

# Nicotine Dependence and Psychiatric Disorders in the United States

## Results From the National Epidemiologic Survey on Alcohol and Related Conditions

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**Background:** No information is available on the co-occurrence of DSM-IV nicotine dependence and Axis I and II psychiatric disorders in the US population.

**Objectives:** To present national data on the co-occurrence of current DSM-IV nicotine dependence and other psychiatric disorders by sex and to estimate the burden of all US tobacco consumption carried by nicotine-dependent and psychiatrically ill individuals.

**Design:** Face-to-face interviews.

**Setting:** The United States.

**Participants:** Household and group-quarters adults (N=43 093).

**Main Outcome Measures:** Prevalence and comorbidity of current nicotine dependence and Axis I and II disorders and the percentage of cigarettes consumed in the United States among psychiatrically vulnerable subgroups.

**Results:** Among US adults, 12.8% (95% confidence interval, 12.0-13.6) were nicotine dependent. Associa-

tions between nicotine dependence and specific Axis I and II disorders were all strong and statistically significant ( $P < .05$ ) in the total population and among men and women. Nicotine-dependent individuals made up only 12.8% (95% confidence interval, 12.0-13.6) of the population yet consumed 57.5% of all cigarettes smoked in the United States. Nicotine-dependent individuals with a comorbid psychiatric disorder made up 7.1% (95% confidence interval, 6.6-7.6) of the population yet consumed 34.2% of all cigarettes smoked in the United States.

**Conclusions:** Nicotine-dependent and psychiatrically ill individuals consume about 70% of all cigarettes smoked in the United States. The results of this study highlight the importance of focusing smoking cessation efforts on individuals who are nicotine dependent, individuals who have psychiatric disorders, and individuals who have comorbid nicotine dependence and other psychiatric disorders. Further, awareness of industry segmentation strategies can improve smoking cessation efforts of clinicians and other health professionals among all smokers and especially among the most vulnerable.

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**S**MOKING IS THE LEADING CAUSE of preventable death in the United States and the single most important avoidable cause of morbidity and premature mortality worldwide.<sup>1,2</sup> Studies have found high smoking rates among mixed samples of psychiatric outpatients and inpatients and especially high rates among patients with specific psychiatric diagnoses.<sup>3-6</sup> A recent national survey also found elevated smoking rates among adults with psychiatric disorders compared with those without such disorders.<sup>7</sup> However, these studies did not address the issue of nicotine dependence. Dependence on psychoactive substances indicates a condition in which repeated self-administration results

in compulsive substance-taking behavior that is very often chronic and continues despite serious consequences.<sup>8</sup> Thus, determining the prevalence and comorbidity of nicotine dependence in the general population and the contribution of these conditions to the total public health burden caused by cigarette smoking is of the highest public health importance.

Surprisingly, little is known about co-occurrence of nicotine dependence and psychiatric disorders in representative samples of the adult general population and how these disorders impact the total smoking public health burden. The most extensive data are available for regional samples, predominantly among young adults and adolescents. These have in-

cluded studies in a health maintenance organization or among urban samples in Michigan,<sup>3,9,10</sup> female twins in Virginia,<sup>11</sup> and young adult and adult samples in urban regions of Germany.<sup>12</sup> In these studies, nicotine dependence was found to be highly associated with a variety of psychiatric disorders, including substance use disorders and mood and anxiety disorders. In the German National Health Interview and Examination Survey,<sup>13</sup> the only national survey of adults to examine psychiatric comorbidity with nicotine dependence, more than 50% of the respondents with dependence fulfilled criteria for at least 1 psychiatric disorder.

To date, no nationally representative survey of the United States has addressed the co-occurrence of nicotine dependence and a broad array of psychiatric disorders among adults, and no community survey has specifically examined the association between nicotine dependence and personality disorders (PDs). The absence of accurate national data on the comorbidity of nicotine dependence and a broad range of psychiatric disorders reflects a gap in our understanding of treatment needs and type of interventions.

To address this gap in our public health knowledge, we present the first nationally representative data on the prevalence and co-occurrence of *DSM-IV*<sup>8</sup> nicotine dependence and *DSM-IV* alcohol and drug use disorders, mood and anxiety disorders, and PDs. These disorders were assessed in the National Institute on Alcohol Abuse and Alcoholism's (NIAAA) 2001-2002 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC).<sup>14,15</sup> Because of the NESARC sample size ( $N=43\,093$ ), accurate estimation was possible for current or recent (past year) prevalence and co-occurrence of *DSM-IV* nicotine dependence and *DSM-IV* Axis I disorders (alcohol and drug use disorders, major depression, dysthymia, mania, hypomania, panic disorder with and without agoraphobia, social phobia, specific phobia, and generalized anxiety disorder) and Axis II disorders (avoidant, dependent, obsessive-compulsive, histrionic, paranoid, schizoid, and antisocial PDs). Most previous studies were based on *DSM-III-R*<sup>16</sup> diagnostic criteria that differ significantly from *DSM-IV* criteria for a number of disorders, especially nicotine dependence and other drug dependence diagnoses. Prior research also used lifetime measures of nicotine dependence and other psychiatric disorders that are less relevant to the public health implications of any associations found, less germane to clinicians and practitioners, and subject to retrospective recall bias. Further, the sample size allowed for the first time the co-occurrence of these disorders to be examined separately by specific psychiatric disorders and sex.

