

# Epidemiology and Correlates of Daily Smoking and Nicotine Dependence Among Young Adults in the United States

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Negative health consequences of smoking stem in large measure from its chronicity. Nicotine is one of the most addictive drugs.<sup>1,2</sup> The striking decline in rates of smoking among youths observed since the 1990s is slowing down,<sup>3</sup> although 25% of high school seniors still smoke daily and are at risk of becoming addicted. Much more is known about the epidemiology of smoking than nicotine dependence, especially regarding racial/ethnic patterns.<sup>4</sup> Recent longitudinal studies identify few racial/ethnic differences in the predictors of smoking onset and daily smoking,<sup>4–11</sup> except for the stronger influences of parents and peers for Whites than for minorities.<sup>12–16</sup> Although lower rates of nicotine dependence are observed among African Americans than among Whites,<sup>1,2,17,18</sup> racial/ethnic differences in correlates of dependence remain to be identified. Little is known about the factors associated with the persistence of dependence.

Daily smoking and nicotine dependence are 2 major indicators of chronic smoking. Although the overwhelming majority of nicotine-dependent individuals are daily smokers, only about half of daily smokers meet criteria for dependence.<sup>18,19</sup> Very few young adults, as few as 5%,<sup>18</sup> become dependent before smoking daily,<sup>18,20,21</sup> suggesting that dependence represents a later stage of involvement. Whether daily smoking and dependence represent qualitatively different stages of smoking, with daily smoking being a behavioral measure and dependence a more dynamic syndrome state, remains to be established.

We examined daily, lifetime dependent, and current dependent smokers and associated racial/ethnic differences in a young adult sample from wave III of the National Longitudinal Study of Adolescent Health (Add Health). We previously analyzed predictors of smoking onset and transition to daily smoking over 1 year in Add Health between

**Objectives.** We describe the epidemiology of smoking behaviors in a national young adult sample and identify common and unique demographic, social, and psychological correlates of daily smoking and lifetime and current nicotine dependence by race/ethnicity.

**Methods.** Data are from the National Longitudinal Survey of Adolescent Health, wave III. Dependence was measured by the Revised Fagerström Test for Nicotine Dependence. Logistic regressions were estimated.

**Results.** Hispanic ethnicity, low education, parental and peer smoking, novelty seeking, early age of smoking onset, and pleasurable initial smoking experiences are significantly correlated with daily smoking and lifetime nicotine dependence. Depressive symptoms are uniquely associated with lifetime and current dependence. Few factors are highly associated with current dependence. Initial sensitivity to smoking has a significantly greater impact on daily smoking than on dependence. Correlates of smoking behaviors are mostly common across racial/ethnic groups, although parental and peer smoking are significant for Whites and Hispanics but not for African Americans.

**Conclusions.** There are more common than unique correlates of each smoking stage and across racial/ethnic groups. Primary prevention and interventions addressing the factors tested could be uniform for most chronic smokers irrespective of dependence status and race/ethnicity. (*Am J Public Health*. 2006;96:299–308. doi:10.2105/AJPH.2004.057232)

waves I and II and observed few racial/ethnic differences.<sup>10</sup>

Psychosocial predictors of adolescent smoking behavior include peer, family, personal, and sociodemographic domains.<sup>5,22–28</sup> Peer smoking is among the strongest predictors of adolescent smoking initiation and current smoking. Other psychosocial predictors include parental smoking, low levels of parent-child closeness, adolescent problem behavior, depression, sensation seeking, low self-esteem, and poor academic performance. There is also evidence, from small selected samples, that sensitivity to the initial smoking experience predicts smoking onset and perhaps dependence.<sup>29</sup> Those who initially experience pleasant rather than aversive sensations are more likely to continue smoking.<sup>30</sup> Thus, tolerance and dependence may result from preexisting individual differences in sensitivity to nicotine, in addition to extensiveness of smoking.<sup>31–34</sup>

The association between initial sensitivity to smoking and nicotine dependence has not been examined in a nationally representative sample. This opportunity exists in Add Health wave III, because we obtained a grant from the National Institute on Drug Abuse to include measures of nicotine dependence and initial sensitivity to nicotine, variables not previously measured, in the interview.

We hypothesized the following: Peer smoking would be more important for daily smoking than dependence. Parental smoking and psychological factors (especially depressive symptoms) would be more important for dependence than for daily smoking. Parental and peer smoking would be more important for Whites than for African Americans.

## METHODS

Data are from Add Health wave III, a subset of participants in a school survey

conducted in 1994–1995 on a national representative sample of 90 118 adolescents in grades 7 through 12.<sup>35</sup> In 1995 (wave I), representative samples of survey participants and nonparticipants were selected for follow-up (mean age  $15.5 \pm 1.7$  years). Siblings and co-twins, if not originally sampled, were added to generate a genetically informative sample but were excluded from national estimates. Wave I interviews were completed with 20 745 adolescents (80% participation). In 1996 (wave II), 14 736 of 16 706 wave I adolescents in target grades 7 to 11 were reinterviewed. In 2001–2002, all students interviewed at wave I were targeted for wave III ( $n=20\,058$ ), except 687 unweighted cases who were part of the genetic sample. Interviews were completed with 15 197 youths (mean age  $21.8 \pm 1.9$  years) (75.8% participation rate). Those not reinterviewed were slightly older, more likely to be males, from single-parent families, and more delinquent than those interviewed; smoking rates were similar. Sampling weights that correct for unequal probabilities of sample selection were applied to the 14 322 core sample cases to obtain a nationally representative sample, excluding the genetic sample ( $N=875$ ).<sup>36</sup>

Excluding 120 cases missing smoking data, we analyzed 14 202 cases. Five strata were defined: (1) ever smoked, even if only 1 or 2 puffs; (2) ever smoked a whole cigarette; (3) ever smoked daily; (4) ever dependent on nicotine; (5) met criteria for last-30-day dependence.

