Original investigation

Depression Among Non-Daily Smokers Compared to Daily Smokers and Never-Smokers in the United States: An Emerging Problem

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Abstract

Introduction: Depression is strongly associated with daily smoking. Yet, little is known about the association between depression and non-daily smoking. The aim of this study was to investigate the prevalence of past-year depression and changes in past-year depression over time among non-daily smokers, compared to daily smokers and never-smokers, overall and stratified by age, gender, income, nicotine dependence, and cigarettes per day.

Methods: Data were drawn from the National Household Survey on Drug Use (NSDUH), an annual cross-sectional study of persons aged 12 and over (total study population $N = 496\ 805$). The prevalence of past-year depression was examined annually among non-daily smokers, daily smokers, and never-smokers from 2005 to 2013 using linear trend analyses.

Results: Past-year depression was common among 10.10% of non-daily smokers, common among 10.78% of daily smokers, and 5.51% of never-smokers in 2013. The prevalence of depression increased from 2005 to 2013 among non-daily smokers (9.06% vs. 10.10%; $p = .034$) while there was no significant change in depression over time among daily smokers. Increases in depression among non-daily smokers occurred for both men and women and appear most pronounced youth, those smoking fewer cigarettes, and those without nicotine dependence.

Conclusions: The prevalence of depression among non-daily smokers was equivalent to daily smokers and nearly twice that among nonsmokers. Depression appears to be increasing over time in non-daily smokers especially among youth, those who smoke less, and those without nicotine dependence. More work on the mental health of non-daily smokers is needed as this is an increasing and understudied group.

Implications: This is the first study to investigate changes in the prevalence of depression among non-daily smokers compared to daily smokers and never-smokers over the past decade in a nationally representative sample of the United States. The results suggest an increase in depression among non-daily smokers over time that did not similarly occur for daily smokers. Further, there were several subgroups of non-daily smokers among whom depression has increased more rapidly. This study suggests the need for more information about the relationship between depression and non-daily smoking including the impact of depression on quit attempts and outcomes.

Introduction

While daily smoking continues to decline in the United States, the decline in non-daily smoking, in comparison, may be considerably slower.[1] As various tobacco control efforts have successfully exerted pressure to reduce smoking over the past decade,[2,3] non-daily smokers comprise an increasing proportion of smokers.[4–7] Further, a significant number of non-daily smokers transition to daily smoking over time.[8–10] Non-daily smoking is associated with significant negative health consequences[11] and the greatest health benefits appear to come from quitting completely.[12–15] At this time, little is known about how non-daily smokers differ from daily smokers in terms of characteristics implicated in smoking persistence.

Major depression is the most common psychiatric disorder in the United States.[16,17] Numerous studies have documented relationships between major depression and lifetime and current smoking,[18–20] daily smoking,[21–23] and nicotine dependence.[18,22–25] In addition, studies suggest that depression is a barrier to successful smoking cessation[26] and increases vulnerability to smoking relapse.[27,28] Despite the well-known association between depression and daily smoking, few studies have examined depression and non-daily smoking.

The few studies that have investigated depression and non-daily versus daily smoking examined a range of samples and measures of depression and report mixed findings. A cross-sectional study of US persons aged 12 and older reported that a past-year major depressive episode was not associated with smoking frequency (daily vs. non-daily; odds ratio [OR] = 1.14, 95% CI = 0.92–1.42)[29] whereas a second cross-sectional study of US persons found no difference in the report of past-month "sad symptoms" in daily versus non-daily smokers (*p* = .33).[30] In one study of college students, daily and non-daily smokers reported similar average numbers of past-two week depression symptoms (daily smokers *M* = 1.50, *SD* = 1.47; non-daily smokers who were former daily smokers *M* = 1.45, *SD* = 1.38; non-daily smokers who were never daily smokers *M* = 1.44, *SD* = 1.36)[31] while a similar proportion of daily and non-daily smokers reported past-two week depression symptoms in a second study of college students (51.9% vs. 52.1%, *p* = .94).[32] Conversely, a cross-sectional study of Air Force recruits found that more non-daily smokers than daily light smokers reported feeling "sad and blue most of the time" (7% vs. 5%, χ²(2) = 8.97, *p* < .01).[33] Although daily smokers are more likely to report depression than nonsmokers, it is less clear whether non-daily smokers are also more likely to report depression than nonsmokers. In addition, no study has examined time trends in depression in non-daily smokers compared to daily or nonsmokers. This information is critical as an increasing prevalence of depression among non-daily smokers could be informative regarding the maintenance and relapse of smoking among this population. Further, a number of demographics are known to vary by depression and smoking status (eg, gender and income).[4,34] To our knowledge, no prior studies have examined the association between depression and non-daily smoking by these demographic subgroups.

The current study used data from repeated annual cross-sectional surveys conducted from 2005 to 2013 in the US population to examine two primary aims. First, the study analyzed the most recent data (from 2013) to investigate the cross-sectional relationship between depression and non-daily smoking compared with daily smoking and nonsmoking overall and by age, gender, income, nicotine dependence, and cigarettes per day (CPD). Second, the study investigated trends in the prevalence of past-year depression from 2005 to 2013 among non-daily smokers compared with daily smokers and lifetime never-smokers overall and stratified by age, gender, income, nicotine dependence, and CPD.

Methods

Study Population

Study data were drawn from The National Survey on Drug Use and Health (NSDUH) public data portal (www.icpsr.umich.edu/) for the years 2005–2013. The NSDUH provides annual cross-sectional national data on the use of tobacco, other substance use, and mental health in the United States and is described in depth elsewhere.[35] Data were collected using audio computer-assigned self-interviewing. A multistage area probability sample for each of the 50 states and the District of Columbia was conducted to represent the male and female civilian non-institutionalized population of the United States aged 12 and older. The datasets from each year were concatenated, adding a variable for the survey year. Analyses were restricted to participants who responded to questions about past-year depression at the time of the interview (*N* = 496 805). Five thousand one hundred and forty six respondents were excluded due to non-response to questions about past-year depression (see Supplementary Table 1 for demographics by smoking status for excluded respondents).

Measures

Past-Year Depression

Depression modules that assessed the DSM-VI[36] criteria for past-year major depressive episode were included in each annual survey. Questions were adapted from the depression section of the National Comorbidity Survey-Replication (NCS-R).[37] Due to additional questions about mental health in 2008 and 2009, a statistical adjustment was applied for depression in the years 2005–2008. This statistical adjustment allowed for comparison across all years (NSDUH, 2013 Codebook: Appendix E at www.icpsr.umich.edu/icpsrweb/ICPSR/studies/35509). The past-year major depressive episode variables were created by combining the youth and adults variables for this study.