As is well known, the vast majority of nicotine consumption in the United States is in the form of cigarettes, and thus the public health burden of nicotine occurs almost entirely through cigarette smoking. To gain an understanding of the contribution of nicotine dependence and psychiatric disorders to this public health burden, we also determined the percentage of all cigarettes in the United States that were consumed by individuals with nicotine dependence and psychiatric disorders. This analysis was stimulated, in part, by tobacco industry docu-

ments recently released as the result of the 1998 master settlement agreement between state attorneys general and major US tobacco manufacturers. Information in these documents suggests that the tobacco industry designed products to target consumer segments with different psychological need profiles, for example, individuals scoring high on neuroticism and anxiety scales who may have used tobacco to manage mood, anxiety, stress, anger, social dependence, insecurity, and other emotional states.<sup>17</sup> The creation of new tobacco brands and their marketing strategies may have resulted in a higher risk of dependence among certain groups who, by virtue of their psychopathology, may have been most influenced by them. The present study provides an opportunity to address this critical question.

## METHOD

### NESARC SAMPLE

The 2001-2002 NESARC is a representative sample of the United States conducted by the NIAAA that has been described in detail elsewhere.<sup>14,15</sup> The target population of the NESARC was the civilian, noninstitutionalized population aged 18 years and older, residing in the continental United States, Alaska, and Hawaii. The sample also included a group-quarters sampling frame (boarding houses, rooming houses, military living off base, non-transient hotels and motels, shelters, facilities for housing workers, college quarters, and group homes). Face-to-face computerized personal interviews were conducted with 43 093 respondents. The overall survey response rate was 81%. African American, Hispanic, and young adult individuals (18-24 years of age) were oversampled in the NESARC. The data were weighted to reflect the design characteristics of the NESARC, to account for oversampling, and to adjust for nonresponse at the household and person levels. The weighted data were then adjusted to be representative of the US civilian population for a variety of socioeconomic variables, including urbanicity, region, age, sex, race, and ethnicity, using the 2000 Decennial Census.

### INTERVIEWER TRAINING FIELD QUALITY CONTROL

Approximately 1800 lay interviewers from the US Bureau of the Census administered the NESARC using laptop computer-assisted software that included built-in skip, logic, and consistency checks. On average, the interviewers had 5 years' experience working on census and other health-related national surveys. The interviewers completed 10 days of training. This was standardized through centralized training sessions under the direction of NIAAA and census headquarters staff.

### DSM-IV NICOTINE DEPENDENCE AND OTHER SUBSTANCE USE DISORDERS

The diagnostic interview used to generate diagnoses presented in this report is the NIAAA Alcohol Use Disorder and Associated Disabilities Interview Schedule-*DSM-IV* Version (AUDADIS-IV),<sup>18</sup> a state-of-the-art structured diagnostic interview designed for use by lay interviewers.

The AUDADIS-IV included an extensive list of symptom questions that separately assessed *DSM-IV* criteria for nicotine dependence and alcohol and drug-specific abuse and dependence for 10 classes of drugs. These included sedatives, tran-

quilizers, opiates (other than heroin or methadone), stimulants, hallucinogens, cannabis, cocaine (including crack cocaine), inhalants/solvents, heroin, and other drugs. Consistent with the DSM-IV, 12-month AUDADIS-IV diagnoses of alcohol and other drug abuse required a respondent to meet at least 1 of the 4 criteria defined for abuse in the 12-month period preceding the interview. Nicotine-, alcohol-, and drug-dependence diagnoses, as defined by AUDADIS-IV, required respondents to satisfy at least 3 of the 7 DSM-IV criteria for dependence during the last year. The withdrawal criterion of each dependence diagnosis was measured as a syndrome, requiring the requisite number of drug-specific withdrawal symptoms as defined in the DSM-IV withdrawal categories.

Rather than assessing nicotine dependence in the same modules as alcohol or drugs, we assessed nicotine dependence in a separate AUDADIS-IV module. This was done to closely adhere to the DSM-IV guidelines<sup>8(p243)</sup> indicating that generic drug dependence criteria do not apply or need to be modified to assess nicotine dependence. For example, the "using nicotine to relieve or avoid withdrawal symptoms" criterion was operationalized using the following 4 symptom items: (1) the use of nicotine upon waking, (2) the use of nicotine after being in a situation in which use was restricted, (3) the use of nicotine to avoid nicotine withdrawal symptoms, and (4) waking up in the middle of the night to use tobacco. The "giving up activities in favor of nicotine use" criterion was assessed as (1) giving up or cutting down on activities that were important, like associating with friends or relatives or attending social activities, because tobacco use was not permitted at the activity and (2) giving up or cutting down on activities that you were interested in or gave you pleasure because tobacco use was not permitted at the activity. The "great deal of time spent using tobacco" criterion was assessed by the single symptom item chain-smoking. The "using tobacco more than intended" criterion was operationalized as having a period when tobacco was used more than intended. Nicotine dependence was assessed for any tobacco product, including cigarettes, cigars, pipes, chewing tobacco, and snuff.

