

Intergenerational Patterns of Smoking and Nicotine Dependence Among US Adolescents

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Of the models developed to account for the etiology of substance use and dependence, familial transmission represents an important class.^{1,2} This is especially the case for tobacco, because most onset begins and ends in adolescence, a period of intense socialization by parents and peers. Parental smoking is an important risk factor for adolescent smoking.³⁻⁷

Studies of familial influences on adolescent smoking have 2 major limitations, regarding informants and constructs. Parental smoking behaviors are ascertained mostly from offspring; nicotine dependence (ND) is rarely assessed.⁸ Over the past decade, however, parental self-reports have been used to examine the associations of parental smoking and ND with adolescent smoking^{5-7,9-19} and dependence.²⁰⁻²⁹ Parental smoking is associated with smoking by offspring in a dose-response relationship: more extensive parental smoking is associated with more extensive adolescent smoking. Parental current, persistent, and dependent smoking is associated with current, heavy, and dependent smoking by adolescents.^{5,10,21,22,24} Although some studies have shown specific effects of parental ND on adolescent smoking and ND,^{22,24-26} others have not.^{11,23} Former parental smoking is also associated with a slightly increased risk of adolescent lifetime and current smoking in some studies,^{6,15,19} but not others.^{10,11}

Associations between parental and offspring smoking differ by gender and race/ethnicity: associations are stronger for mothers than fathers^{7,10,13,28,30} and for daughters than sons,^{4,30} although stronger paternal associations with sons than daughters,¹¹ and no parental or adolescent gender effects,¹² have also been reported. Although the prevalence of smoking and ND are consistently higher among Whites than minorities,^{16,29,31-33} findings for associations between parental and adolescent smoking across racial/ethnic groups vary. Stronger parental influence in White than

Objectives. We examined associations between parental and adolescent smoking and nicotine dependence in the United States.

Methods. We used data from the 2004 to 2012 National Survey on Drug Use and Health, which ascertained smoking behaviors of 1 parent and 1 adolescent aged 12 to 17 years in 35 000 dyads. We estimated associations between parental and adolescent smoking behaviors, adjusted for covariates.

Results. Parental current dependence was strongly associated with adolescents' lifetime smoking (adjusted odds ratio [AOR]=2.96; 95% confidence interval [CI]=2.47, 3.55), whereas parental current nondependent smoking (AOR=2.26; 95% CI=1.92, 2.67) and former smoking (AOR=1.51; 95% CI=1.31, 1.75) were less strongly associated. Only parental nicotine dependence was associated with adolescent nicotine dependence (AOR=1.66; 95% CI=1.00, 2.74). Associations between parental and adolescent smoking did not differ by race/ethnicity. Parents' education, marital status, and parenting and adolescents' mental health, beliefs about smoking, perception of schoolmates' smoking, and other substance use predicted adolescent smoking and dependence.

Conclusions. Reducing parental smoking would reduce adolescent smoking. Prevention efforts should encourage parental smoking cessation, improve parenting, address adolescent mental health, and reinforce adolescents' negative beliefs about smoking. (*Am J Public Health.* 2015;105:e63-e72. doi:10.2105/AJPH.2015.302775)

African American families^{16,34} and similar influences across racial/ethnic groups have been observed.^{17,18,35}

We examined intergenerational associations for cigarette smoking and ND in 9 surveys (2004–2012) of large, nationally representative samples in the National Survey on Drug Use and Health (NSDUH). The sampling of respondent pairs within the same household provides national samples of related family members. The measurement of dependence among parents and adolescents permitted analysis of familial influences on tobacco use that focused on addiction and not only use. Covariates of parental and adolescent smoking and ND^{4,13-18,20,22,34-48} could be controlled to estimate the unique contribution of parental smoking on offspring. Aggregating multiple surveys permitted analyses in subgroups cross-classified by parental and adolescent gender, and race/ethnicity. No other national data set contains dyadic data on ND.

We addressed 3 questions: (1) What is the association between patterns of parental smoking and adolescent lifetime smoking and ND? (2) What are the unique effects of parental smoking and dependence, after adjustment for other risk factors for adolescent smoking? (3) Do the effects of parental smoking and dependence vary by parental and adolescent gender and race/ethnicity?

METHODS

We used data from the 2004 to 2012 surveys of NSDUH, annual cross-sectional surveys of multistage area probability samples of the US population aged 12 years and older. The target civilian noninstitutionalized population represented more than 98% of the US population.⁴⁹ Persons living in noninstitutional group quarters (homeless shelters, rooming houses, college dormitories), and civilians living on military bases were included; individuals on active military duty; persons in jail, drug

treatment programs, or hospitals; and the homeless not in shelters were excluded. Age groups at highest risk for drug use (12–17 and 18–25 years) were oversampled.⁴⁹ Approximately 67 500 persons were interviewed each year. Completion rates ranged from 63% to 70%. We pooled the surveys to increase precision of the estimates.