Cigarette Use

Frequency of cigarette use was assessed at each wave of data collection by the following questions: (1) "Have you ever smoked part or all of a cigarette?," (2) "During the past 30 days, have you smoked

part or all of a cigarette?," and (3) "During the past 30 days, on how many days did you smoke part or all of a cigarette?" Respondents who responded "yes" to the first two questions and answered "30 days" to the third question were classified as past-month daily smokers. Respondents who responded "yes" to the first two questions and answered "1–29 days" to the third question were classified as past-month non-daily smokers. Respondents who responded to "no" to the first question were classified as lifetime never-smokers. Respondents who stated that they had smoked a cigarette in their lifetime but did not smoke a cigarette in the past 30 days (eg, former smokers) were excluded from the analyses.

Cigarettes Per Day

The average number of cigarettes smoked on days in the past month when respondents smoked cigarettes was calculated for both daily and non-daily smokers using the following query: "On the number of days you smoked cigarettes during the past 30 days, how many cigarettes did you smoke per day, on average?" Responses were recoded into three categories; those who smoked (1) 1–5 CPD (ie, a quarter of a pack or less), (2) 6–15 CPD (ie, about half a pack), and (3) 16 or more CPD (ie, a pack or more).

Demographic Characteristics

Demographic variables were categorized as follows: age (12–17 years old as reference group, 18–25, and ≥26), gender (male as reference group, female), and total annual family income (less than $20 000 as reference group, $20 000–$74 999, $75 000 or more).

Nicotine Dependence

Those participants reporting having smoked in the past 30 days were asked the time to smoking the first cigarette after waking in the morning.[38] Smoking within 30 minutes of waking (yes, no) was used as a proxy for nicotine dependence in each annual survey. Those smoking within 30 minutes of waking were categorized as being positive for nicotine dependence and those not smoking within 30 minutes of waking were categorized as negative for nicotine dependence. We used time to first cigarette as the indicator of nicotine dependence as studies have shown that much of the predictive value of the Fagerström Test for Nicotine Dependence[39] can be attributed to the time to first cigarette item and that this item has greater validity than any other single measure.[40]

Statistical Analysis

First, the prevalence of past-year depression in 2013 was calculated by smoking status and stratified by each demographic characteristic (ie, age, gender, total annual family income, nicotine dependence, and CPD). Logistic regressions tested the association between smoking status (non-daily smoking vs. lifetime never smoking; non-daily smoking vs. daily smoking) and past-year depression separately by each level of each demographic variable, nicotine dependence, and CPD using data from 2013 controlling for all other demographic and smoking variables. Differential association was tested with additional logistic regression models fit including 2-way interactions between smoking status and each demographic variable, nicotine dependence or CPD. All models were mutually adjusted for all other demographic and smoking variables.

Second, the prevalence of past-year depression and associated standard errors among the whole population and stratified by smoking status were calculated for each year from 2005 to 2013.

Time trends in the prevalence of past-year depression 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, total annual family income, nicotine dependence, and CPD using the categories listed above. To determine whether there were differential time trends in past-year depression by smoking status, additional logistic regressions were run that included the 2-way interaction of year × smoking status (non-daily vs. daily smokers; non-daily vs. lifetime never-smokers).

Third, separate time trend analyses using logistic regression described above were conducted further stratified by either age, gender, total annual family income, nicotine dependence, or CPD. Time trends in the prevalence of past-year depression by smoking status group within each demographic, nicotine dependence, and CPD 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, nicotine dependence, and CPD (adjusted model). Differential time trends in past-year depression between smoking statuses were tested by 2-way interactions of year × smoking status (non-daily vs. daily smokers; non-daily vs. lifetime never-smokers) in logistic regressions stratified by each demographic, nicotine dependence, and CPD variable category. All analyses were carried out using SUDAAN 11.0.1 and adjusting for complex sampling (www.rti.org/sudaan/).

Results

Depression Among Non-Daily Smokers, Daily Smokers, and Never-Smokers: 2013

In 2013, among US persons aged 12 and older, 10.10% non-daily smokers met criteria for past-year depression compared to 5.51% of lifetime never-smokers (χ^2 = 31.76, df = 1, p < .0001). The prevalence of past-year depression among non-daily smokers and daily smokers (10.78%) did not differ (χ^2 = .5897, df = 1, p = .446; see data from the first row of Table 1).

Depression Among Non-Daily Smokers Compared With Lifetime Never-Smokers by Age, Gender, and Income: 2013

Differences in the association between non-daily smoking, versus never smoking, and past-year depression in 2013 were observed by age and income, but not by gender or dependence (see Table 1). With regard to age, the prevalence of depression was higher in non-daily smokers than never-smokers for all three age groups. Notably, among youth ages 12–17, non-daily smoking was associated with a threefold increased likelihood of reporting past-year depression (adjusted OR = 3.54; 95% CI = 2.63–4.77; p < .0001) compared with lifetime never smoking. The association between non-daily smoking and depression among 12–17 year olds was significantly stronger compared to those ages 18–25 (adjusted OR = 1.92; 95% CI = 1.54–2.40; p < .0001; p-value for interaction [p_{int}] = .002) but not compared to those 26 years and older (adjusted OR = 2.05; 95% CI = 1.42–2.96; p < .001; p_{int} = .314). In terms of total family annual income, the prevalence of past-year depression was greater for non-daily smokers (compared to never-smokers) in all three income groups with stronger relationship for the highest total annual family income level relative to the lowest level (adjusted OR = 3.06; 95%

Table 1. The Association of Past-Year Depression With Smoking Status by Demographic Characteristics (NSDUH, 2013, US Persons Aged 12 Years and Older)

