Predictors of persistent nicotine dependence among adults in the United States

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Abstract

Background—Evidence suggests that nicotine dependence is the key barrier to successful smoking cessation. No previous study has documented predictors of persistent nicotine dependence among adults in the community. The goal of this study is to prospectively identify predictors of continued nicotine dependence over a 3-year period among adults.

Methods—Data were drawn from Waves I and II of the National Epidemiologic Survey of Alcohol and Related Conditions (NESARC), a nationally representative sample of 34,653 adults in the United States. Logistic regression analyses were used to estimate the odds of persistent nicotine dependence at Wave 2 given the presence of various sociodemographic and psychiatric predictors at Wave 1.

Results—Mood, anxiety, personality and illicit substance use disorders were associated with significantly increased risk of persistent nicotine dependence. The strength of these relationships was attenuated slightly after adjusting for demographic differences, but remained statistically significant. Persistent nicotine dependence was more common among unmarried, younger females with lower income levels and lower educational attainment.

Conclusions—To our knowledge, this study is the first to prospectively identify predictors of persistent nicotine dependence among adults. Our results suggest that the incorporation of mental health treatment into alternative smoking cessation approaches may help to increase the effectiveness of these programs and that a greater focus of these services on vulnerable segments of the population is needed in order to reduce continued disparities in smoking in the general population.

Keywords

tobacco; nicotine dependence; epidemiology; persistent

1. Introduction

Cigarette smoking is the leading preventable cause of morbidity and premature mortality (Breslau et al., 1993; Bartal, 2001). Smoking has been causally linked with cancer, heart disease and nearly every chronic disease. Every year, 3% of those who smoke stop successfully, while 70% of smokers say they want to quit (Benowitz, 2010). It remains unclear why some people quit smoking and others do not.

Along with psychological constructs such as anxiety sensitivity and distress tolerance, (Brown et al., 2005; Bernstein et al., 2008; Gonzalez et al., 2008; Gregor et al., 2008; Cosci et al., 2009) evidence increasingly suggests that nicotine dependence is a key barrier to successful smoking cessation (Prokhorov et al., 2001; Baker et al., 2007; Tan et al., 2009). Nicotine dependence is defined as addiction to nicotine and is considered a mental disorder by the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (American Psychiatric Association, 1994). As such, improving our understanding of the factors that are associated with persistence of nicotine dependence, compared with those among whom nicotine dependence remits, are essential to identifying those most vulnerable to persistent, dependent cigarette smoking. This is also critical in identifying potentially modifiable risk factors for persistent nicotine dependence in order to develop more effective treatment and prevention strategies.

Several previous studies have examined predictors of persistent cigarette smoking (Johnson et al., 2009). Evidence suggests that early age of onset, parental smoking, peer smoking and lower education predict persistent smoking (Pierce et al., 1989; Escobedo et al., 1996; Gilman et al., 2003; Hu et al., 2006; Lawrence et al., 2007). Previous research has also documented significant associations between psychiatric disorders and persistent smoking (Breslau et al., 1993; Alvarado et al., 2005; Kollins et al., 2005; Hu et al., 2006). Specific psychiatric disorders (e.g., panic, disruptive behavior disorder) have also been associated with increased risk of onset of nicotine dependence in adolescents and the prevalence of nicotine dependence among adults (Isensee et al., 2003; Griesler et al., 2008). Yet, no previous study has documented predictors of persistent nicotine dependence among adults in the general population.

Against this background, our study begins to fill these gaps by addressing three main goals. First, the study investigated the prevalence of persistent nicotine dependence over a 3-year period among adults in the United States. Second, the study investigated demographic predictors of persistent, compared with remitted, nicotine dependence among adults in the United States. Third, the study examined mental health predictors of persistent nicotine dependence.

2. Method

2.1 Participants

The NESARC (Grant et al., 2004b; Grant et al., 2009) is a nationally representative longitudinal survey of the adult non-institutionalized, civilian population of the United States conducted by the United States Census Bureau under the direction of the National Institute on Alcohol Abuse and Alcoholism (NIAAA). Wave 1 was conducted in 2001-2002 with a sample of 43,093 respondents 18 years of age and over (Grant et al., 2003b). Wave 2 was a 3-year prospective follow-up comprising 34,653 of the Wave 1 respondents, representing a response rate of 86.7% of eligible respondents (Grant et al., 2005). In combination with the Wave 1 response rate of 81%, the cumulative response rate for Wave 2 is 70.2%. Trained lay interviewers with at least five years experience conducted face-to-face assessments using computer-assisted software. Informed consent was obtained from all

participants before beginning the interviews. Interviewers retested a random sample of both the Wave 1 and Wave 2 samples in order to assess the reliability of the survey (Grant et al., 2003a; Ruan et al., 2008). Detailed descriptions of methodology, sampling, and weighting procedures have been reported elsewhere (Grant et al., 2003b; Grant et al., 2005).