Sample

NSDUH used a pair-sampling algorithm to identify 2 participants in selected households (Appendix A, available as a supplement to the online version of this article at <http://www.ajph.org>).^{50,51} Because of privacy concerns, data to link household members and identify their relationship were confidential and available only through a secure data portal administered through the Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration, and Substance Abuse and Mental Health Data Archive.

We identified 35 000 parent–adolescent dyads (21 200 mothers and 13 800 fathers, each with an adolescent aged 12 to 17 years). Adolescents were biological (89.6%), step- (8.3%), or adopted (2.1%) children of the adult interviewee. The ratio of fathers to mothers in the weighted dyads (0.76) was similar to that of fathers to mothers living with an adolescent aged 12 to 17 years in the United States in 2008 (0.79).⁵² We analyzed adolescent lifetime smoking for all the dyads; we restricted analyses of adolescent ND to adolescent lifetime smokers so that predictors of smoking onset would not be confounded with those of dependence.

Interviewers collected data with computer-assisted personal interviewing. For substance use and sensitive behaviors, participants completed audio computer-assisted self-interviewing.

Variables

We classified parental and adolescent self-reported lifetime cigarette smoking (ever smoked part or all of a cigarette) as zero for no and 1 for yes. Parental past-year smoking was defined as having smoked in the past 12 months, and former parental smoking was having last smoked more than 12 months ago.

The survey used the Nicotine Dependence Syndrome Scale to assess self-reported

symptoms of nicotine dependence experienced in the past month from smoking cigarettes among parents and adolescents.⁵³ The survey rated dependence items representing 5 domains on a scale of 1 to 5 (“Not true at all” to “Extremely true”) and averaged scores ($\alpha = 0.86$) for

1. drive (5 items; craving and withdrawal),
2. priority (1 item; preference of smoking over other reinforcers),
3. continuity (5 items; smoking regularity),
4. stereotypy (3 items; smoking invariance, e.g., smoking not affected by other things),
5. tolerance (3 items; reduced sensitivity to smoking effects).

A score of 2.75 or higher defined past-month dependence.

Validity was previously established for the continuous Nicotine Dependence Syndrome Scale total score among adolescents and adults,^{54–57} but not the categorical dependence cut-off. In unpublished analyses, we implemented a receiver operating characteristic analysis in an adolescent–parent data set. The cut-off points that we identified were similar among adolescents (≥ 2.71) and their parents (≥ 2.76), and very close to the 2.75 cut-off in the NSDUH. We also documented concurrent validity of the NSDUH cut-off through associations with cigarettes smoked per day and moderately good concordance with dependence diagnosed by Fagerström-based measures among adolescents and adults (data not shown).

Parental lifetime smoking pattern was a 4-category variable: zero for never smoker; 1 for former smoker; 2 for past-year smoker, not past-month nicotine dependent; and 3 for past-year smoker, past-month dependent.

Seven items measured adolescent perceived levels of (1) parental monitoring, (2) parental support, and (3) parent–adolescent conflict. Maximum likelihood factor analysis supported a correlated 2-factor solution for 6 items ($r_{xy} = 0.51$): monitoring (4 items; limit setting with peers and television, oversight, and assistance with homework; eigenvalue = 1.07; loadings = 0.36–0.67; $\alpha = 0.58$) and support (2 items; encouragement and pride; eigenvalue = 7.00; loadings = 0.88 for both; $\alpha = 0.85$). We averaged items rated on a 4-point scale (1 = always, 2 = sometimes,

3 = seldom, 4 = never) within each domain. We measured parent–adolescent conflict by 1 item on frequency, during the past 12 months, of arguments (1 = 0 times, 2 = 1 or 2, 3 = 3–5, 4 = 6–9, 5 = ≥ 10 times). We standardized scores and treated them as continuous.

Parents and adolescents self-reported any lifetime major depressive episode (scored zero for no and 1 for yes). The NSDUH administered developmentally appropriate depression modules, based on the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*,⁵⁸ adapted from the National Comorbidity Survey–Replication (adults) and –Adolescent.⁵⁹ The survey defined a major depressive episode as experiencing at least 5 of 9 symptoms nearly every day in a 2-week period, when at least 1 symptom was depressed mood most of the day or diminished interest or pleasure in all or almost all activities, and at least 4 other symptoms were significant weight change, insomnia or hypersomnia, psychomotor agitation or retardation, fatigue or loss of energy, feelings of worthlessness, diminished ability to think or concentrate or indecisiveness, or recurrent thoughts of death or suicidal ideation. This definition shows good concordance with clinical reappraisal diagnoses in adults⁶⁰ and adolescents, and discriminant validity in adolescents.⁶¹ Because comparable adult depression scores were unavailable in 2004, a dummy variable indexed the missing assessment in the combined data set.

We coded parents' and adolescents' perceptions of the risk of smoking 1 or more cigarette packs per day as 1 for great, 2 for moderate, and 3 for slight or none. For adolescents' perceptions of smoking by same-grade schoolmates, we coded none or a few as zero and most or all as 1.

For adolescent self-reported delinquency in the past 12 months, we summed 6 items, each scored zero or 1: stealing, fighting at school or work, group fighting, attacking another with intent to hurt, carrying a handgun, and selling illegal drugs. We standardized the scores and treated them as continuous.

