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Original investigation

## Psychological Distress Among Smokers in the United States: 2008–2014

Michael J. Zvolensky PhD<sup>1,2</sup>, Charles Jardin MA, MDiv<sup>1</sup>,  
Melanie M. Wall PhD<sup>3</sup>, Misato Gbedemah MPH<sup>4</sup>, Deborah Hasin PhD<sup>5</sup>,  
Stewart A. Shankman PhD<sup>6</sup>, Matthew W. Gallagher PhD<sup>1</sup>,  
Jafar Bakhshaie MD<sup>1</sup>, Renee D. Goodwin PhD, MPH<sup>4,5</sup>

<sup>1</sup>Department of Psychology, University of Houston, Houston, TX; <sup>2</sup>Department of Behavioral Sciences, University of Texas MD Anderson Cancer Center, Houston, TX; <sup>3</sup>Department of Biostatistics, Mailman School of Public Health, Columbia University, New York, NY; <sup>4</sup>Department of Psychology, Queens College and The Graduate Center, The City University of New York, Queens, NY; <sup>5</sup>Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY; <sup>6</sup>Department of Psychiatry, University of Illinois at Chicago, Chicago, IL

Corresponding Author: Michael Zvolensky, PhD, Department of Psychology, University of Houston, 3695 Cullen Blvd., Room 126, Houston, TX 77204, USA. Telephone: 713-743-8056; Fax: 713-743-8588; E-mail: [mjzvolen@central.uh.edu](mailto:mjzvolen@central.uh.edu)

### Abstract

**Introduction:** Decline in smoking in the United States has slowed over the past 25 years. Mental health problems are common among smokers, and may be an impediment to quitting and remaining abstinent. The study investigated the relationship between serious (past-30-day) psychological distress (SPD) and smoking, estimated trends in the prevalence of SPD among current, former, and never smokers in the United States from 2008 to 2014, and investigated whether heterogeneity in these trends varied by sociodemographic characteristics.

**Methods:** Data were drawn from the National Household Survey on Drug Use (NSDUH), an annual cross-sectional study of persons ages 12 and over ( $N = 270\ 227$ ). SPD and smoking in the past 30 days were examined using logistic regression models among adults 18 and older. The prevalence of SPD was examined annually among current, former, and never smokers from 2008 to 2014.

**Results:** SPD increased among smokers in the United States from 2008 to 2014. An increase in SPD was more rapid among non-daily smokers than daily smokers. The prevalence of SPD was higher among younger smokers, those with less formal education and lower annual family income and higher among current smokers than former and never smokers. The relationships between SPD and smoking were stronger among smokers with higher education levels and annual family income.

**Conclusions:** Our findings suggest an increase in SPD among smokers over time and that as smoking has declined, those with SPD are comprising a greater proportion of the remaining smokers. Results suggest that mental health must be integrated into mainstream tobacco control efforts.

**Implications:** The greater prevalence and increasing rate of Serious Psychological Distress among smokers, relative to former- and never-smokers, from 2008 to 2014 provides support that the greater mental health burden among smokers may be contributing to the slowed reduction in smoking prevalence in the United States. In addition, relationships between SPD and smoking were consistently stronger among smokers with higher levels of education and annual family income. Such results suggest the necessity of incorporating mental health treatments in tobacco use reduction efforts.