2.2 Interviewers, Training, and Field Quality Control

Interviewing was conducted by 1,800 professional interviewers from the Census Bureau using computer-assisted software with built-in skip, logic, and consistency checks. All interviewers had experience with other national health-related surveys with an average of five years of experience, and were further trained for 10 days under the direction of NIAAA. Verification of the interviewer was conducted by regional supervisors who re-contacted a random 10% of all respondents for quality control purposes. In addition, a randomly selected subset of respondents was re-interviewed with 1 to 3 complete sections of the Alcohol Use Disorder and Associated Disabilities Interview Schedule – DSM-IV (AUDADIS-IV). This evaluation served as a test-retest reliability study of NESARC measures (Grant et al., 2003a). In the few cases when accuracy was uncertain, the data were discarded and a supervising interviewer repeated the interview.

2.3 Measures

Diagnoses were assessed with the AUDADIS-IV. This instrument was specifically designed for experienced lay interviewers and was developed to advance measurement of substance use and mental disorders in large-scale surveys. Nicotine dependence was assessed in a unique module separate from the assessment of other substance use. Respondents were considered to have ever used cigarettes if they have smoked 100 or more cigarettes during their lifetime. Four other modes of nicotine use were assessed as well: pipe, cigar, snuff, and chewing tobacco use. The test-retest reliability of the nicotine use variables as well as other AUDADIS-IV nicotine use measures (e.g., frequency and duration of use), were excellent, with interclass correlation coefficients of 0.83 to 0.84 (Grant et al., 2003a; Ruan et al., 2008).

Assessment of cigarette use and nicotine dependence was based on the unique characteristics of nicotine dependence as distinct from other substances. To that end, the AUDADIS-IV used an extensive list of over 40 questions to assess nicotine dependence, and obtained extensive information on time frames of nicotine use and dependence. Diagnoses were made according to the DSM-IV criteria (Schmitz et al., 2003). Criteria for nicotine dependence include 3/7 of the following: (1) the need for more nicotine to achieve desired effect; (2) the subject meets the criteria for nicotine withdrawal syndromes; (3) use of tobacco by the subject more than the subject intended; (4) the persistent desire or unsuccessful efforts to cut down on nicotine use; (5) a great deal of time spent using tobacco (e.g., chain smoking); (6) the necessity to give up activities in favor of nicotine use; (7) and continued use despite recurrent physical or psychological problems likely to have been caused by nicotine use. Nicotine withdrawal was assessed as a syndrome as described by the DSM-IV based on four symptoms: (1) the use of nicotine upon waking; (2) the use of nicotine after being in a situation in which nicotine was restricted; (3) the use of nicotine to relieve or avoid withdrawal symptoms; (4) the need to wake up in the middle of the night to use nicotine. Nicotine dependence was assessed in the lifetime time period at Wave 1 and then in the previous 12-month period at Wave 2 (to determine whether the nicotine dependence was persistent or remitted).

The reliability and validity of the nicotine dependence diagnosis was assessed via random subsample of 347 respondents who were re-interviewed with the nicotine dependence module up to 10-weeks after initial appraisal (Grant et al., 2003b). The reliability of the

previous 12-month (i.e., current) diagnosis was good ($k = 0.63$). Further, a series of linear regression analyses were used to validate the diagnoses by examining the association between nicotine dependence and Short-Form-12v2 physical disability scores (an often-used measure of generic quality of life which generates 10 component and profile scores assessing various dimensions of physical and mental disability) (Grant et al., 2003a; Ruan et al., 2008). Analyses were controlled for age, personality disorders, current comorbid alcohol and drug use, and mood and anxiety disorders.

In this study any mood disorder was comprised of one or more of the following disorders: major depression, dysthymia, mania, and hypomania. Any anxiety disorder encompassed one or more of the following disorders: panic with agoraphobia, panic without agoraphobia, social phobia, specific phobia, posttraumatic stress disorder and generalized anxiety disorder. We also examined personality disorders which consisted of any one or more of the following 10 personality disorders: paranoid, schizoid, schizotypal, antisocial, histrionic, borderline, narcissistic, avoidant, dependent, and obsessive-compulsive disorders.