For adolescents, we classified other substance use from self-reported lifetime use and age of onset: alcohol (ever had a drink of an alcoholic beverage), marijuana (used, even once, marijuana or hashish), other illicit drugs (used, even once, cocaine, crack, heroin, or

TABLE 1—Characteristics of All Parent–Adolescent Dyads and Dyads With an Adolescent Who Ever Smoked: National Survey on Drug Use and Health, United States, 2004–2012

Characteristics	All Dyads (n = 35 000), % or Mean (SD)	Dyads With an Adolescent Lifetime Smoker (n = 7500), % or Mean (SD)
Parents		
Age, y	43.4 (7.0)	43.5 (6.8)
Mothers	56.7	59.2
Parent-adolescent dyads		
Mother-son	29.6	32.9
Mother-daughter	27.1	26.3
Father-son	22.9	22.5
Father-daughter	20.4	18.3
Education		
≤ high school	44.4	51.5
Some college	26.4	27.3
College graduate	29.2	21.2
Marital status		
Married	79.2	73.1
Separated/divorced	12.9	19.0
Widowed	1.2	1.2
Never married	6.7	6.8
Lifetime smoking pattern		
Never smoker	31.1	19.5
Former smoker	43.3	40.5
Past-year smoker, not nicotine dependent	15.0	20.2
Past-year smoker, nicotine dependent	10.6	19.7
Perceived risk of smoking ≥ 1 packs/d		
Great	76.6	72.1
Moderate	18.4	22.3
Slight/none	5.0	5.7
Depression, lifetime	12.8	16.7
Parenting as perceived by adolescent, past 12 mo		
Monitoring	2.1 (0.7)	2.4 (0.7)
Support	1.6 (0.8)	1.8 (0.8)
Conflict	2.9 (1.4)	3.4 (1.4)
Adolescents		
Age, y	14.5 (1.7)	15.5 (1.4)
Male	52.5	55.4
Race/ethnicity		
African American	12.2	9.0
White	60.4	67.4
Hispanic	19.7	17.9
Other	7.7	5.7
Perceived risk of smoking ≥ 1 packs/d		
Great	68.6	59.4
Moderate	24.5	29.9
Slight/none	6.9	10.7

Continued

hallucinogens). We used the reported onset ages to define the order of initiation between cigarettes (age ever smoked part or all of a cigarette) and each of the other drugs: 1 indicated that the adolescent initiated the other drug before cigarettes, and zero indicated the adolescent did not.

Sociodemographic and other characteristics we included in the analyses were age, gender (male or female), race/ethnicity (non-Hispanic White, non-Hispanic African American, Hispanic, or other),⁶² parental education (≤ high school graduate, some college, or college graduate), parental marital status (married, separated or divorced, widowed, never married), and survey year.

Data Analysis

As background to the analysis, we examined the characteristics of (1) parents and adolescents interviewed in dyads and (2) all parents living with an adolescent aged 12 to 17 years (n = 41 900) and all adolescents aged 12 to 17 years living with a parent (n = 193 800) in the total sample. We also assessed the prevalence of smoking and ND among parents and adolescents in the dyads by demographic characteristics.

To determine the unique effect of parental smoking on adolescents, we implemented multivariable logistic regression models for 2 adolescent outcomes: (1) lifetime smoking among all dyads (n = 35 000) and (2) current ND among adolescent lifetime smokers (n = 7500) to identify the specific risk for dependence after having smoked. We indexed parental smoking by the 4-category lifetime smoking pattern variable. Parental covariates were age, gender, education, marital status, perceived risk of smoking, and depression. Adolescent covariates were adolescent perceived quality of the parent–adolescent relationship (monitoring, support, parent–adolescent conflict), age, gender, race/ethnicity, perceived risk of smoking, perceived smoking by schoolmates, other drug use, delinquency, and depression. We included survey year in all models. We estimated interaction effects to determine whether the influence of parental smoking and ND on adolescent smoking and ND differed by parental and adolescent gender, adolescent age (12–13, 14–15, 16–17 years), race/ethnicity, or survey year (2004–2006, 2007–2009, 2010–2012).

TABLE 1—Continued

Perceived smoking of schoolmates		
None/a few smoke	75.3	43.8
Most/all smoke	24.7	56.2
Initiated other substance before cigarettes		
Alcohol before cigarettes	24.6	29.1
Marijuana before cigarettes	6.1	11.8
Other illicit drugs before cigarettes	0.8	1.3
Delinquency, past 12 mo	0.5 (0.9)	1.0 (1.3)
Depression, lifetime	12.2	20.7

Note. Estimates are weighted; samples sizes are unweighted.

For all analyses we used SUDAAN 11.0.1,⁶³ with design effects adjusted by a Taylor series linearization and sample weights reflecting the selection probabilities at various stages of the sampling design. We used weights that were adjusted at the levels of screener and questionnaire dwelling units and of person and pair respondents to account for nonresponse, extreme values, and poststratification.⁵¹ We used parent–adolescent pair-level weights provided by the Substance Abuse and Mental Health Services Administration (Appendix A, available as a supplement to the online version of this article at <http://www.ajph.org>). Weights for the aggregated 2004 to 2012 sample were divided by the number of survey years.

