ORIGINAL ARTICLE

Nicotine Dependence in the United States

Prevalence, Trends, and Smoking Persistence

Naomi Breslau, PhD; Eric O. Johnson, PhD; Eva Hiripi, MS; Ronald Kessler, PhD

Background: The prevalence of smoking in the United States has been closely monitored. However, little is known about the epidemiology of nicotine dependence. We studied *DSM-III-R* nicotine dependence in the United States, trends across cohorts, and the role of nicotine dependence in smoking persistence.

Methods: The Tobacco Supplement to the National Comorbidity Survey was administered to a representative subset of 4414 persons aged 15 to 54 years. The World Health Organization's Composite International Diagnostic Interview was used to assess nicotine dependence.

Results: Lifetime prevalence of nicotine dependence was 24%, nearly half of those who had ever smoked daily for a month or more. The highest risk for nicotine dependence occurred in the first 16 years after daily smoking began, at which point the rate declined and continued at a slower pace for several years. Nicotine dependence increased the risk of smoking persistence, with an odds ratio (OR) of 2.2 (95% confidence interval [CI], 1.6-3.0). Members of the most recent cohort, who were 15 to 24 years of age at the time of the survey, were the least likely to smoke daily, but those who smoked had the highest risk of dependence: OR for daily smoking in the most recent vs earliest cohort was 0.7 (95% CI, 0.5-0.9), and for dependence among smokers, 7.2 (95% CI, 5.0-10.4).

Conclusions: Despite evidence that nicotine dependence is the leading preventable cause of death and morbidity, it remains a common psychiatric disorder. Smoking cessation and the decline in uptake in recent years varied across subgroups of the population.

Arch Gen Psychiatry. 2001;58:810-816

From the Departments of Psychiatry, Henry Ford Health System, Detroit, Mich (Drs Breslau and Johnson), Case Western Reserve University School of Medicine, Cleveland, Ohio (Dr Breslau), and University of Michigan School of Medicine, Ann Arbor (Dr Breslau); and the Department of Health Care Policy, Harvard Medical School, Boston, Mass (Ms Hiripi and Dr Kessler).

DESPITE scientific evidence that smoking is highly addictive, little information is available on the epidemiology of nicotine dependence, as distinct from smoking per se. Robins et al[1] reported on the lifetime prevalence of *DSM-III* nicotine dependence based on data from the St Louis, Mo, site of the Epidemiologic Catchment Area study. Risk factors for nicotine dependence or cohort comparisons were not reported. Kandel et al[2] reported findings on a proxy measure of the *DSM-IV* nicotine dependence from the National Household Survey of Drug Abuse (NHSDA). The report by Kandel et al is on 12-month prevalence, the only period for which the proxy measure of nicotine dependence was assessed in the NHSDA; risk factors for becoming nicotine dependent or trends across cohorts could not be estimated. Data on *DSM-III-R* nicotine dependence were reported by Breslau et al,[3] based on a representative sample of young adults in southeast Michigan. Lifetime prevalence of nicotine dependence was reported by age, sex, race, and educational level. However, trends across cohorts could not be examined because of the narrow age range of this regional sample. National data on *DSM-III-R* nicotine dependence were gathered in the National Comorbidity Survey (NCS); however, only descriptive estimates of the associations with sociodemographic characteristics have been reported to date.[4]

See also page 817

In this report, we present new information on nicotine dependence based on the NCS. Our analysis proceeds as follows. First, we describe the cumulative incidence of daily smoking in the population and the transition from daily smoking to nicotine dependence. Beyond the general knowledge that smoking is highly addictive and that multiple exposures are necessary to cross from intermittent use to depen-

©2001 American Medical Association. All rights reserved.
Downloaded From: http://archpsyc.jamanetwork.com/ on 09/05/2015

SUBJECTS AND METHODS

SAMPLE

The sampling scheme of the NCS has been described in detail previously.[10] Briefly, the NCS is a stratified multistage area probability sample of 8098 persons 15 to 54 years of age selected from the noninstitutionalized population of the United States. Data were gathered between September 1990 and March 1992. The diagnostic interview used to ascertain history of psychiatric disorders according to *DSM-III-R* was a modified version of the World Health Organization's Composite International Diagnostic Interview,[11] a structured interview designed to be administered by trained lay interviewers. The Tobacco Supplement, in which diagnostic information on nicotine dependence is covered, was administered in the second half of the survey to 4414 NCS respondents. Because the NCS fieldwork was conducted in replicates, each designed to be a separate national sample, data from the Tobacco Supplement subsample are representative of the US population.

