Depression among current, former, and never smokers from 2005 to 2013: The hidden role of disparities in depression in the ongoing tobacco epidemic

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Abstract

BACKGROUND—After declining for many years, the prevalence of smoking has remained stable over the past decade. One possible explanation is that there has been an increase in the prevalence of barriers to cessation, like depression, among remaining smokers.

OBJECTIVES—To estimate changes in the prevalence of depression among current, former and never smokers in the United States (U.S.) population from 2005 to 2013 overall and by age, gender, and income.

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=496,805). The prevalence of past 12-month depression was examined annually among current (past 12-month), former (not past 12-month), and lifetime non-smokers from 2005 to 2013. Data were re-analyzed stratified by age, gender, and household income, and adjusted for demographics.

RESULTS—Depression appears to have significantly increased in the United States from 2005–2013 among current, former, and never smokers. Depression prevalence increased among current smokers overall, but the increase among former and never smokers was even more prominent. Striking temporal changes emerged by age, gender and income. Specifically, (1) depression increased significantly among current smokers aged 12–17 (from 16% to 22%, p-value=0.0002) and the prevalence was consistently more than twice as high as that of never smokers; (2) depression increased among male smokers (6.19% to 7.82%, p-value=0.0099); (3) depression increased significantly among smokers in the highest income group (6.36% to 8.91%, p-value=0.0400). Throughout this period, the prevalence of depression among current smokers was consistently twice as high as former and never smokers.

DISCUSSION—Public health efforts aimed at decreasing the prevalence of smoking should take depression into account, a common and modifiable barrier whose treatment may help to increase successful smoking cessation. Future work is needed to disentangle the role of smoking and other factors that lead to increases in depression in the US population.

Keywords

1. INTRODUCTION

The prevalence of current cigarette smoking among adults in the United States (U.S.) has decreased substantially over the past several decades (US Department of Health and Human Services, 2014) from a high of 42% in 1965 to approximately 25.5% in 1990 (American Lung Association, 2007). Current estimates indicate that approximately 18% of Americans self-identify as current smokers (Jamal et al., 2014), suggesting a comparatively slowed

decline in the past two decades. Some data suggest there have been increases in quit attempts in recent years among some subgroups of smokers (e.g., adults aged 25–64), but not others, and overall the rate of quitting has remained relatively stable (Prevention, 2011). More recent data suggest that tobacco control efforts have not equally benefitted all persons with large and increasing inequalities in tobacco use observed among vulnerable subgroups (Williams et al., 2013). Persons with mental health problems are one such subgroup.

Major depression is among the most common mental health conditions, with a lifetime prevalence in the general population of approximately 20% (Hasin et al. 2005). Depression is more than twice as common in smokers than in non-smokers (Weinberger et al., 2016). Meta-analyses of clinical studies have suggested that depression is associated with poorer smoking cessation outcomes (Hitsman et al., 2013) and both community-based and epidemiologic studies have found that depression is associated with decreased likelihood of remaining abstinent over extended periods of time (Weinberger et al., 2016; Zvolensky et al., 2015).

As such, one possible explanation for the lack of improvement in quit rates over time in the U.S. population is that smokers today are more likely to have attributes or conditions, like depression, that make them less likely to quit in response to public health tobacco control efforts, compared with smokers a decade ago. If this is the case, we would expect the prevalence of depression to be higher among smokers in 2013 compared with smokers in 2005. Further, the prevalence of depression is more common overall among those of lower income, younger age, and female gender (Hasin et al., 2005). Yet, the prevalence of smoking has declined more rapidly among those of higher income, older age, and male gender (Hibbs et al., 2016). As such, understanding the changes in depression among smokers over time within these groups will be useful in providing a clearer understanding of what underlies and drives overall trends, as well as highlight high-risk groups who may benefit from tailored intervention and prevention programs. To our knowledge, no prior study has estimated changes in the prevalence of depression among current, former and never smokers in the U.S. over the past decade.

Against this background, the objective of this study is to investigate the relationship between depression and cigarette smoking in the U.S. population, to estimate changes in the prevalence of depression among current smokers in the United States from 2005 to 2013, and to examine the trends in depression among smokers by age, gender and income.

2. METHODS

2.1 Study population

Study data were drawn from The National Survey on Drug Use and Health (NSDUH) public data portal (http://www.icpsr.umich.edu/), for years 2005–2013. The National Survey on Drug Use and Health (NSDUH) provides annual cross-sectional national data on the use of tobacco, other substance use, and mental health in the U.S., and is described in depth elsewhere (SAMHSA 2013). A multistage area probability sample for each of the 50 states and the District of Columbia has been conducted, to represent the male and female civilian non-institutionalized population of the U.S. aged 12 and older. The datasets from each year

were concatenated, adding a variable for the survey year. For this study, analyses were restricted to participants who responded to past year depression questionnaires at the time of the interview. This results in a total study population of N=496,805.

3. MEASURES

3.1 Past year Depression

Depression modules were based on the fourth edition of the DSM-IV criteria for major depressive episode (MDE; APA 1994). MDE questions were adapted from the depression section of the National Comorbidity Survey-Replication (NCS-R; Hedden et al., 2012) for adults and of the National Comorbidity Survey-Adolescent (NCS-A) for adolescents. Separate depression modules were administrated to adults (aged 18 or older) and to adolescents (aged 12–17). Participants were classified as having had a lifetime MDE based on having 5+ out of 9 symptoms for MDE during the same 2-week period in their lifetime and at least one symptom has to be a depression mood or loss of interest or pleasure in daily activities. Respondents with lifetime MDE were further classified as having past year MDE if they met criteria for a lifetime MDE and if they felt depressed or lost interest or pleasure in daily activities a time period of 2 weeks or longer during the past 12 months, while also having some of the other symptoms (weight gain or lost, insomnia or hypersomnia, psychomotor agitation or retardation, fatigue or loss of energy, feeling of worthlessness, diminished ability to think or concentrate or indecisiveness, recurrent thoughts of death or recurrent suicide ideation) for lifetime MDE. Due to changes in the questionnaire in 2008, adjusted past year MDE variables for adults were developed to allow for comparison across years 2005–2008 and later years. The past year MDE variable was created by combining the youth and adults variables for this study.