RESULTS

Table 1 displays parents' and adolescents' characteristics for all pairs and those with an adolescent lifetime smoker. The sample had more mother–adolescent (56.7%) than father–adolescent (43.3%) pairs. Adolescents were aged 14.5 (SD = 1.7) years on average.

With few exceptions, parents and adolescents in dyads were similar to parents living with an adolescent aged 12 to 17 years and adolescents aged 12 to 17 years living with a parent in the total sample (Table A, available as a supplement to the online version of this article at <http://www.ajph.org>). Most statistically significant differences were of no practical importance, except for marital status: 79.2% of parents in dyads and 76.5% in the total sample were married. Because the pair and person samples were in good agreement for parents living with an adolescent and

adolescents living with a parent, and the total person sample was representative of the US population, it is inferred that the pair sample was nationally representative. However, no good external control data on the pair population are available (Art Hughes, Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality, written communication, March 19, 2015).

Smoking and Nicotine Dependence Among Parent–Adolescent Dyads

Almost 70% of parents ever smoked: 43.3% smoked previously, 15.0% smoked in the past year and were not currently dependent, and 10.6% were dependent (Table 2). Although lifetime smoking prevalence was higher among fathers than mothers, prevalence of current ND was slightly higher among mothers than fathers. White parents had the highest prevalence of lifetime smoking and dependence among past-year smokers of any racial/ethnic group. College graduates were less likely to be dependent than individuals with less education.

Among adolescents, 20.6% had ever smoked (Table 2). The average age of smoking onset was 12.8 (SD = 2.5) years. Among lifetime smokers, 7.7% were currently dependent. Prevalence of smoking and ND increased strikingly with age: 4.4% of adolescents aged 12 years and 38.5% of those aged 17 years ever smoked. Among lifetime smokers, 0.1% of participants aged 12 years and 11.6% of those aged 17 years were currently nicotine dependent. Adolescent boys were more likely than adolescent girls to have ever smoked; ND did not differ by gender. White youths were more

likely than minorities to have ever smoked and to be currently dependent.

Associations Between Parental and Adolescent Smoking Behaviors

We observed significant positive associations between the smoking behaviors of parents and adolescents. Although adolescent lifetime smoking rates increased linearly with the extent of parental lifetime smoking, adolescent ND was dramatically higher when the parent was dependent on nicotine. Thirteen percent of adolescents ever smoked if their parent never smoked, 19.3% if their parent formerly smoked, 27.8% if their parent smoked in the past year but was not dependent, and 38.2% if their parent was currently dependent. Among adolescents who were lifetime smokers, 4.6% were dependent if their parent never smoked, 5.6% if their parent formerly smoked, 7.8% if their parent smoked in the past year but was not dependent, 15.1% if their parent was dependent. Adolescents with a dependent parent started smoking earlier (mean age = 12.2 years; SD = 2.4 years) than adolescents with a parent who was a nondependent past-year smoker (mean age = 12.7 years; SD = 2.3 years) or a former or never smoker (both, mean age = 13.0 years; SD = 2.6 years).

After adjustment for covariates, including adolescent use of alcohol, marijuana, and other illicit drugs, effects of parental smoking and ND on adolescent smoking and ND persisted (Table 3). Effects on adolescent lifetime smoking were linearly associated with extent of parental smoking; effects on adolescent ND were specific to parental dependence. The adjusted odds ratio (AOR) of adolescent ever smoking was 1.51 (95% confidence interval [CI] = 1.31, 1.75) when the parent was a former smoker, but 2.96 (95% CI = 2.47, 3.55) when the parent was currently dependent on nicotine (with a never-smoking parent as the reference). The AOR of adolescent ND (beyond the odds of ever smoking) was 1.66 (95% CI = 1.00, 2.74) when the parent was nicotine dependent.

The effects of parental smoking differed by parental and adolescent gender only for adolescent ND (Table 4). Daughters were almost 4 times as likely to be currently dependent when their mothers were currently dependent

TABLE 2—Prevalence of Lifetime Smoking and Nicotine Dependence Among Parent-Adolescent Dyads: National Survey on Drug Use and Health, United States, 2004–2012