Characteristic	Unadjusted prevalence of depression			Non-daily vs. Lifetime never-smoker	*p*, test for multiplicative interaction	Non-daily vs. Daily smoker	*p*, test for multiplicative interaction
	Non-daily smoker	Daily smoker	Lifetime never-smoker				
	%(SE)	%(SE)	%(SE)	AOR[a](95%CI; *p*)	p_{int}[b]	AOR[c](95%CI; *p*)	p_{int}[b]
Overall	10.10(0.72)	10.78(0.59)	5.51(0.28)	**2.22(1.77, 2.78; *p* < .0001)**		**1.29(1.01, 1.65; *p* = .0402)**	
Age							
12–17 years old	22.69(2.26)	18.92(3.81)	8.86(0.36)	**3.54(2.63, 4.77; *p* < .0001)**	Ref.	0.74(0.39, 1.38; *p* = .3353)	Ref.
18–25 years old	10.83(0.86)	11.11(0.79)	7.01(0.32)	**1.92(1.54, 2.40; *p* < .0001)**	.00203	1.08(0.72, 1.63; *p* = .6928)	.45653
≥26 years old	8.92(0.95)	10.65(0.67)	4.09(0.42)	**2.05(1.42, 2.96; *p* = .0002)**	.31388	1.32(0.98, 1.78; *p* = .0708)	.22307
Gender							
Male	6.87(0.82)	8.74(0.91)	3.88(0.41)	**1.53(1.04, 2.23; *p* = .0301)**	Ref.	0.79(0.46, 1.36; *p* = .3900)	Ref.
Female	14.48(1.32)	12.99(1.01)	6.73(0.38)	**2.80(2.22, 3.54; *p* < .0001)**	.34216	1.28(0.82, 1.99; *p* = .2749)	.10763
Total annual family income							
<$20 000	9.44(1.27)	15.00(1.10)	7.10(0.78)	**1.80(1.34, 2.42; *p* = .0002)**	Ref.	0.79(0.46, 1.33; *p* = .3663)	Ref.
$20 000–$74 999	10.56(1.17)	9.96(0.88)	5.52(0.39)	**2.36(1.72, 3.24; *p* < .0001)**	.07249	1.02(0.56, 1.86; *p* = .9477)	.02086
≥$75 000	9.94(1.31)	7.23(1.01)	4.61(0.36)	**3.06(2.23, 4.22; *p* < .0001)**	.03773	**1.93(1.19, 3.14; *p* = .0088)**	.00317
Nicotine dependence							
Yes	11.46(1.81)	12.90(0.82)	N/A	N/A	N/A	0.84(0.50, 1.41; *p* = .5051)	Ref.
No	9.71(0.72)	6.87(0.76)	N/A	N/A	N/A	1.18(0.74, 1.89; *p* = .4893)	.01328
Cigarettes per day							
1–5 cigarettes	9.54(0.79)	7.54(0.95)	N/A	N/A	N/A	0.94(0.61, 1.45; *p* = .7749)	.12254
6–15 cigarettes	13.00(2.28)	10.39(0.94)	N/A	N/A	N/A	1.58(0.95, 2.64; *p* = .0776)	.08457
≥16 cigarettes	9.96(2.34)	12.67(1.07)	N/A	N/A	N/A	0.79(0.30, 2.03; *p* = .6125)	Ref.

AOR = adjusted odds ratio; CI = confidence interval; NSDUH = National Survey on Drug Use and Health; SE = standard error; US = United States. Odds ratios compare past year depression versus no past-year depression. Bold signifies *p* < .05.

[a]Adjusted for age, gender, and total annual family income.

[b]p_{int}, *p*-value from *t* test for product term beta = 0; test for multiplicative interaction.

[c]Adjusted for age, gender, total annual family income, nicotine dependence, and cigarettes per day.

CI = 2.23–4.22; p < .0001; p_{int} = .038). The prevalence of past-year depression was greater for male and female non-daily smokers compared to never-smokers and this association did not differ significantly for women compared to men (women adjusted OR = 2.80; 95% CI = 2.22–3.54; p < .0001; men adjusted OR = 1.53; 95% CI = 1.04–2.23; p = .030; p_{int} = .342).

Depression Among Non-Daily Smokers Compared With Daily Smokers by Age, Gender, Income, Nicotine Dependence, and CPD: 2013

There were no differences in the relationship between non-daily smoking and past-year depression, compared with daily smoking, by age, gender, or CPD (see Table 1). In terms of total annual family income, the relationship between non-daily smoking and past-year depression, compared with daily smoking, was stronger among higher income groups than the lowest income group and for those without nicotine dependence relative to those with nicotine dependence (see Table 1).

Trends in the Prevalence of Depression Among Non-Daily Smokers: 2005–2013

From 2005 to 2013, the prevalence of past-year depression increased significantly among non-daily smokers (9.06%–10.10%, adjusted OR model = 1.02; 95% CI = 1.01–1.03; t test = 2.17; p = .034; see Table 2). This trend remained significant after adjusting for demographics, nicotine dependence, and CPD (adjusted OR model = 1.03; 95% CI = 1.01–1.04; t test = 3.27; p = .002). In addition, the prevalence of past-year depression increased significantly among lifetime never-smokers as did the prevalence of depression overall in the general population (6.62%–7.16%, adjusted OR model = 1.01; 95% CI = 1.00–1.03; t test = 2.20; p = .032) while there was no significant change in past-year depression among daily smokers over this time period. The linear trends between non-daily and daily smokers did not significantly differ (interaction year × smoking status, p-value for differential time trend in adjusted OR model: Wald $F(1)$ = 1.19, p = .280, see Supplementary Figure 1).

Trends in Depression Among Non-Daily Smokers by Nicotine Dependence Status: 2005–2013

From 2005 to 2013, a significant increase in past-year depression among non-daily smokers without nicotine dependence was observed after adjusting for demographics and CPD while no change in depression occurred among those with nicotine dependence (see Table 3). No change in past-year depression from 2005 to 2013 was observed among daily smokers with or without nicotine dependence. The linear trends between non-daily and daily smokers were not significantly different from one another (interaction year × non-daily vs. daily smokers among those with and without past-year depression, Wald $F(1)$ = 0.28, p = .600; Wald $F(1)$ = 1.36, p = .249, respectively).

Trends in Depression Among Non-Daily Smokers by CPD: 2005–2013

From 2005 to 2013, there was an increase in past-year depression among non-daily smokers who reported use of 1–5 CPD and 6–15 CPD (adjusted OR = 1.02; 95% CI = 1.00–1.04; t test = 2.37; p = .021 and adjusted OR = 1.07; 95% CI = 1.02–1.13; t test = 2.63; p = .011, respectively; see Table 4); no change in past-year depression was evident among those using ≥16 CPD. No significant changes

were observed in past-year depression among daily smokers at any level of CPD from 2005 to 2013. There was a significant difference in linear trends between non-daily and daily smokers for those reporting 6–15 CPD (interaction year × non-daily vs. daily smokers, Wald $F(1)$ = 4.04, p = .049), but not for 1–5 CPD (Wald $F(1)$ = 1.89, p = 0.174) or ≥16 CPD (Wald $F(1)$ = 0.62, p = .435).

Trends in Depression Among Non-Daily Smokers by Age: 2005–2013

From 2005 to 2013, past-year depression increased significantly among non-daily smokers aged 12–17 years (adjusted model, p = .0030). While the prevalence of past-year depression in 2005 was greater for daily smokers (17.07%) than non-daily smokers (16.71%), the prevalence of past-year depression by 2013 was now greater for non-daily smokers (22.69%) than daily smokers (18.95%; see Supplementary Table 2). No significant change in past-year depression was found among daily smokers from 2005 to 2013 in any age group. Among never-smokers, significant increases in past-year depression were observed for those aged 12–17(adjusted OR = 1.05; 95% CI = 1.02–1.09; t test = 3.10; p = .003, respectively). The linear trends between daily and non-daily smokers in each age group were not significantly different from one another (interaction year × non-daily vs. daily smokers, Wald $F(1)$ = 0.52, p = .473 for 12–17 year olds; Wald $F(1)$ = 1.67, p = .202 for 18–25 year olds; Wald $F(1)$ = 0.70, p = .406 for 26 years or older; see Supplementary Figure 2).