3.2 Cigarette Use

Cigarette use was assessed by the questions: 'Have you ever smoked part or all of a cigarette?' Participants who answered 'no' to this question were classified as lifetime never smokers. Those who responded 'yes' were asked 'How long has it been since you last smoked part or all of a cigarette?' Participants who responded 'Within the past 30 days' or 'More than 30 days ago but within the past 12 months' to this question were classified as current smokers. Participants who responded 'More than 12 months ago but within the past 3 years' or 'More than 3 years ago' to this question were classified as former smokers.

3.3 Demographic characteristics

Demographic variables were categorized as follows: age (12–17 years old as reference group, 18–25 years old, 26–34 years old, 35–49 years old, 50 years or older), gender (male as reference group, female), total annual family income variable in four categories was collapsed into three categories for analyses: (less than $20,000/year as reference group, $20,000 - $74,000/year, $75,000 or more/year).

3.4 Statistical Analysis

All analyses were performed incorporating the NSDUH sampling weights and controlling for the complex clustered sampling using SUDAAN Version 11 (http://www.rti.org/sudaan/).

First, the prevalence of smoking status (current smokers, former smokers, and never smokers) was calculated with standard errors annually from 2005 to 2013. Time trends of smoking status were assessed using logistic regression models with continuous year as the predictor testing a linear time trend. Second, the prevalence and associated standard errors of depression among the whole population over 12 years old and stratified by current smokers, former smokers, and never smokers were calculated each year. Time trends in the prevalence of depression stratified by smoking status were tested using logistic regression with continuous year to test a linear time trend without and with adjusting for age (12–17, 18–25, 26–34, 35–49, 50+), gender (male, female), and annual family income (<$20,000, $20,000-$74,999, >=$75,000). Differential time trends in depression by smoking status were tested in a logistic regression including the 2-way interaction of year X smoking status (Current vs. Never, Current vs. Former), where year was treated as continuous (linear time trend).

Third, the prevalence of depression and associated standard errors of depression were calculated stratified by demographic characteristic (i.e., age, gender, income) and smoking status for each year. A logistic regression of depression found the three-way interaction of year X smoking status X demographic characteristic to be significant for each of the three demographic characteristics so that the models examining demographics were stratified by smoking status. Time trends in the prevalence of depression within each demographic by smoking status group were tested using logistic regression with continuous year to test a linear time trend without and with controlling for the other demographic variables. Differential time trends in depression between demographic categories were tested by two-way interactions of year X demographic variable in logistic regressions stratified by smoking status. In addition, differential time trends in depression between smoking statuses were tested by two-way interactions of year X smoking status (Current vs. Never, Current vs. Former) in logistic regressions stratified by demographic variables. Year was treated as both continuous (linear trend).

4. RESULTS

4.1 Prevalence of current, former and lifetime never smokers from 2005–2013

The prevalence of current smoking declined significantly from 29.24% in 2005 to 25.24% in 2013 (p<0.0001; see Table 1). The prevalence of former smoking also decreased, albeit at a much slower rate from 37.09% to 36.64%, while the prevalence of lifetime never smoking increased significantly from 33.67% to 38.12% over this time span.

4.2 Prevalence of depression among current, former and lifetime never smokers from 2005–2013

The prevalence of depression increased overall in the population from 2005–2013 (see Table 2). Among current smokers, there was a marginally significant increase in depression during this time period (9.97% to 10.45%, p=0.0335). Unexpectedly, among former smokers and lifetime never smokers, the prevalence of depression increased significantly over time (5.37% to 6.59%, p=0.0002; 5.09% to 5.51%, p=0.0003, respectively). The increasing linear trends across the different smoking groups were not significantly different between current smokers versus never smokers (interaction year X smoking p-value = 0.1206) or between

current smokers versus former smokers (interaction year X smoking p-value = 0.0756). The prevalence of depression remained approximately twice as high for current smokers as among former and never smokers across the time period.

4.3 Prevalence of depression among current, former and lifetime never smokers by age from 2005–2013

The prevalence of depression among current smokers aged 12–17 significantly and substantially increased from 2005 to 2013 (15.98% to 22.42%, p=0.0002). There were no changes in depression among current smokers over age 17 from 2005–2013. Among current smokers, trends did not differ by age and smoking status (interaction year X age, p-value = 0.2314). Among those aged 12–17, current smokers had a prevalence of depression that was more than twice the prevalence of depression among lifetime never smokers (Table 3).

Among former smokers, the prevalence of depression was consistently highest among 12–17 year olds, compared with older age groups, and there were no significant changes in depression among 12–17 year old former smokers over time. The prevalence of depression increased among former smokers over age 50 from 2005 to 2013 (3.37% to 5.48%, p=0.0010). Among former smokers, these trends did not differ by age group over time (interaction year X age, p-value = 0.1952).

The prevalence of depression was considerably lower among lifetime never smokers, compared with former and current smokers. Significant increases, however, in depression were observed among lifetime never smokers under age 26; this trend was significantly different than the trend found among those over age 26 (interaction year X age, p-value = 0.0407). Among those 50 and older, depression trends among current smokers compared with former smokers were significantly different (interaction year X current smokers vs. former smokers, p-value = 0.0271).

However, among those ages 26 and under, there was no significant interaction between smoking group and age group (interaction year X current smokers versus never smokers, p-value = 0.5656 for age 12–17, p-value = 0.1271 for age 18–25, p-value = 0.8378 for age 26–34, p-value = 0.1298 for age 35–49; interaction year X current smokers versus former smokers, p-value = 0.5460 for age 12–17, p-value = 0.8645 for age 18–25, p-value = 0.7921 for age 26–34, p-value = 0.8988 for age 35–49).

4.4 Prevalence of depression among current, former and lifetime never smokers by gender from 2005–2013

The prevalence of depression increased significantly among male smokers over time (6.19% to 7.82%, p=0.0099) while there was no significant change in the prevalence of depression for female smokers (see Table 4); these trends were significantly different from one another (interaction year X gender, p-value = 0.0547). There was a significant increase in depression among both male and female former smokers from 2005 to 2013. There was a significant increase in depression among female never smokers from 2005 to 2013 and no change among male never smokers. Among women, the trends by current smokers versus never smokers were significantly different from one another (interaction year X current smokers vs. never smokers, p-value = 0.0335), but no differences were observed among men. The

prevalence of depression was approximately twice as high for women than men in each of the three smoking groups (current, former, never).