ASSESSMENT

The *DSM-III-R*[12] adopted a unitary definition of dependence across all psychoactive substances. The definition reflects the consensus in the field of addiction on the construct of dependence as a cognitive, behavioral, and physiologic cluster that characterizes compulsive use of all substances.[13-15] It represents a departure from earlier definitions of dependence as a physiologic construct characterized by tolerance and withdrawal symptoms upon cessation. The *DSM-III-R* diagnosis of nicotine dependence requires the lifetime occurrence of 3 or more criterion symptoms of dependence, with some symptoms persisting for a month or more.

The section of the World Health Organization's Composite International Diagnostic Interview on nicotine dependence begins with a screen question that inquires whether the respondent had ever smoked daily for a month or more. *Onset of daily smoking* is defined as the age at which daily smoking for a month or more first occurred. Persons who answer positively to the screen question are asked about the *DSM-III-R* defining symptoms of nicotine dependence. Information on smoking initiation, ie, whether the respondent ever smoked a cigarette and age at first cigarette, is not obtained. *Lifetime prevalence of nicotine dependence* is defined as the proportion of persons in the sample who have ever met the criteria up to the time of the interview. *The onset of nicotine dependence* is defined by the age at which symptoms of dependence first occurred in smokers who have ever met the criteria of nicotine dependence. The Composite International Diagnostic Interview does not inquire about the age at onset of individual symptoms of dependence. The item on age at onset inquires about the respondent's age "at which symptoms like that first occurred," referring to criterion symptoms of dependence endorsed by the respondent. Thus, the age at onset of nicotine dependence in the NCS refers to the age at which multiple symptoms occurred, as opposed to the age at the earliest symptom. *Smoking persistence* is defined as smoking "fairly regularly" in the past 12 months among persons who have ever smoked daily for a month or more.

STATISTICAL ANALYSIS

The NCS data presented herein were weighted to adjust for variation in the probabilities of selection and nonresponse, and to approximate the data to the distribution of the US population on key sociodemographic characteristics.[10] The weights ranged from 0.115 to 6.497. To take into account the complex survey design, the 95% confidence intervals (CIs) of odd ratios (ORs) and Wald χ^2 tests in the survival analyses and the logistic regressions were computed by means of the jackknife repeated replications method, implemented in user-developed SAS macros.[16,17] Cumulative incidence curves of daily smoking and the transition to nicotine dependence were obtained by means of Kaplan-Meier survival methods. For the incidence of daily smoking, time was defined as chronological age. For the transition to nicotine dependence among daily smokers, time was defined as the number of years since the onset of daily smoking. We also present the cumulative incidence curve of nicotine dependence among daily smokers by chronological age.

The associations of daily smoking or nicotine dependence with sociodemographic factors were estimated in discrete-time multivariable survival analyses.[18] Age at time of interview was subdivided into 4 cohorts: 15 to 24, 25 to 34, 35 to 44, and 45 to 55 years. In these analyses, education was defined as time varying, ie, number of years of schooling completed at given ages, rather than as a fixed variable representing the level of education attained at the time of the interview. Survival analyses of daily smoking and nicotine dependence were conducted on person-years through age 24 years, the upper age limit on which members of all 4 cohorts could be compared. In the survival analysis of nicotine dependence, we excluded persons with onset of nicotine dependence before or in the year of onset of daily smoking and persons who began to smoke daily in the year of the interview (n=66). In additional survival models, we examined whether sex and race differences varied across cohorts, by testing interaction terms and estimating models in separate cohorts, when significant interactions were detected.

The associations of sociodemographic predictors with smoking persistence in the past 12 months were estimated in multiple logistic regressions, adjusting for number of years since the onset of daily smoking. In this analysis, education was defined as the level attained at the time of the interview. Persons who began smoking daily in the year of the interview or in the preceding year were excluded (n=38).

dence,[5,6] no information is available on the period of risk for developing dependence after the onset of smoking. Second, we examine sociodemographic predictors of daily smoking and nicotine dependence. Third, we examine trends in smoking and nicotine dependence across four 10-year birth cohorts represented in the NCS. Although secular trends in smoking have been reported,[7-9] no such information has been reported on the risk of becoming dependent. Last, we evaluate the role of nicotine dependence in the persistence of smoking.