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## Introduction

There are currently over 1 billion cigarette smokers worldwide,<sup>1</sup> with 45.3 million smokers residing in the United States.<sup>2</sup> Smoking remains the leading preventable cause of death and disability, accounting annually for 443 000 deaths in the United States,<sup>2</sup> and 6 million deaths worldwide.<sup>3</sup> The impact of smoking in terms of mortality is greater than that collectively caused by human immunodeficiency virus (HIV), illegal drug use, alcohol use, motor vehicle injuries, suicide, and homicide.<sup>2</sup> Despite the impact of smoking on health, prevalence rates for smoking have generally stabilized in the United States. In 2013, 21.3% of the US population smoked cigarettes,<sup>4</sup> a decrease from 22.1% in each of the previous 2 years<sup>5,6</sup> and down from 25.4% in 2003.<sup>4</sup> However, these declines are small relative to those observed prior to 1990.<sup>7</sup> Moreover, while smoking rates have been declining, the total number of smokers has fluctuated between 69.6 million in 2010<sup>8</sup> and 66.9 million in 2013.<sup>4</sup> Similar trends have been observed worldwide. Globally, the number of smokers has increased, yet has not kept pace with general population increases, leading to a decline in the smoking prevalence rate.<sup>9</sup> Overall, the reasons for the slowed rate of decline in smoking prevalence are not fully understood.

Psychological distress is disproportionately common among cigarette smokers, and a link between greater psychological distress and smoking persistence/inability to quit and remain abstinent is well-established.<sup>10</sup> There are several possible explanations for the link between smoking and psychological distress. Both smoking and psychological distress are elevated among specific demographic groups, suggesting they may share common risk factors.<sup>11,12</sup> Alternatively, the self-medication hypothesis suggests psychological distress, such as anxiety and depression, motivates smoking to alleviate negative affect.<sup>13,14</sup> Some evidence also suggests smoking could lead to psychological distress,<sup>15</sup> perhaps via alterations to the hypothalamic–pituitary–adrenal axis that may increase physiological vulnerability to stressors.<sup>16</sup> Indeed, these hypotheses may not be mutually exclusive, as evidence across studies suggests the possibility of bidirectional effects between smoking and psychological distress.<sup>13,14</sup> As such, psychological distress is one possible factor that may be related to the stagnated rates of smoking prevalence. If smokers who can quit have quit, and those with psychological distress have more trouble quitting, then we might expect to see an increase in psychological distress among smokers in recent years. If this is the case, we would expect to see an increase in psychological distress occurring disproportionately among smokers, relative to former and never smokers.

Specifically, numerous population-based studies have reported that adults with psychological distress exhibit less success in quitting and remaining abstinent than those without psychological distress.<sup>10,17–19</sup> The impact of psychological distress on quit success may be a factor contributing to the slowed decline in smoking prevalence in the United States. As the prevalence of smoking decreases, those smokers remaining are more likely to have greater difficulties quitting and maintaining abstinence, and an important factor contributing to such treatment resistance may be greater levels of psychological distress among persistent smokers.<sup>20</sup>

Although promising, past work is limited in several formative ways. First, the extent to which current adult smokers in the United States are affected by psychological distress remains unclear. Specifically, there is a lack of data on the relation between serious (past-month) psychological distress (SPD) and cigarette smoking, as much data report relations between either past year or lifetime mental disorders and current (past-month) smoking. This is a problem as

it is harder to identify a relation between smoking and psychological distress when they are measured with reference to potentially disparate timeframes. Second, there is little information on the prevalence of psychological distress among smokers in the United States over time. As such, it is not yet clear whether or to what degree there have been changes in the prevalence of psychological distress among smokers over time, especially during this past decade of relative stagnation in smoking decline. Increases in the prevalence of psychological distress over time, in parallel with decreases in the number of smokers, would suggest psychological distress may be a maintaining factor for smoking among the remaining more treatment-resistant smokers.<sup>20</sup> Third, there is evidence that smoking and psychological distress covary with numerous sociodemographic factors.<sup>11,12</sup> Thus, it would be highly informative from a public health perspective to explicate the degree to which psychological distress is present among distinct groups of smokers.

In sum, the present study examined the relationship between SPD and cigarette use in the United States, and examined these relations by smoking pattern (ie, daily vs. non-daily smoking) and demographic characteristics. The study also examined changes in prevalence of SPD among smokers over time and by demographics. Consistent with previous work,<sup>20,21</sup> it was hypothesized that the prevalence of SPD among current smokers would increase over the observational time periods, without similar increases among former and never smokers.

