Comorbidity of Psychiatric Disorders and Nicotine Dependence Among Adolescents: Findings From a Prospective, Longitudinal Study

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Abstract

Objective—To examine prospectively the comorbidity of *DSM-IV* psychiatric disorders and nicotine dependence in adolescence.

Method—A multiethnic sample (*N* = 1,039) of adolescents from grades 6 to 10 in the Chicago public schools (mean age 14.1 years) was interviewed at home five times, and mothers were interviewed three times over a 2-year period (2003–2005). Completion rates at each wave were 96% of the initial sample. Selected *DSM-IV* psychiatric disorders were ascertained from youths and mothers about youths at two annual waves with the NIMH Diagnostic Interview Schedule for Children, Version IV-Y and IV-P; *DSM-IV* symptoms of nicotine dependence were ascertained from youths at every wave using a measure developed for adolescents.

Results—Psychiatric disorders most often preceded the onset of the first criterion of nicotine dependence. Prospective associations between psychiatric disorders and nicotine dependence were examined through logistic regressions. After controlling for comorbid disorders, it was found that lifetime disruptive disorder significantly predicted the onset of a nicotine dependence criterion (adjusted odds ratio 2.1). Early onset of any psychiatric disorder increased this risk. Other predictors included novelty seeking and extensiveness of smoking. By contrast, nicotine dependence did not predict the onset of a psychiatric disorder; significant predictors included the youths' prior other psychiatric disorders, novelty seeking, and parental depression and antisocial behavior.

Conclusions—Nicotine dependence does not seem to contribute to the onset of psychiatric disorders, whereas disruptive disorder is an important etiologic factor for nicotine dependence in adolescence.

Keywords

adolescence; comorbidity; psychiatric disorders; nicotine dependence

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Comorbidity between psychiatric disorders and nicotine dependence in the general population has been investigated mostly among adults.[1–3] With exceptions,[4–6] most adolescent studies are based on clinical or high-risk samples.[7–10] Furthermore, studies based on general population samples of youths have examined nicotine dependence in relation to scalar rather than diagnostic measures of psychopathology,[11–14] the latter having been examined in relation to cigarette use, not dependence.[15–19] Thus, adolescent daily smokers are six times as likely as occasional smokers to meet the diagnosis of a disruptive disorder.[19]

Mood, anxiety, and disruptive behavior disorders are elevated among nicotine-dependent youths.[6–12,20] Furthermore, there seem to be reciprocal influences between psychiatric disorders and nicotine dependence. Mood,[15,21] anxiety,[6,22] and especially disruptive disorders[4,5,7,14,21,23] predict nicotine dependence in adolescence and among adolescents reinterviewed as young adults. Correlatively, nicotine dependence and heavy smoking predict anxiety[18,22] and disruptive disorders[24] among adolescents reinterviewed as young adults and mood and anxiety disorders among young adults.[15,25]

Risk factors for adolescent nicotine dependence include sociodemographic characteristics, smoking history, smoking by parents and peers, parent psychopathology, and personality characteristics. Rates of dependence are higher among whites than minorities and among female subjects than male subjects.[12,26] Higher rates of dependence are also associated with earlier onset of smoking a whole cigarette, shorter latency between onset and daily smoking, pleasant physiological experiences on first tobacco use, frequency of smoking and use of other tobacco products, low harm avoidance, novelty seeking, and having friends who smoke and parents who smoke or are nicotine dependent,[12,13,26–32] although lack of association has been reported between peers and parents and dependence.[5,8,27,33] Parental psychopathology, in particular, depression and antisocial behavior, is a risk factor for child depression and disruptive behavior problems,[34–36] factors associated with youth smoking and dependence. Other risk factors for psychiatric disorders include sex, race/ethnicity, and prior history of a psychiatric disorder.[37–40] Female subjects experience higher rates of mood and anxiety disorders; male subjects experience higher rates of disruptive disorder.[39] Although findings are inconsistent, whites and Hispanics have higher rates of mood and anxiety disorders than African Americans; differences have not been observed for disruptive disorder.[38,39]

The current study investigates the predictive comorbidity between *DSM-IV* psychiatric disorders and nicotine dependence in adolescence. Two primary questions are addressed: Do psychiatric disorders predict the onset of the first symptom of nicotine dependence? Does nicotine dependence predict the onset of a psychiatric disorder? For each question, we also investigated the significance of other potential risk factors.

We tested the following hypotheses:

1. The onset of nicotine dependence symptoms will be more likely among youths who

    a. have a lifetime psychiatric disorder.

    b. experience high levels of initial pleasant sensitivity to tobacco, smoke more extensively, are high on novelty seeking, and have a nicotine-dependent parent.

    c. are female subjects and whites.

2. The onset of a psychiatric disorder will be more likely among the following youths:

    a. those who report symptoms of nicotine dependence and smoke more extensively.

b. those who have a prior psychiatric disorder; are high on novelty seeking, specifically for onset of disruptive disorder; and have a parent with a history of psychopathology, particularly depression for onset of mood and disruptive disorders and antisocial behavior for onset of disruptive disorder.

c. Female subjects will be more likely than male subjects, and whites and Hispanics more likely than African Americans, to develop an anxiety or mood disorder. Male subjects will be more likely than female subjects to develop a disruptive disorder.