4.5 Prevalence of depression among current, former and lifetime never smoker by income from 2005–2013

The prevalence of depression increased among current smokers in the highest income group from 2005–2013 (see Table 5). There were also increases in depression among former smokers in the low and middle-income groups and among the lowest and highest income groups among lifetime never smokers. There was no differential trend in prevalence of smoking by income category among current or former smokers. Within the lowest income group, there were significantly different trends related to depression prevalence over time for current smokers compared with former smokers (unadjusted analyses, interaction year X current smokers vs. former smokers, p-value =0.0282); the interaction emerged as non-significant across all other income groups. There were no significant differences in depression prevalence over time by smoking group in the other income groups. The prevalence of depression in the lowest income group was consistently approximately twice as high among current smokers compared with never smokers.

5. DISCUSSION

The overarching goal of this study was to investigate the relationship between depression and cigarette use in the U.S. from 2005 and 2013 by smoking status overall and by age, gender and income. The study had three main findings. First, there was not a significant increase in depression among current smokers per se from 2005 to 2013. Depression increased among all groups from 2005 to 2013. Although depression increased among current smokers, the increases among former and never smokers were more pronounced. Second, despite these differing trends, depression remained consistently twice as prevalent among current smokers as among former and never smokers. Third, there were significant increases in depression from 2005 to 2013 by age, gender and income subgroups of smokers. Specifically, (1) the prevalence of depression in current smokers ages 12–17 increased significantly and substantially over this period (16% to 22%); (2) depression increased among male, but not female, smokers from 2005 to 2013; (3) while the highest prevalence of depression was found for the lowest income group, significant increases in depression from 2005 to 2013 were detected among current smokers in the highest income group, but not the lower income levels.

Overall, the prevalence of depression among current smokers remained relatively stable over this time period, with a slight increase, and was observed at nearly twice the rate of that for former and never smokers. Therefore, the findings are not supportive of our central hypothesis that depression increased disproportionately among smokers overall from 2005 to 2013. Although there was not a substantial increase in depression among current smokers in the general population, there were increases in depression among subgroups—many of whom are newer smokers and among whom quitting has been more substantial (e.g., high income). Such data suggest that while the trend in increased depression is not evident

overall, increases in depression among certain subgroups could be contributing to the stability of smoking rates over time.

Whereas a marginally significant increase in depression emerged among current smokers, a significant increase emerged for former and never smokers. The prevalence of depression among former and never smokers demonstrated a greater increase over time, yet remains low relative to current smokers. The observed increase of depression among former and never smokers aligns and extends previously reported upward national trends for the prevalence of depression in the U.S. nearly ten years ago (Compton et al., 2006). Together, the present findings corroborate prior research that posits higher rates of depression among current smokers relative to non-smokers but we do not observe a prominent, significant increase in depression among smokers during this time period.

Within the youngest age group (12–17 year olds), the prevalence of depression markedly and significantly increased from 15.98% in 2005 to 22.42% in 2013, which translates to more than one in five current smoking youth experiencing depression in 2013. As such, this group is a particularly vulnerable subgroup of the smoking population. Indeed, the majority of adults (88%) who become daily, lifelong smokers use their first cigarette before age 18 (US Department of Health and Human Services, 2012). The elevated prevalence of depression experienced by this group may intensify the challenges they may experience when trying to quit, as depressed mood poses a major challenge and barrier to quit success (Anda et al., 1990; Leventhal et al., 2014). Current smokers exhibited a markedly higher rate of depression relative to never smokers. Indeed, prevalence of depression among 12–17-year-old current smokers was consistently more than twice that of 12–17-year-old never smokers. Consideration of these findings suggests that young smokers are an important subgroup of smokers to target. Using these data, we cannot gain insight into the mechanism of this relationship, but given that over one in five youth who identify as a current smoker meet criteria for depression, it may be useful to include smoking in youth depression screens and intervention programs. Although current data do not permit explication of a causal effect between smoking and depression, numerous studies suggest that smoking is associated with increased risk of the onset (Fergusson et al., 2003) and persistence (Bakhshaie et al., 2015) of depression, though the direction of effect cannot be examined here and while some data suggest depression is associated with smoking relapse (Zvolensky et al., 2015) other studies suggest no link between depression and relapse to smoking (Taylor et al., 2015). A nearly equal number of studies (Fluharty et al. 2016) suggest the reverse pathway (Taylor et al., 2014); the relation appears to be bi-directional and possible mechanisms are not well understood (Goodwin (In Press). To ensure timely and effective prevention and treatment efforts, additional work should focus on elucidating targetable underlying factors associated with both forms of the smoking-depression relation.

Among smokers, an increase in depression was observed among men, but not women. This finding provides initial evidence that the depression prevalence disparity between men and women smokers may be closing. Until recent decades, women have disproportionately encountered greater quit difficulties and lower cessation rates relative to men (US Department of Health and Human Services, 2001). Recent data suggest that tobacco-related inequality, including quit success, have balanced to be nearly equivalent across men and

women. The increase in depression across male smokers may be a byproduct of the decreased tobacco-related inequality across sexes. It should be noted, however, that both men and women continue to combat unique sex-specific tobacco-related health consequences and challenges (U. S. Department of Health and Human Services, 2014). In addition to an increase in depression across current male smokers, the prevalence of depression increased in both male and female former smokers, as well as among female never smokers. These findings are somewhat unexpected and would appear to be important targets for future study. Together, findings suggest that there are several significant differences in trends in depression by gender over time that are revealed when examining changes by smoking status. Interestingly, major depression appears to have significantly increased among women (never smokers) over the past decade. Additionally, depression appears to be increased in both male and female former smokers. Former smokers are a heterogenous group at least in terms of smoking history, but they are growing in prevalence and comprise and increasing proportion of the US population. As such, this result also warrants future inquiry.