### Independent Variables

**Smoking behaviors.** *Ever daily smokers* smoked daily for 30 days. *Nicotine dependence (lifetime, current)* was measured by the Revised Fagerström Test for Nicotine Dependence.<sup>37</sup> Respondents were asked 6 questions about their smoking behavior during the last 30 days; those reporting no current symptoms but more extensive prior smoking were asked about symptoms experienced during that period. The following questions were asked: How soon after you wake up do you have your first cigarette (within 5 minutes, within 6 to 30 minutes, within 31 to 60 minutes, after 60 minutes; coded 3 to 0)? Do you find it difficult not to smoke in places where it is forbidden, for example, in church, at the library, or

in theaters (no, yes)? Which cigarette would you hate most to give up (the first one in the morning, all others; coded 1,0)? How many cigarettes a day do you smoke (10 or fewer, 11 to 20, 21–30, 31 or more; coded 0 to 3)? Do you smoke more frequently during the first hours after waking than during the rest of the day (no, yes)? Do you still smoke even if you are so ill that you are in bed most of the day (no, yes)? No, yes responses were coded 0, 1. A score of 4 defined nicotine dependence.<sup>38</sup> Current dependence refers to last-30-day symptoms ( $\alpha=.65$ ); lifetime dependence refers to current or past symptoms ( $\alpha=.72$ ).

Because of skip errors, the last-30-day and prior dependence questions were not asked consistently of all smokers, generating missing data for 275 of the 5508 ever daily smokers; additionally, 108 daily smokers did not answer at least 3 dependence questions (total missing=383). Because 2660 (51.9%) of the remaining ever daily smokers met criteria for lifetime dependence, 199 dependent daily smokers ( $51.9\% \times 383$ ) are presumably missing, representing 6.96% of the daily smokers estimated to be dependent ( $199/2660 + 199$ ). All sample sizes are unweighted.

Current dependence among lifetime dependent smokers measures persistence of symptoms.

### Covariates

**Sociodemographic variables.** *Race/ethnicity* was Non-Hispanic African American, non-Hispanic White, Hispanic, or Other (Asian, Native American). Non-Hispanic qualifier is mostly not used in the text. *Gender* was male or female. *Age* was 18 to 19, 20, 21, 22, 23, 24, or 25 to 27 years. *Education* was less than 12th grade, high school graduate, some college, or college graduate. *Student status* was enrolled or not enrolled in school. *Work status* was not working, working part-time, or working full-time. *Family income* was annual household income logarithmically transformed. *Marital status* was not currently married or cohabiting, married, or cohabiting. *Children* was recorded as yes or no.

**Social-psychological variables.** *Novelty seeking* was a summed score of 9 five-point items from Cloninger's Tridimensional Personality Questionnaire<sup>39</sup> asking how true each was for respondents (e.g., "I often do things based on how I feel at the moment") 1=not true to 5=

very true ( $\alpha=.87$ ). *Self-esteem* was a summed score of 4 five-point items (e.g., have many good qualities); 5=strongly agree to 1=strongly disagree ( $\alpha=.79$ ). *Delinquency* was a summed frequency of participation in 11 delinquent behaviors in past 12 months (e.g., deliberately damaged property); 0=none, 1=1 or 2 times; 3=3 or 4 times, and 5=5 or more times ( $\alpha=.77$ ). Excluded selling marijuana or other drugs. *Depressive symptoms* was a combination of 9 of 20 items from the Center for Epidemiologic Studies Depression Scale.<sup>40</sup> Summed ratings of the frequency of 9 feelings experienced the past week (e.g., poor appetite, depressed); 0=never or rarely to 3=most or all the time ( $\alpha=.82$ ).

**Interpersonal variables.** *Parental smoking* was combined from wave III youth's reports of each residential parent's smoking at prior interview: no parent ever smoked; both parents ever smoked; only mother; only father; no parent in household. *Peer smoking* was based on youth reports at waves II or I that at least 1 of 3 best friends smoked daily.

**Smoking history.** *Onset age of smoking a whole cigarette* was age in years. *Time to daily smoking* was time elapsed between onset ages of smoking a whole cigarette and daily smoking. *Initial sensitivity to smoking experience* (Modified Pomerleau et al.<sup>30</sup>; added 2 items) was the extent to which smokers experienced each of 9 symptoms with their first few cigarettes; scored 1=none to 4=intense experience. Three scales averaged the scores of component items: (1) dizziness; (2) pleasant symptoms (pleasant sensations, relaxation, pleasurable rush or buzz,  $\alpha=.77$ ); (3) unpleasant symptoms (unpleasant sensations, nausea, coughing, difficulty inhaling, heart pounding,  $\alpha=.80$ ).

### Statistical Analysis

Three smoking behaviors were modeled: (1) ever smoked daily, (2) lifetime dependence, (3) current dependence. Logistic regressions estimated the association of individual characteristics with each behavior: (1) ever smoked daily among those who ever smoked a whole cigarette ( $n=8373$ ); (2) lifetime dependence among ever daily smokers ( $n=5125$ ); (3) current dependence among those ever dependent ( $n=2660$ ).

Smoking a whole cigarette defined the initial smoking experience in model 1 because

age of onset of smoking was not asked of those having smoked only 1 or 2 puffs. The same covariates were included in all 3 models, but time between the ages of first smoking a whole cigarette and smoking daily was added to the dependence models. Number of cigarettes smoked daily was not included because it was a Revised Fagerström Test for Nicotine Dependence item. Metric regression coefficients of covariates were multiplied by their standard deviations to obtain standardized regression coefficients. The 3 outcomes were not independent.

Differences of effect sizes between covariates of different outcomes were tested by pooling each pair of outcomes into 1 logistic model that allowed overlap between outcomes.<sup>41,42</sup> Each pooled model included a dummy variable for 1 smoking outcome and interaction terms between the dummy and each covariate; the interactions tested the statistical significance of differences in covariate effects on each outcome.<sup>42</sup>

Models were adjusted for design effects and sampling weights<sup>43</sup> and were estimated for all subjects and separately for non-Hispanic Whites, non-Hispanic African Americans, and Hispanics. Interaction terms between race/ethnicity and statistically significant predictors in any models run separately for each ethnic group were included in models fitted to the total sample to assess statistically significant race/ethnic differences in risk and protective factors. Models were reestimated by retaining only significant interactions.