2.4 Analytic Strategy

We calculated the prevalence of sample characteristics and independent and dependent variables. We used cross-tabulations and unadjusted logistic regression models to examine sociodemographic predictors of persistent nicotine dependence versus remitted nicotine dependence. We also examined lifetime psychiatric disorders at Wave 1 as predictors of persistent nicotine dependence versus remitted nicotine dependence using cross-tabulations and three logistic regression models: 1) unadjusted, 2) adjusted for significant sociodemographic predictors and 3) adjusted for significant sociodemographic predictors and drug abuse or dependence. We adjusted for only drug abuse/dependence because alcohol abuse/dependence was not significantly associated with persistent nicotine dependence. Interactions between each sociodemographic factor and each psychiatric disorder were tested and logistic regression models were stratified by sociodemographic factor in cases where significant interactions emerged, in order to interpret the interactions. Logistic regression models allowed us to examine the odds of persistent nicotine dependence at Wave 2 (dependent variable) given various lifetime psychiatric disorders at Wave 1 (independent variables) through the estimation of odds ratios (OR).

All analyses were conducted in SUDAAN software (Shah et al., 1995) using Taylor Series Linearization, a variance estimation procedure, in order to account for the complex sampling design of the NESARC. Weight and stratification variables are available specifically for this purpose and are applied to ensure that the data are representative of the general population.

3. Results

3.1 Prevalence

At Wave 1, 17.5% of the sample (n=5256) met criteria for lifetime nicotine dependence. At Wave 2, 48.9% of the sample (n=2793) no longer met criteria for nicotine dependence, while 51.1% of the sample (n=2903) had persistent nicotine dependence (Table 1).

3.2 Sociodemographic characteristics associated with persistent nicotine dependence vs. remitted nicotine dependence

Being female, younger than 65, having less formal education and being either separated/divorced or never married were associated with increased risk of persistent nicotine dependence, compared with those with remitted nicotine dependence (Table 2). There were no race/ethnicity differences between persistent and remitted nicotine dependence.

3.3 Mood disorders and persistent nicotine dependence

Any mood disorder, major depression, dysthymia, and bipolar disorder were all associated with a significantly increased risk of persistent nicotine dependence, compared with that among those without mood disorders (Table 2). The strength of these associations was attenuated after adjusting for demographics, drug use and drug dependence, but remained statistically significant.

3.4 Anxiety disorders and persistent nicotine dependence

Any anxiety disorder, panic disorder, specific phobia, social phobia and PTSD were associated with significantly increased risk of persistent nicotine dependence, compared with those without these disorders (Table 2). The strength of these associations was attenuated after adjusting for demographic characteristics and drug use disorders, but remained statistically significant.

3.5 Personality disorders and persistent nicotine dependence

Having a personality disorder was associated with significantly increased likelihood of persistent nicotine dependence, compared with those without a personality disorder (Table 2).

3.6 Substance use disorders and persistent nicotine dependence

Drug abuse or dependence was associated with significantly increased likelihood of persistent nicotine dependence (Table 2). In contrast, alcohol abuse/dependence was not associated with increased persistence of nicotine dependence.

3.7 Interactions

We found significant interactions between age and major depression, sex and agoraphobia, and education and posttraumatic stress disorder, specific phobia, any anxiety disorder, and any mood or anxiety disorder. We also found significant interactions between age and any personality disorder, ethnicity and any personality disorder, and household income and any personality disorder.

The relationship between major depression and nicotine dependence appears to be stronger among younger age groups. In models adjusting for other sociodemographic variables and any substance use disorder, adjusted odds ratios (AORs) predicting persistent nicotine dependence based on the presence of major depression decreased as age increased, with the AOR being significant only among the 2 youngest age groups (Age 18-29: AOR=1.62, 95% CI=1.20-2.18; Age 30-44: AOR=1.44, 95% CI=1.11-1.85; Age 45-64: AOR=1.17, 95% CI=0.92-1.48; Age 65+: AOR=1.07, 95% CI=0.57-1.99).

The relationship between agoraphobia and nicotine dependence appears to be stronger among females than males. In models adjusting for other sociodemographic variables and any substance disorder, females were found to have a positive relationship (AOR=3.80, 95% CI = 0.74-19.46), while males showed a negative relationship (AOR=0.47, 95% CI=0.14-1.60), although neither relationship reached statistical significance in the adjusted model.