Depression significantly increased from 2005 to 2013 among smokers in the highest income bracket. This upward trend in depression is consistent with the hypotheses that an increase in depression would be observed in the highest income group since rates of smoking have declined most rapidly in this group (vs. lower income groups) (Hiscock et al., 2012)). Thus, the increase in depression among smokers in the highest income bracket may reflect that depression is a barrier to quitting in groups with highest rates of decline.

While the prevalence of depression increased over time in the highest income bracket, in general, the prevalence of depression was highest among smokers in the lowest income bracket (<$20,000/year). Relative to their never smoking counterparts, depression was nearly twice as common among low-income smokers. This finding is particularly alarming because income inequality is linked to worse health outcomes generally (Braveman et al., 2010; Martinson, 2012) and the additive negative impact of cigarette use may exacerbate existing health conditions, which are likely already compromised. Lower income smokers tend to have greater challenges in quitting and lower quit success rates relative to smokers from higher income brackets (Hiscock et al., 2012), though this is also somewhat counterintuitive given the high and increasing price of cigarettes resulting from tobacco control efforts. This observation may be partly explained by low rates of, or limited, health insurance coverage and a lack of access to health care (Adler and Newman, 2002; Andrulis, 1998); yet, given the higher prevalence of depression among lower income smokers relative to higher income smokers in the current study, depressive symptoms may be another factor that disproportionately impacts tobacco-related health disparities among socioeconomically disadvantaged smokers (Kanjilal et al., 2006; Reitzel et al., 2013).

The present study has several limitations. First, despite the consecutive annual survey methodology, the present study is more associative/descriptive than predictive and does not elucidate the predictive value of demographic characteristics or smoking on depressive symptoms over time. A useful next step in this line of work would be to longitudinally examine the impact of demographics and smoking use on depression, particularly among those more vulnerable to depression including younger, male, and lower income smokers.

Second, the current study focused on select demographic variables and on only one mood disorder, and therefore, findings cannot be extrapolated to other demographic variables or other disorders. Accordingly, further evaluation of the associations between different demographic variables (e.g., race/ethnicity, sexual orientation) across smoking categories and other mood disorders (e.g., bipolar disorder), or other disorders (e.g., anxiety disorders, psychotic disorders, obsessive-compulsive disorders), would be advisable. Finally, depression symptomatology was not homogeneous across the sample, which may have partly contributed to some counterintuitive findings. Examining the impact of heterogeneous symptoms clusters on outcomes is a growing area of work interest. Thus, future research might focus on how heterogeneous depressive symptoms dimensions or clusters relate to smoking and demographic characteristics over time.

Although depression did not increase disproportionately among current smokers relative to former and never smokers as initially hypothesized, critical increases in depression trends were identified among specific population subgroups. These subgroups may be contributing to the slowed decline in smoking overall. It would be beneficial to understand the association between depression and smoking in these subgroups and to direct prevention and intervention efforts toward improving long-term mental and physical health. Importantly, and unexpectedly, the study suggests that depression is increasing significantly in the US population over the past decade. This is an alarming finding that warrants future research both on its own and as it relates to cigarette use and other common comorbid behaviors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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- Depression was twice as high among smokers as past or non-smokers from 2005–2013.

- Depression did not significantly increase overall for current smokers over time.

- Depression did increase significantly for demographic subgroups of current smokers.

- Depression increased most among highest-income daily, young, and male smokers.
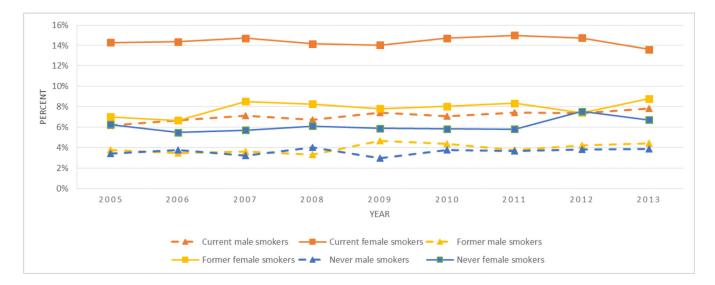
Figure 1.
Changes in past year depression with smoking status by gender (NSDUH, 2005–2013, aged 12+)
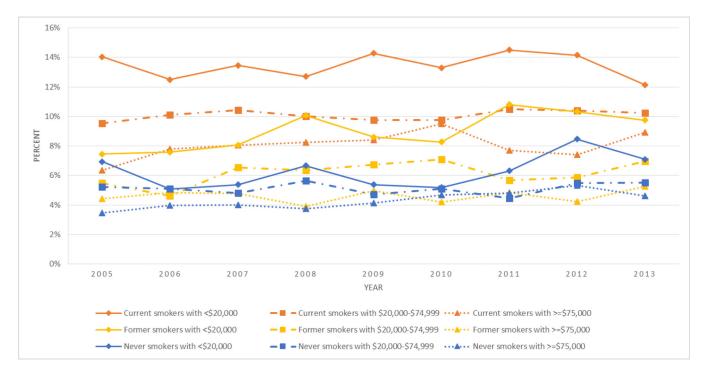
Figure 2.
Changes in past year depression with smoking status by family income (NSDUH, 2005–2013, aged 12+)

Table 1

Prevalence of three smoking categories for each year between 2005 – 2013 (NSDUH, aged 12+)

Smoking Status	2005*	2006	2007	2008	2009	2010	2011	2012	2013	Linear Trend	
										Unadjusted OR[b](95%CI)	t-test(p-value)
	Prevalence of smoking in 3 categories (%, s.e.)										
Total sample (N)	55,905	55,279	55,435	55,110	55,234	57,313	58,397	55,268	55,160		
Current smokers[a](n)	18,427	17,822	17,571	17,299	17,229	17,181	17,004	15,791	15,124		
%	29.24	29.14	28.31	27.97	27.85	27.17	26.01	26.12	25.24	0.97(0.97,0.98)	t=−11.38(<0.0001)
s.e.	(0.35)	(0.36)	(0.33)	(0.43)	(0.36)	(0.35)	(0.36)	(0.35)	(0.31)		
Former smokers(n)	13,246	13,044	12,859	12,549	12,403	12,975	12,760	12,090	12,028		
%	37.09	37.06	36.95	37.17	36.97	37.14	36.73	35.8	36.64	1.00(0.99,1.00)	t=−2.12(0.0382)
s.e.	(0.45)	(0.39)	(0.37)	(0.49)	(0.40)	(0.32)	(0.46)	(0.40)	(0.36)		
Never smokers(n)	24,232	24,413	25,005	25,262	25,602	27,157	28,633	27,387	28,008		
%	33.67	33.8	34.74	34.86	35.18	35.69	37.26	38.08	38.12	1.03(1.02,1.03)	t=13.23(<0.0001)
s.e.	(0.40)	(0.38)	(0.36)	(0.47)	(0.36)	(0.36)	(0.39)	(0.36)	(0.37)		

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 each smoking category to increase/decrease during 2005–2013, and t tests showed the significance of time trends.