Trends in Depression Among Non-Daily Smokers by Gender: 2005–2013

Among non-daily smokers, past-year depression prevalence significantly increased from 2005 to 2013 among both men (4.90%–6.87%, adjusted OR = 1.03; 95% CI = 1.00–1.07; t test = 2.10; p = .040) and women (14.65%–14.48%; adjusted OR = 1.02; 95% CI = 1.00–1.04; t test = 2.18; p = .033; see Supplementary Table 3). Among daily smokers, there were no significant changes in past-year depression among men or women from 2005 to 2013. A significant increase in past-year depression was observed among female never-smokers from 2005 to 2013 (6.28%–6.73%, unadjusted OR = 1.02; 95% CI = 1.01–1.04; t test = 3.37; p = .001). There was no significant difference in the linear trends between daily and non-daily smokers in men and women (interaction year × non-daily vs. daily smokers, Wald $F(1)$ = 0.13, p = .721 for men; Wald $F(1)$ = 1.77, p = .189 for women).

Trends in Depression Among Non-Daily Smokers by Income: 2005–2013

Among non-daily smokers, the prevalence of past-year depression increased significantly in the middle-income group ($20 000–$74 999 per year) from 2005 to 2013 (8.63%–10.56%, adjusted OR = 1.04; 95% CI = 1.01–1.07; t test = 2.80; p-value = .007; see Supplementary Table 4). Among daily smokers, there were no significant changes in past-year depression by total annual family income level from 2005 to 2013. The linear trends for non-daily and daily smokers in each income level did not significantly differ from one another (lowest income group, interaction year × non-daily vs. daily smokers, Wald $F(1)$ = 0.03, p = .857; middle income group, Wald $F(1)$ = 2.48, p = .121; highest income group, Wald $F(1)$ = 0.01, p = .922; see Supplementary Figure 3a and b).

Table 2. Prevalence of Depression in Past Year Among Current Non-Daily, Daily, and Lifetime Never-Smokers (NSDUH, 2005–2013, US Persons Aged 12 Years and Older)

Smoking status	2005[a]	2006	2007	2008	2009	2010	2011	2012	2013	Linear trend Unadjusted OR (95%CI)	p[b]	Adjusted OR (95%CI)	p[b]
Prevalence of past-year depression													
Total sample (n)	4700	4266	4438	4372	4509	4570	4662	4764	4867	1.01 (1.01, 1.02)	$t = 2.83$ (.0064)	1.01 (1.00, 1.03)	$t = 2.20$ (.0317)
%	6.62	6.47	6.86	6.82	6.87	6.94	6.88	7.16	7.16				
SE	0.22	0.18	0.18	0.20	0.20	0.19	0.19	0.2	0.2				
Current non-daily smokers (%)	9.06	9.25	8.97	9.18	10.31	9.55	9.68	10.13	10.10	1.02 (1.00, 1.03)	$t = 2.17$ (.0343)	1.03 (1.01, 1.04)	$t = 3.27$ (.0018)
SE	0.59	0.54	0.71	0.66	0.69	0.59	0.64	0.79	0.72				
Current daily smokers (%)	10.44	10.58	12.04	10.72	11.10	11.05	12.13	10.96	10.78	1.01 (0.99, 1.02)	$t = 0.62$ (.5396)	1.01 (0.99, 1.03)	$t = 0.79$ (.4305)
SE	0.60	0.50	0.57	0.58	0.59	0.64	0.69	0.57	0.59				
Lifetime never-smokers (%)	5.09	4.78	4.67	5.24	4.66	4.98	4.94	6.01	5.51	1.02 (1.01, 1.03)	$t = 3.33$ (.0015)	N/A	N/A
SE	0.31	0.25	0.22	0.28	0.22	0.21	0.2	0.24	0.28				
[c]Differential time trend; year as continuous × smoking status										$F(2) = 0.98(0.3822)$		N/A	
[d]Differential time trend: year as continuous × smoking (current non-daily vs. current daily smoker)										$F(1) = 0.75(0.3898)$		$F(1) = 1.19(0.2800)$	
[e]Differential time trend: year as continuous × smoking (current non-daily vs. never-smoker)										$F(1) = 0.18(0.6739)$		N/A	

CI = confidence interval; NSDUH = National Survey on Drug Use and Health; OR = odds ratio; SE = standard error; US = United States. Odds ratios are for past-year depression, versus no past-year depression. Logistic regressions were applied to examine the time trend within each particular group. An odds ratio greater than one indicated a significant trend for the prevalence of depression among each smoking category to increase during 2005–2013, and p-value for t tests showed the significance of time trends. Adjusted models: adjusted for age (12–17 years old, 18–25 years old, 26 years old or older) gender (male, female), total annual family income (<$20 000, $20 000–$74 999, ≥$75 000), nicotine dependence (yes, no), and cigarettes per day (1–5 cigarettes per day, 6–15 cigarettes per day, 16 or more cigarettes per day). Bold signifies $p < .05$.

[a]2005 as reference year.

[b]p-value for t test when beta = 0.

[c]Differential time trend among all smoking categories—slope over time differed by smoking status (non-daily, daily, and lifetime never-smokers), an interaction term between year and smoking was included in the regression.

[d]Differential time trend—slope over time differed by smoking status (non-daily vs. daily smokers), an interaction term between year and smoking was included in the regression.

[e]Differential time trend—slope over time differed by smoking status (non-daily vs. lifetime never-smokers), an interaction term between year and smoking was included in the regression.

Table 3. Prevalence of Past-Year Depression Among Current Non-Daily and Daily Smokers Stratified by Nicotine Dependence (NSDUH, 2005–2013, US Persons Aged 12 Years and Older)

Smoking status by nicotine dependence	2005[a]	2006	2007	2008	2009	2010	2011	2012	2013	Unadjusted OR (95%CI)	p[b]	Adjusted OR (95%CI)	p[b]
				Prevalence of past-year depression							Linear trend		
Current non-daily smokers													
By nicotine dependence													
Yes (%)	10.94	10.74	10.15	9.12	10.58	11.15	12.05	11.40	11.46	1.02 (0.97, 1.06)	t = 0.80 (.4288)	1.03 (0.98, 1.07)	t = 1.14 (.2586)
SE	1.74	1.54	1.51	1.44	1.30	1.41	1.76	1.63	1.81				
No (%)	8.58	8.81	8.65	9.19	10.24	9.1	9.02	9.78	9.71	1.02 (1.00, 1.03)	t = 1.79 (.0789)	**1.03 (1.01, 1.04)**	**t = 2.70 (.0091)**
SE	0.68	0.59	0.79	0.74	0.78	0.56	0.70	0.86	0.72				
Differential time trend: year × depression status among non-daily smoker										F(1) = 0.00(0.9640)		F(1) = 0.01(0.9343)	
Current daily smokers													
By nicotine dependence													
Yes (%)	11.82	12.1	14.39	12.65	13.11	12.64	13.94	12.41	12.9	1.01 (0.99, 1.03)	t = 0.66 (.5089)	1.01 (0.99, 1.03)	t = 0.79 (.4315)
SE	0.73	0.71	0.78	0.76	0.85	0.90	0.96	0.77	0.82				
No (%)	7.93	7.87	7.74	7.12	7.56	8.29	8.67	8.41	6.87	1.00 (0.97, 1.03)	t = 0.09 (.9254)	1.00 (0.97, 1.03)	t = 0.23 (.8169)
SE	0.80	0.76	0.67	0.72	0.67	0.81	0.79	0.98	0.76				
Differential time trend: year × depression status among daily smoker										F(1) = 0.12(0.7287)		N/A	
Differential time trend among ND by # year as continuous × smoking status (non-daily vs. daily)										F(1) = 0.20(0.6543)		F(1) = 0.28(0.6003)	
Differential time trend among non-ND by # year as continuous × smoking status (non-daily vs. daily)										F(1) = 0.65(0.4235)		F(1) = 1.36(0.2489)	