The reliability of nicotine dependence was assessed in a test-retest study conducted as part of the NESARC survey proper<sup>19</sup> using procedures similar to those used in the German National Health Interview and Examination Survey.<sup>13</sup> A random subsample of 347 respondents was reinterviewed with the AUDADIS-IV nicotine dependence module within 10 weeks of their NESARC interview. The reliability of current 12-month nicotine dependence was good ( $\kappa=0.63$ ). The validity of nicotine dependence was assessed in a series of linear regression analyses, using the NESARC data, that examined the associations between nicotine dependence and Short-Form-12v2 physical disability scores, controlling for age, PDs, current comorbid alcohol and drug use, and mood and anxiety disorders. The Short-Form-12v2, a reliable and valid measure of generic quality of life used in large population surveys,<sup>20</sup> yields 10 component and profile scores assessing various dimensions of physical and mental disability and impairment. In the present analyses, the focus was on 6 physical disability scores of the Short-Form-12v2 measuring (1) limitations in physical functioning due to physical problems, (2) role impairment due to physical problems, (3) general physical health, (4) bodily pain, (5) vitality, and (6) overall physical disability. Nicotine dependence was shown to be a highly significant ( $P<.001$ ) predictor of all 6 of these disability scores. Respondents with nicotine dependence had significantly greater physical disability and dysfunction than respondents who did not have nicotine dependence.

The reliability<sup>15,19,21-25</sup> and validity<sup>26-39</sup> of AUDADIS-IV alcohol and drug use disorders are well documented in clinical and especially general population samples. The psychometric properties of AUDADIS-IV alcohol and drug use disorders also

were documented in the World Health Organization/National Institutes of Health International Study on Reliability and Validity.<sup>40-44</sup>

## ANXIETY AND MOOD DISORDER ASSESSMENT

The DSM-IV mood and anxiety diagnoses reported here included major depression, dysthymia, mania, hypomania, panic disorder with and without agoraphobia, social phobia, specific phobia (simple phobia), and generalized anxiety disorder.

The current (last 12 months) mood and anxiety diagnoses presented in this article are defined in the DSM-IV as "primary" or independent diagnoses. In the DSM-IV, the term primary is used as a shorthand to indicate those mental disorders that are not substance induced and that are not due to a general medical condition.<sup>8(p192)</sup> Diagnoses of major depression also ruled out bereavement.

The reliability of AUDADIS-IV measures of DSM-IV mood and anxiety disorders are documented in test-retest studies among general population samples.<sup>19,21,22</sup> In these test-retest studies, the reliabilities associated with mood and anxiety disorders were fair to good, ranging from  $\kappa=0.42$  for specific phobia to  $\kappa=0.64$  for major depression. The validity of mood and anxiety disorders was assessed using the same procedures as those used for nicotine dependence. Each mood and anxiety disorder was shown to be a highly significant ( $P<.05$  to  $P<.001$ ) predictor of the 4 mental disability scores of the Short-Form-12v2, controlling for age, PDs, and current substance use, mood, and anxiety disorders. Respondents with each mood or anxiety disorder had significantly greater mental disability and social/occupational dysfunction than respondents who did not have the specific mood or anxiety disorder.

## PERSONALITY DISORDER ASSESSMENT

Diagnoses of PDs require an evaluation of the individual's long-term patterns of functioning.<sup>8(p630)</sup> Diagnoses of PDs using the AUDADIS-IV were made accordingly. Respondents were asked a series of personality symptom questions about how they felt or acted most of the time throughout their lives regardless of the situation or whom they were with. They were instructed not to include times when they were depressed, manic, anxious, drinking heavily, using medicines or drugs, or experiencing withdrawal symptoms (defined earlier in the AUDADIS-IV) or times when they were physically ill. To receive a DSM-IV diagnosis, respondents needed to endorse the requisite number of DSM-IV symptom items for the particular PD, and at least 1 positive symptom item must have caused social and/or occupational dysfunction.

The reliability of AUDADIS-IV categorical diagnoses of each PD also was assessed in a test-retest study conducted as part of the NESARC.<sup>19</sup> A random subsample of 282 respondents was reinterviewed with the antisocial PD module, and another subsample of 315 respondents was reinterviewed with the AUDADIS-IV modules containing the remaining PD measures. The reliability of the PD diagnoses in these community samples ranged from fair to good, from  $\kappa=0.40$  for histrionic PD to  $\kappa=0.67$  for antisocial PD. Reliabilities of the AUDADIS-IV diagnoses compare favorably with those found for semistructured personality interviews conducted in treated samples of patients.<sup>45</sup>

The validity of PDs was assessed using the same procedures as those used for mood and anxiety disorders.<sup>15</sup> With the exception of histrionic PD, all PDs were shown to be highly significant ( $P<.01$  to  $P<.001$ ) predictors of the 4 Short-Form-12v2 mental disability scores. Respondents with these PDs had significantly greater mental disability and social/occupational dysfunction than respondents who did not have the PD.