Characteristic	Parents					Adolescents		
	Lifetime Smoker, % (95% CI)	Never Smoker, % (95% CI)	Former Smoker, Did Not Smoke in Past Year, % (95% CI)	Past-Year Smoker, Not Dependent, % (95% CI)	Past-Year Smoker, Dependent, % (95% CI)	Lifetime Smoker, % (95% CI)	Dependent (Among Lifetime Smokers; n = 7500), % (95% CI)	No. (n = 35 000)
Total	68.9 (68.0, 69.7)	31.1 (30.3, 32.0)	43.3 (42.3, 44.2)	15.0 (14.4, 15.6)	10.6 (10.1, 11.2)	20.6 (19.9, 21.3)	7.7 (6.9, 8.7)	
Gender								
Male	73.4 ^b (72.1, 74.7)	26.6 (25.3, 27.9)	47.8 (46.3, 49.2)	15.7 (14.7, 16.7)	10.0 ^a (9.2, 10.8)	21.8 ^b (20.7, 22.9)	7.3 (6.2, 8.6)	17 900
Female	65.4 ^a (64.3, 66.5)	34.6 (33.5, 35.7)	39.8 (38.6, 41.0)	14.4 (13.7, 15.2)	11.2 ^b (10.5, 11.9)	19.4 ^a (18.4, 20.3)	8.2 (7.0, 9.7)	17 100
F	(1) = 82.12***		(3) = 33.94***			(1) = 9.89**	(1) = 1.05	
Race/ethnicity								
White	78.0 ^c (77.0, 78.9)	22.0 (21.1, 23.0)	50.5 (49.4, 51.6)	14.3 (13.6, 15.0)	13.2 ^c (12.5, 13.9)	23.0 ^c (22.1, 23.9)	9.4 ^b (8.3, 10.7)	22 100
African American	57.3 ^b (54.7, 60.0)	42.7 (40.1, 45.3)	30.5 (28.1, 33.0)	18.4 (16.5, 20.6)	8.4 ^b (7.1, 9.9)	15.3 ^a (13.6, 17.2)	4.0 ^a (2.3, 6.9)	3 900
Hispanic	51.6 ^a (49.5, 53.7)	48.4 (46.3, 50.5)	30.9 (28.9, 32.9)	16.2 (14.8, 17.8)	4.5 ^a (3.6, 5.6)	18.8 ^b (17.2, 20.5)	3.1 ^a (1.9, 5.0)	6 200
Other	49.9 ^a (45.8, 54.1)	50.1 (45.9, 54.2)	30.8 (27.1, 34.8)	12.4 (10.3, 15.0)	6.7 ^b (5.4, 8.3)	15.2 ^a (12.7, 18.0)	8.3 ^b (5.0, 13.3)	2 800
F	(3) = 224.40***		(9) = 97.82***			(3) = 25.74***	(3) = 16.16***	
Parental education								
≤ high school	67.6 ^a (66.4, 68.8)	32.4 (31.2, 33.6)	32.7 (31.5, 34.0)	18.9 (17.9, 20.0)	16.0 ^c (15.1, 16.9)	23.9 ^c (22.8, 25.1)	9.7 ^c (8.4, 11.3)	16 000
Some college	71.8 ^b (70.2, 73.4)	28.2 (26.7, 29.9)	45.7 (44.0, 47.5)	15.3 (14.2, 16.5)	10.7 ^b (9.8, 11.7)	21.3 ^b (19.9, 22.7)	7.4 ^b (5.8, 9.3)	9 800
College graduate	68.2 ^a (66.5, 69.7)	31.9 (30.3, 33.5)	57.0 (55.4, 58.7)	8.6 (7.8, 9.5)	2.5 ^a (2.0, 3.1)	15.0 ^a (13.7, 16.4)	3.2 ^a (2.2, 4.5)	9 200
F	(2) = 8.86***		(6) = 160.64***			(2) = 49.83***	(2) = 22.86***	
Adolescent age, y								
12	...	...	...	...	...	4.4 ^a (3.6, 5.4)	0.1 ^a (0.0, 0.4)	6 300
13	...	...	...	...	...	9.7 ^b (8.4, 11.3)	5.7 ^b (3.2, 10.0)	6 500
14	...	...	...	...	...	15.9 ^c (14.4, 17.6)	4.9 ^b (3.3, 7.2)	6 000
15	...	...	...	...	...	23.8 ^d (22.0, 25.7)	7.0 ^b (5.3, 9.3)	5 700
16	...	...	...	...	...	31.1 ^e (29.1, 33.1)	6.8 ^b (5.5, 8.4)	5 500
17	...	...	...	...	...	38.5 ^f (36.3, 40.8)	11.6 ^c (9.6, 14.0)	5 000
F	...	...	...	...	...	(5) = 221.56***	(5) = 16.64***	

Note. CI = confidence interval. Estimates are weighted; samples sizes are unweighted. F tests for percentage differences in smoking and nicotine dependence by each demographic characteristic.

^{a-f}For each characteristic, rates in the same column with different superscripts are significantly different from each other at $P < .05$.