RESULTS

Smoking Patterns

A total of 75.5% ever smoked, 63.3% smoked a whole cigarette, 42.8% ever smoked daily, 21.7% met criteria for lifetime nicotine dependence, and 14.1% were currently dependent; 53.1% of those who ever smoked daily met criteria for lifetime dependence, and 66.2% of lifetime dependents were currently dependent.

Racial/ethnic groups varied greatly in reaching each smoking stage (Table 1). Differences were largest at the lowest stages of involvement and decreased with each successive stage. African Americans were the least likely to initiate smoking or to smoke a whole

TABLE 1—Prevalence of Smoking Behaviors by Gender and Race/Ethnicity (Add Health, Wave III) (n = 14 202)<sup>a</sup>

	Ever Tried (Among Total Sample)		Ever Smoked Whole Cigarette (Among Those Who Ever Tried)		Ever Daily (Among Smokers of Whole Cigarette)		Lifetime Dependent (Among Ever Daily Smokers)		Last 30 Days Dependent (Among Lifetime Dependent <sup>b</sup> )	
	% (No.)	OR (95% CI)	% (No.)	OR (95% CI)	% (No.)	OR (95% CI)	% (No.)	OR (95% CI)	% (No.)	OR (95% CI)
Total Sample	75.5 (14 202)	...	83.8 (10 377)	...	67.8 (8 373)	...	53.1 (5 125)	...	66.2 (2 660)	...
Gender										
Male (reference)	76.6 (6 691)	...	85.6 (5 013)	...	68.6 (4 182)	...	54.6 (2 604)	...	70.8 (1 409)	...
Female	74.4* (7 511)	...	82.0*** (5 364)	...	66.9 (4 191)	...	51.4 (2 521)	...	60.7*** (1 251)	...
Race/ethnicity <sup>c</sup>										
White (reference)	80.2 (7 775)	...	87.8 (6 220)	...	70.8 (5 428)	...	55.3 (3 634)	...	65.8 (2 021)	...
African American	60.1*** (3 036)	...	67.4*** (1 802)	...	61.9*** (1 180)	...	51.1 (6 14)	...	78.2** (3 00)	...
Hispanic	71.0*** (2 322)	...	80.3*** (1 616)	...	54.9*** (1 217)	...	37.6*** (5 93)	...	53.5* (217)	...
Asian	68.5*** (962)	...	73.3*** (658)	...	60.3* (484)	...	40.1** (248)	...	64.9 (103)	...
American Indian	83.7 (107)	...	82.4 (81)	...	60.5 (64)	...	57.2 (36)	...	78.6 (19)	...
Ratios of odds ratios <sup>d</sup>										
African Americans to Whites	...	0.37 (0.32, 0.44)	...	0.29 (0.24, 0.35)	...	0.69 (0.53, 0.94)	...	0.84 (0.74, 0.97)	...	1.87 (1.17, 2.97)
Hispanics to Whites	...	0.60*** (0.49, 0.75)	...	0.57*** (0.44, 0.75)	...	0.50 (0.40, 0.63)	...	0.49** (0.35, 0.67)	...	0.60*** (0.39, 0.92)

Note. OR = odds ratio; CI = confidence interval.  
<sup>a</sup>Unweighted numbers; weighted percentages. Data are missing for ever daily (n = 25), lifetime dependent (n = 383).  
<sup>b</sup>Who ever smoked daily.  
<sup>c</sup>The 4 categories other than Hispanic exclude Hispanic members.  
<sup>d</sup>Statistical significance shown for racial/ethnic differences between the 2 ratios for each smoking stage.  
 \*P < .05; \*\*P < .01; \*\*\*P < .001.

cigarette, once having smoked 1 or 2 puffs; Whites and American Indians were most likely to do so. Whites were most likely to smoke daily among those who ever smoked a whole cigarette and to meet criteria for lifetime dependence among ever daily smokers, except the American Indians. Hispanics were the least likely to be daily smokers, and Hispanics and Asians the least likely to meet criteria for dependence. However, African Americans and American Indians had the highest rates of current dependence.

The ratios of African American to White odds increased with increasing smoking and approached 2 for current dependence. The ratios of minority to White odds were significantly higher for Hispanics than for African Americans at the earliest stages of experimentation but became lower beginning with daily smoking.

Males were more likely than females to have ever smoked and especially to be currently dependent.

### Multivariate Models

*Ever daily smoking.* At the univariate level, all variables except gender, age, and family income were highly significant correlates of having ever smoked daily. When other covariates were controlled for, all remained significant, except 3 social-psychological factors: delinquency, depressive symptoms, and self-esteem (Table 2). Race/ethnicity strongly differentiated those who progressed to daily smoking: African Americans and Hispanics were much less likely than Whites to have progressed. School status and education were negatively related to daily smoking; cohabiting and having children were positively related.

Smoking by at least 1 best friend in high school and smoking by parents during respondents' adolescence were highly significant predictors of daily smoking, especially when both parents smoked. When only 1 parent smoked, mothers and fathers were equally influential. Novelty seeking was a highly significant correlate of daily smoking.

Initial pleasant experiences and dizziness were strongly positively associated with daily smoking, whereas unpleasant experiences were negatively associated. The rate of daily smoking declined as the age of initial smoking increased.

*Lifetime nicotine dependence.* Of the socio-demographic variables, race/ethnicity, school status, and education were highly significant negative correlates of dependence; no parent in household at last interview when respondents were adolescents was a positive correlate; marital status and having a child were not significant (Table 2). Parental, peer smoking, depressive symptoms, and pleasant initial experiences were highly significant positive correlates of lifetime dependence. Unpleasant initial smoking experiences were not significant. The age at which the person first smoked a whole cigarette and the interval between onset ages of smoking a whole cigarette and daily smoking were also highly significant. The younger the age of onset and the shorter the time to daily smoking, the greater the risk of lifetime dependence. A similarly negative association was observed with onset age of daily smoking (data not presented).