**Table 1. Prevalence of 12-Month *DSM-IV* Nicotine Dependence and Other Axis I and II Psychiatric Disorders in the Total Sample and by Sex\***

Disorder	Total		Men		Women	
	No.	% (SE)	No.	% (SE)	No.	% (SE)
Nicotine dependence	4962	12.8 (0.39)	2390	14.1 (0.47)	2572	11.5 (0.40)
Any alcohol use disorder	3327	8.5 (0.24)	2214	12.4 (0.36)	1113	4.9 (0.22)
Alcohol abuse	1843	4.7 (0.18)	1249	6.9 (0.28)	594	2.6 (0.16)
Alcohol dependence	1484	3.8 (0.14)	965	5.4 (0.21)	519	2.3 (0.13)
Any drug use disorder	777	2.0 (0.10)	497	2.8 (0.17)	280	1.2 (0.10)
Any drug abuse	528	1.4 (0.08)	348	2.0 (0.12)	180	0.8 (0.09)
Any drug dependence	549	0.6 (0.05)	149	0.9 (0.10)	100	0.4 (0.04)
Any mood disorder	4065	9.2 (0.22)	1339	7.1 (0.22)	2726	11.1 (0.34)
Major depression	3119	7.1 (0.20)	927	4.9 (0.20)	2192	9.1 (0.30)
Dysthymia	843	1.8 (0.09)	245	1.2 (0.10)	598	2.4 (0.15)
Mania	724	1.7 (0.08)	277	1.5 (0.09)	447	1.8 (0.12)
Hypomania	480	1.16 (0.07)	208	1.2 (0.11)	272	1.1 (0.08)
Any anxiety disorder	4755	11.1 (0.33)	1403	7.6 (0.29)	3352	14.3 (0.45)
Panic disorder with agoraphobia	254	0.6 (0.05)	60	0.3 (0.05)	194	0.8 (0.07)
Panic disorder without agoraphobia	653	1.5 (0.07)	187	1.0 (0.08)	466	2.1 (0.13)
Social phobia	1140	2.8 (0.13)	393	2.1 (0.14)	747	3.3 (0.17)
Specific phobia	3073	7.1 (0.26)	843	4.6 (0.22)	2230	9.5 (0.37)
Generalized anxiety	894	2.1 (0.10)	232	1.3 (0.11)	662	2.8 (0.15)
Any PD	6295	14.8 (0.36)	2834	15.6 (0.46)	3461	14.1 (0.37)
Avoidant PD	995	2.4 (0.11)	339	1.9 (0.14)	656	2.8 (0.16)
Dependent PD	208	0.5 (0.05)	61	0.4 (0.07)	147	0.6 (0.06)
Obsessive-compulsive PD	3261	7.9 (0.23)	1416	7.9 (0.28)	1845	7.9 (0.27)
Paranoid PD	2105	4.4 (0.15)	758	3.8 (0.20)	1347	5.0 (0.20)
Schizoid PD	1425	3.1 (0.12)	602	3.2 (0.18)	823	3.1 (0.14)
Histrionic PD	808	1.8 (0.09)	355	1.9 (0.13)	453	1.8 (0.11)
Antisocial PD	1422	3.6 (0.15)	949	5.5 (0.25)	473	1.9 (0.11)

Abbreviation: PD, personality disorder.

\*Numbers are based on unweighted figures, and percentages are based on weighted figures.

## CURRENT CIGARETTE SMOKER AND CURRENT NUMBER OF CIGARETTES SMOKED

Among those in the survey who were lifetime smokers of cigarettes (defined as smoking at least 100 cigarettes over the life course), current cigarette use was defined as any smoking during the year preceding the interview. Among current smokers, the total number of cigarettes smoked in the last year was determined by respondents' answers to the following 2 questions: "On the days that you smoked in the past year, about how many cigarettes did you usually smoke?" and "About how often did you usually smoke in the past year?" (eg, daily, 5 to 6 days per week). The total number of cigarettes smoked in the past year was the product of the respondent's replies to these 2 questions.

Similar to the high reliabilities found for other AUDADIS-IV nicotine measures, the test-retest reliabilities of the number of cigarettes smoked in the past year and the number of days smoked in the past year were excellent, with intraclass coefficients of 0.83 and 0.84.<sup>19</sup>

## STATISTICAL ANALYSIS

Cross-tabulations were used to calculate prevalences of nicotine dependence and all other Axis I and II disorders. Odds ratios (OR) derived from logistic regression analyses were used to study associations between nicotine dependence and other Axis I and II disorders in the total population and among men and women. All standard errors and 95% confidence limits were estimated using SUDAAN,<sup>46</sup> a software package that uses Taylor series linearization to adjust for design effects of complex sample surveys like the NESARC.

We multiplied the total number of cigarettes smoked in the past year by the weighted number of persons in the following 4 groups to arrive at the percentage of all cigarettes consumed in the past year (ie, in 2001-2002) in each group: (1) dependent cigarette smokers with a comorbid psychiatric disorder, (2) dependent cigarette smokers without a comorbid psychiatric disorder, (3) nondependent cigarette smokers with a psychiatric disorder, and (4) nondependent cigarette smokers without a psychiatric disorder.