Method

Sample

The data are from the Transition to Nicotine Dependence Study, a prospective five-wave longitudinal household study of a multiethnic cohort of 1,039 6th to 10th graders selected from the Chicago public schools and one of their parents. A two-stage design was implemented to select the target sample for the follow-up. In phase I (spring 2003), 15,763 students in grades 6 to 10 were sampled from 43 public schools in the Chicago public schools. The schools were divided into eight segments, and the survey administration was staggered over 4 months. The survey completion rate was 83.1%. A target sample of 1,236 youths was selected: 1,106 tobacco users who had reported having started to use tobacco in the prior 12 months and 130 non–tobacco users susceptible of starting to smoke, divided among non-Hispanic whites, non-Hispanic African Americans, and Hispanics. Susceptible non–tobacco users satisfied two of three criteria as per Pierce et al.[41]: might try smoking a cigarette soon, did not answer "definitely not" to whether would smoke if a friend offered them a cigarette, or will be smoking cigarettes in 1 year. Non–tobacco users were included as targets in the household sample so as to not have to indicate to parents that their child was a tobacco user when requesting active parental consent for child participation. In phase II, on average of 9 weeks after each school survey, 1,039 youths (84.1% of 1,236 target; 272 white, 343 African American, and 424 Hispanic) and one parent (86.8% were mothers) participated in the 2-year (2003–2005) longitudinal follow-up consisting of three annual 90-minute computerized household interviews with youths and parents (wave [W] 1, W3, and W5) and two 20-minute biannual interviews with youths 6 months after W1 and W3 (W2 and W4). Of the 1,039 youths, 922 were tobacco users (832 smokers), and 117 were non–tobacco users susceptible to starting to smoke. Completion rates at W2 to W5 were 96.0% of the W1 sample. The National Opinion Research Center at the University of Chicago conducted the fieldwork.

Differences between participants and nonparticipants in the household interview are available on the *Journal*'s Web site at www.jaacap.com through the Article Plus feature.

Human Subject Procedures

Passive parental consent was obtained for the school survey and active consent, for the household interviews. Adolescent assent was obtained for both administrations. Interviewers emphasized that all answers would be confidential. All procedures were approved by the institutional review boards of the New York State Psychiatric Institute, Columbia University, and National Opinion Research Center.

Data Collection: Overview

Selected *DSM-IV* child psychiatric disorders were ascertained at W1, W3, and W5 from youths and mothers. Youths reported at every wave about their smoking, other tobacco use, and *DSM-IV* nicotine dependence symptoms and annually about their use and *DSM-IV* abuse and dependence symptoms for other substances, novelty seeking, and exposure to smoking siblings

and peers. Mothers reported annually on their smoking, *DSM-IV* nicotine dependence symptoms, *DSM-IV* depression, and delinquency.

Definitions of Variables

Variables were measured from youths (Y) and from parents (P) about themselves or the youths. Predictor variables were measured by W3; and outcome variables, by W5. The highest values reported by each period were selected.

(Y-P) Psychiatric Disorders—Measured by the NIMH Diagnostic Interview Schedule for Children (Diagnostic Interview Schedule for Children, Version IV-Y and IV-P).[42] Mood disorders (major depressive disorder and dysthymia) were assessed at W1, W3, and W5; anxiety disorders (social phobia, panic, generalized anxiety, and posttraumatic stress disorder [PTSD]) and disruptive behavior disorders (attention-deficit/hyperactivity disorder [ADHD], oppositional defiant disorder [ODD], and conduct disorder [CD]) were assessed at W3 and W5. Each disorder was ascertained from parents and youths, except ADHD (parents only). For each disorder, lifetime and symptoms in the last 12 months were asked about at the first assessment; the symptoms in the last 12 months were asked about at subsequent assessments. For dysthymia and PTSD, only the symptoms in the last 12 months were asked about at all assessments. Scoring that combined criteria from parent and child reports without impairment was used.[43]

(Y-P) Onset Ages of Psychiatric Disorders (not available for PTSD)—The earliest age reported by parent or youth for a specific disorder defined onset age for the class.

(Y) Nicotine Dependence—Measured as per *DSM-IV* [44] by an instrument developed for adolescents.[45] The 11-item scale measured symptoms in the last 12 months that define the seven *DSM-IV* dependence criteria[44]: tolerance, withdrawal, impaired control, unsuccessful attempts to quit, great deal of time spent on using, neglect important activities, and use despite physical or psychological problems ($\alpha = .85$). Full dependence was defined when three criteria were met.

(Y) Onset Age of First Nicotine Dependence Criterion—Month/year of first criterion minus birth date.

(Y) Onset Age of Full Nicotine Dependence—Month/year of third criterion minus birth date.

(Y) Onset Age of Cigarette Use—Month/year first used cigarettes minus birth date.

(Y) Initial Sensitivity First Tobacco Use.[46]—Experiences associated with first tobacco use. Two scales averaged the scores of component items: pleasant symptoms (pleasant sensations, relaxation, pleasurable dizziness, and pleasurable rush/buzz [$\alpha = .71$]); unpleasant symptoms (unpleasant sensations, nausea, unpleasurable dizziness, unpleasurable rush/buzz, coughing, heart pounding, headache, and bad taste [$\alpha = .78$]). Each symptom was coded 1 = none to 4 = intense experience.

(Y) Lifetime Smoking—At W1, ever smoked a cigarette, even a puff; at subsequent waves, smoked since the prior interview.