*Current nicotine dependence.* Significant negative correlates of current dependence included higher education and being female, Hispanic, and enrolled in school (Table 2). Maternal smoking was the only parental behavior significantly correlated with current dependence. Peer smoking was not significant. There were 4 other notable patterns. Novelty seeking and depressive symptoms were positively correlated with current nicotine dependence; unpleasant and pleasant experiences were both negatively correlated, with low levels of significance.

*Common and stage-specific correlates.* The 2 sets of pooled logistic models provided tests of the commonality and uniqueness of the correlates of daily smoking, lifetime dependence, and current dependence (Table 2). However, the test of differences between 2 regression coefficients has much lower power than the tests for outcome-specific effects. Null results are especially difficult to interpret when original effects sizes are small and results of the pooled statistical tests are inconsistent. For example, test A differs from zero, test B does not, and the test of the difference between A and B is not significant (intransitive relation among the 3 tests).

Several covariates had similar associations across the 3 behaviors: race/ethnicity (Whites more positive than Hispanics); education (negative, strongest for current dependence); being a

student (negative); parental smoking (positive); and novelty seeking (positive). Several positive covariates of daily smoking—cohabiting, having a child, and initial dizziness—were not significant for either dependent status, whereas depressive symptoms were significant (positive) for lifetime and current dependence but not for daily smoking. Two variables were associated with daily smoking and lifetime dependence, but not current dependence: friends' smoking (positive, strongest for daily smoking), and older age at smoking onset (negative).

Longer intervals between onset ages of smoking a whole cigarette and smoking daily were also associated with lower lifetime dependence. Once dependent, age of onset and time to daily smoking were unrelated to current dependence. Unpleasant experiences were negatively associated with daily smoking and current dependence but at a lower level of significance. Age and initial pleasant experiences had opposite effects on lifetime (positive) and current (negative) dependence. Part-time work had a small negative association with lifetime dependence.

*Racial/ethnic-specific patterns.* Patterns of association between the covariates and the smoking behaviors were similar among Whites, African Americans, and Hispanics. Relatively few interactions were significant and reflected predominantly patterns of association among Whites not observed among minorities (Table 3).

Among sociodemographic factors, education had a strong negative association with daily smoking and current dependence for Whites and daily smoking for African Americans. Student status was also related to lower rates of lifetime and current dependence for Whites and current dependence for African Americans. For Hispanics, having a high school degree was associated with increased daily smoking. For Whites, cohabitation was associated with higher odds of daily smoking.

Parental smoking (by 1 or both parents) was a highly significant correlate of lifetime dependence for Whites; smoking by both parents was significant for Hispanics. Best friends' smoking was significant for daily smoking and lifetime dependence for Whites and Hispanics. Neither parental nor peer smoking were significant for African Americans for any smoking behavior. Delinquency



**TABLE 2—Logistic Regressions of Daily Smoking, Lifetime and Current Nicotine Dependence (Add Health Wave III)<sup>a</sup>**