## RESULTS

### PREVALENCE OF NICOTINE DEPENDENCE AND OTHER AXIS I AND II DISORDERS

Among the total sample, 28.4% were current users of any tobacco product, while 24.9% were current cigarette smokers. The prevalence of nicotine dependence was 12.8% in the total sample (**Table 1**). These individuals constituted nearly half of all current nicotine users. By sex, the prevalence of nicotine dependence was 14.1% among men and 11.5% among women. Nicotine dependence associated with cigarette use constituted 93.7% of all nicotine dependence.

The prevalence of any alcohol use disorder (8.5%) was much greater than any drug use disorder (2.0%), and for both these disorders, the rates for abuse exceeded those for dependence. The 12-month prevalence rates of any



**Table 2. Prevalence Rates and Odds Ratios of Nicotine Dependence and Axis I and II Psychiatric Disorders**

Comorbid Disorder	12-Month Prevalence of Comorbid Disorder Among Respondents With Nicotine Dependence, % (SE)	12-Month Prevalence of Nicotine Dependence Among Respondents With Comorbid Disorder, % (SE)	Odds Ratio* of Nicotine Dependence and Comorbid Disorder (95% Confidence Interval)
Any alcohol use disorder	22.8 (0.72)	34.5 (1.11)	4.4 (3.9-4.9)
Alcohol abuse	9.3 (0.52)	25.5 (1.31)	2.5 (2.1-2.9)
Alcohol dependence	13.5 (0.61)	45.4 (1.77)	6.4 (5.6-7.4)
Any drug use disorder	8.2 (0.49)	52.4 (2.29)	8.1 (6.7-9.8)
Any drug abuse	4.8 (0.41)	44.7 (2.86)	5.7 (4.5-7.3)
Any drug dependence	3.4 (0.31)	69.3 (3.46)	15.9 (11.4-22.2)
Any mood disorder	21.1 (0.73)	29.2 (1.03)	3.3 (3.0-3.6)
Major depression	16.6 (0.63)	30.0 (1.07)	3.3 (3.0-3.7)
Dysthymia	4.6 (0.35)	32.0 (2.08)	3.3 (2.8-4.0)
Mania	4.6 (0.34)	35.3 (2.32)	3.9 (3.2-4.7)
Hypomania	3.0 (0.31)	33.4 (2.82)	3.5 (2.7-4.5)
Any anxiety disorder	22.0 (0.78)	25.3 (0.82)	2.7 (2.4-3.0)
Panic disorder with agoraphobia	1.8 (0.22)	39.8 (3.52)	4.6 (3.4-6.2)
Panic disorder without agoraphobia	4.3 (0.36)	35.6 (2.57)	3.9 (3.2-4.8)
Social phobia	5.8 (0.42)	27.1 (1.67)	2.6 (2.2-3.1)
Specific phobia	14.3 (0.63)	25.6 (0.95)	2.6 (2.3-2.9)
Generalized anxiety	5.3 (0.41)	32.7 (2.02)	3.4 (2.8-4.2)
Any PD	31.7 (0.87)	27.3 (0.85)	3.3 (3.0-3.6)
Avoidant PD	5.8 (0.43)	31.4 (2.01)	3.3 (2.7-3.9)
Dependent PD	1.7 (0.24)	44.0 (4.26)	5.5 (3.9-7.7)
Obsessive-compulsive PD	14.4 (0.70)	23.3 (1.12)	2.3 (2.0-2.6)
Paranoid PD	11.7 (0.57)	33.9 (1.55)	3.8 (3.4-4.4)
Schizoid PD	7.7 (0.45)	31.3 (1.72)	3.3 (2.8-3.8)
Histrionic PD	5.6 (0.43)	38.5 (2.25)	4.5 (3.7-5.5)
Antisocial PD	12.2 (0.63)	42.7 (1.75)	5.7 (4.8-6.6)

Abbreviation: PD, personality disorder.

\*Odds of having an Axis I or II disorder among individuals with nicotine dependence relative to the odds of having an Axis I or II disorder among individuals without nicotine dependence.

mood and anxiety disorder were 9.2% and 11.1%, respectively, in the total sample. The most prevalent mood and anxiety disorders were major depression (7.1%) and specific phobia (7.1%). The most prevalent PD in the general population was obsessive-compulsive PD (7.9%), followed by paranoid (4.4%), antisocial (3.6%), schizoid (3.1%), avoidant (2.4%), histrionic (1.8%), and dependent (0.5%) PDs.

#### PREVALENCE OF CURRENT AXIS I AND II DISORDERS AMONG RESPONDENTS WITH CURRENT NICOTINE DEPENDENCE

As indicated in the first column of **Table 2**, the prevalence of any alcohol use disorder was 22.8% among respondents with current nicotine dependence. The rate of any current mood disorder among respondents with nicotine dependence was 21.1%, and the rate of any current anxiety disorder in the same group was 22.0%. The rate of any PD among nicotine-dependent individuals was 31.7%. The prevalence of any drug use disorder among nicotine-dependent individuals was lower (8.2%).