(Y) Number Cigarettes Smoked Lifetime—Recoded to midpoint: smoked one or more puffs but never a whole cigarette = 0.5; 1 cigarette = 1; 2 to 5 cigarettes = 3; 6 to 15 = 10; 16 to 25 = 20; 26 to 99 = 62; and 100+ cigarettes = 100.

(Y) Other Tobacco Use Lifetime (Smokeless, Cigars, Pipes, Bidis, Kreteks)

(Y) Alcohol, Marijuana, and Other Illicit Substance Use and Abuse/Dependence Lifetime—Combined ever used and *DSM-IV* abuse or dependence on alcohol, marijuana, or any other illicit drug (OID), ascertained by the Diagnostic Interview Schedule for Children, Version IV-Y: never used alcohol, marijuana, or OID; used but no abuse/dependence; lifetime alcohol, marijuana, or OID abuse/dependence.

(Y) Perceived Peer Smoking—At least one friend currently smoked.

(Y) Perceived Siblings' Smoking—Sibling ever smoked.

(P) Parent Smoking/Nicotine Dependence Lifetime—Combined ever smoked and *DSM-IV* nicotine dependence, measured by the same scale as for the youths ($\alpha = .80$): never smoked; smoked but no dependence; lifetime nicotine dependence.

(P) Parent Lifetime Depression—*DSM-IV* major depressive disorder as per the Composite International Diagnostic Interview, Version 2.1.

(P) Parent Lifetime Delinquency—Count of 11 delinquent activities (range 0–11; $\alpha = .89$).

(Y) Youth Novelty Seeking—Based on Cloninger Tridimensional Personality Questionnaire.[47] Average of nine 5-point items (not at all true to very true; $\alpha = .80$).

(Y) Age (in years)

(Y) Race/Ethnicity—Non-Hispanic white, non-Hispanic African American, and Hispanic.

(Y) Sex—Additional details regarding the study methods is available online at www.jaacap.com through the Article Plus feature.

Analytical Samples for Current Study

Five analytical samples were defined as of W3: total crosssectional sample ($N = 1,039$) to provide background descriptive information about the prevalence of smoking, nicotine dependence, and psychiatric disorders in the cohort; longitudinal sample of lifetime smokers without nicotine dependence symptoms as of W3 ($n = 419$) to examine psychiatric disorders as predictors of the onset of nicotine dependence by W5; and three longitudinal samples of lifetime smokers without a lifetime diagnosis of an anxiety ($n = 686$), mood ($n = 636$), or disruptive ($n = 580$) disorder as of W3 to examine nicotine dependence as a predictor of the onset of each psychiatric disorder by W5.

Statistical Analysis

Logistic regressions were estimated to identify the prospective associations between psychiatric disorders and onset of nicotine dependence, and nicotine dependence and onset of psychiatric disorders. The outcome variable for onset of dependence was meeting at least one criterion by W5. The three outcome variables for onset of psychiatric disorders by W5 were meeting the *DSM-IV* criteria for any anxiety, mood, or disruptive disorder, respectively, in the last 12 months. Multivariate analyses controlled for comorbidity among psychiatric disorders; smoking history (age at onset of smoking, initial sensitivity to tobacco, quantity smoked lifetime, and other tobacco use lifetime); other substance use and abuse/dependence lifetime (alcohol, marijuana, or OID); peer and sibling smoking; novelty seeking; and parental nicotine dependence, depression and delinquency. To the extent possible, identical covariates were

included across all models. Smoking history covariates were included in models predicting psychiatric disorder because they may have unique effects over those of dependence. Selected two-way interaction effects were tested to examine whether the impact of predictors for each outcome were moderated by sex or race/ethnicity. All analyses were weighted and conducted in SAS Version 9.1 (SAS Institute, Cary, NC). To control for type I errors in univariate analyses, the Holm procedure,[48] a modified Bonferroni approach, was applied to conceptually related groups of variables. See the Article Plus feature available at www.jaacap.com for more details regarding the Holm procedure.

The Appendix presents the distribution of covariates for the four longitudinal samples.

Results

Descriptive Analyses

Rates of Smoking, Nicotine Dependence, and Psychiatric Disorders in Total Sample by W3—Adolescents were, on average, 15.1 years old (SD 1.4 years, range 12–18 years); 45.8% were male adolescents; 26.2% were non-Hispanic white, 33.0% were non-Hispanic African American, and 40.8% were Hispanic. By W3, 74.8% reported having ever smoked (*n* = 779). (The rates of lifetime smoking reported in the household were lower than those reported in the school survey. See the Article Plus feature at www.jaacap.com.). These youths were light smokers: 34.0% had ever smoked less than one cigarette; 8.2%, a whole cigarette; 19.1%, 2 to 5 cigarettes; 12.4%, 6 to 15; 5.8%, 16 to 25; 8.0%, 26 to 99; and 12.5%, 100 or more cigarettes. Almost 44% of smokers had experienced at least one nicotine dependence criterion; 20.5% met the criteria for full dependence.