Predictors	A. Ever Smoked Daily (Among Smokers of a Whole Cigarette n = 8373)			B. Lifetime Dependence (Among Ever Daily Smokers, n = 5125)			C. Current Dependence (Among Lifetime Dependents, n = 2660)			P, A vs B	P, B vs C	
	No.	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	No.	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	No.	Unadjusted OR (95% CI)	Adjusted OR (95% CI)			
<b>Race/ethnicity</b>												
White (ref)	5428	...	...	3634	...	...	2021	...	...	...	...	...
African American	1180	0.67*** (0.53, 0.85)	0.64*** (0.51, 0.79)	614	0.84 (0.68, 1.04)	0.80* (0.65, 0.98)	300	1.87** (1.17, 2.98)	1.26 (0.77, 2.07)	1.26 (0.77, 2.07)	...	...
Hispanic	1217	0.50*** (0.40, 0.63)	0.39*** (0.30, 0.51)	593	0.49*** (0.35, 0.67)	0.39*** (0.28, 0.55)	217	0.60* (0.39, 0.92)	0.43*** (0.26, 0.70)	0.43*** (0.26, 0.70)	...	...
Other	548	0.63** (0.46, 0.85)	0.81 (0.56, 1.15)	284	0.62* (0.41, 0.95)	0.70 (0.45, 1.08)	122	1.13 (0.58, 2.22)	1.44 (0.78, 2.69)	1.44 (0.78, 2.69)	...	...
<b>Gender</b>												
Male (ref)	4,182	...	...	2604	...	...	1409	...	...	...	...	...
Female	4,191	0.93 (0.82, 1.04)	1.07 (0.91, 1.26)	2521	0.88 (0.76, 1.02)	0.91 (0.77, 1.07)	1251	0.64*** (0.50, 0.80)	0.70** (0.54, 0.90)	0.70** (0.54, 0.90)	...	...
<b>Age, y</b>												
18, 19 (ref)	858	...	...	513	...	...	254	...	...	...	...	...
20	1084	1.22 (0.95, 1.57)	1.05 (0.74, 1.48)	679	1.12 (0.87, 1.45)	1.14 (0.86, 1.50)	358	0.79 (0.52, 1.22)	0.80 (0.47, 1.37)	0.80 (0.47, 1.37)	...	...
21	1364	1.08 (0.84, 1.38)	1.06 (0.80, 1.41)	856	1.14 (0.88, 1.48)	1.12 (0.86, 1.44)	434	0.93 (0.60, 1.43)	0.84 (0.53, 1.33)	0.84 (0.53, 1.33)	...	...
22	1581	1.04 (0.81, 1.34)	1.27 (0.94, 1.72)	963	1.13 (0.86, 1.48)	1.30 (0.97, 1.73)	494	0.87 (0.57, 1.34)	0.95 (0.59, 1.55)	0.95 (0.59, 1.55)	...	...
23	1673	1.19 (0.92, 1.55)	1.28 (0.94, 1.73)	1038	1.38* (1.04, 1.82)	1.59** (1.15, 2.20)	550	0.67 (0.44, 1.02)	0.71 (0.44, 1.17)	0.71 (0.44, 1.17)	...	0.004
24	1372	1.13 (0.89, 1.43)	1.32 (0.95, 1.83)	812	1.12 (0.85, 1.47)	1.47** (1.10, 1.95)	422	0.62* (0.40, 0.98)	0.69 (0.41, 1.17)	0.69 (0.41, 1.17)	...	0.009
25–27	441	1.39 (0.96, 2.02)	1.42 (0.96, 2.09)	264	1.62** (1.15, 2.31)	1.79** (1.20, 2.68)	148	0.95 (0.52, 1.72)	0.86 (0.44, 1.67)	0.86 (0.44, 1.67)	...	...
Family income (log) <sup>b</sup>	6918	1.04 (0.95, 1.15)	1.02 (0.92, 1.13)	4246	0.97 (0.88, 1.07)	1.00 (0.91, 1.11)	2,216	0.92 (0.80, 1.07)	0.99 (0.85, 1.15)	0.99 (0.85, 1.15)	...	...
<b>Education</b>												
<12th grade (ref)	829	...	...	650	...	...	434	...	...	...	...	...
High school graduate	3308	0.64*** (0.50, 0.83)	0.75 (0.57, 1.00)	2258	0.70** (0.53, 0.92)	0.81 (0.61, 1.08)	1307	0.34*** (0.23, 0.51)	0.40*** (0.26, 0.60)	0.40*** (0.26, 0.60)	...	0.002
Some college	3106	0.31*** (0.24, 0.41)	0.43*** (0.32, 0.59)	1720	0.35*** (0.27, 0.47)	0.55*** (0.40, 0.77)	748	0.22*** (0.15, 0.33)	0.32*** (0.21, 0.50)	0.32*** (0.21, 0.50)	...	0.002
College graduate	1130	0.19*** (0.15, 0.26)	0.22*** (0.16, 0.31)	497	0.27*** (0.19, 0.38)	0.41*** (0.27, 0.63)	171	0.13*** (0.08, 0.22)	0.21*** (0.11, 0.38)	0.21*** (0.11, 0.38)	...	0.03
<b>Student's status</b>												
Not enrolled (ref)	5584	...	...	3715	...	...	2099	...	...	...	...	...
Enrolled	2789	0.47*** (0.40, 0.55)	0.73** (0.59, 0.89)	1410	0.48*** (0.41, 0.57)	0.74** (0.60, 0.93)	561	0.49** (0.39, 0.62)	0.66** (0.49, 0.89)	0.66** (0.49, 0.89)	...	...
<b>Work status</b>												
Not working (ref)	2408	...	...	1495	...	...	829	...	...	...	...	...
Part-time work	1614	0.70*** (0.60, 0.81)	0.88 (0.71, 1.08)	896	0.60*** (0.49, 0.74)	0.75* (0.61, 0.94)	396	0.79 (0.59, 1.06)	1.15 (0.82, 1.61)	1.15 (0.82, 1.61)	...	0.036
Full-time work	4351	1.09 (0.95, 1.25)	1.06 (0.90, 1.25)	2734	0.86 (0.72, 1.02)	0.86 (0.71, 1.04)	1435	1.06 (0.81, 1.38)	1.23 (0.93, 1.63)	1.23 (0.93, 1.63)	...	0.04
<b>Has a child</b>												
No (ref)	6691	...	...	3935	...	...	1962	...	...	...	...	...
Yes	1682	2.16*** (1.81, 2.58)	1.57*** (1.27, 1.95)	1190	1.54*** (1.29, 1.83)	1.08 (0.88, 1.32)	698	1.06 (0.81, 1.37)	0.93 (0.69, 1.26)	0.93 (0.69, 1.26)	...	0.02
<b>Marital status</b>												
Not currently married/ not cohabiting (ref)	5418	...	...	3143	...	...	1527	...	...	...	...	...
Currently married	1472	1.45*** (1.18, 1.77)	0.98 (0.76, 1.27)	920	1.40*** (1.16, 1.69)	0.99 (0.80, 1.23)	521	0.95 (0.72, 1.26)	0.85 (0.62, 1.18)	0.85 (0.62, 1.18)	...	...
Currently cohabiting	1483	2.09*** (1.78, 2.45)	1.56*** (1.31, 1.86)	1062	1.44*** (1.21, 1.72)	1.17 (0.97, 1.41)	612	1.17 (0.88, 1.56)	1.03 (0.76, 1.41)	1.03 (0.76, 1.41)	...	0.03