CI = confidence interval; NSDUH = National Survey on Drug Use and Health; OR = odds ratio; US = United States. Odds ratios are for past year depression, versus no past year depression. Logistic regressions were applied to examine the time trend within each particular group. An odds ratio greater than one indicated a significant trend for the prevalence of depression among each smoking category stratified by nicotine dependence to increase during 2005–2013, and *p*-value for *t* tests showed the significance of time trends. Adjusted models: adjusted for age (12–17 years old, 18–25 years old, 26 years old or older), gender (male, female) and total annual family income (<$20 000, $20 000–$74 999, ≥$75 000) and cigarettes per day (1–5 cigarettes per day, 6–15 cigarettes per day, 16 or more cigarettes per day). Bold signifies *p* < .05.

[a]2005 as reference year.

[b]*p*-value for *t* test when beta = 0.

Table 4. Prevalence of Past-Year Depression Among Current Non-Daily and Daily Smokers Stratified by CPD (NSDUH, 2005–2013, US Persons Aged 12 Years and Older)

Smoking status by CPD	2005[a]	2006	2007	2008	2009	2010	2011	2012	2013	Unadjusted OR (95%CI)	p[b]	Adjusted OR (95%CI)	p[b]
	Prevalence of past-year depression									Linear trend			
Current non-daily smokers													
Total CPD	796	695	693	685	737	757	708	686	667				
%	9.07	9.27	8.96	9.2	10.3	9.55	9.71	10.16	10.13	**1.02 (1.00, 1.03)**	**t = 2.20 (.0317)**	**1.02 (1.01, 1.04)**	**t = 3.04 (.0035)**
SE	0.6	0.54	0.71	0.66	0.69	0.59	0.64	0.8	0.72				
By CPD													
1–5 CPD (%)	9.25	9.04	8.87	9.13	10.10	9.16	8.99	10.49	9.54	1.01 (0.99, 1.03)	t = 1.34 (.1851)	**1.02 (1.00, 1.04)**	**t = 2.37 (.0208)**
SE	0.71	0.59	0.78	0.68	0.68	0.57	0.68	0.90	0.79				
6–15 CPD (%)	7.22	8.17	8.59	7.78	9.97	12.22	10.78	7.81	13	**1.07 (1.01, 1.12)**	**t = 2.49 (.0154)**	**1.07 (1.02, 1.13)**	**t = 2.63 (.0109)**
SE	1.31	1.70	1.47	1.76	1.49	1.89	2.10	1.43	2.28				
≥16 CPD (%)	10.71	12.95	10.6	12.29	12.97	7.9	15.64	10.67	9.96	0.99 (0.91, 1.08)	t = −0.20 (.8444)	0.98 (0.90, 1.07)	t = −0.46 (.6476)
SE	3.25	2.93	4.11	2.60	2.75	1.99	3.86	2.74	2.34				
Differential time trend: year as continuous × depression status among non-daily smoker										$F(2) = 1.91(0.1568)$		$F(2) = 2.19(0.1207)$	
Current daily smokers													
Total CPD	966	880	945	813	902	832	841	803	739				
%	10.46	10.59	12.06	10.74	11.11	11.07	12.14	10.97	10.79	1.01 (0.99, 1.02)	t = 0.60 (.5496)	1.00 (0.99, 1.02)	t = 0.43 (.6693)
SE	0.6	0.5	0.57	0.58	0.59	0.64	0.69	0.57	0.59				
By CPD													
1–5 CPD (%)	11.33	7.88	10.68	9.01	8.99	10.56	9.80	10.46	7.54	0.99 (0.95, 1.02)	t = −0.73 (.4661)	0.99 (0.95, 1.03)	t = −0.67 (.5047)
SE	1.33	1.24	1.30	1.18	0.91	1.32	1.33	1.33	0.95				
6–15 CPD (%)	9.31	10.39	10.78	9.90	10.48	8.67	11.81	9.59	10.39	1.01 (0.98, 1.03)	t = 0.41 (.6869)	1.01 (0.98, 1.03)	t = 0.42 (.6779)
SE	0.83	0.93	0.99	0.87	0.82	0.76	0.95	0.72	0.94				
≥16 CPD (%)	10.97	11.55	13.34	11.89	12.39	13.29	13.38	12.41	12.67	1.02 (0.99, 1.04)	t = 1.38 (.1730)	1.01 (0.99, 1.04)	t = 1.06 (.2949)
SE	0.79	0.80	1.04	0.89	1.05	1.24	1.15	1.08	1.07				
Differential time trend: year as continuous × depression status among daily smoker										$F(2) = 1.05(0.3546)$		$F(2) = 0.94(0.3967)$	
Differential time trend among 1–5 CPD by # year as continuous × smoking status (non-daily vs. daily)										$F(1) = 1.35(0.2504)$		$F(1) = 1.89(0.1738)$	
Differential time trend among 6–15 CPD by # year as continuous × smoking status (non-daily vs. daily)										$F(1) = 3.89(0.0531)$		**$F(1) = 4.04(0.0490)$**	
Differential time trend among 16 or more CPD by # year as continuous × smoking status (non-daily vs. daily)										$F(1) = 0.37(0.5450)$		$F(1) = 0.62(0.4350)$	

CI = confidence interval; CPD = cigarettes per day; NSDUH = National Survey on Drug Use and Health; OR = odds ratio; SE = standard error; US = United States. Odds ratios are for past year depression, versus no past year depression. Logistic regressions were applied to examine the time trend within each particular group. An odds ratio greater/less than one indicated a significant trend for the prevalence of depression among each smoking category stratified by CPD to increase/decrease during 2005–2013, and p-value for t tests showed the significance of time trends. Adjusted models: adjusted for age (12–17 years old, 18–25 years old, 26 years old or older), gender (male, female), total annual family income (<$20 000, $20 000–$74 999, ≥$75 000), nicotine dependence (yes, no) and cigarettes per day (1–5 CPD, 6–15 CPD, 16 or more CPD). Bold signifies $p < .05$.