©2001 American Medical Association. All rights reserved.
Downloaded From: http://archpsyc.jamanetwork.com/ on 09/05/2015

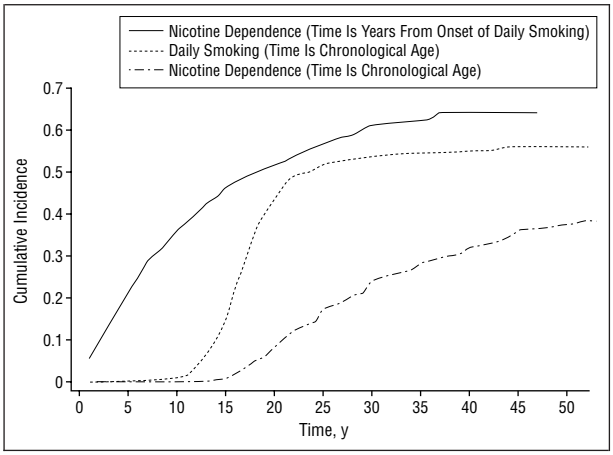

Figure 1. Cumulative incidence curves of daily smoking and nicotine dependence in the National Comorbidity Survey (n=4144 for daily smoking and 2136 for nicotine dependence).

RESULTS

DAILY SMOKING AND THE TRANSITION TO NICOTINE DEPENDENCE

The lifetime prevalence (SE) of daily smoking in the sample was 49.5% (1.3%) and of *DSM-III-R* nicotine dependence, 24.1% (1.0%). The onset of daily smoking occurred almost entirely before age 25 years, with an accelerated rate between 15 and 20 years of age (**Figure 1**). In contrast, the onset of nicotine dependence among daily smokers continued into the 40s. A comparison of the ages at onset of nicotine dependence and daily smoking within individuals showed that in only 5.4% of dependent smokers the onset of nicotine dependence occurred before or in the same year in which daily smoking began. (These persons were excluded from the analysis.) Thus, in most cases, the onset of nicotine dependence lagged by 1 year or more after daily smoking began. The highest rate of becoming nicotine dependent occurred in the first 16 years from the year after the onset of daily smoking, at which point the rate of becoming dependent declined and continued at a lower pace for approximately 10 years (Figure 1).

Multivariable survival analyses were used to estimate the risk of ever becoming a daily smoker and smokers' risk of nicotine dependence across the 4 birth cohorts of the NCS and by sociodemographic characteristics (**Table 1**). The results for becoming a daily smoker (Table 1) show that members of the most recent cohort, ie, those who had reached 15 to 24 years of age at the time of the survey, had a lower risk of ever smoking daily than members of earlier cohorts. Females had a lower risk of daily smoking than males, and nonwhites had a lower risk than whites. The risk of daily smoking was unrelated to one's educational level at the time at which daily smoking began.

The lifetime risk of nicotine dependence among those who had ever smoked daily for a month or more varied across the 4 NCS cohorts and between racial groups, but not between the sexes or by educational level (Table 1). Compared with members of the earliest cohort, ie, those 45 to 54 years of age at the time of the survey, each successively more recent cohort of daily smokers had a significantly higher risk of becoming dependent. The most recent cohort was more than 7-fold more likely to become dependent than was the earliest cohort. Black smokers had a lower risk of becoming dependent than did white smokers, whereas other nonwhite smokers did not differ from white smokers.

TRENDS ACROSS COHORTS

To illustrate more clearly the results on cohort differences, we present the cumulative incidence curves of daily smoking and the transition to dependence in the 4 NCS cohorts. Members of the most recent cohort were the least likely to ever smoke daily, whereas members of the earliest cohort were the most likely to ever smoke daily, with the 2 intermediate birth cohorts showing largely overlapping curves (**Figure 2**). The intercohort disparity emerges at approximately age 18 years, when members of the most recent cohort diverge from the earlier cohorts, showing a sharp decline in the incidence of daily smoking. The differences between the most recent cohort and each of the earlier cohorts were statistically significant.

With respect to the transition to nicotine dependence (**Figure 3**), we found the opposite trend from the trend of daily smoking. Specifically, at each year since daily smoking began, each cohort showed a significantly higher cumulative incidence of nicotine dependence than the preceding cohort. The most recent cohort, whose members were the least likely to ever smoke daily, showed the highest risk of dependence among those who did smoke daily.

CHANGES IN SOCIODEMOGRAPHIC CORRELATES OF DAILY SMOKING AND NICOTINE DEPENDENCE ACROSS COHORTS

The sex difference in daily smoking was considerably narrower in recent than in earlier cohorts. The OR for females vs males in the most recent cohort was 0.8 (95% CI, 0.6-1.1), whereas in the earliest cohort it was 0.5 (95% CI, 0.4-0.6). In contrast, the gap in daily smoking between whites and blacks widened over time: in the most recent cohort, the OR for blacks vs whites was 0.3 (95% CI, 0.2-0.5), whereas in the earliest cohort it was 0.6 (95% CI, 0.4-1.0). With respect to the transition to nicotine dependence, there was little evidence of change in sociodemographic correlates.