When specific Axis I and II disorders were considered, the prevalence of current alcohol dependence (13.5%) was greater than the prevalence of current alcohol abuse (9.3%) among nicotine-dependent individuals. The opposite was true for any drug use disorder where the prevalence of drug abuse (4.8%) was greater than de-

pendence (3.4%). Major depression (16.6%) and specific phobia (14.3%) were by far the most prevalent mood and anxiety disorders among individuals with current nicotine dependence. As for the Axis II PDs, no intra-cluster patterns were observed. Obsessive-compulsive PD (14.4%, cluster C PD), antisocial PD (12.2%, cluster B PD), and paranoid PD (11.7%, cluster A PD) were the most prevalent among nicotine-dependent individuals.

#### PREVALENCE OF CURRENT NICOTINE DEPENDENCE AMONG RESPONDENTS WITH CURRENT AXIS I AND II DISORDERS

Nicotine dependence was most prevalent among individuals with a current alcohol or drug use disorder (34.5% and 52.4%, respectively). The corresponding prevalences of nicotine dependence among individuals with any mood or anxiety disorder or PD were somewhat lower (29.2%, 25.3%, and 27.3%, respectively).

Among individuals with a current substance use disorder, the rate of nicotine dependence was greater for those with alcohol or drug dependence (45.4% and 69.3%, respectively) than for those with alcohol or drug abuse (25.5% and 44.7%, respectively). There was little variation in the prevalence of nicotine dependence among individuals with specific mood (30.0%-35.3%), anxiety (25.6%-39.8%), and personality (23.3%-44.0%) disorders.

**Table 3. Prevalence Rates and Odds Ratios of Nicotine Dependence and Comorbid Disorders by Sex**

Comorbid Disorder	Men			Women		
	12-Month Prevalence of Comorbid Disorder Among Respondents With Nicotine Dependence, % (SE)	12-Month Prevalence of Nicotine Dependence Among Respondents With Comorbid Disorder, % (SE)	Odds Ratio of Nicotine Dependence and Comorbid Disorder (95% Confidence Interval)	12-Month Prevalence of Comorbid Disorder Among Respondents With Nicotine Dependence, % (SE)	12-Month Prevalence of Nicotine Dependence Among Respondents With Comorbid Disorder, % (SE)	Odds Ratio of Nicotine Dependence and Comorbid Disorder (95% Confidence Interval)
Any alcohol use disorder	29.2 (1.10)	33.5 (1.33)	3.9 (3.4-4.5)	15.6 (0.96)	36.8 (1.88)	5.1 (4.3-6.1)
Alcohol abuse	12.1 (0.84)	24.8 (1.63)	2.1 (1.8-2.6)	6.0 (0.63)	27.2 (2.41)	3.0 (2.3-3.9)
Alcohol dependence	17.1 (0.92)	44.5 (1.98)	5.7 (4.8-6.7)	9.6 (0.77)	47.3 (2.88)	7.5 (6.0-9.5)
Any drug use disorder	10.3 (0.80)	51.6 (2.56)	7.1 (5.7-8.8)	5.8 (0.61)	54.0 (4.25)	9.5 (6.7-13.7)
Any drug abuse	6.0 (0.64)	43.3 (3.23)	4.9 (3.7-6.4)	3.5 (0.49)	47.5 (5.27)	7.2 (4.6-11.1)
Any drug dependence	4.3 (0.51)	70.1 (4.53)	14.8 (9.6-23.1)	2.4 (0.32)	67.5 (5.40)	16.4 (10.0-26.8)
Any mood disorder	15.6 (0.89)	30.9 (1.60)	3.0 (2.6-3.6)	27.2 (1.18)	28.1 (1.24)	3.8 (3.3-4.3)
Major depression	11.1 (0.73)	32.2 (1.88)	3.1 (2.6-3.7)	22.9 (1.07)	28.9 (1.31)	3.8 (3.3-4.3)
Dysthymia	2.7 (0.35)	31.2 (3.46)	2.8 (2.0-3.9)	6.8 (0.64)	32.4 (2.48)	3.9 (3.1-4.8)
Mania	4.0 (0.41)	37.2 (3.58)	3.7 (2.8-5.0)	5.3 (0.56)	33.8 (2.90)	4.1 (3.1-5.3)
Hypomania	3.0 (0.46)	33.7 (4.13)	3.1 (2.1-4.6)	3.1 (0.39)	33.2 (3.65)	3.9 (2.9-5.4)
Any anxiety disorder	15.8 (0.95)	29.5 (1.57)	2.8 (2.4-3.3)	29.0 (1.23)	23.3 (0.95)	2.9 (2.5-3.3)
Panic disorder with agoraphobia	0.8 (0.21)	40.0 (6.53)	4.1 (2.4-7.0)	2.8 (0.39)	39.7 (4.20)	5.2 (3.6-7.5)
Panic disorder without agoraphobia	2.4 (0.35)	36.0 (4.65)	3.5 (2.4-5.1)	6.4 (0.66)	35.4 (2.91)	4.5 (3.5-5.7)
Social phobia	4.1 (0.46)	27.4 (2.65)	2.3 (1.8-3.1)	7.8 (0.7)	26.8 (2.12)	3.0 (2.4-3.7)
Specific phobia	10.2 (0.77)	31.6 (1.98)	3.0 (2.5-3.6)	18.9 (1.01)	22.9 (1.09)	2.6 (2.3-3.0)
Generalized anxiety	3.1 (0.41)	35.1 (3.84)	3.4 (2.4-4.8)	7.7 (0.68)	31.7 (2.24)	3.8 (3.1-4.7)
Any PD	32.0 (1.20)	29.1 (1.12)	3.2 (2.8-3.6)	31.3 (1.18)	25.5 (1.09)	3.4 (3.0-3.8)
Avoidant PD	4.9 (0.60)	36.1 (3.45)	3.6 (2.6-4.8)	6.8 (0.67)	28.3 (2.42)	3.2 (2.5-4.1)
Dependent PD	1.5 (0.34)	56.0 (6.60)	7.8 (4.6-13.4)	2.0 (0.35)	37.3 (5.15)	4.7 (3.0-7.3)
Obsessive-compulsive PD	14.1 (0.98)	25.4 (1.59)	2.2 (1.9-2.7)	14.6 (0.91)	21.3 (1.38)	2.3 (1.9-2.7)
Paranoid PD	10.6 (0.84)	39.1 (2.43)	4.2 (3.4-5.3)	13.0 (0.86)	30.2 (1.82)	3.7 (3.1-4.4)
Schizoid PD	7.0 (0.66)	31.2 (2.45)	2.9 (2.3-3.6)	8.4 (0.61)	31.4 (2.21)	3.8 (3.1-4.6)
Histrionic PD	5.6 (0.62)	41.7 (3.23)	4.5 (3.4-6.0)	5.5 (0.54)	35.4 (2.93)	4.4 (3.4-5.8)
Antisocial PD	15.5 (0.94)	39.8 (2.04)	4.6 (3.8-5.5)	8.3 (0.69)	50.7 (2.99)	8.5 (6.6-11.1)