## Methods

### Study Population

Study data came from The National Survey on Drug Use and Health (NSDUH), which collects annual cross-sectional national data on the use of tobacco, other substance use, and mental health in the United States.<sup>22</sup> A multistage area probability sample for each of the 50 states and the District of Columbia was conducted, to represent the civilian noninstitutionalized population of the United States aged 12 and older. Data were collected from eligible participants using audio computer-assisted self-interviews. NSDUH respondents received an incentive of \$30. The datasets from each year were concatenated, adding a variable for the survey year. Analyses were restricted to adult participants (ages 18 and older) who responded to questions about past-month serious psychological distress at the time of the interview ( $N = 270\,227$ ) in total. All study protocols for data collection and management have been approved by the relevant institutional review boards. For a full description of the NSDUH study design and execution, see the survey website ([www.oas.samhsa.gov/NSDUH/Methods.cfm](http://www.oas.samhsa.gov/NSDUH/Methods.cfm)).

### Measures

#### Serious (Past-Month) Psychological Distress (SPD)

The psychological distress scale (K6) screening measure for nonspecific psychological distress was used to create past-30-day (ie, past-month) serious psychological distress indicator, and was included in each annual survey.<sup>23</sup> The past-month serious psychological distress was composed of six questions. Adult participants were asked how often they experienced symptoms of psychological distress during the past 30 days. These six questions include the following symptoms of distress: feeling nervous, feeling hopeless, feeling restless or fidgety, feeling so sad or depressed that nothing could cheer you up, feeling that everything was an effort, and feeling down on yourself, no good, or worthless. Response options were 4 = “all of the time,”

3 = “most of the time,” 2 = “some of the time,” 1 = “a little of the time,” and 0 = “none of the time,” along with responses matching “Don’t know,” refusals, bad data, blanks, and legitimate skips. Items were summed across the six items to calculate a total score for past-month serious psychological distress. Participants with 13 or greater score were classified with having past-month serious psychological distress.<sup>24</sup> The K6 has demonstrated strong sensitivity and specificity in detecting adults with DSM-IV diagnoses (excluding substance use disorders).<sup>24</sup>

### Smoking

Cigarette use was assessed by the questions, (1) “Have you ever smoked part or all of a cigarette?,” (2) “Have you smoked at least 100 cigarettes in your entire life?,” and (3) “During the past 30 days, have you smoked part or all of a cigarette?” and “How long has it been since you last smoked part or all of a cigarette?”. Participants who responded “yes” to the first two questions, and answered “Within the past 30 days” to the last question were classified as current smoker. Among current smokers, those who answered “30 days” to the question, “During the past 30 days, that is since [DATEFILL], on how many days did you smoke part or all of a cigarette?” were classified as current daily smoker and those who responded to “1–29 days” to the last question were classified as current non-daily smoker. Those who responded “Yes” to the first two questions and answered “More than 12 months ago but within the past 3 years” or “More than 3 years ago” to the third question were classified as former smoker. Participants who responded to “no” to the second question, and answered “More than 30 days ago but within the past 12 months,” “More than 12 months ago but within the past 3 years” or “More than 3 years ago” to the third question were classified as never smoker.

### Demographic Characteristics

Demographic variables were categorized as follows: age (18–25 years old as reference group, 26–34 years old, 35–49 years old, 50 years or older), gender (male as reference group, female), race/ethnicity variable in seven categories was collapsed into four categories for analyses: (non-Hispanic white as reference group, non-Hispanic black, Hispanic, others), total annual family income (less than \$20 000 as reference group, \$20 000–\$49 999, \$50 000–\$74 999, \$75 000 or more), education (less than high school as reference group, high school graduate, some college, college graduate) and marital status variable in four categories was collapsed into three categories for analyses: (married as reference; widowed, separated or divorced; never married).