[a] who smoked in the past 12 months

[b] Odds ratios are for current smokers versus all other categories; former smokers versus all other categories; never smokers versus all other categories.

* 2005 as a reference year

s.e. - standard error

CI, confidence interval; OR, odds ratio; NSDUH, National Survey on Drug Use and Health; s.e., standard error

Table 2

Prevalence of depression in past year for age 12+ among current, former and never smokers (NSDUH, 2005–2013)

Smoking status	Total	2005*	2006	2007	2008	2009	2010	2011	2012	2013	Linear Trend			
		Prevalence of depression in past year (%, s.e.)									Unadjusted OR (95%CI)	t-test (p-value)	Adjusted OR[b,c] (95%CI)	t-test (p-value)
Total n of past year depression	41,148	4,700	4,266	4,438	4,372	4,509	4,570	4,662	4,764	4,867				
Total % of past year depression	6.87	6.62	6.47	6.86	6.82	6.87	6.94	6.88	7.16	7.16				
s.e.	(0.06)	(0.22)	(0.18)	(0.18)	(0.20)	(0.20)	(0.19)	(0.19)	(0.20)	(0.20)	**1.01** **(1.00, 1.02)**	**t=2.83** **(0.0064)**	**1.02** **(1.01, 1.02)**	**t=3.93** **(0.0002)**
Current smokers[a] (n)	17,691	2,183	1,958	2,002	1,874	2,024	1,996	1,940	1,884	1,830				
(%)	10.46	9.97	10.21	10.6	10.19	10.51	10.59	10.94	10.73	10.45				
s.e.	(0.14)	(0.39)	(0.35)	(0.41)	(0.36)	(0.41)	(0.44)	(0.42)	(0.39)	(0.41)	1.01 (1.00, 1.02)	t=1.47 (0.1457)	**1.01** **(1.00, 1.02)**	**t=2.18** **(0.0335)**
Former smokers (n)	8,776	1,036	935	999	975	945	983	987	920	996				
(%)	5.90	5.37	5.08	6.06	5.78	6.23	6.15	5.99	5.79	6.59				
s.e.	(0.10)	(0.28)	(0.28)	(0.30)	(0.36)	(0.37)	(0.33)	(0.28)	(0.35)	(0.37)	**1.02** **(1.01, 1.04)**	**t=3.01** **(0.0038)**	**1.03** **(1.01, 1.04)**	**t=4.00** **(0.0002)**
Never smokers (n)	14,681	1,481	1,373	1,437	1,523	1,540	1,591	1,735	1,960	2,041				
(%)	5.12	5.09	4.78	4.67	5.24	4.66	4.98	4.94	6.01	5.51				
s.e.	(0.09)	(0.31)	(0.25)	(0.22)	(0.28)	(0.22)	(0.21)	(0.20)	(0.24)	(0.28)	**1.02** **(1.01, 1.03)**	**t=3.33** **(0.0015)**	**1.02** **(1.01, 1.04)**	**t=3.88** **(0.0003)**
Differential time trend: year × smoking status (current vs. never smokers)											F(1)=2.50(0.1193)		F(1)=2.48(0.1206)	
Differential time trend: year×smoking status (current vs. former smokers)											F(1)=2.41(0.1259)		F(1)=3.27(0.0756)	

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 to increase/decrease during 2005–2013, and t tests showed the significance of time trends.

[a] who smoked in the past 12 months

[b] Odds ratios are for past year depression versus no past year depression.

[c] Adjusted models: were adjusted for age (12–17, 18–25, 26–34, 34–49, 50+ or older), gender (male, female) & income (<$20,000, $20,000–$74,999, >=$75,000).

* 2005 as a reference year

s.e. - standard error

CI, confidence interval; OR, odds ratio; NSDUH, National Survey on Drug Use and Health; s.e., standard error

Table 3

Prevalence of depression in past year among current, former and never smokers stratified by age (NSDUH, 2005–2013, aged 12+)