NICOTINE DEPENDENCE AND PERSISTENCE IN SMOKING

We examined the impact of nicotine dependence on smoking persistence in the past 12 months among persons who had ever smoked daily for a month or more, by means of multiple logistic regression. Time from onset of daily smoking, age, sex, race, and education were included as covariates. Smokers who had ever been dependent were more likely to smoke in the past 12 months than smokers who had never been dependent (OR, 2.2; 95% CI, 1.6-3.0).

©2001 American Medical Association. All rights reserved.
Downloaded From: http://archpsyc.jamanetwork.com/ on 09/05/2015

Table 1. Sociodemographic Predictors of Daily Smoking and Transition to Nicotine Dependence*

	Daily Smoking			Nicotine Dependence in Daily Smokers†		
	No. of Subjects	AOR‡	95% CI‡	No. of Subjects	AOR‡	95% CI‡
Age, y						
15-24	1063	0.7§	0.5-0.9	289	7.2§	5.0-10.4
25-34	1356	0.9	0.7-1.0	699	2.9§	2.2-3.9
35-44	1220	0.9	0.7-1.0	661	1.7§	1.4-2.1
45-54	775	1.0	. . .	487	1.0	. . .
χ^2_3	10.73§			112.75§		
Sex						
Female	2247	0.7§	0.6-0.8	1004	1.1	0.9-1.3
Male	2167	1.0	. . .	1132	1.0	. . .
χ^2_1	44.11§			0.72		
Race/ethnicity						
Black	498	0.6§	0.5-0.8	237	0.7§	0.5-0.9
Hispanic	496	0.6§	0.5-0.8	151	1.0	0.7-1.5
Other	163	0.5§	0.3-0.9	65	1.0	0.4-2.5
White	3257	1.0	. . .	1683	1.0	. . .
χ^2_3	23.74§			8.40§		
Education, y‖						
≤12	4414	1.0	0.6-1.6	2136	1.2	0.9-1.7
13-15	2187	1.0	0.6-1.5	954	1.2	0.9-1.6
≥16	989	1.0	. . .	377	1.0	. . .
χ^2_2	0.09			2.11		

*Total sample, N = 4414; subset of daily smokers, n = 2136.
†The analysis of nicotine dependence was performed on persons with a history of daily smoking, excluding persons with onset of nicotine dependence before or in the year of onset of daily smoking and persons with onset of daily smoking in the year of the interview.
‡Adjusted odds ratios (AORs) and 95% confidence intervals (CIs) estimated in 2 separate multiple discrete-time survival analyses.
§$P<.05$.
‖Education is a time-varying variable. Persons in higher levels of education are included in all lower levels they previously attained.

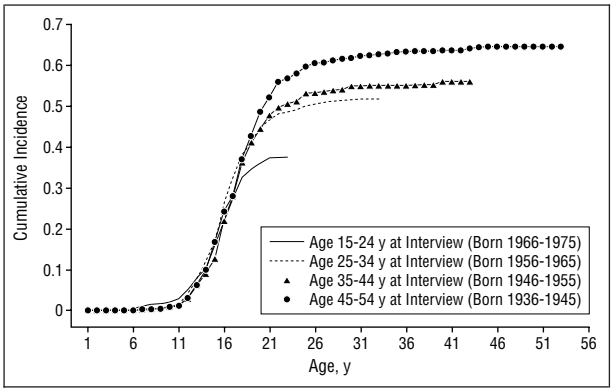

Figure 2. Cumulative incidence of daily smoking in the 4 National Comorbidity Survey cohorts (n=4144).

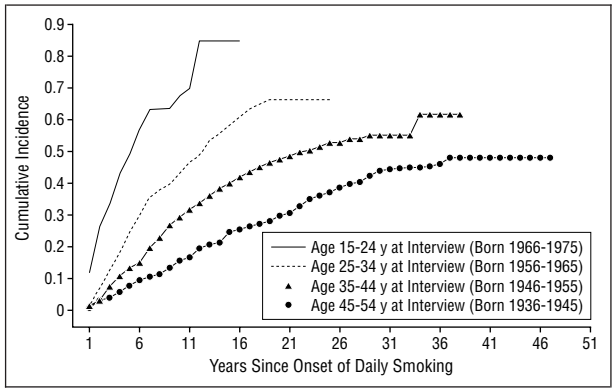

Figure 3. Cumulative incidence of nicotine dependence among daily smokers in the 4 National Comorbidity Survey cohorts (n=2136).