Rates of lifetime psychiatric disorders in the sample were high. By W3, 8.3% met the criteria for any anxiety; 14.6%, for any mood; 19.6%, for any disruptive disorder; and 31.8%, for any disorder (Table 1). Rates of disorders varied by sex but not race/ethnicity. Anxiety and mood disorders were statistically significantly higher among female subjects than male subjects. There was substantial comorbidity among disorders, with odds of 5.2 (confidence interval [CI] 3.2–8.3) between anxiety and mood, 3.2 (CI 2.0–5.1) between disruptive and mood, and 2.8 (CI 1.9–4.1) between anxiety and disruptive.

Temporal Ordering of Psychiatric Disorders and Nicotine Dependence by W3— On average, psychiatric disorders started at a younger age than smoking and nicotine dependence, whether the first criterion or the full syndrome. Smokers started smoking at the age of 12.9 (SD 2.1) years, on average. Smokers who developed symptoms of dependence experienced the first criterion at the age of 14.0 (SD 1.6) years and the third criterion 6 months later at the age of 14.5 (SD 1.5) years. The average onset ages for the three psychiatric disorders were 1.5 to 2.9 years lower than the average onset age for smoking. Of those who experienced a lifetime psychiatric disorder, onset ages were 10.0 (SD 3.9) years for anxiety disorder (excluding PTSD), 11.4 (SD 2.9) years for mood disorder, 10.3 (SD 3.1) years for disruptive disorder, and 10.3 (SD 3.3) years for any disorder. To establish more precisely the temporal ordering between the onset of psychiatric disorders and dependence, youths diagnosed with a lifetime psychiatric disorder who had at least one lifetime nicotine dependence criterion and three or more criteria were considered. Three groups were defined for each dependence outcome: onset of psychiatric disorder before, after, and at the same age as dependence. Psychiatric disorders, particularly disruptive disorder, preceded the onset of the first criterion and full dependence. In 84.0% of cases, disruptive disorder preceded the first dependence criterion; in 4.3%, the two occurred at the same age. For full dependence, the percentages were 90.6% before and 2.6% tied. For mood disorder, the percentages for the first criterion were 79.0% before and 9.7% tied; for full dependence, the percentages were 79.3% before and 10.0% tied. For anxiety disorder (excluding PTSD), the percentages for the first criterion were 72.5%

before and 9.5% tied; for full dependence, the percentages were 69.2% before and 25.6% tied. For any disorder, the percentages for the first criterion were 85.3% before and 4.8% tied; for full dependence, the percentages were 90.4% before and 4.2% tied.

Comorbidity Between Psychiatric Disorders and Nicotine Dependence

Psychiatric Disorders as Predictors of Nicotine Dependence—Logistic regressions were estimated among smokers without symptoms of dependence by W3 ($n = 419$) to examine the effect of psychiatric disorders on the onset of at least one criterion of nicotine dependence by W5. Only new onsets of the first criterion were examined ($n = 77$) because only 20 youths developed full dependence.

At the univariate level, disruptive disorder predicted new onset of nicotine dependence criteria; anxiety and mood disorder did not (Table 2). Youths who met the diagnostic criteria for a lifetime disruptive disorder by W3 were twice as likely to develop nicotine dependence as those not diagnosed. This effect remained statistically significant with control for comorbid psychiatric disorders and other covariates, including novelty seeking and tobacco and drug use history. Novelty seeking and quantity smoked lifetime were also statistically significant predictors.

In a separate multivariate model, the substitution of a variable that indexed any psychiatric disorder for the three separate diagnoses predicted the onset of a dependence criterion.

Early Onset of Psychiatric Disorder and Onset of Nicotine Dependence—Logistic regressions were reestimated to examine whether early onset of any psychiatric disorder increased the likelihood of developing nicotine dependence by W5. Youths positive for any psychiatric disorder were stratified into three groups: early (lower 25th percentile—onset age of 7 years and younger), mid (26th to 74th percentile—onset age of 8–12 years), and late onset (upper 75th percentile—onset age of 13 years and older). The contrast group consisted of youths without any psychiatric disorder. The same covariates as in Table 2 were included.

In univariate analysis, early and mid onset of any psychiatric disorder increased the odds more than twofold for developing any dependence criterion. The unadjusted odds ratios were 2.6, 2.1, and 1.4 for early, mid, and late onset, respectively, with early and mid onset statistically significantly different from those without disorder ($p < .05$). In a multivariate model, only youths with early onset of any disorder were more likely to develop any nicotine dependence criteria than youths without any disorder: adjusted odds ratios (AORs) of 2.8 ($p < .05$), 1.8, and 1.4 for early, mid, and late onset, respectively (data not presented).

Nicotine Dependence as a Predictor of Psychiatric Disorders—Logistic regressions were estimated to examine the predictive effect of nicotine dependence on the onset of each psychiatric disorder by W5 among smokers without that disorder by W3. At W5, there were 38 new cases of anxiety disorder, 14 new cases of mood, and 45 new cases of disruptive disorder. Minority youths, particularly Hispanics, were more likely than whites to develop a disruptive disorder.

Few factors predicted the onset of psychiatric disorders. The youths' prior psychiatric disorders were the strongest predictors of the onset of a different disorder: lifetime mood disorder predicted anxiety disorder, and disruptive disorder predicted mood disorder (Table 3). A significant disorder-by-race/ethnicity interaction ($p < .03$) indicated that prior mood disorder predicted the onset of anxiety disorder among whites (AOR 19.4) but not among African American youths (AOR 0.8). Novelty seeking and parental depression and antisocial behavior predicted the onset of disruptive disorder.