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

TABLE 3—Parental and Adolescent Predictors of Adolescent Lifetime Smoking and Nicotine Dependence Among Adolescent Lifetime Smokers: National Survey on Drug Use and Health, United States, 2004–2012

Characteristic	Lifetime Smoking		Nicotine Dependence	
	OR (95% CI)	AOR (95% CI)	OR (95% CI)	AOR (95% CI)
Parents				
Age, y	1.00 (0.99, 1.01)	0.99 (0.98, 1.00)	0.98* (0.96, 0.99)	0.99 (0.96, 1.01)
Gender				
Fathers (Ref)	1.00	1.00	1.00	1.00
Mothers	1.14** (1.04, 1.25)	1.04 (0.93, 1.17)	1.33* (1.02, 1.74)	1.08 (0.78, 1.48)
Education				
College graduate (Ref)	1.00	1.00	1.00	1.00
Some college	1.53*** (1.34, 1.75)	1.15 (0.98, 1.34)	2.43*** (1.55, 3.82)	1.58 (0.99, 2.51)
≤ high school	1.78*** (1.58, 2.01)	1.26** (1.09, 1.45)	3.29*** (2.18, 4.97)	2.23*** (1.40, 3.53)
Marital status				
Married (Ref)	1.00	1.00	1.00	1.00
Widowed	1.11 (0.79, 1.58)	1.01 (0.64, 1.60)	1.84 (0.67, 5.04)	1.85 (0.57, 6.03)
Separated/divorced	1.85*** (1.64, 2.08)	1.45*** (1.25, 1.69)	2.11*** (1.55, 2.87)	1.84*** (1.29, 2.61)
Never married	1.11 (0.94, 1.31)	1.13 (0.91, 1.41)	1.45 (0.91, 2.30)	2.11* (1.18, 3.78)
Lifetime smoking pattern				
Never smoker (Ref)	1.00	1.00	1.00	1.00
Former smoker	1.61*** (1.42, 1.82)	1.51*** (1.31, 1.75)	1.23 (0.78, 1.95)	0.94 (0.56, 1.56)
Past-year smoker, not dependent	2.60*** (2.26, 2.98)	2.26*** (1.92, 2.67)	1.76* (1.09, 2.84)	1.08 (0.64, 1.81)
Past-year smoker, dependent	4.15*** (3.60, 4.79)	2.96*** (2.47, 3.55)	3.69*** (2.35, 5.81)	1.66* (1.00, 2.74)
Perceived risk of smoking ≥ 1 packs/d				
Great (Ref)	1.00	1.00	1.00	1.00
Moderate	1.38*** (1.24, 1.53)	1.07 (0.93, 1.22)	1.51** (1.13, 2.02)	1.08 (0.77, 1.53)
Slight/none	1.27* (1.06, 1.52)	1.04 (0.82, 1.31)	1.75* (1.03, 2.97)	1.49 (0.88, 2.53)
Parenting as perceived by adolescent, past 12 mo ^a				
Lack of monitoring	1.61*** (1.54, 1.67)	1.23*** (1.15, 1.31)	1.60*** (1.41, 1.81)	1.38*** (1.18, 1.61)
Lack of support	1.40*** (1.34, 1.45)	1.05 (1.00, 1.11)	1.21*** (1.09, 1.34)	1.01 (0.88, 1.15)
Conflict	1.54*** (1.47, 1.61)	1.23*** (1.16, 1.30)	1.28*** (1.12, 1.46)	1.15 (0.97, 1.35)
Depression, lifetime				
Never (Ref)	1.00	1.00	1.00	1.00
Ever	1.50*** (1.33, 1.70)	1.15 (0.99, 1.34)	1.23 (0.89, 1.70)	0.91 (0.62, 1.34)
Adolescents				
Age, y	1.59*** (1.55, 1.64)	1.62*** (1.56, 1.69)	1.33*** (1.19, 1.49)	1.45*** (1.27, 1.66)
Gender				
Female (Ref)	1.00	1.00	1.00	1.00
Male	1.16** (1.06, 1.27)	1.23*** (1.10, 1.37)	1.14 (0.89, 1.47)	0.92 (0.68, 1.24)
Race/ethnicity				
African American (Ref)	1.00	1.00	1.00	1.00
White	1.65*** (1.43, 1.92)	1.99*** (1.65, 2.39)	2.50** (1.38, 4.54)	3.49*** (1.84, 6.61)
Hispanic	1.28** (1.07, 1.52)	1.62*** (1.30, 2.01)	0.77 (0.35, 1.67)	0.77 (0.32, 1.87)
Other	0.99 (0.78, 1.27)	1.51** (1.11, 2.04)	2.17* (1.01, 4.67)	3.48** (1.47, 8.22)
Perceived risk of smoking ≥ 1 packs/d				
Great (Ref)	1.00	1.00	1.00	1.00
Moderate	1.55*** (1.41, 1.71)	1.31*** (1.17, 1.47)	1.49** (1.12, 1.98)	1.38* (1.01, 1.89)
Slight/none	2.17*** (1.83, 2.56)	1.94*** (1.58, 2.39)	2.16*** (1.47, 3.17)	1.50 (0.95, 2.38)