[a]2005 as reference year.

[b]p-value for t test when beta = 0.

Discussion

Key Results and Interpretation

A primary finding of the current study is that the prevalence of past-year depression increased from 2005 to 2013 among non-daily smokers, but not daily smokers, and there was no difference between non-daily and daily smokers in the prevalence of past-year depression in the most recent data year. A number of potential mechanisms for the relationship between depression and smoking have been proposed including those related to genetics, self-medication, incentive learning, expectancy, and attention and motivational processes.[41–44] A prior study suggested that non-daily smokers were less likely than daily smokers to report smoking to relieve negative states[45] while reporting negative affect regulation as a reason for non-daily smoking was associated with greater past-two week depressive symptoms among college students.[46] More research is needed to understand the mechanisms, including affect-regulation processes, underlying the depression-smoking relationship in general and specifically for non-daily smokers.

The association between depression and non-daily smoking further suggests a need to learn more about how depression impacts quit outcomes for non-daily smokers since depression has been linked to lower abstinence success in the general smoking population.[18,20,26,27] Non-daily smokers are less likely than daily smokers to consider themselves to be "a smoker," report being addicted to smoking, expect quitting to be difficult, and express interest in smoking cessation interventions.[10,32,47–49] There are mixed data regarding whether non-daily smokers are less likely[47] or more likely[48,50] than daily smokers to make a quit attempt. Understanding more about the impact of depression to motivation to quit and abstinence outcomes for non-daily smokers will provide information that can be used in interventions for this important subgroup of smokers.

The prevalence of past-year depression significantly increased over the study period for young non-daily smokers. Younger smokers are more likely to report nondaily smoking compared to older smokers. Younger nondaily smokers are equally likely to increase their smoking from nondaily to daily smoking as they are to reduce their smoking from nondaily to no smoking.[9] Further, many adolescents do not believe that non-daily smoking causes significant harm.[51] It would be useful to more closely examine the association of depression to the onset of non-daily smoking and to an increase from non-daily to daily smoking among adolescents.

While much research has reported a higher prevalence of depression for women than men (eg,[16]), the gender difference in the prevalence of depression narrowed for both daily and non-daily smokers from 2005 to 2013. Further, the prevalence of depression among non-daily smokers increased over time for both men and women. It should be noted that while the prevalences of depression in 2013 did not differ statistically for men and women, the confidence intervals only overlapped by 0.01 and differences in the relationship of depression and smoking status for men versus women should continue to be examined over time. In a recent study, male non-daily smokers scored higher than female non-daily smokers on affect-related motives for smoking.[52] Further, male non-daily smokers reported fewer past year quit attempts and were less likely to intend to quit in the next 30 days than female non-daily smokers.[52] While few studies of smokers with depression examine cessation outcomes by gender, studies that do have suggested a greater impact of depression on treatment outcomes for women compared to men.[53] More research is needed to understand the best way to treat both men and women with depression especially non-daily smokers with depression.

Lower socioeconomic status is associated with a greater prevalence of depression[54,55] as well as higher prevalence of smoking, greater nicotine addiction, lower quit motivation, and less success quitting smoking.[56–58] Further, those in lower income groups report worse health compared to higher income groups.[59,60] While some research has suggested that non-daily smokers, compared to daily smokers, are more likely have to higher incomes[7,48] and our results showed an significant increase in past-year depression for middle-income non-daily smokers, little is known about non-daily smoking and income at the current time.

Learning more about the relationship of depression to non-daily smoking, including the mechanisms of this relationship, may inform interventions for non-daily smokers especially for younger and lower SES smokers. It may be beneficial for treatment programs targeting non-daily smoking to include information about the link between depression and smoking and coping skills related to mood.

Limitations and Generalizability

A number of limitations of the current study should be noted. Results may not generalize to those not included in the NSDUH study (ie, institutionalized persons, persons living outside of the United States). While data for the NSDUH were collected annually, these data were cross-sectional. Longitudinal data would be needed to examine the relationship of non-daily smoking and depression in the same persons over time. In addition, variables that were included in the analyses were limited to those collected in the NSDUH study. As one example, time to first cigarette was used as a proxy for nicotine dependence and it would be useful for future studies to examine other measures of nicotine dependence. Non-daily smokers may be former nonsmokers who began non-daily smoking or former daily smokers who reduced their cigarette consumption to non-daily levels in an effort to quit or for other reasons.[8,9,61] It would be important for future research to examine whether depression relates to non-daily smoking differently for subgroups of non-daily smokers. In addition, as non-daily smokers can either quit smoking or increase to become daily smokers,[9,10,62] it would be important for longitudinal research to examine the relationship between depression and transitions in smoking for non-daily smokers (increases to daily smoking and decreases to nonsmoking). Finally, the variables that were examined and included as covariates were selected a priori based on previous research suggesting their relationships with smoking and/or depression. There may be other variables that would be important to examine or covary for when examining the relationship between smoking and depression that were beyond the scope of the current study but can be examined in future studies.

Conclusions

In the current study of US persons aged 12 and older, the prevalence of past-year depression for non-daily smokers was equivalent to daily smokers and greater than never-smokers. While the prevalence of past-year depression remained stable for daily smokers over time, past-year depression increased among non-daily smokers, especially among youth, those who smoke less, and those who appear not to be dependent on nicotine. More work on the mental health of non-daily smokers is needed to better understand the smoking behavior of this understudied, but important group of smokers, in order to improve quit outcomes and reduce the negative consequences of smoking.