In addition, nicotine dependence modified the risk of smoking persistence differentially across subgroups of the population (**Table 2**). A significant interaction between nicotine dependence and any of the sociodemographic variables indicates that the relationship of the variable with smoking persistence differed significantly between dependent and nondependent smokers. A significant interaction was detected between nicotine dependence and age. Dependent smokers who were 15 to 24 years of age were more likely to have continued to smoke in the past 12 months than dependent smokers in the oldest age group (OR, 6.1; 95% CI, 1.8-20.9). However, nondependent smokers did not differ significantly across age groups. A significant interaction was also detected between nicotine dependence and sex, with female smokers more likely to persist than male smokers if they were dependent, but less likely to persist if they were nondependent. With respect to race, we found that among dependent smokers, blacks differed little from whites, whereas among nondependent smokers, blacks were more likely to persist than whites (OR, 2.5; 95% CI, 1.4-4.2). Hispanic smokers, dependent and nondependent, differed little from white smokers, whereas members of the "other" racial category showed a higher risk of smoking persistence than whites.

In contrast to the interactions of nicotine dependence with age, sex, and race, education was a strong predictor of smoking persistence in both dependent and nondependent smokers: smokers with less than 12 years of

©2001 American Medical Association. All rights reserved.
Downloaded From: http://archpsyc.jamanetwork.com/ on 09/05/2015

Table 2. Sociodemographic Predictors of Smoking Persistence Among Daily Smokers With and Without History of Nicotine Dependence*

	Dependent Smokers			Nondependent Smokers			
	No. of Subjects	AOR†	95% CI†	No. of Subjects	AOR†	95% CI†	Interactions‡
Age, y							
15-24	144	6.1§	1.8-20.9	141	1.4	0.5-4.2	
25-34	360	1.9	0.9-3.9	351	1.2	0.5-3.0	
35-44	326	1.4	0.9-2.2	350	0.9	0.5-1.7	
45-54	219	1.0	. . .	273	1.0	. . .	
χ^2_3	9.72§			2.22			13.02§
Sex							
Female	513	1.3	0.9-1.9	516	0.7	0.5-1.0	
Male	536	1.0	. . .	599	1.0	. . .	
χ^2_1	2.38			3.11			5.02§
Race/ethnicity							
Black	88	0.8	0.4-1.4	146	2.5§	1.4-4.2	
Hispanic	80	0.7	0.3-1.7	75	0.9	0.5-1.6	
Other	30	2.2	0.7-6.8	37	2.7§	1.2-6.1	
White	851	1.0	. . .	857	1.0	. . .	
χ^2_3	3.92			20.12§			10.36§
Education, y‖							
<12	206	5.3§	2.1-13.5	195	8.6§	4.6-16.0	
12	376	2.2§	1.2-4.1	390	3.9§	2.5-6.2	
13-15	292	2.2§	1.2-4.1	316	3.4§	2.2-5.3	
≥16	175	1.0	. . .	214	1.0	. . .	
χ^2_3	13.09§			62.66§			2.40

*n = 2164. Smoking persistence is defined as smoking in the year of or the year before the year of the interview; persons with onset of daily smoking during this period were excluded.

†Adjusted odds ratios (AORs) and 95% confidence intervals (CIs) estimated in 2 multiple regression analyses.

‡Interactions estimated in multiple logistic regressions to test differences between dependent and nondependent smokers on each predictor.

§$P<.05$.

schooling had the highest odds of persistence, relative to smokers who completed college.

COMMENT

The key findings of this study are as follows. In the NCS sample of persons 15 to 54 years of age, the lifetime prevalence of *DSM-III-R* nicotine dependence was 24%. The risk of daily smoking was lower in females than in males and in nonwhites than in whites. The onset of daily smoking rarely occurred after age 25 years. Smokers' transition to nicotine dependence continued into the 40s. The highest rate of smokers' progression to nicotine dependence occurred in the first 16 years after the year at which daily smoking began, and, from that point, the transition to dependence continued at a lower rate for approximately a decade. The risk of nicotine dependence in daily smokers did not vary between the sexes or by educational level, but was lower among black than among white smokers. Dependent smokers were twice as likely to smoke in the year preceding the interview as were nondependent smokers. Members of the most recent cohort were the least likely to ever smoke daily, but those who did smoke daily had the highest risk of becoming dependent, compared with members of earlier cohorts.

Several limitations in this study warrant comment. First, because NCS data are based on retrospective reports, inferences regarding cohort effects should take into account the possibility of differential recall or reporting bias across age groups. However, our finding of a lower risk of daily smoking in members of the most recent cohort is consistent with the trends of "ever smoking" and "regular smoking" in the 1991 to 1993 NHSDA.[7] It is also consistent with the trend in daily smoking in high school seniors up to 1992, the year of the NCS, based on the Monitoring the Future Study.[8,9] Furthermore, the closing of the sex difference and the widening of the race difference in daily smoking in recent cohorts, observed in this study, have been found among high school seniors in the Monitoring the Future Study.[8,9] Data from Monitoring the Future do not rely on retrospective reports.