In models stratified by level of education, the relationship between anxiety disorders and persistent nicotine dependence appeared stronger at lower levels of education; as level of education increased, the magnitude of the AOR's decreased in models adjusting for other sociodemographic variables and any substance disorder (Table 3).

The relationship between any personality disorder and persistence of nicotine dependence appears to be strongest among individuals aged 30-44. In models adjusting for sociodemographics and any substance disorder, any personality disorder is most strongly associated with persistence of nicotine dependence for those aged 30-44 (AOR = 2.03, 95% CI = 1.58-2.60) and the strength of this association decreases with increasing age.

The relationship between any personality disorder and persistence of nicotine dependence also appears to vary with ethnicity. In models adjusting for sociodemographics and any substance disorder, individuals of Asian/Native Hawaiian/Pacific Islander ethnicity showed the strongest association between having a personality disorder and continuing to have nicotine dependence (AOR = 6.26, 95% CI = 1.78-21.98), followed by those of black (AOR = 2.10, 95% CI = 1.45-3.05) and white ethnicities (AOR = 1.67, 95% CI = 1.39-2.00). There was no significant relationship between any personality disorder and persistence of nicotine dependence among individuals of American Indian/Alaska Native and Hispanic/Latino ethnicities.

The relationship between any personality disorder and persistence of nicotine dependence also varies with household income. In models adjusting for sociodemographics and any substance disorder, the persistence of nicotine dependence was more strongly associated with the presence of any personality disorder among lower income groups ($0-$19,999: AOR = 2.12, 95% CI = 1.59-2.82; $20,000-34,999: AOR = 2.31, 95% CI = 1.74-3.05; $35,000-$59,999: AOR = 1.38, 95% CI = 1.03-1.83; $60,000+: AOR = 1.41, 95% CI = 1.04-1.90).

4. Discussion

To our knowledge, this is the first study to investigate predictors of persistent nicotine dependence among adults in a representative community sample in the United States. We found that mood and anxiety disorders were strong predictors of persistent nicotine dependence. Our findings also indicate that specific demographic characteristics (i.e., younger age, female gender, lower income, lower education) were associated with increased odds of persistent nicotine dependence. There were also significant interactions between education and mood and anxiety disorders, as well as age, ethnicity, income and personality disorders in predicting continued nicotine dependence. The implications of these results for future research and community and clinical prevention and intervention strategies will be discussed.

Overall, smoking rates have declined in the general US population over the past several decades (Escobedo et al., 1996). Yet, recent evidence suggests that those who continue smoking are more likely to have nicotine dependence, as compared with smokers in previous generations (Goodwin et al., 2009). As such, it is important to identify segments of the population who may be most vulnerable to persistent nicotine dependence, which appears to be the biggest contributor to morbidity and mortality of any documented health risk behavior. Our results suggest that females are more vulnerable than males. This is of interest for several reasons. First, historically, smoking has always been more common among males than females, though the gender gap has narrowed substantially in recent years (Escobedo et al., 1996). Previous research has shown that it is more difficult for females to stop smoking (Perkins et al., 2008). There is evidence to suggest that females metabolize nicotine more quickly (Benowitz et al., 2006) and that faster nicotine metabolism is associated with increased withdrawal symptoms (Rubinstein et al., 2008). Consistent with this, our results suggest that the most persistent nicotine dependence is more common among females. As such, these more recent data suggest that population gender differences in smoking, or at least levels of smoking, may be changing over time. This information may

be particularly useful in planning community-based prevention strategies and targeting high-risk female populations. This is also of interest because the prevalence estimates of both alcohol and illicit drug dependence are significantly more common among males (Grant, 1996; Grant, 1997). There are strong associations between alcohol and illicit drug use and smoking, (Torabi et al., 1993) as it was thought that smoking may be a "gateway" drug for illicit drug use and that these behaviors go together. Interestingly, our results show that anxiety and mood disorders are more strongly associated with persistent nicotine dependence than alcohol or illicit drug use disorders. To our knowledge, no previous study has examined the relative strength of these associations. These results suggest increased focus on females as a group at highest risk for persistent nicotine dependence, and that the success of smoking cessation programs may be improved by the inclusion of treatment of depression and anxiety disorders.