### Statistical Analysis

Using data from 2008 to 2014, logistic regressions tested the association between smoking status (current smoking vs. former smoking, current smoking vs. never smoking) and past-month SPD overall and separately by each level of each demographic variable, controlling for all other demographic and smoking variables. Adjusted prevalence of past-month serious SPD from 2008 to 2014 was calculated from the logistic regression using the average marginal prediction approach,<sup>25</sup> by smoking status and each demographic characteristic (ie, age, gender, race, total annual family income, education, marital status). Differential associations were tested with additional logistic regression models including 2-way interactions between smoking status and each demographic variable. All models were mutually adjusted for all other demographic variables.

Second, the prevalence of past-month SPD and associated standard errors among the whole population and stratified by smoking status were calculated for each year from 2008 to 2014. Time trends in the prevalence of past-month SPD stratified by smoking status were tested using logistic regression with continuous year as the predictor for the linear time trend. These analyses were conducted twice: first with no covariates (unadjusted) and then while adjusting for age, gender, race, total annual family income, education, and marital status using the categories listed above. To determine whether there were differential time trends in past-month SPD by smoking status, additional logistic regressions were run that included the 2-way interaction of year by smoking status (current vs. former smokers; current vs. never smokers).

Third, separate time trend analyses using logistic regression described above were conducted that were further stratified by total annual family income. A logistic regression of past-month SPD found the 3-way interaction of year by smoking status by total annual family income to be significant, so the models examining total annual family income were stratified by smoking status. Time trends in the prevalence of past-month SPD by smoking status group within each demographic variable were tested using logistic regression with continuous year as the predictor to test the linear time trend. These analyses were conducted twice: once with no covariates (unadjusted model) and once controlling for the other demographic variables (adjusted model). Differential time trends in past-month SPD between smoking status were tested by 2-way interactions of year by smoking status (current vs. former smokers; current vs. never smokers) in logistic regressions stratified by total annual family income variable category.

Fourth, all analyses were rerun on past-month SPD among current daily and non-daily smokers. All analyses were carried out using SUDAAN 11.0.1 and adjusting for complex sampling ([www.rti.org/sudaan/](http://www.rti.org/sudaan/)).

## Results

### Serious Psychological Distress and Smoking

SPD was significantly more common among current smokers, compared with former (7.6% vs. 3.6%, AOR = 2.22 [2.0, 2.5]) and never smokers (7.6% vs. 3.7%, AOR = 2.1 [2.0, 2.3] See Supplementary Table 1). These associations remained significant after adjusting for demographics.

### Serious Psychological Distress and Smoking, by Demographics

SPD was significantly more common among smokers, compared with former and never smokers in all age groups; the strength of the relationship between SPD and smoking was the strongest among 18–25 year olds where 12.3% of current smokers reported SPD versus 7.5% of former smokers and 3.2% of never smokers. The relationship between SPD and smoking compared with that among former smokers was significantly stronger in this younger age group, relative to those 50 and older, and marginally stronger than those 35–49.

SPD was significantly associated with smoking, compared with former and never smokers, among both males and females. The relationship between SPD and current smoking, compared with never smoking, was significantly stronger among females compared with males ( $p_{int} = .015$ ).

The relationship between SPD and smoking, compared with never smoking, was significant in all race/ethnicity groups; and this link was significantly stronger among non-Hispanic white adults, compared with non-Hispanic black and other/mixed race. The relationship between SPD and smoking, compared with former smoking, was also significant in all groups and strongest among Hispanic adults; this relationship was significantly stronger than that among non-Hispanic white adults.

The relationships between SPD and smoking, compared with former and never smoking, were significant among all income, education and marital status groups. The strength of these relationships was fairly consistent within various groups with few exceptions. Specifically, the relationship between SPD and smoking was significantly stronger among those with the highest income, versus lowest income, ( $p_{\text{int}} = .014$ ), yet the prevalence of SPD was more than 4 times higher among smokers of low versus high income (eg, 14.7% vs. 4.1%). The lower income group had substantially higher prevalence of SPD, but the relationship between SPD and smoking was stronger in the higher income group see Supplementary Table 2.