Abbreviation: PD, personality disorder.

### ASSOCIATIONS BETWEEN CURRENT NICOTINE DEPENDENCE AND CURRENT AXIS I AND II DISORDERS

Associations between current nicotine dependence and current Axis I and II disorders are shown in the third column of Table 2. All OR were substantial in size and significant. Nicotine dependence was most strongly related to any drug use disorder (OR, 8.1) and any alcohol use disorder (OR, 4.4). The relationship was stronger for alcohol (OR, 6.4) and drug (OR, 15.9) dependence than for alcohol (OR, 2.5) or drug (OR, 5.7) abuse. There was little variation in the strength of associations between nicotine dependence and specific mood (OR, 3.3-3.9), anxiety (OR, 2.6-4.6), and personality (OR, 2.3-5.7) disorders. Comorbidity rates and associations between current nicotine dependence and current Axis I and II disorders among men and women were strikingly similar to one another and to those observed for the total population (**Table 3**).

### CURRENT CIGARETTE CONSUMPTION AMONG RESPONDENTS WITH NICOTINE DEPENDENCE AND OTHER PSYCHIATRIC DISORDERS

Nicotine-dependent individuals made up only 12.8% of the population, but they consumed 57.5% of all cigarettes smoked in the United States. Individuals with a cur-

rent psychiatric disorder (with and without nicotine dependence) made up 30.3% of the population, and they consumed 46.3% of all cigarettes smoked in the United States. Although respondents with current nicotine dependence and at least 1 comorbid psychiatric disorder made up only 7.1% of the total US adult population, they consumed 34.2% of all cigarettes smoked in the United States.

Respondents without comorbidity between nicotine dependence and psychiatric disorders smoked lower proportions of the total number of cigarettes smoked. Those with a current psychiatric disorder but no nicotine dependence consumed 12.1% of all cigarettes smoked. Respondents with nicotine dependence and no psychiatric disorder consumed 23.3% of all cigarettes smoked. Current smokers without nicotine dependence or a psychiatric disorder consumed 30.4% of all cigarettes smoked.

### COMMENT

The co-occurrence of *DSM-IV* current nicotine dependence and PDs and of current substance use, mood, and anxiety disorders and PDs is pervasive in the US population. Among respondents with current nicotine dependence, between 21.1% and 31.7% had a current alcohol use, mood, or anxiety disorder or PD. The prevalence of any drug use disorder among individuals with nicotine

dependence was 8.2%. Current nicotine dependence also was highly prevalent among individuals with Axis I or II disorders (25.3%-52.4%). Further, associations between current nicotine dependence and current alcohol and drug use disorders, specific mood and anxiety disorders, and PDs all were substantial and statistically significant for the total sample and among men and women.

Nicotine dependence was more strongly related to alcohol and drug use disorders, especially drug dependence, than any other Axis I or II disorder examined in this study. These results are consistent with evidence concerning the reciprocal effects of nicotine and other psychoactive substances through shared physiological effects, cross-tolerance, or cueing.<sup>47-50</sup> With regard to physiological effects, substance abusers may smoke to decrease some of the negative effects of alcohol or other drugs. Synergistic physiological effects may contribute to the concurrent use of nicotine and other substances but also may lead to increased use of both kinds of substance and/or the development of nicotine and substance dependence because of cross-tolerance. The use of one of these substances also may cue the use of the other, creating a learned association between the 2 consumption behaviors. Further research is needed to test these different hypotheses.