Supplementary Material

Funding

Declaration of Interests

References

1. Goodwin RD, Wall M, Gbedemah M, et al. *Nicotine dependence among smokers from 2003–2013: A new test of the hardening hypothesis*. under review.
2. Pleis JR, Lucas JW, Ward BW. Summary health statistics for US adults: National Health Interview Survey, 2008. National Center for Health Statistics. *Vital Health Sta*. 2009;10:242.
3. Blackwell DL, Lucas JW, Clarke TC. Summary health statistics for U.S. adults: National Health Interview Survey, 2012. National Center for Health Statistics. *Vital Health Sta*. 2014;10:260.
4. CDC. Current cigarette smoking among adults — United States, 2005–2014. *Morb Mortal Wkly Rep*. 2015;64(44):1233–1240.
5. Edwards SA, Bondy SJ, Kowgier M, McDonald PW, Cohen JE. Are occasional smokers a heterogeneous group? An exploratory study. *Nicotine Tob Res*. 2010;12(12):1195–1202. doi:10.1093/ntr/ntq168.
6. Nguyen QB, Zhu SH. Intermittent smokers who used to smoke daily: a preliminary study on smoking situations. *Nicotine Tob Res*. 2009;11(2):164–170. doi:10.1093/ntr/ntp012.
7. Hassmiller KM, Warner KE, Mendez D, Levy DT, Romano E. Nondaily smokers: who are they? *Am J Public Health*. 2003;93(8):1321–1327. doi:10.2105/AJPH.93.8.1321.
8. Bondy SJ, Victor JC, Diemert LM, et al. Transitions in smoking status over time in a population-based panel study of smokers. *Nicotine Tob Res*. 2013;15(7):1201–1210. doi:10.1093/ntr/nts259.
9. White HR, Bray BC, Fleming CB, Catalano RF. Transitions into and out of light and intermittent smoking during emerging adulthood. *Nicotine Tob Res*. 2009;11(2):211–219. doi:10.1093/ntr/ntn017.
10. Robertson L, Iosua E, McGee R, Hancox RJ. Nondaily, low-rate daily, and high-rate daily smoking in young adults: a 17-year follow-up. *Nicotine Tob Res*. 2016;18(5):943–949. doi:10.1093/ntr/ntv167.
11. Schane RE, Ling PM, Glantz SA. Health effects of light and intermittent smoking: a review. *Circulation*. 2010;121(13):1518–1522. doi:10.1161/CIRCULATIONAHA.109.904235.
12. Carter BD, Abnet CC, Feskanich D, et al. Smoking and mortality—beyond established causes. *N Engl J Med*. 2015;372(7):631–640. doi:10.1056/NEJMsa1407211.
13. Thun MJ, Carter BD, Feskanich D, et al. 50-year trends in smoking-related mortality in the United States. *N Engl J Med*. 2013;368(4):351–364. doi:10.1056/NEJMsa1211127.
14. Hart C, Gruer L, Bauld L. Does smoking reduction in midlife reduce mortality risk? Results of 2 long-term prospective cohort studies of men and women in Scotland. *Am J Epidemiol*. 2013;178(5):770–779. doi:10.1093/aje/kwt038.
15. Begh R, Lindson-Hawley N, Aveyard P. Does reduced smoking if you can't stop make any difference? *BMC Med*. 2015;13(5):257. doi:10.1186/s12916-015-0505-2.
16. Grant BF, Hasin DS, Chou P, Stinson FS, Dawson DA. Nicotine dependence and psychiatric disorders in the United States. *Arch Gen Psychiatry*. 2004;61(11):1107–1115. doi:10.1001/archpsyc.61.11.1107.
17. Kessler RC, Berglund P, Demler O, et al. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). *JAMA*. 2003;289(23):3095–3105. doi:10.1001/jama.289.23.3095.
18. Weinberger AH, Kashan RS, Shpigel DM, et al. Depression and cigarette smoking behavior: a critical review of population-based studies. *Am J Drug Alcohol Abuse*. 2016;1–16. doi:10.3109/00952990.2016.1171327.
19. Lasser K, Boyd JW, Woolhander S, Himmelstein DU, McCormick D, Bor DH. Smoking and mental illness: a population-based prevalence study. *JAMA*. 2000;284(20):2606–2610. doi:10.1001/jama.284.20.2606.
20. Smith PH, Mazure CM, McKee SA. Smoking and mental illness in the US population. *Tob Control*. 2014;23(e2):147–153. doi:10.1136/tobaccocontrol-2013–051466.
21. Breslau N, Peterson EL, Schultz LR, Chilcoat HD, Andreski P. Major depression and stages of smoking. A longitudinal investigation. *Arch Gen Psychiatry*. 1998;55(2):161–166. doi:10.1001/archpsyc.55.2.161.
22. Breslau N, Novak SP, Kessler RC. Psychiatric disorders and stages of smoking. *Biol Psychiatry*. 2004;55(1):69–76. doi:10.1016/S0006-3223(03)00317-2.
23. Fergusson DM, Goodwin RD, Horwood LJ. Major depression and cigarette smoking: results of a 21-year longitudinal study. *Psychol Med*. 2003;33(8):1357–1367. doi:10.1017/S0033291703008596.
24. John U, Meyer C, Rumpf HJ, Hapke U. Smoking, nicotine dependence and psychiatric comorbidity--a population-based study including smoking cessation after three years. *Drug Alcohol Depend*. 2004;76(3):287–295. doi:10.1016/j.drugalcdep.2004.06.004.
25. Goodwin RD, Pagura J, Spiwak R, Lemeshow AR, Sareen J. Predictors of persistent nicotine dependence among adults in the United States. *Drug Alcohol Depend*. 2011;118(2–3):127–133. doi:10.1016/j.drugalcdep.2011.03.010.
26. Hitsman B, Papandonatos GD, McChargue DE, et al. Past major depression and smoking cessation outcome: a systematic review and meta-analysis update. *Addiction*. 2013;108(2):294–306. doi:10.1111/add.12009.
27. Zvolensky MJ, Bakhshaie J, Sheffer C, Perez A, Goodwin RD. Major depressive disorder and smoking relapse among adults in the United States: a 10-year, prospective investigation. *Psychiatry Res*. 2015;226(1):73–77. doi:10.1016/j.psychres.2014.11.064.
28. Weinberger AH, Pilver CE, Desai RA, Mazure CM, McKee SA. The relationship of major depressive disorder and gender to changes in smoking for current and former smokers: longitudinal evaluation in the US population. *Addiction*. 2012;107(10):1847–1856. doi:10.1111/j.1360-0443.2012.03889.x.
29. Berg CJ, Wen H, Cummings JR, Ahluwalia JS, Druss BG. Depression and substance abuse and dependency in relation to current smoking status and frequency of smoking among nondaily and daily smokers. *Am J Addict*. 2013;22(6):581–589. doi:10.1111/j.1521-0391.2013.12041.x.
30. Tong EK, Ong MK, Vittinghoff E, Perez-Stable EJ. Nondaily smokers should be asked and advised to quit. *Am J Prev Med*. 2006;30(1):2330. doi:10.1016/j.amepre.2005.08.048.
31. Pinsker EA, Berg CJ, Nehl EJ, Prokhorov AV, Buchanan TS, Ahluwalia JS. Intent to quit among daily and non-daily college student smokers. *Health Educ Res*. 2013;28(2):313–325. doi:10.1093/her/cys116.
32. Berg CJ, Sutfin EL, Mendel J, Ahluwalia JS. Use of and interest in smoking cessation strategies among daily and nondaily college student smokers. *J Am Coll Health*. 2012;60(3):194–202. doi:10.1080/07448481.2011.586388.
33. Cooper TV, Taylor T, Murray A, et al. Differences between intermittent and light daily smokers in a population of U.S. military recruits. *Nicotine Tob Res*. 2010;12(5):465–473. doi:10.1093/ntr/ntq025.
34. Kessler RC, McGonagle KA, Zhao S, et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: results from the national comorbidity survey. *Arch Gen Psychiatry*. 1994;51(1):8–19. doi:10.1001/archpsyc.1994.03950010008002.
35. SAMHSA. *National Survey on Drug Use and Health, 2013. Codebook*. Rockville, MD: SAMHSA; 2014.