Second, the NCS Tobacco Supplement did not gather information on smoking initiation; consequently, we could not estimate the risk of nicotine dependence among persons who had ever smoked. Nonetheless, the NCS data allowed us to chart important aspects in the course of tobacco use. We found that nicotine dependence is distinctly a later stage than daily smoking: in most dependent smokers (95%), the onset of nicotine dependence lagged by at least 1 year after the onset of daily smoking. Furthermore, the transition to nicotine dependence slowed down only after 16 years following the year in which daily smoking began. The data also allowed us to examine important factors in this transition, as described above. In the absence of information on smoking initiation, we could not determine whether the observed lower risk of daily smoking in members of the most recent cohort reflects a lower risk of initiation or a lower risk of the transition to daily smoking among those who ever smoked, or both. To address this question, we examined cohort differ-

©2001 American Medical Association. All rights reserved.
Downloaded From: http://archpsyc.jamanetwork.com/ on 09/05/2015

ences in smoking initiation in the NHSDA.[19] Analysis of the 1992 (the year of the NCS) NHSDA public use data, subdivided to correspond to the NCS cohorts, showed a lower prevalence of ever smoking among persons 15 to 24 years of age than among earlier cohorts, 61.5% (in 15- to 24-year-olds) vs 74.5% (in 25- to 34-year-olds), 78.1% (in 35- to 44-year-olds), and 80.9% (in 45- to 54-year-olds). These cohort differences in smoking initiation might account in part for the cohort differences in daily smoking observed in this study.

Finally, the NCS data are based on *DSM-III-R*, and, strictly speaking, direct inferences on nicotine dependence according to the current definition in *DSM-IV* cannot be drawn. *DSM-IV* requires the clustering of 3 or more dependence symptoms within a 1-year period, a requirement that theoretically might reclassify some *DSM-III-R* dependent smokers as nondependent according to *DSM-IV*. However, the available evidence suggests that the differences between the 2 diagnostic systems have little influence on prevalence estimates of nicotine dependence and on the classification of smokers as dependent vs nondependent.[20,21]

The estimate of the lifetime prevalence of *DSM-III-R* nicotine dependence in the NCS is similar to the estimate reported by Breslau et al,[3] 24% and 20%, respectively. The higher figure reported by Robins et al[1] from the St Louis site of the Epidemiologic Catchment Area study (36.6%) might be due to the use of the *DSM-III* in that study. Evidence suggesting that the *DSM-III* definition of nicotine dependence might be overinclusive has been reported.[22] Studies on 12-month prevalence of nicotine dependence yielded discrepant results.[2,23] Sex and race differences observed in the NCS are also in accord with those reported by Breslau et al[3] and Andreski and Breslau[24] and by Kandel and Chen using NHSDA data.[25]

The results on the role of nicotine dependence in the persistence of smoking are in accord with previous reports.[21,26,27] In addition, they shed new light on 2 points. First, the study clarifies previous findings on race differences in smokers' potential for quitting. According to previous reports (reviewed by Giovino et al[28]), black smokers are less successful than white smokers in their efforts to quit. The extent to which the race difference in quitting is due to a greater likelihood of black smokers' becoming dependent has not been previously examined. Our analysis showed that the greater persistence of black smokers is not due to a higher rate of dependence in black vs white smokers. In fact, black smokers are less likely than white smokers to become dependent. Furthermore, among dependent smokers, blacks do not differ from whites in the potential for quitting. Instead, it is only among nondependent smokers that blacks are at a relative disadvantage.

Second, previous studies have consistently reported marked differences in the rates of smoking cessation across educational levels.[26,28] However, the possibility that nicotine dependence might modify this relationship has not been previously tested. Our results show that smokers who completed college, dependent and nondependent, were far less likely to have persisted in smoking in the year preceding the interview than were smokers with lower education.

A potential explanation of our findings that members of the most recent cohort had the lowest risk of smoking but the highest conditional risk of dependence might be the following. The growing awareness of the addictive potential of smoking and its adverse health effects has resulted in declining numbers who take up smoking. Those in recent cohorts who do take up smoking might be more deviant than smokers in earlier cohorts with respect to personality traits that influence smoking and the progression to nicotine dependence (eg, risk taking, impulsivity). A similar interpretation was suggested by Heath et al[29] for the observation of no heterogeneity in the relative magnitude of genetic and environmental influences on smoking across birth cohorts, despite the declining prevalence of smoking in recent cohorts. It should be noted that, since 1992, when the NCS was completed, smoking prevalence has been rising slowly among adolescents, a reversal of the trend in the previous decade.[30] The implication of the rise in smoking for the conditional risk of nicotine dependence in these new cohorts is unclear.