Age	2005*	2006	2007	2008	2009	2010	2011	2012	2013	Linear Trend			
										Unadjusted OR (95%CI)	t-test (p-value)	Adjusted OR[b,c] (95%CI)	t-test (p-value)
	Prevalence of depression in past year stratified by age (%, s.e.)												
Current smokers[a]													
12–17 (%)	15.98	14.32	16.07	15.93	15.59	16.23	15.73	16.51	22.42	**1.03 (1.01,1.05)**	**t=3.33 (0.0015)**	**1.04 (1.02, 1.06)**	**t=4.03 (0.0002)**
s.e.	(1.03)	(0.89)	(0.86)	(0.92)	(0.94)	(0.97)	(0.82)	(1.06)	(1.39)				
18–25 (%)	11.04	10.11	9.70	9.80	10.44	10.71	10.11	11.10	10.73	1.01 (0.99, 1.02)	t=0.81 (0.4200)	1.01 (1.00, 1.03)	t=1.42 (0.1617)
s.e.	(0.52)	(0.43)	(0.36)	(0.43)	(0.49)	(0.38)	(0.43)	(0.49)	(0.48)				
26 – 34 (%)	10.13	10.72	10.57	10.5	10.5	9.03	11.77	10.76	10.76	1.01 (0.98, 1.03)	t=0.58 (0.5665)	1.01 (0.98, 1.03)	t=0.54 (0.5885)
s.e.	(0.91)	(0.80)	(0.87)	(0.80)	(0.85)	(0.77)	(1.09)	(0.82)	(0.91)				
35–49 (%)	10.1	10.37	11.65	11.33	11.56	12.43	12.15	11.77	11.32	1.02 (1.00, 1.04)	t=1.85 (0.0690)	1.02 (1.00, 1.04)	t=1.87 (0.0665)
s.e.	(0.72)	(0.62)	(0.71)	(0.74)	(0.85)	(0.87)	(0.87)	(0.88)	(0.81)				
50 or older (%)	7.02	8.65	8.98	7.75	8.4	8.74	8.91	8.54	7.54	1.00 (0.97, 1.04)	t=0.28 (0.7814)	1.00 (0.97, 1.04)	t=0.04 (0.9654)
s.e.	(0.96)	(0.86)	(1.13)	(1.06)	(0.91)	(0.98)	(1.03)	(0.87)	(0.87)				
Differential time trend among current smokers: year as continuous×age groups										F(2)=2.43(0.0963)		F(4)=1.44(0.2314)	
Former smokers													
12–17 (%)	13.26	11.76	14.10	13.48	13.57	15.22	12.40	13.60	15.55	1.02 (0.99, 1.05)	t=1.24 (0.2195)	1.03 (1.00, 1.06)	t=1.70 (0.0948)
s.e.	(0.87)	(0.98)	(1.10)	(1.40)	(1.34)	(1.24)	(1.26)	(1.49)	(1.47)				
18–25 (%)	7.91	7.33	8.39	9.07	6.65	7.48	7.98	8.25	9.44	1.01 (0.99, 1.04)	t=1.29 (0.2009)	1.01 (0.99, 1.04)	t=1.13 (0.2620)
s.e.	(0.60)	(0.64)	(0.61)	(0.56)	(0.55)	(0.55)	(0.58)	(0.72)	(0.76)				
26–34 (%)	7.36	6.96	7.41	6.38	7.42	6.45	6.44	6.32	8.32	1.00 (0.96, 1.04)	t=−0.00 (1.0000)	1.00 (0.96, 1.04)	t=0.04 (0.9695)
s.e.	(0.85)	(0.76)	(0.91)	(0.64)	(0.78)	(0.60)	(0.86)	(0.72)	(1.00)				
35–49 (%)	6.51	5.56	6.52	6.16	6.59	6.26	7.69	6.05	7.00	1.02 (0.99, 1.04)	t=1.38 (0.1719)	1.02 (0.99, 1.0)	t=1.45 (0.1512)
s.e.	(0.45)	(0.62)	(0.53)	(0.54)	(0.56)	(0.57)	(0.53)	(0.52)	(0.73)				
50 or older (%)	3.37	3.69	4.79	4.66	5.41	5.56	4.63	5.03	5.48	**1.05 (1.02, 1.08)**	**t=3.21 (0.0021)**	**1.05 (1.02, 1.08)**	**t=3.46 (0.0010)**
s.e.	(0.38)	(0.40)	(0.47)	(0.55)	(0.57)	(0.58)	(0.43)	(0.56)	(0.47)				
Differential time trend among former smokers: year as continuous × age groups										F(2)=0.52(0.5956)		F(4)=1.57(0.1952)	

Age	2005*	2006	2007	2008	2009	2010	2011	2012	2013	Unadjusted OR (95%CI)	t-test (p-value)	Adjusted OR[b,c] (95%CI)	t-test (p-value)
				Prevalence of depression in past year stratified by age (%, s.e.)								Linear Trend	
Never smokers													
12–17 (%)	6.39	6.04	6.00	6.47	6.14	6.04	6.79	7.93	8.86	**1.05 (1.03, 1.06)**	**t=6.27 (0.0000)**	**1.05 (1.03,1.06)**	**t=6.17 (0.0000)**
s.e.	(0.31)	(0.32)	(0.26)	(0.28)	(0.32)	(0.25)	(0.27)	(0.27)	(0.36)				
18–25 (%)	6.06	5.35	5.94	6.67	5.79	6.3	6.35	7.2	7.01	**1.03 (1.01, 1.04)**	**t=3.74 (0.0004)**	**1.03 (1.01, 1.04)**	**t=3.60 (0.0007)**
s.e.	(0.52)	(0.32)	(0.41)	(0.48)	(0.32)	(0.42)	(0.37)	(0.48)	(0.32)				
26–34 (%)	3.84	5.76	3.94	5.21	4.97	5.27	4.58	5.13	4.63	1.01 (0.97,1.05)	t=0.46 (0.6493)	1.01 (0.97, 1.05)	t=0.49 (0.6241)
s.e.	(0.60)	(0.72)	(0.57)	(0.92)	(0.63)	(0.61)	(0.63)	(0.68)	(0.68)				
35–49 (%)	5.17	5.66	4.75	5.76	4.56	4.58	5.24	5.63	4.38	0.99 (0.96,1.02)	t=−0.76 (0.4530)	0.99 (0.96, 1.02)	t=−0.72 (0.4760)
s.e.	(0.65)	(0.73)	(0.52)	(0.65)	(0.55)	(0.56)	(0.53)	(0.60)	(0.54)				
50 or older (%)	4.19	2.6	3.37	3.4	3.13	3.86	3.13	4.85	3.73	1.03 (0.99,1.07)	t=1.34 (0.1865)	1.03 (0.99,1.07)	1.68 (0.0989)
s.e.	(0.77)	(0.44)	(0.54)	(0.59)	(0.55)	(0.50)	(0.44)	(0.59)	(0.62)				
Differential time trend among never smokers: year as continuous × age groups										**F(2)=3.88(0.0259)**		**F(4)=2.67(0.0407)**	
Differential time trend: year as continuous × smoking (current vs. never smokers; current vs. former smokers) among each age category										Unadjusted		Adjusted	
Differential time trend among 12–17 years old: year × smoking (current vs. never smokers)										F(1)=1.14(0.2908)		F(1)=0.33(0.5656)	
Differential time trend among 18–25 years old: year × smoking (current vs. never smokers)										**F(1)=4.32(0.0420)**		F(1)=2.39(0.1271)	
Differential time trend among 26–34 years old: year × smoking (current vs. never smokers)										F(1)=0.02(0.8846)		F(1)=0.04(0.8378)	
Differential time trend among 35–49 years old: year × smoking (current vs. never smokers)										F(1)=2.57(0.1144)		F(1)=2.36(0.1298)	
Differential time trend among 50+ or older: year × smoking (current vs. never smokers)										F(1)=0.77(0.3829)		F(1)=2.04(0.1586)	
Differential time trend among 12–17 years old: year × smoking (current vs. former smokers)										F(1)=0.58(0.4507)		F(1)=0.37(0.5460)	
Differential time trend among 18–25 years old: year × smoking (current vs. former smokers)										F(1)=0.38(0.5389)		F(1)=0.03(0.8645)	
Differential time trend among 26–34 years old: year × smoking (current vs. former smokers)										F(1)=0.08(0.7786)		F(1)=0.07(0.7921)	
Differential time trend among 35–49: year × smoking (current vs. former smokers)										F(1)=0.04(0.8356)		F(1)=0.02(0.8988)	
Differential time trend among 50+ or older: year × smoking (current vs. former smokers)										F(1)=3.56(0.0642)		**F(1)=5.13(0.0271)**	