Our findings also suggest that lower educational attainment predicts persistent nicotine dependence, as does lower income. These predictors are consistent with those of persistent smoking. It has been shown that rising cigarette prices/taxes are associated with decreased smoking prevalence (Frieden et al., 2005). Yet, the high levels of smoking and nicotine dependence among those with the lowest income levels suggests that this demographic is still smoking, despite cigarette price increases. It is conceivable that, similar to illicit drugs, changes in the price of cigarettes may do less to affect use among the subgroup of smokers with dependence on nicotine. Previous data have suggested that nicotine is as addictive as heroin, and it may be that alternative routes will be needed to help this subgroup give up smoking. Higher taxes are thought to be an effective anti-smoking strategy yet those with the lowest education and income levels are persistently those with the highest levels of smoking and nicotine dependence, suggesting new, alternative strategies are needed.

Results of this study indicate that mood and anxiety disorders are statistically significant predictors of continued nicotine dependence. This seems particularly valuable with regards to developing new and alternative smoking cessation interventions. Previous studies have repeatedly demonstrated strong links between psychiatric disorders and smoking (Lasser et al., 2000) and nicotine dependence (Grant et al., 2004a) and several studies show that depression is associated with less success in quit attempts (Blondal et al., 1999; Hitsman et al., 1999). While there are some interventions with demonstrated efficacy that combine the treatment of psychiatric diagnoses and nicotine dependence (MacPherson et al.; Evins et al., 2008), to our knowledge, there are no widely available smoking cessation programs that systematically evaluate and treat mood and anxiety disorders as a component of smoking cessation. The findings of this study provide new evidence that indeed mood and anxiety disorders predict continued nicotine dependence. As noted earlier, it was somewhat surprising that mood and anxiety disorders – PTSD and Panic Disorders in particular – were stronger predictors of persistent nicotine dependence than alcohol and illicit drug use disorders, which have traditionally been considered among the strongest predictors of smoking (Torabi et al., 1993; Mackesy-Amiti et al., 1997; Johnson et al., 2000). Our results suggest that in fact there may be different psychiatric predictors of dependent versus non-dependent smoking. The reason that anxiety and mood disorders are so strongly linked with persistence of nicotine dependence cannot be determined from these data. Previous studies have provided evidence of common genetic underpinnings and that a causal link exists between the two. Several twin studies have suggested shared genetic factors for major depression and nicotine dependence (Lyons et al., 2008) as well as both genetic and unique environmental influences on both (Edwards et al., 2011). PTSD and nicotine dependence also appear to have a common genetic contribution (Koenen et al., 2005).

Of interest are the potential mechanisms underlying the relationships between different psychiatric diagnoses and persistent nicotine dependence; people who have current anxiety,

mood, or personality disorders may try to mitigate their symptoms by consuming nicotine, which is known to produce positive reinforcing effects on the brain through increases in serotonin and dopamine releases. The process of self-medicating through nicotine use may lead to an increased likelihood of persistent nicotine dependence. It is also possible that having a current psychiatric diagnosis predisposes an individual to certain affective vulnerability factors (e.g., anxiety sensitivity or negative affectivity), which could increase their likelihood of having persistent nicotine dependence (compared to remitted/former nicotine dependence). Further longitudinal studies could help explicate these potential mediating pathways.

Longitudinal studies have provided evidence suggesting that nicotine dependence leads to increased risk of depression (Boden et al., 2010) and studies have sequentially linked smoking and anxiety disorders in both directions (Isensee et al., 2003). This is the first multi-wave study to document that depression and anxiety disorders predict the persistence of nicotine dependence.

Results from our interaction models indicate that higher levels of formal education partially buffer the deleterious effect of anxiety and mood disorders on the persistence of nicotine dependence. In addition, our interaction models suggest that being of younger age or of Asian/Native Hawaiian/Pacific Islander and black ethnicity, and/or having a lower income in combination with having a personality disorder are strongly associated with the persistence of nicotine dependence. These results are consistent with the findings of previous studies on predictors of smoking (Kandel et al., 2009; Zvolensky et al., 2010). While the specific mechanisms of these interactions are not known, these results highlight the presence of ongoing disparities in nicotine dependence and the need for programs aimed at reaching ethnic minority groups, younger people, and those with lower levels of formal education and income who appear to be more vulnerable both to continued nicotine dependence, as well as mood, anxiety, and personality disorders.

Limitations of this study should be considered when interpreting these results. First, with only 2 waves of data, it is not possible to examine these relationships over a long time period. Future studies that examine the interrelationships between mental disorders, nicotine dependence and demographic characteristics over time are needed next to further our understanding of how these factors may play a role in continued nicotine dependence. Second, there may be other factors, such as spousal or parental smoking, or traumatic life events, that may contribute to nicotine dependence which could not be included here. Third, while these results are generalizable to the adult US population, they may not be applicable to developing countries or others where smoking trends and availability of cigarettes differ significantly. Therefore, additional studies in these contexts are needed in order to understand whether and to what degree these findings are applicable.

