women (Moon-Howard, 2003), they show lower cessation rates (Geronimus, Neidert, & Bound, 1993; King, Polednak, Bendel, Vilsaint, & Nahata, 2004) compared with White women. Sociodemographic differences may contribute to disparities in smoking cessation in adulthood for Black women (King et al., 2004). Older cohorts of Black women may have received less education regarding the health risks of smoking (Mickens, Ameringer, Brightman, & Leventhal, 2010). Black older light smokers may represent a particularly important target of intervention.

Overall, the findings of the present study highlight the importance of depressive symptoms in smoking in middle-aged and older women. Extending existing literature on depressive symptoms and smoking (Anda et al., 1990, McClave et al., 2009; Niaura et al., 2001), we found that depressive symptoms were related concurrently to more light and heavier smoking as well as to reduced smoking cessation. In addition, we found that
depressive symptoms were positively related to the high-risk situations of smoking uptake and relapse among former smokers. The findings that a majority of smokers in the sample were light smokers and that light smoking was related to depressive symptoms are important and suggest that middle-aged and older women may offer a promising target for smoking cessation interventions.

The present study has several strengths. A central contribution is the analysis of depressive symptoms and smoking in middle-aged and older women, a population that has been neglected in smoking research. Additional strengths are the large representative sample, the longitudinal design, and the availability of well-validated measures of depressive symptoms.

Some limitations should be noted in interpreting these results. The WHI Observational Study measure of smoking relied on self-report, and self-report measures are subject to both social desirability and common method variance. However, several comparisons of self-report with biochemical or cross-informant measures of smoking have found that self-report measures are accurate in most situations, particularly, as in the WHI, in studies of adults who are not in smoking intervention studies (Caraballo, Giovino, Pechacek, & Mowery, 2001; Rebagliato, 2002). Nevertheless, the self-report format may have underestimated true smoking status and overestimated true smoking cessation. In addition, consistent with some other studies (Falba et al., 2004; Godtfredsen et al., 2005, 2006), we used a cutoff of less than 15 cigarettes/day to define light smoking. The WHI Observational Study did not index “less than 10 cigarettes/day” or intermittent daily smoking, both of which have been suggested as alternative operationalizations of light smoking (Husten, 2009). Furthermore, future research might examine the role of depressive symptoms in more subtle aspects of smoking change, such as the transition from heavy to light smoking. Moreover, in the smoking cessation analyses, participants lost to follow-up through either death or failure to respond were treated as missing. An alternative approach would have been to consider these participants as continuing smokers. Finally, because participants in the WHI Observational Study were healthier emotionally and physically than the general population of women in their cohort, the results may not be generalizable to all groups of women. For example, the prevalence of smoking in the WHI Observational Sample was substantially lower than that reported in comparable aged samples of women (e.g., see Langer et al., 2003).

In conclusion, the results of this study indicate that depressive symptoms are important correlates of both light and heavier smoking, maintenance of smoking, and smoking uptake and relapse among former smokers among middle-aged and older women. Efforts to help middle-aged and older women smokers reduce negative mood or enhance skills for coping may offer promising avenues of smoking cessation intervention. Recent reviews conclude that depressed smokers profit by including a focus on mood management along with traditional smoking intervention strategies (Gierisch, Bastian, Calhoun, McDuffie, & Williams, 2010; Ranney, Melvin, Lux, McClain, & Lohr, 2006). More broadly, understanding the relation of depressive symptoms to smoking maintenance and cessation in middle-aged and older women provides an essential foundation for the development of effective interventions to reduce women’s smoking in middle and later adulthood.

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Declaration of Interests
None declared.

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Depressive symptoms and smoking


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