Previous studies also have found significant associations between nicotine dependence and substance use disorders and mood and anxiety disorders. The earlier studies, however, were very different in design, with numerous features that limited their generalizability or the information they provided. For example, the German National Comorbidity Survey that included nicotine dependence was too small to examine the relationship of nicotine dependence to specific substance use, mood, and anxiety disorders. Studies of adolescents and young adults are limited by restricted age ranges. Previous studies also were limited geographically and by use of lifetime measures of disorders, which provide much less information on the current public health implications of any associations found. Nonetheless, the magnitude of the associations between nicotine dependence and other Axis I disorders examined among adolescents and young adults<sup>3,9,10</sup> was similar to that found in this study. These similarities suggest that these comorbid patterns become established early and persist. This indicates that a large part of the prevention effort should be targeted at young individuals.

The NESARC is the first national survey to assess DSM-IV nicotine dependence as well as DSM-IV Axis II PDs. Current nicotine dependence was highly associated with avoidant, dependent, obsessive-compulsive, paranoid, schizoid, histrionic, and antisocial PDs in the overall sample and among men and women. These results are consistent with earlier research showing associations between smoking (or nicotine dependence) and personality characteristics, primarily neuroticism and extroversion.<sup>8,10</sup> In these studies, neuroticism was found to account in part for the associations between smoking and nicotine dependence and major depression by acting as a common genetic and/or environmental predisposition to both disorders. That a broad array of PDs might contribute to the associations between nicotine depen-

dence and other Axis I disorders is intriguing and the subject of separate ongoing analyses.

We showed that a very high percentage of cigarettes smoked in the United States were consumed by those with nicotine dependence and/or psychiatric disorders relative to their representation in the population as a whole. For example, nicotine-dependent individuals made up 12.8% of the population, but they consumed 57.5% of all cigarettes smoked in the United States. Nicotine-dependent individuals with a comorbid psychiatric disorder made up 7.1% of the population yet consumed 34.2% of all cigarettes smoked in the United States. These striking results are consistent with those of Lasser et al,<sup>7</sup> who found a high rate of smoking among individuals with a psychiatric disorder in the early 1990s. A recent analysis by Le Cook et al<sup>17</sup> of 239 relevant industry documents dated 1960 to 1996 suggests that the industry designed products to target consumer segments with various psychological needs. Psychological needs in these studies, measured in some by standard, well-validated psychiatric assessment instruments (eg, Eysenck Neuroticism Scale<sup>51</sup> and Taylor-Spence Manifest Anxiety Scale<sup>52</sup>), included neuroticism, anxiety, obsessive behavior, social dependence, nervousness, irritation, and smoking to manage mood, anxiety, anger, worry, unhappiness, social insecurity, and family and other stresses. These psychological and personality characteristics are, of course, strikingly similar to the DSM-IV Axis I and II disorder symptomatology measured in our study. Further, these analyses suggest that the industry not only sought to incorporate knowledge of personality characteristics in the design of existing and new brands but also conducted research to relate these psychological and personality characteristics to corresponding smoking behaviors. For example, one industry study<sup>53</sup> cited by Le Cook concluded that these psychological and personality constructs were positively associated with cigarette consumption, depth of inhalation, and anticipated difficulty in giving up smoking.

Our study is the first to demonstrate that nicotine dependence is highly associated with DSM-IV Axis I and II disorders in a representative sample of the US general population. This study also is the first to show that individuals with nicotine dependence, psychiatric disorders, and comorbid nicotine dependence and psychiatric disorders carry a very large share of the burden of all US tobacco consumption. These results clearly indicate the importance of focusing smoking prevention and cessation efforts on these vulnerable subgroups of the population who may have been more likely to be influenced by tobacco advertising. Further, in the past, smoking prevention and cessation research has focused on individual differences in psychological response, need, and addiction to tobacco use to identify prevention and intervention targets. The present study suggests that research on macro-level approaches is also needed, addressing the best methods to counter consumer segmentation and other marketing strategies. Such information may increase our understanding of the factors that undermine the effectiveness of existing coping and cessation strategies.

The results of this study are consistent with the conclusions of Le Cook et al<sup>17</sup> that awareness of tobacco prod-

uct development and marketing can improve smoking cessation efforts by clinicians and other health care professionals among all smokers and especially among the most vulnerable. This knowledge also can be used in broader public policy interventions, such as media campaigns, to target antitobacco advertisements toward psychiatrically vulnerable subgroups of the population. Moreover, the sheer magnitude of the comorbidity found between DSM-IV nicotine dependence and Axis I and II disorders suggests that knowledge of the psychological and personality constructs underlying product development will be helpful in researching causes of nicotine dependence and its psychiatric comorbidity.

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### Correction

#### Error in Image Orientation.

The Cover image for the September issue of the ARCHIVES, in addition to the thumbnail image that appeared in the "Art and Images in Psychiatry" article titled *The Family (Squatting Couple)* (2004;61:864), was reversed. The image should have appeared as shown here. The ARCHIVES regrets the error. This correction was made previously to online versions of this article.