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 age to increase/decrease during 2005–2013, and t tests showed the significance of time trends.

[a] who smoked in the past 12 months

[b] Odds ratios are for past year depression versus no past year depression.

[c] Adjusted models: were adjusted for gender (male, female) and income (<$20,000, $20,000–$74,999, >=$75,000).

*
2005 as a reference year

s.e. - standard error

CI, confidence interval; OR, odds ratio; NSDUH, National Survey on Drug Use and Health; s.e., standard error

Table 4

Prevalence of depression in past year among current, former and never smokers stratified by gender (NSDUH, 2005–2013, aged 12+)

Gender	2005*	2006	2007	2008	2009	2010	2011	2012	2013	Linear Trend			
										Unadjusted OR (95%CI)	t-test (p-value)	Adjusted OR[b,c] (95%CI)	t-test (p-value)
	Prevalence of depression in past year stratified by gender (%, s.e.)												
Current smokers[a]													
Male (%)	6.19	6.70	7.16	6.76	7.42	7.10	7.44	7.38	7.82	**1.02 (1.01, 1.04)**	**t=2.74 (0.0081)**	**1.02 (1.01, 1.04)**	**t=2.66 (0.0099)**
s.e.	(0.42)	(0.45)	(0.55)	(0.44)	(0.49)	(0.47)	(0.50)	(0.45)	(0.61)				
Female (%)	14.29	14.36	14.70	14.17	14.03	14.70	15.00	14.73	13.60	1.00 (0.99, 1.01)	t=-0.08 (0.9392)	1.00 (0.99, 1.02)	t=0.69 (0.4913)
s.e.	(0.60)	(0.55)	(0.60)	(0.62)	(0.65)	(0.72)	(0.67)	(0.63)	(0.76)				
Differential time trend among current smokers: year as continuous × gender										**F(1)=5.14(0.0270)**		F(1)=3.84(0.0547)	
Former smokers													
Male (%)	3.78	3.50	3.65	3.31	4.68	4.36	3.79	4.22	4.42	**1.03 (1.00, 1.05)**	**t=2.09 (0.0413)**	**1.03 (1.00, 1.06)**	**t=2.59 (0.0122)**
s.e.	(0.35)	(0.33)	(0.32)	(0.32)	(0.41)	(0.40)	(0.32)	(0.51)	(0.40)				
Female (%)	7.03	6.68	8.53	8.28	7.83	8.06	8.35	7.42	8.79	**1.02 (1.00, 1.04)**	**t=2.22 (0.0304)**	**1.03 (1.01, 1.05)**	**t=3.05 (0.0034)**
s.e.	(0.49)	(0.46)	(0.55)	(0.69)	(0.65)	(0.58)	(0.54)	(0.50)	(0.54)				
Differential time trend among former smokers: year as continuous × gender										F(1)=0.17(0.6793)		F(1)=0.17(0.6801)	
Never smokers													
Male (%)	3.41	3.78	3.21	4.03	2.99	3.77	3.70	3.85	3.88	1.01 (0.99, 1.04)	t=1.18 (0.2412)	1.02 (1.00, 1.04)	t=1.71 (0.0930)
s.e.	(0.28)	(0.36)	(0.28)	(0.36)	(0.28)	(0.33)	(0.35)	(0.32)	(0.41)				
Female (%)	6.28	5.49	5.73	6.13	5.89	5.84	5.82	7.56	6.73	**1.02 (1.01, 1.04)**	**t=3.37 (0.0013)**	**1.03 (1.01, 1.04)**	**t=3.63 (0.0006)**
s.e.	(0.42)	(0.32)	(0.31)	(0.40)	(0.39)	(0.31)	(0.32)	(0.38)	(0.38)				
Differential time trend among never smokers: year as continuous × gender										F(1)=0.56(0.4572)		F(1)=0.19(0.6668)	
Differential time trend: year as continuous × smoking (current vs. never smokers; current vs. former smokers among each gender category										Unadjusted		Adjusted	
Differential time trend among male: year × smoking (current vs. never smokers)										F(1)=0.62(0.4347)		F(1)=0.12(0.7281)	
Differential time trend among female: year × smoking (current vs. never smokers)										**F(1)=6.18(0.0157)**		**F(1)=4.74(0.0335)**	
Differential time trend among male: year × smoking (current vs. former smokers)										F(1)=0.02(0.8837)		F(1)=0.21(0.6489)	
Differential time trend among female: year × smoking (current vs. former smokers)										F(1)=3.28(0.0752)		F(1)=3.55(0.0644)	

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 gender to increase/decrease during 2005–2013, and t tests showed the significance of time trends.

[a] who smoked in the past 12 months

[b] Odds ratios are for past year depression versus no past year depression.

[c] Adjusted models: were adjusted for age (12–17, 18–25, 26–34, 34–49, 50+ or older) & income (<$20,000, $20,000–$74,999, >=$75,000).