A closer examination of sociodemographic predictors of smoking across cohorts showed that the sex gap in the risk of daily smoking that characterized earlier cohorts has nearly closed in recent cohorts, whereas the racial gap has widened during the same period. These findings are consistent with previous reports.[31-33] Changing social norms about sex differences in a wide range of behaviors might be reflected in the closing sex difference in smoking. A similar trend has been reported with respect to the sex difference in alcohol use.[7] The widening racial differences in recent cohorts is difficult to explain.

The findings on the relationship between level of educational attainment and the persistence of smoking in the year preceding the interview are consistent with previous reports on the increasing inequality in daily smoking across educational levels.[34-36] Our finding that the risk of daily smoking was unrelated to educational level at the time of onset of daily smoking might appear at first glance to conflict with studies that reported an inverse relationship between smoking and education.[31,33,36] However, these studies did not estimate the risk of smoking by level of education at the time of smoking onset, but at the time of the interview.

The growing availability of scientific information on the adverse health effects of smoking has been followed by dramatic reductions in the overall prevalence of smoking in the population. However, changes in daily smoking, nicotine dependence, and smoking persistence have varied across subgroups of the population, as shown herein. Further research is needed to elucidate the biological and sociocultural bases of these variations.

Accepted for publication December 21, 2000.

This study was supported in part by grant RO1 48802 from the National Institutes of Mental Health, Bethesda, Md (Dr Breslau).

The data reported herein come from the NCS. The NCS is a collaborative epidemiologic investigation of the preva-

©2001 American Medical Association. All rights reserved.
Downloaded From: http://archpsyc.jamanetwork.com/ on 09/05/2015

lence, causes, and consequences of psychiatric morbidity and comorbidity supported by the National Institute of Mental Health (grants R01 MH46376, R01 MH49098, and R01 MH52861), with supplemental support from the National Institute on Drug Abuse, Bethesda (through a supplement to grant MH46376) and the W. T. Grant Foundation, New York, NY (90135190), R. C. Kessler, PhD, principal investigator. Preparation for this report was also supported by National Institute of Mental Health grant K05 MH00507.

A complete list of NCS publications, along with abstracts, study documentation, interview schedules, and the raw NCS public use data files, can be obtained directly from the NCS Homepage at http://www.hcp.med.harvard.edu/ncs/.

Corresponding author and reprints: Naomi Breslau, PhD, Henry Ford Health System, One Ford Place, 3A, Detroit, MI 48202-3450 (e-mail: nbresla1@hfhs.org).