Continued

TABLE 3—Continued

Perceived smoking of school mates				
None/a few smoke (Ref)	1.00	1.00	1.00	1.00
Most/all smoke	4.16*** (3.76, 4.62)	2.18*** (1.93, 2.45)	3.03*** (2.24, 4.09)	1.93*** (1.38, 2.70)
Initiated other substance before cigarettes ^b				
Alcohol before cigarettes	1.34*** (1.22, 1.47)	0.55*** (0.49, 0.63)	0.70* (0.50, 0.97)	0.70 (0.49, 1.01)
Marijuana before cigarettes	2.77*** (2.37, 3.23)	1.71*** (1.36, 2.14)	0.99 (0.63, 1.56)	0.98 (0.62, 1.55)
Other illicit drugs before cigarettes	1.85** (1.18, 2.90)	0.62 (0.33, 1.16)	0.95 (0.38, 2.38)	1.09 (0.37, 3.19)
Delinquency, past 12 mo ^a	1.79*** (1.71, 1.86)	1.65*** (1.56, 1.74)	1.38*** (1.27, 1.49)	1.42*** (1.29, 1.57)
Depression, lifetime				
Never (Ref)	1.00	1.00	1.00	1.00
Ever	2.36*** (2.10, 2.65)	1.34*** (1.16, 1.55)	1.29 (0.95, 1.76)	1.11 (0.79, 1.57)

Note. AOR = adjusted odds ratio; CI = confidence interval; OR = odds ratio. Estimates are weighted; samples sizes are unweighted. Total sample size was n = 35 000 parent-adolescent dyads; for adolescent lifetime smokers, the sample size was n = 7500.

^aStandardized scores. Multivariate models adjusted by survey year.

^bReference group for each substance variable was all others.

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

(AOR = 3.85; 95% CI = 1.94, 7.63), and more than twice as likely when their mothers were former smokers ($P < .05$) or nondependent smokers (not significant) as when their mothers never smoked. Fathers' dependence and smoking pattern had no effect on daughters' dependence (Table 4). Sons' dependence was not affected by parental dependence and smoking pattern. Effects of parental lifetime smoking pattern on adolescent lifetime smoking and ND did not differ by race/ethnicity, adolescent age, or survey year (data not shown).

More parental and adolescent factors were associated with both adolescent lifetime smoking and ND than were uniquely associated with adolescent lifetime smoking or ND (Table 3). Common factors were parents having at most a high school education, separation or divorce, parental ND, low monitoring, higher adolescent age, White race, adolescent delinquency, and beliefs that smoking entails risk and that most or all schoolmates smoked. Unique predictors of adolescent lifetime smoking were a parent being a former or nondependent past-year smoker, parent-adolescent conflict, adolescent

male gender, depression, starting to use marijuana before cigarettes, and starting alcohol before cigarettes, which was negatively associated with lifetime smoking. Having a parent who never married was the only unique predictor of adolescent ND.

DISCUSSION

We examined the associations between parental and adolescent lifetime smoking and past-month ND in a national sample of parent-adolescent dyads. Effects of parental smoking on adolescent smoking and dependence were striking and persisted with control for important parental and adolescent factors. Parental ND was associated with adolescent lifetime smoking and dependence. Parental nondependent past-year smoking and former smoking also predicted adolescent smoking, but more weakly than parental ND, and did not predict adolescent dependence. Only parental ND predicted adolescent ND, with mothers having a stronger impact than fathers on daughters' dependence. Although the prevalence of smoking and ND was lower among African American and Hispanic than White adolescents, associations between parental smoking and adolescent lifetime smoking and ND did not differ across racial/ethnic groups. Parental smoking effects did not differ among older and younger adolescents or over the study period.

TABLE 4—Associations Between Parental Lifetime Smoking Pattern and Adolescent Nicotine Dependence by Gender: National Survey on Drug Use and Health, United States, 2004–2012

Parent-Adolescent Dyad	Parent Former Smoker, Did Not Smoke in Past Year AOR (95% CI)	Parent Past-Year Smoker, Not Dependent, AOR (95% CI)	Parent Past-Year Smoker, Dependent, AOR (95% CI)
Mother-son	0.64 ^a (0.26, 1.60)	1.20 ^{a,b} (0.48, 3.02)	1.78 ^{a,b} (0.70, 4.48)
Mother-daughter	2.49 ^{*b} (1.16, 5.36)	2.21 ^b (0.96, 5.05)	3.85 ^{***b} (1.94, 7.63)
Father-son	0.91 ^{a,b} (0.32, 2.59)	1.29 ^{a,b} (0.47, 3.83)	1.13 ^{a,b} (0.47, 3.83)
Father-daughter	0.53 ^a (0.20, 1.40)	0.34 ^{*a} (0.13, 0.89)	0.62 ^a (0.24, 1.60)

Note. AOR = adjusted odds ratio; CI = confidence interval; OR = odds ratio. Estimates are weighted; samples sizes are unweighted. Sample size was n = 7500 adolescent lifetime smokers. Controlled for the parental factors of age, gender, education, marital status, perceived risk of smoking, depression; the adolescent factors of perceived quality of the parent-adolescent relationship (monitoring, support, parent-adolescent conflict), age, gender, race/ethnicity, perceived risk of smoking, perceived smoking by schoolmates, other drug use, delinquency, and depression; and survey year. Reference group was parent never smokers. Overall interaction of parental lifetime smoking pattern and parent-adolescent gender was significant ($F(9) = 2.02$; $P < .05$).

^{a,b}ORs for each level of parental smoking with different superscripts are significantly different from each other at $P < .05$.