In sum, our results suggest that there are segments of the general US population particularly vulnerable to persistent nicotine dependence, and that mood and anxiety disorders appear to be particularly strong predictors of persistence. Future longitudinal studies that examine predictors of nicotine dependence over a longer time period are needed to understand how both demographic characteristics and psychiatric disorders may affect trajectories of nicotine dependence across the life course. These findings highlight the importance of reaching vulnerable segments of the population with nicotine dependence/smoking cessation treatments as this population appears to bear a disproportionate burden of the disease, and have the most limited resources with which to access and afford smoking cessation programs (Escobedo et al., 1996). Given our findings, and in light of all the previous evidence linking psychiatric disorders with smoking, integration of evaluation and treatment

of mood and anxiety disorders in smoking cessation programs could be a fruitful avenue toward improving success rates.

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Table 1

Characteristics of respondents in the NESARC with Wave 1 Nicotine Dependence

	N	Prevalence, % (95% CI)
Wave 1 Nicotine Dependence	5696	17.5 (16.5-18.4)
Characteristics		
Gender		
Male	2731	53.9 (52.4-55.5)
Female	2965	46.1 (44.5-47.6)
Age		
18-29 years	1217	23.8 (22.3-25.4)
30-44 years	1938	34.4 (32.7-36.1)
45-64 years	2059	34.0 (32.5-35.5)
65+ years	482	7.8 (7.0-8.7)
Education		
Less than high school	960	16.3 (15.1-17.6)
High school	1776	32.4 (30.7-34.0)
Some college or higher	2958	51.4 (49.5-53.2)
Race		
White	3993	80.5 (78.6-82.2)
Black	842	7.8 (6.7-9.0)
American Indian/Alaska Native	172	3.8 (3.1-4.7)
Asian/Native Hawaiian/Pacific Islander	89	2.0 (1.4-2.7)
Hispanic/Latino	600	6.0 (5.0-7.2)
Marital Status		
Married/cohabiting	2784	59.7 (58.0-61.5)
Separated/widowed/divorced	1620	19.7 (18.6-20.9)
Never married	1292	20.5 (19.0-22.1)
Household Income		
$0-$19,999	1512	20.7 (19.3-22.0)
$20,000-$34,999	1297	21.4 (20.0-22.9)
$35,000-$59,999	1494	28.7 (27.1-30.3)
$60,000+	1393	29.3 (27.2-31.4)
Remitted Nicotine Dependence (Wave 2)	2793	48.9 (47.2-50.6)
Persistent Nicotine Dependence (Wave 2)	2903	51.1 (49.4-52.8)

	N	Prevalence, % (95% CI)
Wave 1 Psychiatric Disorders		
Major Depression	1836	30.8 (29.2-32.4)
Dysthymia	580	9.3 (8.4-10.3)
Bipolar Disorder	643	10.9 (9.8-12.1)
Any Mood Disorder	2057	34.2 (32.5-36.0)
Panic Disorder with or Without Agoraphobia	660	11.2 (10.2-12.3)
Agoraphobia	21	0.4 (0.2-0.6)
Social Phobia	547	9.6 (8.6-10.6)
Specific Phobia	1023	18.0 (16.6-19.4)
Generalized Anxiety Disorder	516	8.4 (7.6-9.4)
Posttraumatic Stress Disorder	896	14.2 (13.2-15.3)
Any Anxiety Disorder	2238	37.8 (36.3-39.3)
Any Mood or Anxiety Disorder	3049	51.4 (49.6-53.1)
Alcohol Abuse or Dependence	3393	61.5 (59.8-63.2)
Drug Abuse or Dependence	1620	29.9 (28.2-31.7)
Any Substance Disorder	3651	65.9 (64.2-67.6)
Any Mood, Anxiety or Substance Disorder	4614	81.0 (79.6-82.3)
Any Personality Disorder	2226	38.02 (36.3-39.8)

Table 2

Predictors of persistent nicotine dependence among adults in the US (Wave 2)