Continued

TABLE 2—Continued

Residential parents ever smoked by prior interview										
No parent (ref)	3573	...	...	1867	...	...	...	774	...	...
Both parents	1293	2.35*** (1.96, 2.81)	1.83*** (1.49, 2.26)	929	2.33*** (1.87, 2.89)	1.89*** (1.49, 2.41)	...	566	1.49** (1.11, 2.01)	1.38 (0.99, 1.93)
Only mother	1527	2.03*** (1.72, 2.40)	1.43*** (1.18, 1.73)	1073	1.76*** (1.43, 2.16)	1.34* (1.06, 1.68)	...	605	2.03*** (1.56, 2.64)	1.87*** (1.39, 2.51)
Only father	1409	1.66*** (1.40, 1.97)	1.45*** (1.18, 1.78)	884	1.77*** (1.42, 2.21)	1.56*** (1.23, 1.96)	...	482	1.24 (0.93, 1.66)	1.25 (0.92, 1.69)
No parent in household	571	1.93*** (1.44, 2.60)	1.22 (0.88, 1.69)	372	2.26*** (1.71, 2.97)	1.50* (1.08, 2.07)	...	233	1.65* (1.07, 2.55)	1.96** (1.20, 3.22)
Friend smoked at prior interview										
No (ref)	3428	...	...	1628	...	...	...	698	...	...
Yes	4917	2.75*** (2.40, 3.16)	1.89*** (1.60, 2.23)	3482	1.85*** (1.60, 2.14)	1.34*** (1.15, 1.57)	...	1950	1.17 (0.94, 1.45)	1.12 (0.86, 1.46)
Novelty seeking <sup>b</sup>	8277	1.33*** (1.24, 1.42)	1.26*** (1.15, 1.38)	5073	1.26*** (1.17, 1.35)	1.22*** (1.12, 1.33)	...	2630	1.28*** (1.15, 1.41)	1.22** (1.08, 1.38)
Self-esteem	8373	0.86*** (0.81, 0.92)	0.93 (0.85, 1.01)	5125	0.87*** (0.81, 0.93)	0.97 (0.89, 1.05)	...	2660	1.03 (0.94, 1.12)	1.10 (0.99, 1.22)
Delinquency <sup>b</sup>	8351	1.14*** (1.06, 1.22)	1.06 (0.98, 1.15)	5111	1.06 (0.99, 1.13)	1.02 (0.95, 1.09)	...	2650	1.08 (1.00, 1.17)	1.03 (0.94, 1.13)
Depressive symptoms <sup>b</sup>	8373	1.13*** (1.07, 1.20)	0.94 (0.87, 1.02)	5125	1.25*** (1.15, 1.35)	1.17*** (1.06, 1.28)	...	2660	1.14** (1.04, 1.25)	1.12* (1.00, 1.25)
Initial sensitivity to smoking										
Dizziness <sup>b</sup>	8207	1.25*** (1.15, 1.37)	1.18** (1.07, 1.30)	5051	0.98 (0.89, 1.07)	0.96 (0.87, 1.06)	...	2621	0.95 (0.84, 1.08)	1.01 (0.89, 1.14)
Pleasant symptoms <sup>b</sup>	8184	2.42*** (2.24, 2.62)	2.84*** (2.60, 3.10)	5039	1.06 (0.98, 1.16)	1.21*** (1.11, 1.33)	...	2622	0.84** (0.75, 0.94)	0.88* (0.77, 1.00)
Unpleasant symptoms <sup>b</sup>	8208	0.67*** (0.62, 0.72)	0.66*** (0.60, 0.71)	5053	1.05 (0.94, 1.18)	0.99 (0.88, 1.12)	...	2625	0.88* (0.77, 1.00)	0.85* (0.74, 0.98)
Onset age of smoking whole cigarette, y										
≤2 (ref)	1113	...	...	846	...	...	...	574	...	...
13-14	1675	0.64*** (0.50, 0.83)	0.68** (0.49, 0.88)	1178	0.60*** (0.49, 0.75)	0.57*** (0.44, 0.73)	...	668	0.86 (0.65, 1.14)	0.89 (0.64, 1.24)
15-17	3401	0.46*** (0.37, 0.56)	0.54*** (0.44, 0.68)	2155	0.44*** (0.36, 0.54)	0.37*** (0.29, 0.48)	...	1052	1.03 (0.79, 1.35)	1.10 (0.78, 1.54)
≥18	2090	0.20*** (0.16, 0.25)	0.26*** (0.20, 0.34)	905	0.28*** (0.22, 0.36)	0.20*** (0.15, 0.27)	...	343	1.00 (0.70, 1.44)	1.22 (0.78, 1.89)
Time between smoking whole cigarette and smoking daily, y										
<1 (ref)	...	...	...	1895	...	...	...	1055	...	...
1	...	...	...	1146	0.86 (0.70, 1.05)	0.76* (0.61, 0.94)	...	590	0.72* (0.54, 0.95)	0.81 (0.58, 1.14)
2	...	...	...	833	0.71** (0.56, 0.90)	0.57*** (0.43, 0.75)	...	413	0.78 (0.57, 1.08)	0.93 (0.67, 1.30)
≥3	...	...	...	1144	0.70*** (0.58, 0.85)	0.40* (0.33, 0.49)	...	540	0.63*** (0.48, 0.82)	0.77 (0.55, 1.09)

Note. OR = odds ratio; CI = confidence interval; Ref = reference.  
<sup>a</sup>Unweighted numbers; weighted estimates. Coefficients for missing values not shown.  
<sup>b</sup>Based on standardized scores for continuous covariates.  
 \* $P < .05$ ; \*\* $P < .01$ ; \*\*\* $P < .001$ .

**TABLE 3—Logistic Regressions of Daily Smoking, Lifetime and Current Nicotine Dependence: Adjusted Odds Ratios of Predictors With Significant Racial/Ethnic Interaction Terms (Add Health Wave III)<sup>a</sup>**