Similarly, the relationship between SPD and smoking, compared with former smoking, was significantly stronger in the two highest education groups (ie, some college, college graduate) versus the lowest income group (ie, less than high school education;  $p_{\text{int}} = .029$ ;  $p_{\text{int}} = .025$ , respectively). Yet, the prevalence of SPD was nearly 3 times higher among those without a high school education, compared with college graduates.

The relationship between SPD and smoking (vs. former and never smoking) was stronger among married compared with never married adults ( $p_{\text{int}} = .005$ ;  $p_{\text{int}} = .0001$ ), though the prevalence of SPD was twice as high among never married, compared with married, adults.

### Serious Psychological Distress Among Smokers: 2008–2014

Time trend analyses revealed a small but significant increase in SPD among current smokers from 2008 to 2014 (AOR = 1.02 [1.01, 1.03];  $p = .0074$ ), which persisted after adjusting for demographics (Table 1). There was no change in the prevalence of SPD among former or never smokers over this time period. The trend in SPD among smokers was significantly different compared with that among never smokers (Wald  $F[1] = 0.00$ ,  $p = .0380$ ; Figure 1).

### Serious Psychological Distress Among Daily and Non-Daily Smokers

We examined trends in SPD among daily and non-daily smokers from 2008 to 2014 to estimate whether these trends differed substantially by frequency of smoking (Table 2). Results suggest that there was a significant increase in SPD over this period for both daily and non-daily smokers, and that the rate of increase appears more rapid in non-daily smokers, compared with daily smokers (Wald  $F[1] = 3.30$ ,  $p = .0722$ ) for adjusted models (Figure 2).

### Discussion

The present investigation sought to examine the prevalence of SPD among smokers across demographic groups and to address whether the prevalence of SPD among smokers has changed between 2008 and 2014, and if so, among whom this change has occurred. Results indicate a significant increase in SPD among current smokers over the observed time period. No significant change in SPD was observed among former and nonsmokers over the same period. During that time, the prevalence of SPD was consistently higher among smokers who were younger, had less formal education and had lower annual family income. Further, the present results suggest that the

**Table 1.** Prevalence of SPD Among Current, Former, and Never Smokers From 2008 to 2014 (NSDUH, Age  $\geq 18$ )

Smoking status	Total	2008	2009	2010	2011	2012	2013	2014	Linear trend			
	Prevalence of acute SPD among current, former and never smokers (unweighted $n$ , weighted %, weighted s.e.)								Unadjusted OR <sup>a</sup> (95%CI)	$t$ -test ( $p$ )	Adjusted OR <sup>ab</sup> (95%CI)	$t$ -test ( $p$ )
<b>With having acute SPD</b>												
Total $n$	17 879	2407	2527	2504	2569	2647	2606	2619	1.01 (1.00, 1.03)	$t = 1.89$ (.0613)	1.02 (1.01, 1.03)	$t = 2.73$ (.0074)
%	4.9	4.78	4.73	4.82	4.74	5.17	5.1	4.97				
s.e.	0.06	0.16	0.13	0.18	0.13	0.17	0.2	0.14				
Current smoker ( $n$ )	7829	1066	1182	1137	1094	1171	1110	1069	1.04 (1.02, 1.06)	$t = 4.28$ (.0000)	1.04 (1.02, 1.06)	$t = 4.22$ (.0001)
%	9.4	8.69	8.99	8.64	9.1	9.92	10.34	10.17				
s.e.	0.17	0.5	0.37	0.43	0.4	0.36	0.54	0.37				
Former smoker ( $n$ )	1136	135	160	152	156	162	158	213	1.03 (0.98, 1.09)	$t = 1.14$ (.2571)	1.04 (0.98, 1.09)	$t = 1.22$ (.2236)
%	2.8	2.32	2.89	2.97	2.62	2.66	3.03	3.13				
s.e.	0.12	0.3	0.35	0.38	0.28	0.34	0.4	0.32				
Never smoker ( $n$ )	7450	1007	988	1003	1081	1091	1134	1146	1.02 (1.00, 1.05)	$t = 1.96$ (.0523)	1.01 (0.98, 1.03)	$t = 0.55$ (.5803)
%	3.65	3.79	3.34	3.67	3.54	4	3.71	3.52				
s.e.	0.08	0.23	0.17	0.21	0.19	0.23	0.24	0.15				
<b>Differential time trend</b>									Unadjusted Wald $F(p)$		Adjusted Wald $F(p)$	
Differential time trend: year as continuous $\times$ smoking (current daily vs. former smoker)									Wald $F(1) = 0.02(.9023)$		Wald $F(1) = 0.00(.9465)$	
Differential time trend: year as continuous $\times$ smoking (current daily vs. never smoker)									Wald $F(1) = 5.57(.0201)$		Wald $F(1) = 0.00(.0380)$	