Discussion

We examined the prospective association between psychiatric disorders and nicotine dependence in a multiethnic sample of adolescents. For most youths, the onset of a psychiatric disorder preceded the onset of nicotine dependence. Of the three classes of disorder, only disruptive disorder predicted the onset of nicotine dependence. By contrast, nicotine dependence did not predict the onset of a psychiatric disorder.

After controlling for covariates, including abuse or dependence on substances other than nicotine (alcohol, marijuana, and OIDs), it was found that disruptive disorder more than doubled the risk for developing nicotine dependence. This finding is consistent with an emergent body of evidence documenting the unique effects of disruptive behavior disorders on nicotine dependence[4,7,8,23] and parallels the effects of disruptive disorders on abuse and dependence on alcohol, marijuana, and OIDs.[24,49] The lack of prospective associations between mood and anxiety disorders and dependence was unexpected, given prior research. However, previous studies have examined the impact of psychiatric disorder on cigarette smoking, not dependence,[16,17] or have examined dependence in older adolescents and young adults, not young adolescents.[6,22,25] Specific psychiatric disorders may be differentially important as risk factors for nicotine dependence at different stages of the life cycle. Disruptive disorders may be important in early adolescence, whereas mood and anxiety disorders may be important in later adolescence and young adulthood. How psychopathology and nicotine dependence influence each other over the course of development remains to be understood.

Novelty seeking had a unique impact on the onset of dependence with control for disruptive disorder, although the two were significantly correlated ($r = 0.21$, $p < .001$) and share similar behavioral features, such as impulsivity and poor behavioral control. Youths high on novelty seeking may experience heightened physiological sensitivity to nicotine, may experience it as more subjectively rewarding, and may affiliate to a greater extent with smoking peers—all factors associated with use as well as addiction.[50–52] The other unique predictor of dependence was extensiveness of smoking.[13,27] It is noteworthy that youths reported symptoms of nicotine dependence at low levels of cigarette consumption. The mean number of cigarettes smoked lifetime by W3 was 10.16 (SD 12.29) cigarettes among youths who went on to experience dependence symptoms in the next 12 months. By W5, lifetime smoking had increased only to 42.60 (SD 38.68) cigarettes. The observation that dependence develops among youths who have smoked only a few cigarettes has been made by other investigators.[32,53] Two interpretations may account for this finding. Youths may be more sensitive to the physiological effects of nicotine, as suggested by animal models.[54] Youths may also subjectively interpret experiences of dependence differently than adults. Unexpectedly, we did not observe an effect of initial pleasant tobacco experiences on the onset of dependence, an effect reported by others[12,27,28] and by ourselves.[30] On the basis of survival analysis in another sample of new tobacco users from the same study, youths with high levels of initial sensitivity were most likely to develop dependence, whether a single criterion or the full syndrome.[30] Because higher levels of initial sensitivity are associated with more rapid onset of dependence symptoms, the exclusion of already dependent youths restricted the current sample to youths with lower levels of initial sensitivity who would experience onset of dependence more slowly. Indeed, youths excluded from the sample because they already experienced dependence symptoms by W3 had a higher average initial pleasant sensitivity score (mean 1.61, SD 0.60) than those included (mean 1.19, SD 0.35, $p < .001$).

Although disruptive disorder predicted the onset of nicotine dependence, nicotine dependence did not predict the onset of disruptive disorder. Similarly, the effect of nicotine dependence on mood disorder was not statistically significant, although the adjusted odds were slightly more than 2 (AOR 2.4). The most significant predictor of new psychiatric disorders was another

prior psychiatric disorder, in particular, disruptive for mood disorder and mood for anxiety disorder. However, the latter pattern was observed among whites but not among African American youths. This may be explained by the higher rates of mood and anxiety disorders reported among whites than African Americans; Hispanic youths were more likely than whites to develop a disruptive disorder. The effect of a prior disorder on the onset of a new disorder is consistent with heterotypic continuity of psychiatric disorder over time among children. The specific associations that we observed parallel those reported by others. Costello et al.[40] found that depression predicted subsequent anxiety disorder, and Capaldi[55] found that conduct problems predicted subsequent depressive symptoms. Comorbidity may develop along specific pathways over time, depending on the first manifest disorder. We also found that novelty seeking predicted the onset of disruptive disorder probably because of the continuity of their common behavioral characteristics. In addition, there was intergenerational transmission of psychopathology.[34–36] Youths with a depressed or antisocial parent were more likely to manifest a disruptive disorder. Interestingly, parental depression did not predict child mood disorder.

Several factors may account for the lack of prospective impact of nicotine dependence and other factors on the onset of a psychiatric disorder. There were few cases of new disorders, especially mood, in the sample. Because subjects who already had disorders were removed from the analytic samples, the samples were restricted to later-onset psychiatric cases whose etiology may differ from earlier onset cases. Furthermore, the 1-year follow-up interval may have been too short a period to observe effects of dependent smoking on psychiatric disorders, especially among youths who had low levels of nicotine consumption. A longer duration of regular chronic smoking may be necessary for effects on psychiatric outcome to become manifest. Studies that have documented the effects of heavy smoking or nicotine dependence on psychiatric disorders, particularly mood and anxiety disorders, have done so in early adulthood or in the period between adolescence and early adulthood, not adolescence.[15,18,22,25]