*P < .05; ***P < .001.

The strong link between parental and adolescent smoking can be accounted for by 3 processes: adolescent imitation of the parent, parental socialization of the adolescent, and genetic predisposition. The relative influence of these processes may differ for lifetime smoking, which indexes smoking onset, and ND, which indexes addiction. The finding that adolescent lifetime smoking was more strongly affected by parental current smoking, whether dependent or not, than by former smoking is partially consistent with a role-modeling effect. Because former parental smoking reduced but did not eliminate risk, other aspects of the family environment or genetic factors may be important in smoking initiation by the adolescent. Parents who formerly smoked may have exposed the adolescent to parental smoking during an earlier developmental period, and they may have less strict attitudes regarding smoking and more prosmoking norms than nonsmokers, or they may have personality or psychological characteristics associated with smoking.^{6,15,19,64,65} The specific effect of parental dependence on adolescent dependence suggests that genetic factors may be more important for the intergenerational transmission of heavy smoking and dependence than for smoking onset.^{21,66}

Maternal smoking, particularly ND, had a stronger influence than paternal smoking on ND for daughters, a pattern reported previously.³⁰ This may be attributable to gender differences in the consequences of exposure to maternal prenatal smoking, socialization, and vulnerability to ND.^{30,67-70}

Consistent with well-documented epidemiological patterns, White youths and their parents were more likely to smoke and be dependent than minority youths and their parents, particularly African Americans. However, White youths were no more vulnerable than minority youths to parental smoking influences.^{17,18,22,35} Identifying factors that account for the lower rates of smoking among African American than White youths remains an important question. Minority youths may be more exposed than White youths to protective factors against smoking, including lower prevalence of parental smoking and ND, as we observed; higher levels of familial anti-smoking norms; greater religiosity; and fewer smoking peers.^{16,34,71-73}

Parental and adolescent characteristics independently predicted adolescent smoking and ND, after adjustment for other risk factors. Most factors were common predictors of these 2 smoking stages⁷⁴: low parental education, parental separation or divorce, parental ND, low monitoring, higher adolescent age, White race, adolescent delinquency, and beliefs that smoking entails moderate risk and that most or all schoolmates smoked. The finding that adolescent depression was not associated with ND was unexpected because of the comorbidity between depression and smoking among adolescents.^{41,46-48} This may be partially explained by the time frame of the assessments: lifetime depression and past-month dependence.

Parental effects may be mediated by variables included in the models, such as parenting, youth depression and delinquency, and unmeasured variables, such as cigarette availability and number of smoking friends. Parental smoking has been found to predict adolescent smoking directly as well as indirectly, through reduced parental monitoring, availability of cigarettes in the household, and adolescent selection of smoking friends.^{41,15,37,44,75,76}

Limitations

The survey assessed ND symptoms for the past month, not respondents' lifetime. Only 1 parent and 1 adolescent were assessed per household, limiting the examination of within-family effects. Indeed, parental smoking effects derived from data on 1 parent are smaller than effects that take into account smoking by the other parent.¹² Although the data were cross-sectional, we interpreted the associations between parents and adolescents as reflecting parental influence on adolescents, because we assumed that it is unlikely that parents smoke in response to their adolescents' smoking. However, we cannot determine to what extent adolescents' perceptions of smoking risk and smoking by schoolmates may have been affected by the adolescent's own smoking status.

Other factors that could contribute to the associations that we observed, such as tobacco use by household members other than the assessed parent, smoking by close friends, community norms regarding smoking, and exposure to protobacco advertisements, were not available and could not be taken into account in the analysis. These limitations

notwithstanding, the NSDUH dyadic data make a unique contribution to important questions regarding the influence of parental smoking on adolescents' smoking behavior, and among subgroups, in a very large national population sample. The estimation of parental effects can be made with greater precision and generalizability than is feasible in small regional samples.

Conclusions

Our findings are important from a public health perspective because they identify groups of young people at risk for smoking and ND and suggest that reducing smoking by parents would reduce smoking by the next generation. Providing smoking cessation assistance to parents in a pediatric care setting could be a promising strategy, because it would occur early in a child's life, with the expected outcomes of reduced smoking onset and increased cessation among youths who started to smoke.^{19,64,65,77,78} With some exceptions,^{79,80} this approach has been successful.⁷⁸

Prevention efforts should also target improving parenting, adolescent mental health, and reinforcing negative beliefs about smoking.⁸¹ Reducing parental smoking would still be a most crucial intervention. ■

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Contributors

D. B. Kandel and P. C. Griesler designed the study and wrote the article. P. C. Griesler and M.-C. Hu performed the data analysis. All authors revised the article and approved the final version.

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Human Participant Protection

This study involved secondary data analysis of restricted-use, confidential data. Permission to access and analyze

these data under highly restrictive and secure procedures was granted by the Substance Abuse and Mental Health Services Administration and the Center for Behavioral Health Statistics and Quality. The institutional review boards of the New York State Psychiatric Institute and Columbia University also approved access to the data and all procedures.

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