CI = confidence interval; NSDUH = National Survey on Drug Use and Health; OR = odds ratio; SPD = serious psychological distress.

<sup>a</sup>Odds ratios are for having SPD vs. not.

<sup>b</sup>Adjusted for age (18–25, 26–34, 35–49,  $\geq 50$ ); gender (male, female); total annual family income ( $\leq$  \$20K, \$20–49 999, \$50–74 999K,  $\geq$  \$75K); race (non-Hispanic white, non-Hispanic black, Hispanic, other), education (less than HS, HS graduate, some college, college graduate), marital status (married, widowed, separated or divorced, never married).



prevalence of psychological distress has increased more rapidly among non-daily smokers, compared with daily smokers, though the increase has been significant in both groups.

The greater prevalence of SPD among smokers, relative to former- and never-smokers, and the increasing rate of SPD among smokers, but not former- or never-smokers, from 2008 to 2014 provides further support that the greater mental health burden among smokers may be contributing to the slowed reduction in smoking prevalence in the United States. Notably, the disparity in SPD prevalence among current smokers relative to former- and never-smokers was also observed within each of the demographic groups examined. The disparity between current and former smokers is particularly suggestive of how SPD may serve as a substantial barrier to sustaining smoking cessation (ie, 12 months or more—this study’s definition of a “former smoker”). Levels of SPD among former smokers were similar to those among never smokers (Figure 1). Moreover, the prevalence of SPD among former smokers remained effectively unchanged from 2008 to 2014. There are at least two potential explanations for this, which may not be mutually exclusive. First, it may be that adults most likely to transition from being current- to former-smokers are less likely to suffer from SPD. Under this explanation, SPD serves as a considerable barrier to successfully

quitting smoking. Alternatively, the reduced rates of SPD among former smokers may suggest smoking cigarettes played a role in sustaining SPD and the greater likelihood for the remission of psychological distress following a successful quit attempt. While it is known that smoking often serves an affect regulatory role,<sup>26</sup> work is still ongoing to decipher the direction of causation between SPD and smoking.<sup>14</sup> It may be that the true effects are bidirectional, such that SPD exacerbates smoking, and smoking exacerbates SPD.<sup>13</sup> At the least, the present results support previous work highlighting the relation between smoking status and SPD.<sup>10–12,17,18,22,27,28</sup> Future work is needed to explore the mechanisms underlying these associations, including neurobiological, social contextual, and emotion regulatory processes.<sup>13,29,30</sup>