Interactions of Race/Ethnicity with Specific Covariates	A. Ever Smoked Daily (Among Smokers of a Whole Cigarette, n = 8373)		B. Lifetime Dependence (Among Ever Daily Smokers, n = 5125)		C. Current Dependence (Among Lifetime Dependents, n = 2660)	
	No.	Adjusted OR (95% CI)	No.	Adjusted OR (95% CI)	No.	Adjusted OR (95% CI)
<b>Education</b>						
Among Whites (vs <12)	465	...	395	...	301	...
High school graduate	2099	0.57** (0.37, 0.87)	1590	...	991	0.28*** (0.16, 0.48)
Some college	2065	0.32*** (0.21, 0.50)	1276	...	595	0.22*** (0.12, 0.40)
College graduate	799	0.17*** (0.10, 0.26)	373	...	134	0.14*** (0.07, 0.28)
Among African Americans (vs <12)	162	...	122	...	72	...
High school graduate	522	0.42** (0.25, 0.72)	292	...	151	1.46 (0.63, 3.34)
Some college	379	0.35*** (0.19, 0.62)	153	...	62	2.99* (1.02, 8.70)
College graduate	117	0.25** (0.11, 0.59)	47	...	15	0.53 (0.07, 3.73)
Among Hispanics (vs <12)	168	...	108	...	46	...
High school graduate	518	1.95* (1.20, 3.15)	276	...	117	0.67 (0.27, 1.62)
Some college	436	0.91 (0.53, 1.55)	178	...	45	0.65 (0.17, 2.40)
College graduate	95	0.50 (0.19, 1.29)	31	...	9	1.52 (0.17, 13.8)
<b>School enrollment</b>						
Among Whites (vs not enrolled)	3596	...	2608	...	1585	...
Currently enrolled	1832	...	1026	0.69** (0.55, 0.86)	436	0.70* (0.50, 0.97)
Among African Americans (vs not enrolled)	821	...	469	...	242	...
Currently enrolled	359	...	145	1.05 (0.60, 1.82)	58	0.26* (0.09, 0.73)
Among Hispanics (vs not enrolled)	828	...	446	...	179	...
Currently enrolled	389	...	147	1.28 (0.67, 2.42)	38	0.40 (0.10, 1.60)
<b>Marital status</b>						
Among Whites (vs not married/cohabiting)	3371	...	2127	...	1099	...
Currently married	1029	0.93 (0.72, 1.21)	705	...	433	...
Currently cohabiting	1028	1.75*** (1.42, 2.15)	802	...	489	...
Among African Americans (vs not married/cohabiting)	876	...	440	...	210	...
Currently married	125	1.62 (0.78, 3.35)	70	...	36	...
Currently cohabiting	179	1.09 (0.69, 1.70)	104	...	54	...
Among Hispanics (vs not married/cohabiting)	774	...	376	...	139	...
Currently married	248	0.99 (0.61, 1.59)	111	...	38	...
Currently cohabiting	195	1.45 (0.89, 2.34)	106	...	40	...
<b>Parental Smoking</b>						
Among Whites (vs no)	2215	...	1269	...	552	...
Both parents smoked	1004	...	759	1.89*** (1.43, 2.49)	479	...
Only mother smoked	980	...	730	1.39* (1.06, 1.82)	437	...
Only father smoked	906	...	628	1.68*** (1.30, 2.16)	379	...
Among African Americans (vs no)	488	...	220	...	96	...
Both parents smoked	105	...	59	1.63 (0.75, 3.53)	35	...
Only mother smoked	310	...	197	1.08 (0.61, 1.93)	102	...
Only father smoked	158	...	77	1.12 (0.55, 2.30)	35	...
Among Hispanics (vs no)	583	...	238	...	69	...
Both parents smoked	144	...	85	2.02* (1.02, 4.02)	35	...
Only mother smoked	187	...	115	1.97 (0.98, 3.93)	52	...
Only father smoked	217	...	111	1.08 (0.52, 2.25)	40	...

Continued

TABLE 3—Continued

Friend smoking							
Among Whites (vs no)	2006	...	1055	...	465	...	
Friend smoked	3399	1.97*** (1.60, 2.40)	2565	1.40*** (1.10, 1.62)	1546	...	
Among African Americans (vs no)	610	...	266	...	119	...	
Friend smoked	562	1.16 (0.80, 1.60)	343	1.10 (0.70, 1.77)	176	...	
Among Hispanics (vs no)	547	...	201	...	66	...	
Friend smoked	665	2.12** (1.30, 3.50)	390	2.30* (1.20, 4.39)	35	...	
Delinquency							
Delinquency for Whites <sup>b</sup>	5417	...	3626	0.98 (0.90, 1.06)	2014	...	
Delinquency for African Americans <sup>b</sup>	1176	...	612	1.14* (1.03, 1.26)	298	...	
Delinquency for Hispanics <sup>b</sup>	1212	...	590	1.17 (0.96, 1.44)	216	...	
Pleasant sensation							
Pleasant sensation for Whites <sup>b</sup>	5428	...	3575	1.24*** (1.13, 1.37)	1992	0.85* (0.73, 0.98)	
Pleasant sensation for African Americans <sup>b</sup>	1180	...	604	0.93 (0.72, 1.21)	295	0.66* (0.46, 0.96)	
Pleasant sensation for Hispanics <sup>b</sup>	1217	...	580	1.38* (1.00, 1.91)	213	1.82* (1.08, 3.08)	
Onset age of smoking a whole cigarette							
Among Whites (vs ≤ 12)	842		679		477		
Onset age 13–14	1241	0.60** (0.42, 0.86)	916	0.55*** (0.43, 0.70)	555	...	
Onset age 15–17	2205	0.47*** (0.36, 0.61)	1500	0.32*** (0.25, 0.41)	764	...	
Onset age ≥ 18	1079	0.22*** (0.16, 0.31)	505	0.17*** (0.12, 0.24)	206	...	
Among African Americans (vs ≤ 12)	101		61		42		
Onset age 13–14	157	0.63 (0.28, 1.39)	83	0.66 (0.23, 1.89)	44	...	
Onset age 15–17	467	0.95 (0.49, 1.83)	273	0.35 (0.12, 1.03)	132	...	
Onset age ≥ 18	438	0.41** (0.22, 0.78)	192	0.24** (0.09, 0.65)	80	...	
Among Hispanics (vs ≤ 12)	127		81		41		
Onset age 13–14	216	1.08 (0.48, 2.44)	136	0.63 (0.24, 1.61)	47	...	
Onset age 15–17	501	0.72 (0.36, 1.44)	245	0.93 (0.37, 2.33)	93	...	
Onset age ≥ 18	362	0.51 (0.24, 1.10)	130	0.27* (0.09, 0.78)	35	...	

Note. OR = odds ratio; CI = confidence interval.

<sup>a</sup>Unweighted numbers; weighted estimates. Main effects not shown.

<sup>b</sup>Standardized scores for continuous covariates.

\* $P < .05$ ; \*\* $P < .01$ ; \*\*\* $P < .001$ .

was significantly associated with increased lifetime dependence among African Americans.

Pleasant sensations at smoking onset were highly significant correlates of increased lifetime dependence among Whites and Hispanics and current dependence among Hispanics; however, pleasant sensations were associated with lower current dependence among Whites and African Americans.

Age of smoking onset was highly significant among Whites: earlier onset was associated with increased daily smoking and lifetime dependence. Although the same pattern was observed among minorities, the coefficients reached statistical significance among African Americans for both behaviors and among Hispanics for lifetime dependence only when onset occurred at age 18.