[*] 2005 as a reference year

s.e. – standard error

CI, confidence interval; NSDUH, National Survey on Drug Use and Health; OR, odds ratio; s.e., standard error

Table 5

Prevalence of depression among current, former and never smokers by family income (NSDUH, 2005–2013, aged 12+)

Family income	2005*	2006	2007	2008	2009	2010	2011	2012	2013	Unadjusted OR (95%CI)	t-test (p-value)	Adjusted OR[b,c] (95%CI)	t-test (p-value)
										Linear Trend			
Current smokers[a]	Prevalence of depression in past year stratified by family income (%, s.e.)												
<$20,000 (%)	14.04	12.49	13.45	12.70	14.27	13.30	14.50	14.14	12.14	1.00 (0.98,1.02)	t=0.02 (0.9826)	1.00 (0.98,1.02)	t=0.36 (0.7212)
s.e.	(0.71)	(0.84)	(0.94)	(0.92)	(0.93)	(0.86)	(1.05)	(0.84)	(0.71)				
$20,000–$74,999 (%)	9.54	10.12	10.43	10.02	9.76	9.74	10.50	10.41	10.25	1.01 (0.99,1.02)	t=0.84 (0.4039)	1.01 (1.00,1.03)	t=1.50 (0.1378)
s.e.	(0.55)	(0.39)	(0.57)	(0.52)	(0.51)	(0.57)	(0.55)	(0.60)	(0.64)				
>=$75,000 (%)	6.36	7.78	8.06	8.25	8.41	9.48	7.71	7.42	8.91	1.02 (1.00,1.05)	t=1.73 (0.0893)	**1.03 (1.00,1.05)**	**t=2.10 (0.0400)**
s.e.	(0.63)	(0.76)	(0.84)	(0.68)	(0.78)	(0.78)	(0.69)	(0.71)	(0.73)				
Differential time trend among current smokers: year as continuous×family income										F(2)=1.11(0.3371)		F(2)=0.91(0.4061)	
Former smokers													
<$20,000 (%)	7.45	7.58	8.06	10.06	8.61	8.27	10.81	10.33	9.75	**1.04 (1.01,1.08)**	**t=2.51 (0.0147)**	**1.05 (1.01,1.08)**	**t=2.51 (0.0149)**
s.e.	(0.74)	(0.87)	(1.04)	(1.32)	(0.99)	(1.02)	(1.10)	(0.92)	(0.91)				
$20,000–$74,999 (%)	5.49	4.62	6.54	6.34	6.73	7.09	5.67	5.87	6.95	**1.03 (1.00,1.05)**	**t=2.32 (0.0237)**	**1.03 (1.01,1.06)**	**t=2.92 (0.0049)**
s.e.	(0.42)	(0.36)	(0.42)	(0.56)	(0.54)	(0.48)	(0.37)	(0.46)	(0.53)				
>=$75,000 (%)	4.43	4.84	4.77	3.90	4.96	4.21	4.85	4.23	5.27	1.01 (0.98,1.04)	t=0.56 (0.5797)	1.01 (0.98,1.05)	t=0.89 (0.3763)
s.e.	(0.49)	(0.47)	(0.40)	(0.41)	(0.55)	(0.47)	(0.46)	(0.54)	(0.54)				
Differential time trend among former smokers: year as continuous×family income										F(2)=1.13(0.3299)		F(2)=0.82(0.4447)	
Never smokers													
<$20,000 (%)	6.93	5.07	5.38	6.66	5.38	5.19	6.30	8.46	7.10	**1.03 (1.00,1.07)**	**t=2.14 (0.0364)**	1.03 (1.00,1.06)	t=1.99 (0.0513)
s.e.	(0.85)	(0.54)	(0.53)	(0.80)	(0.48)	(0.48)	(0.69)	(0.88)	(0.78)				
$20,000–$74,999 (%)	5.21	5.10	4.80	5.63	4.71	5.08	4.46	5.49	5.52	1.00 (0.99,1.02)	t=0.47 (0.6384)	1.01 (0.99,1.03)	t=0.72 (0.4749)
s.e.	(0.38)	(0.39)	(0.32)	(0.42)	(0.33)	(0.36)	(0.34)	(0.37)	(0.39)				
>=$75,000 (%)	3.45	3.96	4.00	3.76	4.14	4.68	4.79	5.31	4.61	**1.05 (1.02,1.07)**	**t=4.02 (0.0002)**	**1.05 (1.03,1.08)**	**t=4.54 (<0.0001)**
s.e.	(0.41)	(0.40)	(0.43)	(0.35)	(0.42)	(0.49)	(0.37)	(0.48)	(0.36)				
Differential time trend among never smokers: year as continuous×family income										**F(2)=4.10(0.0214)**		**F(2)=4.48(0.0153)**	

Family income	2005*	2006	2007	2008	2009	2010	2011	2012	2013	Linear Trend			
										Unadjusted OR (95%CI)	t-test (p-value)	Adjusted OR^{b,c} (95%CI)	t-test (p-value)
Prevalence of depression in past year stratified by family income (%, s.e.)										Unadjusted		Adjusted	
Differential time trend: year as continuous×smoking (current vs. never smokers: current vs. former smokers) among each family income category													
Differential time trend among <$20,000: year×smoking (current vs. never smokers)										F(1)=2.60(0.1124)		F(1)=1.84(0.1804)	
Differential time trend among $20,000–74,999: year×smoking (current vs. never smokers)										F(1)=0.03(0.8584)		F(1)=0.13(0.7213)	
Differential time trend among >=75,000: year×smoking (current vs. never smokers)										F(1)=2.03(0.1593)		F(1)=2.46(0.1220)	
Differential time trend among <$20,000: year×smoking (current vs. former smokers)										**F(1)=5.06(0.0282)**		F(1)=3.96(0.0512)	
Differential time trend among $20,000–74,999: year×smoking (current vs. former smokers)										F(1)=2.25(0.1389)		F(1)=2.32(0.1332)	
Differential time trend among >=75,000: year×smoking (current vs. former smokers)										F(1)=0.34(0.5623)		F(1)=0.41(0.5266)	

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 family income to increase/decrease during 2005–2013, and t tests showed the significance of time trends.

^{a}who smoked in the past 12 months

^{b}Odds ratios are for past year depression versus no past year depression.

^{c}Adjusted models: were adjusted for age (12–17, 18–25, 26–34, 34–49, 50+ or older) and gender (male, female).

*
2005 as a reference year

s.e. - standard error

CI, confidence interval; OR, odds ratio; NSDUH, National Survey on Drug Use and Health; s.e., standard error