Interestingly, the present data demonstrated a greater increase in SPD among non-daily smokers compared with daily smokers over the time period observed. By 2014, the rates of SPD among daily and non-daily smokers were nearly equivalent. Increasing rates of SPD among non-daily smokers may provide one explanation for difficulties with smoking cessation reported by such smokers, as the mechanisms underlying such difficulties with cessation may differ between daily and non-daily smokers.<sup>31</sup> Indeed, non-daily smokers may provide a unique insight into the role SPD has in smoking cessation difficulties, as smoking rate and nicotine dependence—known barriers to smoking cessation—are characteristically lower in this group relative to daily smokers.<sup>32</sup> Future work is needed to understand how the observed increase in SPD among non-daily smokers may impact smoking cessation attempts within this group. As some work suggests non-daily smokers may be more likely to use other tobacco products in addition to cigarettes,<sup>32</sup> future work is needed to clarify whether the relation between SPD and use of other tobacco products may explain the near equivalence of SPD among daily and non-daily smokers observed in the present study. Furthermore, a moderated mediation approach may be useful in clarifying the mechanisms underlying the interplay of SPD and smoking among daily and non-daily smokers.<sup>31</sup>

Notably, the present data suggest that SPD may be particularly common among certain subgroups of smokers. The relation of SPD

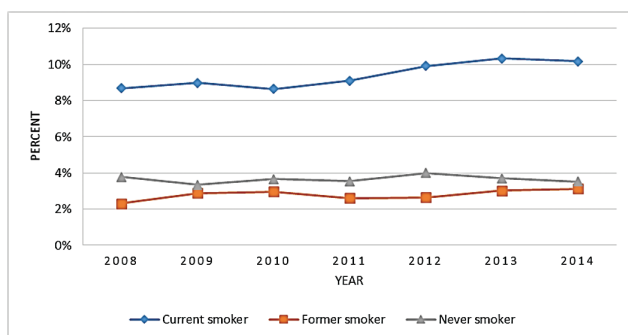


Figure 1. Acute psychological distress among smokers, former smokers, and never smokers: 2008–2014.

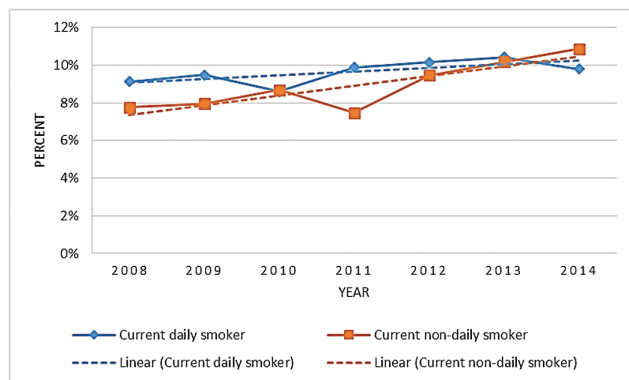
Table 2. Prevalence of Acute SPD Among Current Daily and Non-Daily Smokers From 2008 to 2014 (NSDUH, Age ≥18)

Smoking status	Total	Prevalence of acute SPD among current daily and non-daily smokers (unweighted n, weighted %, weighted s.e.)							Linear trend			
		2008	2009	2010	2011	2012	2013	2014	Unadjusted OR <sup>a</sup> (95%CI)	t-test (p)	Adjusted OR <sup>ab</sup> (95%CI)	t-test (p)
With having acute SPD												
Current daily smoker (n)	5307	743	823	765	765	805	731	675	1.02 (1.00, 1.05)	t = 2.03 (.0444)	1.02 (1.00, 1.05)	t = 2.22 (.0287)
%	9.63	9.12	9.48	8.61	9.89	10.15	10.43	9.8				
s.e.	0.21	0.61	0.5	0.47	0.56	0.52	0.59	0.46				
Current non-daily smoker (n)	2522	323	359	372	329	366	379	394	1.07 (1.03, 1.10)	t = 3.75 (.0003)	1.07 (1.03, 1.10)	t = 3.64 (.0004)
%	8.93	7.77	7.96	8.68	7.46	9.46	10.18	10.86				
s.e.	0.24	0.67	0.58	0.73	0.53	0.82	0.97	0.73				
Differential time trend									Unadjusted Wald F(p)		Adjusted Wald F(p)	
Current daily vs. non-daily smoker									Wald F(1) = 3.91(.0504)		Wald F(1) = 3.30(.0722)	

CI = confidence interval; NSDUH = National Survey on Drug Use and Health; OR = odds ratio; SPD = serious psychological distress.