Other limitations must be acknowledged. Prospectively, we could only examine the onset of any dependence criterion but not full dependence. Similarly, we could only examine the broad classes of psychiatric disorder and not specific disorders within classes. In particular, we could not conclusively determine whether ADHD predicted the onset of nicotine dependence independently from its comorbidity with ODD and CD. In a reduced model that included only ADHD and a combined ODD/CD variable, ODD/CD (AOR 2.0, $p < .04$) but not ADHD (AOR 1.8, $p < .29$) uniquely predicted the onset of nicotine dependence, although the AORs were almost identical for both disorders. Whether ODD/CD is more important than ADHD for nicotine dependence[4] cannot be determined in our study because of limited statistical power. The assessment of smoking and dependence was based on the youths' reports and is subject to errors of recall, interpretation, and denial, especially among young respondents.[56] For psychiatric disorders, this bias may have been lessened by ascertainment from parents and youths. Within these limitations, a strength of the study is the longitudinal assessment of psychiatric disorders and nicotine dependence using *DSM-IV*–based instruments in a community sample of young adolescents. The data underscore the unique impact of disruptive disorder on the development of nicotine dependence. Prior research has focused on depression as a risk for smoking but not for dependence among youths who have already smoked. The present results suggest that, in childhood and early adolescence, disruptive disorder should be the focus of prevention and intervention efforts. Youths with disruptive disorder are at increased risk not only for developing mood disorder but also for other negative psychosocial outcomes, including smoking and the development of nicotine dependence with the health burdens that it entails.

Acknowledgements

Appendix

Prevalence and Means of Covariates in Longitudinal Analytical Samples by Wave 3

Predictors by Wave 3	Nicotine Dependence (*n* = 419)	Anxiety Disorder (*n* = 686)	Mood Disorder (*n* = 626)	Disruptive Disorder (*n* = 580)
Age, mean (SD), y	15.13 (1.36)	15.18 (1.31)	15.17 (1.32)	15.24 (1.31)
Female, %	50.8	52.2	50.4	54.6
Race/ethnicity				
White, %	26.4	27.8	27.0	28.6
African American, %	30.3	32.0	32.9	29.8
Hispanic, %	43.3	40.2	40.1	41.6
Anxiety disorder lifetime, %	5.8	—	5.8	6.5
Mood disorder lifetime, %	12.3	14.7	—	14.4
Disruptive disorder lifetime, %	15.2	20.7	19.9	—
Any psychiatric disorder lifetime, %	28.0	—	—	—
Novelty seeking, mean (SD)	2.88 (0.74)	2.56 (0.65)	2.55 (0.64)	2.51 (0.64)
Smoked/nicotine dependence lifetime				
Smoked, no dependence criteria, %	—	58.2	59.9	61.7
1+ dependence criteria, %	—	41.8	40.1	38.3
Alcohol, marijuana or other illicit drug use/abuse/ dependence lifetime				
Never used, %	22.7	17.3	17.9	19.0
Used, never abused/dependent, %	63.2	58.3	58.7	61.6
Ever abused/dependent, %	14.2	24.4	23.4	19.5
Age at onset of smoking, mean (SD), y	12.78 (2.12)	12.82 (2.14)	12.84 (2.10)	12.92 (2.12)
Initial sensitivity to tobacco				
Pleasant experiences, mean (SD)	1.19 (0.34)	1.35 (0.49)	1.34 (0.48)	1.34 (0.49)
Unpleasant experiences, mean (SD)	1.64 (0.56)	1.64 (0.54)	1.63 (0.53)	1.64 (0.54)
No. cigarettes smoked lifetime, mean (SD)	3.78 (11.73)	19.49 (33.41)	19.56 (33.28)	16.52 (30.82)
Other tobacco use lifetime, %	28.7	34.1	33.7	33.0
Peer smoking currently, %	82.7	88.7	87.9	88.5
Sibling smoking lifetime, %	47.5	53.1	53.0	50.8
Parent smoking/nicotine dependence lifetime[a]				
Never smoked, %	28.9	27.1	27.1	27.6
Smoked, never dependent, %	45.7	45.3	46.4	47.5
Ever dependent, %	25.4	27.6	26.6	24.8
Parent depression lifetime,[a] %	14.9	13.6	11.2	13.8
Parent delinquency lifetime,[a] mean (SD)	0.66 (1.44)	0.73 (1.43)	0.65 (1.34)	0.71 (1.48)

Note: Weighted estimates, unweighted *n*'s.

[a] Parent report.

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Table 1

Rates of Adolescent Diagnostic Interview Schedule for Children Version IV–Y and IV–P Lifetime Psychiatric Disorders, Smoking and Nicotine Dependence by Wave 3 by Sex and Race/Ethnicity