## DISCUSSION

The prevalence of lifetime smoking in Add Health parallels the prevalence in another age-matched national sample from the 2002 National Survey on Drug Abuse and Health (72.5%).<sup>44</sup> Slightly more than half of Add Health daily smokers have been dependent on nicotine, as measured by the Revised Fagerström Test for Nicotine Dependence. Minorities are less likely than Whites to initiate smoking, become daily smokers once having experimented with cigarettes, and be dependent on nicotine once having smoked daily. Once dependent, current dependence, which can be interpreted as a measure of persistence, is similar among African Americans and Whites.

Attributes from all domains of variables are highly significant correlates of each behavior, although only 5 covariates have adjusted odds larger than 2. Mostly the same factors are associated with daily smoking and lifetime dependence. Of 19 common predictors, 5 are not associated with either outcome, 9 are associated with both, 4 are uniquely associated with daily smoking, and 1 is uniquely associated with dependence. Race/ethnicity, low education, not in school, role models for smoking in one's close interpersonal network, the trait of novelty seeking, and 2 aspects of smoking history—early age of smoking onset and pleasurable initial smoking experiences—predict daily smoking and lifetime dependence. Friends' smoking and pleasant initial experiences are particularly important for daily smoking.



This finding confirms our initial hypothesis that peer smoking would have greater influence on daily smoking than dependence. Depressive symptoms solely distinguish dependent from nondependent daily smokers. However, daily smoking and depressive symptoms by themselves are insufficient indicators of dependence. Only two thirds of daily smokers who are highly depressed, that is, the upper 10% of the distribution, are dependent (data not presented).

Several factors are significant only for daily smoking. Unpleasant experiences at initial smoking are negatively associated with daily smoking; the converse is true for initial dizziness and 2 family-related statuses, cohabiting and having a child (positive).

Current dependence is an important indicator of persistence of dependence. Once dependent, few factors uniquely identify those who remain dependent. Education has a stronger negative association with current dependence than lifetime dependence. Pleasant initial smoking experiences are negatively related to current dependence, an association opposite to that for lifetime dependence. Older age of onset of smoking and longer duration of nondaily smoking are significant only for lifetime dependence and play no role on remaining dependent.

Parental smoking, depressive symptoms, and novelty seeking are associated with increased risk of both lifetime and persistent dependence. Covariates with the highest odds are age of onset of smoking a whole cigarette, for ever daily smoking, and lifetime dependence; duration of nondaily smoking for lifetime dependence; initial pleasant symptoms for ever daily smoking; and being Hispanic and education for all 3 stages. The negative association of education with all stages of smoking is striking.

Initial sensitivity experiences have complex associations with smoking outcomes. A wider range of initial smoking experiences correlate with daily smoking than nicotine dependence. Furthermore, pleasant experiences are positively associated with daily smoking and lifetime dependence but negatively associated with persistent dependence. Initial pleasant experiences, which create a higher risk at the earliest stage of extensive smoking, may become less important for lifetime dependence and be protective for remaining dependent.

Thus, environmental and individual factors contribute to daily smoking and nicotine dependence in addition to preexisting and genetic biobehavioral differences in response to nicotine, reflected in initial sensitivity to smoking. The unique association of negative mood with dependence suggests that they may share a common genetic risk.<sup>45</sup>

The examination of interpersonal influences on youth dependence constitutes a unique contribution of this study. The role of parental smoking on offspring dependence has rarely been investigated, and results are inconsistent.<sup>46,47</sup> We observed significant associations of parental smoking, whether by 1 parent or both, with daily smoking and dependence. In addition, considering that best friends' smoking was measured on average 5 years earlier, its strong effect on daily smoking and lifetime dependence is remarkable, perhaps channeled through current friends' extensiveness of smoking. We do not know whether these friends are the same. Either peer influences in adolescence have enduring influences on youths' development or young people continue to select similar friends over time.

The weaker interpersonal influences of parents and peers among African Americans than Whites is strongly documented by this study for daily smoking and dependence. Prior studies documented these racial/ethnic differences for smoking onset.<sup>7,10</sup>

Inferences are limited by the cross-sectional and retrospective nature of most of the data and potential censoring of smoking behaviors. Associations such as those involving depressive symptoms may be consequences as well as determinants of dependence. Furthermore, longer follow-ups are necessary to determine whether the negative associations observed with age of onset and duration of daily smoking are partially because of censoring. We did not include number of cigarettes smoked, a Revised Fagerström Test for Nicotine Dependence indicator, as a covariate of dependence. In addition, this study did not assess clinical diagnoses that may be important to take into account in treatment plans. The measure of depressive symptoms does not index mood disorders, such as a depressive episode, which requires that symptoms be present nearly every day for at least 2 weeks, or major depression.

The overall similarity in patterns of association of covariates across smoking behaviors and racial/ethnic groups, with the important exceptions of depressive symptoms and interpersonal influences, are noteworthy results of this study. Little difference by race/ethnicity in the factors tested suggests that interventions for adolescents susceptible to becoming daily smokers or dependent do not need to be tailored for these factors, although the role of parents and peers would need to be emphasized among White and Hispanic youths.

Our findings suggest that the causal factors may be similar across groups so that primary prevention addressing these factors could be uniform, but they cannot inform about the relative impact of different approaches to motivating or supporting changes in behavior. ■

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### Contributors

M.-C. Hu conducted the analyses. M. Davies oversaw statistical issues. D. B. Kandel originated the study, received approval for the addition of dependence items in Add Health III, supervised all aspects of the study implementation, and led the writing. All authors helped to conceptualize ideas, interpret findings, and review drafts of this article.

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### Human Participant Protection

Nicotine Dependence Among US Youths, institutional review board protocol 4846R, and Risk Factors for Adolescent Smoking in Add Health: A Feasibility Study, institutional review board protocol 4789R, both part of research grant DA13288, were approved by the New York State Psychiatric Institute–Columbia University Department of Psychiatry institutional review board, most recently on May 28, 2004 and February 24, 2004, respectively.

Add Health obtained a certificate of confidentiality issued by the Department of Health and Human Services in accordance with the provisions of section 301(d) of the Public Health Service Act (42 USC §241(d)).

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