REFERENCES

1. Robins LN, Helzer JE, Przybeck T. Substance abuse in the general population. In: Barrett J, Rose RM, eds. *Mental Disorders in the Community: Progress and Challenge, Proceedings of the American Psychopathological Association*. New York, NY: Guilford Press; 1986:9-31.
2. Kandel D, Chen K, Warner LA, Kessler RC, Grant B. Prevalence and demographic correlates of symptoms of last year dependence on alcohol, nicotine, marijuana and cocaine in the U.S. population. *Drug Alcohol Depend*. 1997;44:11-29.
3. Breslau N, Kilbey MM, Andreski P. *DSM-III-R* nicotine dependence in young adults: prevalence, correlates, and associated psychiatric disorders. *Addiction*. 1994; 89:743-754.
4. Anthony JC, Warner LA, Kessler RC. Comparative epidemiology of dependence on tobacco, alcohol, controlled substances, and inhalants: basic findings from the National Comorbidity Survey. *Exp Clin Psychopharmacol*. 1994; 2:244-268.
5. Koob G. Drugs of abuse: anatomy, pharmacology, and function of rewards pathways. *Trends Pharmacol Sci*. 1992;13:177-184.
6. Ouellette J, Wood W. Habit and intention in everyday life: the multiple processes by which past behavior predicts future behavior. *Psychol Bull*. 1998;124:54-74.
7. Johnson RA, Gerstein DR. Initiation of use of alcohol, cigarettes, marijuana, cocaine, and other substances in US birth cohorts since 1919. *Am J Public Health*. 1998;88:27-33.
8. Johnston LD, O'Malley PM, Bachman JG. College students and young adults. In: *National Survey Results on Drug Use From the Monitoring the Future Study, 1975-1992*. Vol 2. Washington, DC: US Dept of Health and Human Services, Public Health Service; 1993. NIH publication 93-3598.
9. Johnston LD, O'Malley PM, Bachman JG. Trends in cigarette smoking among American teens: 1999. University of Michigan News and Information Services. Available at: http://www.monitoringthefuture.org. Accessed May 25, 2000.
10. Kessler RC. The National Comorbidity Survey: preliminary results and future directions. *Int J Methods Psychiatr Res*. 1995;5:139-151.
11. World Health Organization. *Composite International Diagnostic Interview (CIDI): Version 1.0*. Geneva, Switzerland: World Health Organization; 1990.
12. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition*. Washington, DC: American Psychiatric Association; 1987.
13. Jaffe JH. Tobacco smoking and nicotine dependence. In: Wonnacott S, Russell MAH, Stolerman IP, eds. *Nicotine Psychopharmacology: Molecular, Cellular, and Behavioural Aspects*. Oxford, England: Oxford University Press; 1990:1-37.
14. Edwards G, Gross MM. Alcohol dependence: provisional description of a clinical syndrome. *BMJ*. 1976;1:1058-1061.
15. Rounsaville BJ, Kranzler HR. The *DSM-III-R* diagnosis of alcoholism. In: Tasman A, Hales RE, Frances AJ, eds. *Review of Psychiatry*. Washington, DC: American Psychiatric Press Inc; 1989:323-340.
16. Kish L, Frankel MR. Inferences from complex samples. *J R Stat Soc*. 1974;36:1-37.
17. *SAS User's Guide, Release 6.12*. Cary, NC: SAS Institute Inc; 1996.
18. Efron B. Logistic regression: survival analysis and the Kaplan-Meier curve. *J Am Stat Assoc*. 1988;83:414-425.
19. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Office of Applied Studies. *National Household Survey on Drug Abuse, 1992* [computer file]. ICPSR version. Research Triangle Park, NC: Research Triangle Institute; 1994. Distributed by: Inter-university Consortium for Political and Social Research, Ann Arbor, Mich.
20. Cottler LB, Schuckit MA, Helzer JE, Crowley T, Woody G, Nathan P, Hughes J. The *DSM-IV* field trial for substance use disorders: major results. *Drug Alcohol Depend*. 1995;38:59-69.
21. Breslau N, Johnson EO. Predicting smoking cessation and major depression in nicotine-dependent smokers: a comparison of the Fagerström Questionnaire and *DSM* nicotine dependence. *Am J Public Health*. 2000;90:1122-1127.
22. Hughes JR, Gust SW, Pechacek TF. Prevalence of tobacco dependence and withdrawal. *Am J Psychiatry*. 1987;144:205-208.
23. Stanton WR. *DSM-III-R* tobacco dependence and quitting during late adolescence. *Addict Behav*. 1995;20:595-603.
24. Andreski P, Breslau N. Smoking and nicotine dependence in young adults: differences between blacks and whites. *Drug Alcohol Depend*. 1993;32:119-125.
25. Kandel DB, Chen K. Extent of smoking and nicotine dependence in the United States: 1991-1993. *Nicotine Tob Res*. 2000;2:263-274.
26. Breslau N, Kilbey M, Andreski P. Nicotine dependence, major depression, and anxiety in young adults. *Arch Gen Psychiatry*. 1991;48:1069-1074.
27. Pinto RP, Abrams DB, Monti PM, Jacolus SI. Nicotine dependence and the likelihood of quitting smoking. *Addict Behav*. 1987;12:371-374.
28. Giovino GA, Henningfield JE, Tomar SL, Escobedo LG, Slade J. Epidemiology of tobacco use and dependence. *Epidemiol Rev*. 1995;17:48-65.
29. Heath AC, Cates R, Martin NG, Meyer J, Hewitt JK, Neale MC, Eaves LJ. Genetic contribution to risk of smoking initiation: comparisons across birth cohorts and across cultures. *J Subst Abuse*. 1993;5:221-246.
30. Johnston LD, O'Malley PM, Bachman JG. Secondary school students. In: *National Survey Results on Drug Use From the Monitoring the Future Study, 1975-1997*. Vol 1. Washington, DC: National Institute on Drug Abuse; 1998.
31. Garfinkel L. Trends in cigarette smoking in the United States. *Prev Med*. 1997; 26:447-450.
32. Birkett NJ. Trends in smoking by birth cohort for births between 1940 and 1975: a reconstructed cohort analysis of the 1990 Ontario Health Survey. *Prev Med*. 1997;26:534-541.
33. Laaksonen M, Uutela A, Vartianinen E, Jousilahti P, Helakorpi S, Puska P. Development of smoking by birth cohort in the adult population in eastern Finland 1972-97. *Tob Control*. 1999;8:161-168.
34. Breslau N, Peterson E. Smoking cessation in young adults: age at initiation of cigarette smoking and other suspected influences. *Am J Public Health*. 1996; 86:214-220.
35. Kabat GC, Wynder EL. Determinants of quitting smoking. *Am J Public Health*. 1987;77:1301-1305.
36. Pierce JP. International comparisons of trends in cigarette smoking prevalence. *Am J Public Health*. 1989;79:152-157.

©2001 American Medical Association. All rights reserved.
Downloaded From: http://archpsyc.jamanetwork.com/ on 09/05/2015