Psychiatric Disorder	Total, %	Male, %	Female, %	White, %	African American, %	Hispanic, %
Anxiety						
Social phobia	3.5	2.4	4.5	4.2	3.0	3.5
Panic	2.3	1.8	2.8	3.0	0.9	3.0
Generalized anxiety	2.3	2.1	2.5	2.7	2.1	2.2
Posttraumatic stress	2.6	0.8^a	4.3^{b**}	1.9	1.8	3.8
Any anxiety	8.3	5.2^a	11.0^{b*}	8.7	6.6	9.5
Mood						
Major depression	14.2	9.1^a	18.5^{b*}	15.4	11.7	15.4
Dysthymia	1.0	1.0	1.0	0.7	0.3	1.8
Any mood	14.6	9.4^a	19.0^{b*}	15.8	11.7	16.3
Disruptive						
Attention-deficit/hyperactivity	5.4	6.9	4.1	5.7	6.9	3.8
Oppositional defiant	9.5	8.0	10.8	9.8	11.4	7.7
Conduct	11.8	13.8	10.1	10.2	14.4	10.7
Any disruptive	19.6	20.9	18.4	17.8	23.6	17.4
Any psychiatric disorder	31.8	27.1^a	35.8^{b*}	31.6	32.4	31.6
Smoking behavior						
Ever smoked	74.8	75.8	74.0	79.7^a	70.3^b	75.3^{ab*}
Total sample, $N \geq$	(1,000)	(470)	(530)	(264)	(331)	(405)
Nicotine dependence (among smokers)						
Ever 1+ criterion	43.9	41.1	46.3	47.0	45.6	40.5
Ever 3+ criteria	20.5	19.2	21.6	22.1^a	26.1^a	15.1^{b*}
Total smokers, N	(779)	(363)	(416)	(217)	(241)	(321)

Note: Within each strata, groups with different superscript letters are significantly different from each other at *p* level indicated by the Holm procedure, a modified Bonferroni approach. Weighted estimates; unweighted *n*'s.

*
  p < .05;

**
  p < .01.

Table 2

Logistic Regressions Predicting the Onset of Any *DSM-IV* Nicotine Dependence Criterion by Wave 5 From *DSM-IV* Psychiatric Disorders and Other Covariates Among Lifetime Smokers Who Had Not Experienced Any *DSM-IV* Nicotine Dependence Criteria by Wave 3 (*n* = 419)

Predictors by Wave 3	1+ Nicotine Dependence Criteria by Wave 5			
	UOR	95% CI	AOR	95% CI
Age, y	1.0	0.8–1.2	0.9	0.7–1.2
Female (vs. male)	0.8	0.5–1.4	0.9	0.5–1.7
Race/ethnicity (vs. white)				
African American	0.9	0.5–1.7	1.1	0.6–2.2
Hispanic	0.6	0.3–1.1	0.5	0.3–1.1
Anxiety disorder lifetime	1.2	0.4–3.3	1.0	0.3–3.4
Mood disorder lifetime	1.8	0.9–3.6	1.7	0.8–3.7
Disruptive disorder lifetime	2.2*	1.2–4.2	2.1*	1.0–4.5
Novelty seeking	1.7**	1.2–2.4	1.7**	1.1–2.5
Age of onset of smoking	1.0	0.9–1.2	1.1	0.9–1.4
Initial sensitivity to tobacco				
Pleasant experiences	1.5	0.8–3.0	0.9	0.4–2.2
Unpleasant experiences	0.8	0.5–1.3	0.8	0.5–1.3
No. cigarettes smoked lifetime	1.0**	1.0–1.1	1.0***	1.0–1.1
Other tobacco use lifetime	1.5	0.9–2.6	1.5	0.8–2.9
Alcohol, marijuana, or other illicit drug use/abuse/ dependence lifetime (vs. never used)				
Used, never abused/dependent	1.3	0.7–2.5	1.2	0.6–2.6
Ever abused/dependent	2.1	0.9–4.7	1.2	0.4–3.4
Peer smoking currently	1.8	0.8–4.0	1.8	0.4–4.4
Sibling smoking lifetime	1.1	0.7–1.8	1.1	0.6–1.9
Parent smoking/nicotine dependence lifetime (vs. never smoked)*a*				
Smoked, never dependent	1.3	0.7–2.4	1.9	0.9–4.2
Ever dependent	1.9	0.9–3.8	2.3	0.9–5.4
Parent depression lifetime*a*	1.3	0.6–2.5	1.0	0.5–2.2
Parent delinquency lifetime*a*	1.0	0.9–1.2	1.0	0.8–1.2
−2 log L (*df* = 22)				335.98
Any psychiatric disorder lifetime	1.9*	1.1–3.2	1.9*	1.0–3.5
−2 log L (*df* = 19)				339.33

Note: UOR = unadjusted odds ratio; AOR = adjusted odds ratio; CI = confidence interval. For the UORs, *p* is significant at level indicated by the Holm procedure, a modified Bonferroni approach. Weighted estimates, unweighted *N*s.

*a*Parent report.

*
 p < .05;

**
 p < .01;

***
 p < .001.

Table 3

Logistic Regressions Predicting the Onset of *DSM-IV* Psychiatric Disorders by Wave 5 From at Least One *DSM-IV* Nicotine Dependence Criterion by Wave 3 and Other Covariates Among Lifetime Smokers Without the Outcome Psychiatric Disorder by Wave 3