36. APA. *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed., text revision (DSM-IV-TR). Washington DC: American Psychiatric Association; 2002.

37. Hedden S, Gfroerer J, Barker P, Smith S, Pemberton MR, Saavedra LM, Forman-Hoffman VL, Ringeisen H, Novak SP. *Comparison of NSDUH Mental Health Data and Methods with Other Data Sources. CBHSQ Data Review*. Rockville, MD: Substance Abuse and Mental Health Services Administration (US); 2012.

38. Fagerström K, Russ C, Yu CR, Yunis C, Foulds J. The Fagerström Test for Nicotine Dependence as a predictor of smoking abstinence: a pooled analysis of varenicline clinical trial data. *Nicotine Tob Res*. 2012;14(12):1467–1473. doi:10.1093/ntr/nts018.

39. Heatherton TF, Kozlowski LT, Frecker RC, Fagerström KO. The Fagerström Test for Nicotine Dependence: a revision of the Fagerström Tolerance Questionnaire. *Br J Addict*. 1991;86(9):1119–1127. doi:10.1111/j.1360-0443.1991.tb01879.x.

40. Baker TB, Piper ME, McCarthy DE, et al. Time to first cigarette in the morning as an index of ability to quit smoking: implications for nicotine dependence. *Nicotine Tob Res*. 2007;9(4):555–570. doi:10.1080/14622200701673480.

41. Kassel JD, Stroud LR, Paronis CA. Smoking, stress, and negative affect: correlation, causation, and context across stages of smoking. *Psychol Bull*. 2003;129(2):270–304. doi:10.1037/0033-2909.129.2.270.

42. Tsuang MT, Francis T, Minor K, Thomas A, Stone WS. Genetics of smoking and depression. *Hum Genet*. 2012;131(6):905–915. doi:10.1007/s00439-012-1170-6.

43. Morozova M, Rabin RA, George TP. Co-morbid tobacco use disorder and depression: a re-evaulation of smoking cessation therapy in depressed smokers. *Am J Addict*. 2015;24(8):687–794. doi:10.1111/ajad.12277.

44. Mathew AR, Hogarth L, Leventhal AM, Cook JW, Hitsman B. Cigarette smoking and depression comorbidity: systematic review & proposed theoretical model [published online ahead of print 2016]. *Addiction*. 2016. doi:10.1111/add.13604.

45. Shiffman S, Dunbar MS, Scholl SM, Tindle HA. Smoking motives of daily and non-daily smokers: a profile anlaysis. *Drug Alcohol Depend*. 2012;126(3):362–368. doi:10.1016/j.drugalcdep.2012.05.037.

46. Berg CJ. Reasons for nondaily smoking among young adults: scale development and validation. *J Smok Cessat*. 2014;9(1):17–25. doi:10.1017/jsc.2013.8.

47. Lenk KM, Chen V, Bernat DH, Forster JL, Rode PA. Characterizing and comparing young adult intermittent and daily smokers. *Subst Use Misuse*. 2009;44(14):2128–2140. doi:10.3109/10826080902864571.

48. Schauer GL, Malarcher AM, Berg CJ. Differences in smoking and cessation characteristics among adult nondaily smokers in the United States: findings from the 2009–2010 national adult tobacco survey. *Nicotine Tob Res*. 2014;16(1):58–68. doi:10.1093/ntr/ntt113.

49. Rubinstein ML, Rait MA, Sen S, Shiffman S. Characteristics of adolescent intermittent and daily smokers. *Addict Behav*. 2014;38(9):1337–1341. doi:10.1016/j.addbeh.2014.04.021.

50. Tindle HA, Shiffman S. Smoking cessation behavior among intermittent smokers versus daily smokers. *Am Journal Public Health*. 2011;101(7):1–3. doi:10.2105/AJPH.2011.300186.

51. Amrock SM, Weitzman M. Adolescents' perceptions of light and intermittent smoking in the United States. *Pediatrics*. 2015;135(2):246–254. doi:10.1542/peds.2014–2502.

52. Allen AM, Scheuermann TS, Nollen N, Hatsukami D, Ahluwalia JS. Gender differences in smoking behavior and dependence motives among daily and nondaily smokers. *Nicotine Tob Res*. 2016;18(6):1408–1413. doi:10.1093/ntr/ntv138.

53. Weinberger AH, Mazure CM, Morlett A, McKee SA. Two decades of smoking cessation treatment research on smokers with depression: 1990–2010. *Nicotine Tob Res*. 2013;15(6):1014–1031. doi:10.1093/ntr/nts213.

54. Lorant V, Deliège D, Eaton W, Robert A, Philippot P, Ansseau M. Socioeconomic inequalities in depression: a meta-analysis. *Am J Epidemiol*. 2003;157(2):98–112.

55. Everson SA, Maty SC, Lynch JW, Kaplan GA. Epidemiologic evidence for the relation between socioeconomic status and depression, obesity, and diabetes. *J Psychosom Res*. 2002;53(4):891–895.

56. Reid JL, Hammond D, Boudreau C, Fong GT, Siahpush M, ITC Collaboration. Socioeconomic disparities in quit intentions, quit attempts, and smoking abstinence among smokers in four western countries: findings from the International Tobacco Control Four Country Survey. *Nicotine Tob Res*. 2010;12(suppl 1):20–33. doi:10.1093/ntr/ntq051.

57. Hiscock R, Bauld L, Amos A, Fidler JA, Munafo M. Socioeconomic status and smoking: a review. *Ann N Y Acad Sci*. 2012;1248(1):107–123. doi:10.1111/j.1749-6632.2011.06202.x.

58. Higgins ST, Kurti AN, Redner R, et al. Co-occurring risk factors for current cigarette smoking in a U.S. nationally representative sample. *Prev Med*. 2016;92:110–117. doi:10.1016/j.ypmed.2016.02.025.

59. Braveman PA, Cubbin C, Egerter S, Williams DR, Pamuk E. Socioeconomic disparities in health in the United States: what the patterns tell us. *Am J Public Health*. 2010;100(suppl 1):S186–S196. doi:10.2105/AJPH.2009.166082.

60. Martinson ML. Income inequality in health at all ages: a comparison of the United States and England. *Am J Public Health*. 2012;102(11):2049–2056. doi:10.2105/AJPH.2012.300929.

61. Gilpin E, Cavin SW, Pierce JP. Adult smokers who do not smoke daily. *Addiction*. 1997;92(4):473–480. doi:10.1111/j.1360-0443.1997.tb03379.x.

62. Kvaavik E, von Soest T, Pedersen W. Nondaily smoking: a population-based, longitudinal study of stability and predictors. *BMC Public Health*. 2014;14(1):123. doi:10.1186/1471-2458-14-123.