	Remitted Nicotine Dependence (n=2793)	Persistent Nicotine Dependence (n=2903)			
	n (%)	n (%)	OR (95% CI)	AOR-1 (95% CI)	AOR-2 (95% CI)
Sex					
Male (n=2731)	1405 (56.2)	1326 (51.7)	1.00	---	---
Female (n=2965)	1388 (43.8)	1577 (48.3)	1.20 (1.05-1.37)**	---	---
Age					
18-29 years (n=1217)	572 (22.9)	645 (24.7)	1.00	---	---
30-44 years (n=1938)	865 (31.5)	1073 (37.1)	1.09 (0.93-1.29)	---	---
45-64 years (n=2059)	1024 (34.5)	1035 (33.5)	0.90 (0.76-1.07)	---	---
65+ years (n=482)	332 (11.0)	150 (4.8)	0.40 (0.31-0.52)***	---	---
Education					
Less than high school (n=962)	407 (14.4)	555 (18.1)	1.00	---	---
High school (n=1776)	802 (29.7)	974 (34.9)	0.94 (0.77-1.14)	---	---
Some college or higher (n=2958)	1584 (55.9)	1374 (47.1)	0.67 (0.55-0.83)***	---	---
Race					
White (n=3993)	1944 (80.5)	2049 (80.4)	1.00	---	---
Black (n=842)	396 (7.5)	446 (8.0)	1.07 (0.87-1.32)	---	---
American Indian/Alaska Native (n=81)	81 (3.3)	91 (4.3)	1.29 (0.91-1.83)	---	---
Asian/Native Hawaiian/Pacific Islander (n=47)	47 (2.3)	42 (1.7)	0.74 (0.45-1.20)	---	---
Hispanic/Latino (n=325)	325 (6.5)	275 (5.6)	0.87 (0.68-1.10)	---	---
Marital Status					
Married/Cohabiting (n=2784)	1461 (63.2)	1323 (56.4)	1.00	---	---
Separated/Widowed/Divorced (n=1620)	736 (17.7)	884 (21.7)	1.37 (1.20-1.57)***	---	---

	Remitted Nicotine Dependence (n=2793)	Persistent Nicotine Dependence (n=2903)			
	n (%)	n (%)	OR (95% CI)	AOR-1 (95% CI)	AOR-2 (95% CI)
Never Married (n=1292)	596 (19.2)	696 (21.9)	1.28 (1.08-1.51) ***	---	---
Household Income					
$0-$19,999 (n=1512)	639 (17.4)	873 (23.7)	1.00	---	---
$20,000-$34,999 (n=1297)	620 (20.4)	677 (22.4)	0.80 (0.67-0.97) ***	---	---
$35,000-$59,999 (n=1494)	758 (29.3)	736 (28.1)	0.70 (0.58-0.85) ***	---	---
$60,000+ (n=1393)	776 (32.8)	617 (25.8)	0.58 (0.48-0.70) ***	---	---
Mood Disorders					
Major Depression (n=1836)	803 (26.5)	1033 (35.0)	1.49 (1.30-1.71) ***	1.37 (1.19- 1.57) ***	1.33 (1.16-1.52) ***
Dysthymia (n=580)	240 (7.4)	340 (11.2)	1.58 (1.29-1.95) ***	1.44 (1.16-1.79) **	1.38 (1.11-1.71) ***
Bipolar Disorder (n=643)	258 (8.1)	385 (13.6)	1.80 (1.46-2.21) ***	1.56 (1.26- 1.94) ***	1.49 (1.20-1.84) ***
Any Mood Disorder (n=2057)	908 (29.5)	1149 (38.8)	1.51 (1.33-1.72) ***	1.38 (1.21- 1.58) ***	1.34 (1.17-1.53) ***
Anxiety Disorders					
Panic Disorder with or Without Agoraphobia (n=660)	263 (8.4)	397 (13.8)	1.74 (1.42-2.14) ***	1.56 (1.26- 1.93) ***	1.51 (1.22-1.86) ***
Agoraphobia (n=21)	10 (0.3)	11 (0.4)	1.38 (0.57-3.35)	1.31 (0.53-3.23)	1.35 (0.55-3.29)
Social Phobia (n=547)	251 (8.8)	296 (10.3)	1.20 (0.95-1.52)	1.12 (0.88-1.44)	1.08 (0.84-1.39)
Specific Phobia (n=1023)	459 (15.7)	564 (20.1)	1.35 (1.12-1.61) **	1.26 (1.04-1.52) *	1.23 (1.02-1.49) *
Generalized Anxiety Disorder (n=516)	213 (7.0)	303 (9.8)	1.44 (1.16-1.78) **	1.31 (1.06-1.61) *	1.26 (1.02-1.55) *
Posttraumatic Stress Disorder (n=896)	311 (9.4)	585 (18.9)	2.24 (1.89-2.66) ***	2.04 (1.70-2.45) ***	2.00 (1.67-2.40) ***
Any Anxiety Disorder (n=2238)	967 (32.4)	1271 (43.0)	1.57 (1.39-1.78) ***	1.47 (1.28-1.69) ***	1.44 (1.25-1.65) ***
Any Mood or Anxiety Disorder (n=3049)	1365 (45.7)	1684 (56.8)	1.56 (1.37-1.78) ***	1.45 (1.26-1.66) ***	1.41 (1.22-1.62) ***
Substance Use Disorders					
Alcohol Abuse or Dependence (n=3393)	1663 (61.5)	1730 (61.6)	1.00 (0.87-1.16)	1.02 (0.88-1.18)	---