Predictors by Wave 3	Anxiety Wave 5 (n = 686)				Mood Wave 5 (n = 626)				Disruptive Wave 5 (n = 580)			
	UOR	95% CI	AOR	95% CI	UOR	95% CI	AOR	95% CI	UOR	95% CI	AOR	95% CI
Age, y	0.9	0.7–1.2	1.0	0.7–1.4	0.8	0.6–1.3	0.7	0.4–1.3	0.8	0.7–1.1	0.8	0.6–1.1
Female (vs. male)	1.2	0.6–1.8	0.9	0.4–1.9	2.2	0.7–7.3	2.0	0.5–7.1	1.1	0.6–2.0	1.1	0.5–2.1
Race/ethnicity (vs. white)												
African American	0.9	0.4–2.3	—	—	0.8	0.2–2.9	0.9	0.2–3.5	1.9	0.8–4.5	2.1	0.8–5.7
Hispanic	1.3	0.6–2.9	—	—	0.4	0.1–1.6	0.5	0.1–2.6	1.8	0.8–4.2	2.6*	1.0–6.5
Anxiety disorder lifetime	—	—	—	—	2.6	0.5–13.2	1.9	0.3–11.8	1.4	0.6–3.0	1.4	0.4–5.2
Mood disorder lifetime	4.9*	—	—	—	—	—	—	—	1.3	0.6–3.1	0.9	0.3–2.2
Race/ethnicity × mood disorder[a]												
White mood (vs. no mood)	—	—	19.4[b]*	3.9–51.1	—	—	—	—	—	—	—	—
African American mood (vs. no mood)	—	—	0.8	0.1–7.3	—	—	—	—	—	—	—	—
Hispanic mood (vs. no mood)	—	—	8.3	1.1–25.0	—	—	—	—	—	—	—	—
Disruptive disorder lifetime	1.9	0.9–3.8	1.7	0.7–4.3	4.6*	1.5–13.9	4.0*	1.1–14.2	—	—	—	—
Novelty seeking	1.2	0.8–2.2	1.2	0.7–2.0	1.3	0.6–2.8	1.1	0.4–2.5	1.6*	1.0–2.4	1.6*	1.0–2.7
Nicotine dependence lifetime												
1[+] criterion	1.2	0.6–2.2	0.8	0.3–2.0	2.9	0.9–9.3	2.4	0.5–10.7	1.9	1.0–3.6	1.5	0.7–3.5
Age of onset of smoking	0.9	0.8–1.0	0.8	0.7–1.0	1.0	0.8–1.4	1.1	0.8–1.6	0.9	0.8–0.9	0.9	0.8–1.0
Initial sensitivity to tobacco												
Pleasant experiences	1.0	0.5–2.0	0.9	0.4–2.2	0.9	0.3–2.9	0.6	0.1–2.7	1.7	0.9–2.9	1.2	0.6–2.5
Unpleasant experiences	0.7	0.4–1.4	0.6	0.3–1.2	1.2	0.4–3.1	1.0	0.4–3.0	1.7	1.0–2.7	1.7	0.9–3.0
No. cigarettes smoked lifetime	1.0	1.0–1.0	1.0	0.9–1.0	1.0	0.9–1.0	1.0	0.9–1.0	1.0	0.9–1.0	1.0	0.9–1.0
Other tobacco use lifetime	0.7	0.3–1.4	0.4	0.2–1.0	0.5	0.1–2.0	0.6	0.1–2.7	1.1	0.6–2.1	1.1	0.5–2.2
Alcohol, marijuana, or other illicit drug use/abuse/dependence lifetime (vs. never used)												
Used, never abused/dependent	1.6	0.6–4.6	2.1	0.7–6.7	1.1	0.2–5.3	1.3	0.2–7.8	0.9	0.9–2.1	0.8	0.3–2.3
Ever abused/dependent	1.9	0.6–6.0	2.1	0.5–8.3	1.4	0.3–8.1	1.1	0.1–9.4	2.1	0.8–5.3	1.8	0.6–5.7
Peer smoking currently	0.9	0.4–2.5	0.6	0.2–2.1	1.7	0.2–12.9	1.3	0.1–12.0	1.1	0.4–2.9	0.8	0.3–2.4
Sibling smoking lifetime	1.5	0.8–2.9	1.7	0.8–3.7	1.5	0.5–4.9	1.1	0.3–3.8	1.2	0.7–2.3	1.0	0.5–1.9
Parent smoking/nicotine dependence lifetime (vs. never smoked)[c]												
Smoked, never dependent	1.2	0.6–2.5	1.1	0.5–2.6	1.3	0.3–5.6	0.8	0.2–4.1	0.7	0.3–1.4	0.5	0.2–1.1
Ever dependent	0.4	0.2–1.3	0.3	0.1–1.1	1.5	0.3–7.1	0.7	0.1–4.1	1.4	0.7–3.0	0.9	0.4–2.3
Parent depression lifetime[c]	2.3	1.1–4.8	1.5	0.6–3.7	1.2	0.2–6.2	1.4	0.2–8.0	2.2**	1.0–4.5	2.5*	1.1–5.9
Parent delinquency lifetime[c]	0.8	0.6–1.1	0.7	0.5–1.4	1.2	0.9–1.6	1.3	0.9–1.8	1.2*	1.0–1.4	1.2*	1.0–1.5
−2 log L (df)	249.05 (24)				108.44 (22)				270.55 (22)			

Note: UOR = unadjusted odds ratio; AOR = adjusted odds ratio; CI = confidence interval. For the UORs, *p* is significant at level indicated by the Holm procedure, a modified Bonferroni approach. Weighted estimates; unweighted *n*'s.

[a] Main effects not shown; calculation of race/ethnicity by predictor interaction for each group includes the main and interaction effects.

[b] Contrast group, African American.

[c] Parent report.

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*
$p < .05$;

**
$p < .01$;

***
$p < .001$.