<sup>a</sup>Odds ratios are for having SPD vs. not.

<sup>b</sup>Adjusted for age (18–25, 26–34, 35–49, ≥50); gender (male, female); total annual family income (≤ \$20K, \$20–49 999, \$50–74 999K, ≥\$75K); race (non-Hispanic white, non-Hispanic black, Hispanic, other), education (less than HS, HS graduate, some college, college graduate), and marital status (married, widowed, separated or divorced, never married).



**Figure 2.** Acute psychological distress among daily and non-daily smokers: 2008–2014.

with smoking status was generally stronger among non-Hispanic whites and those with greater income and education. Yet, the prevalence of SPD was consistently greater among the more systemically disadvantaged groups, such as racial/ethnic minorities and adults with less income and education. Thus, as would be expected, while SPD serves as one of only a few predictors of smoking (ie, among the more advantaged demographic groups), its effect on smoking is observed to be strongest. However, when accompanied by an increasing number of aversive experiences (eg, economic stress), SPD remains a risk factor for smoking, albeit with diminished effects in the presence of other such risk factors. Similarly, the relation of SPD with smoking status was stronger among older adults, but as observed in the general population,<sup>11</sup> the prevalence of SPD was greater among younger adult smokers. While the prevalence of SPD may decline over time, its relative effect on smoking status may increase with age. For gender, the strongest relationship between SPD and smoking was observed among women, who also reported a greater prevalence of SPD across smoking status groups.<sup>11</sup> The high SPD among women who smoke may contribute in part to the greater difficulty women experience in quitting smoking relative to males.<sup>33,34</sup>

Despite the differential rates of SPD observed across demographic groups of smokers, rates of SPD were univocally elevated among smokers compared with former- and never-smokers regardless of demographic membership. Although these data collectively provide novel empirical insight into the subgroups of smokers for the greatest elevations in SPD, again, mechanistic work is needed to understand the reasons that these subgroups are the most psychologically vulnerable. For example, compensatory changes in neurophysiology or emotion regulatory styles (eg, coping-motivated use) associated with smoking may be related to increased risk of psychological distress, especially among younger persons wherein brain development is in more active phase.<sup>35,36</sup> Additionally, examining additional variables, such as discrimination and access to smoking cessation treatments, may further identify the constellation of risk factors that may mediate the contribution of SPD to stagnant smoking prevalence, particularly among ethnic minority and low-income smokers.

The present study has several limitations. First, causal inferences cannot be drawn from these observational data. Future work is needed that examines the relation of smoking status with psychological distress by following the same participants over time to make conclusions about causation. Second, the study employed self-report measures and therefore method variance or reporting biases (eg, retrospective recall biases) may have played a role in the observed

relations. Third, we could not discern the exact chronology of some theoretically and clinically-relevant events (eg, exact dates of onset of psychological distress). Therefore, it was not possible to determine whether the initiation of smoking or the onset of psychological distress occurred first. Future work is needed to determine the chronological relations of these variables.

Overall, the current data highlight the persistently high and, most importantly, increasing level of psychological distress among smokers in the United States. These data add to a growing literature suggesting it may be advisable to address psychological distress to reduce the prevalence of smoking and highlight that the relative risk is more evident among certain segments of the population.

## Supplementary Material

Supplementary data are available at *Nicotine & Tobacco Research* online.

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## Declaration of Interests

None declared.

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