	Remitted Nicotine Dependence (n=2793)	Persistent Nicotine Dependence (n=2903)			
	n (%)	n (%)	OR (95% CI)	AOR-1 (95% CI)	AOR-2 (95% CI)
Drug Abuse or Dependence (n=1620)	708 (26.6)	912 (33.1)	1.37 (1.18-1.58) ***	1.27 (1.09-1.49) **	---
Any Substance Use Disorder (n=3651)	1767 (64.7)	1884 (67.1)	1.12 (0.96-1.29)	1.12 (0.97-1.31)	---
Any Mood, Anxiety or Substance Use Disorder (n=4614)	2213 (47.7)	2401 (82.8)	1.28 (1.07-1.52) **	1.21 (1.01-1.45) *	---
Any Personality Disorder (n=2226)	899 (31.1)	1327 (44.62)	1.78 (1.54-2.07) ***	1.65 (1.41-1.93) ***	1.61 (1.37-1.89) ***

*
p 0.05,

**
p 0.01,

***
p 0.001

Column percentages are reported. They are interpreted as, 47.1% of individuals with remitted nicotine dependence had any mood or anxiety disorder and 58.4% of individuals with persistent nicotine dependence had any mood or anxiety disorder.

Adjusted odds ratios 1 (AOR-1) is adjusted for sex, age, education, marital status and household income.

Adjusted odds ratios 2 (AOR-2) is adjusted for sex, age, education, marital status, household income and drug use or dependence.

Table 3
Adjusted regression models stratified by education

	Remitted Nicotine Dependence (n=407)	Persistent Nicotine Dependence (n=555)	
	n (%)	n (%)	AOR (95% CI)
Less than High School			
Specific Phobia (n=191)	56 (12.8)	135 (26.5)	2.10 (1.40-3.15) ***
Posttraumatic Stress Disorder (n=173)	45(8.1)	128 (21.9)	2.85 (1.82-4.47) ***
Any Anxiety Disorder (n=393)	133 (29.3)	260 (46.2)	1.86 (1.30-2.65) ***
Any Mood or Anxiety Disorder (n=532)	186 (41.9)	346 (62.8)	2.04 (1.46-2.85) ***

	Remitted Nicotine Dependence (n=802)	Persistent Nicotine Dependence (n=974)	
	n (%)	n (%)	AOR (95% CI)
High School			
Specific Phobia (n=296)	125 (15.0)	171 (17.7)	1.08 (0.78-1.50)
Posttraumatic Stress Disorder (n=263)	76 (7.9)	187 (18.5)	2.32 (1.61-3.34) ***
Any Anxiety Disorder (n=675)	262 (29.6)	413 (41.3)	1.48 (1.15-1.90) **
Any Mood or Anxiety Disorder (n=915)	376 (42.2)	539 (53.5)	1.36 (1.06-1.75) *

	Remitted Nicotine Dependence (n=1584)	Persistent Nicotine Dependence (n=1374)	
	n (%)	n (%)	AOR (95% CI)
Some College or Higher			
Specific Phobia (n=536)	278 (16.9)	258 (19.4)	1.13 (0.87-1.47)
Posttraumatic Stress Disorder (n=460)	190 (10.5)	270 (18.0)	1.70 (1.33-2.19) ***
Any Anxiety Disorder (n=1170)	572 (34.7)	598 (42.9)	1.33 (1.10-1.62) **
Any Mood or Anxiety Disorder (n=1602)	803 (48.5)	799 (56.9)	1.31 (1.07-1.59) **

*
p 0.05,

**
p 0.01,

***
p 0.001

Adjusted odds ratios (AOR) are adjusted for sex, age, marital status, household income and drug use or dependence