



Published in final edited form as:

Addiction. 2011 May ; 106(5): 1010–1020. doi:10.1111/j.1360-0443.2011.03403.x.

Comorbid Psychiatric Disorders and Nicotine Dependence in Adolescence

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Abstract

Aims—To examine bi-directional influences of onset of psychiatric disorders and nicotine dependence among adolescent smokers.

Design—A prospective longitudinal cohort of adolescents and mothers drawn from a large city school system. Adolescents were interviewed five times and mothers three times over two years.

Setting—Chicago, Illinois.

Participants—Subsample of adolescent smokers (N=814).

Measurements—Selected DSM-IV psychiatric disorders, nicotine dependence and selected risk factors were ascertained.

Findings—Among lifetime smokers, 53.7% experienced at least one nicotine dependence criterion; 26.1% full dependence; 14.1% experienced an anxiety, 18.8% a mood, and 29.5% a disruptive disorder. Nicotine dependence and psychiatric disorders were comorbid: nicotine dependent youths had higher rates of individual and multiple disorders than those not dependent. Controlling for other covariates, mood disorder and nicotine dependence did not predict each other; anxiety disorder predicted nicotine dependence. Bi-directional influences were observed for disruptive disorder and nicotine dependence. Predictors of onset of full nicotine dependence included earlier onset age of tobacco use, high initial pleasant sensitivity to tobacco, alcohol and illicit drug use, abuse and dependence, and parental nicotine dependence. Predictors of psychiatric disorder onset included gender, race/ethnicity, other psychiatric disorders, illicit drug abuse or dependence, and parental depression and delinquency.

Conclusions—Initial pleasant experiences of smoking are predictive of later development of nicotine dependence. There may be reciprocal influences between disruptive disorder and development of nicotine dependence in adolescence and intergenerational transmission of parental nicotine dependence and psychopathology.

Keywords

Comorbidity; psychiatric disorders; nicotine dependence; adolescence

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Declarations of interest: None

INTRODUCTION

Substance use disorders are comorbid with psychiatric disorders among adolescents and adults. The association between psychiatric and substance use disorders could result from three processes: psychiatric disorder causes substance use disorder; substance use disorder leads to psychiatric disorder; both are affected by common underlying factors [1,2]. These hypotheses remain to be tested with regards to nicotine dependence (ND) in adolescence.

Reciprocal influences between psychiatric disorders and ND in adolescence and early adulthood have rarely been investigated. Most studies have examined unidirectional influences from psychiatric disorder to ND. Because dependent smokers are most often compared with a combined group of non-dependent smokers and non-smokers, the role of psychiatric disorders in progression to ND among smokers is confounded with the role of disorders in smoking initiation. Furthermore, given comorbidity among psychiatric disorders, control for other disorders is essential for determining the unique impact of a psychiatric disorder and ND on each other. Control for multiple disorders has rarely been implemented. Risk factors common to both behaviors and those unique to each must also be considered. These include sociodemographic characteristics, youth's tobacco use history and other substance use, and parental psychopathology and tobacco use [3–18].

We identified eighteen longitudinal studies that examined comorbidity of psychiatric disorders (mood, anxiety, disruptive) with ND or daily smoking among adolescents or young adults in population samples. Nine studies included non-smokers or examined changes in ND level [19–31] and are not considered further. Nine additional studies examined influence of disorders on onset of ND or daily smoking among smokers [2,17,32–38]. Results are inconclusive. All but one [37] reported positive effects of one or more disorders. Only two studies [32,38] controlled simultaneously for all three disorders; effects were observed exclusively for disruptive disorder. Effects of mood and anxiety do not appear to persist controlling for disruptive disorder. Three studies also examined the reverse influences of ND or daily smoking on mood and anxiety [2,34,37]. Two reported positive ND effects on onset of major depression [2] or panic attacks and disorder [34], controlling for the other disorder class. Most studies included only sociodemographic or other substance use as additional covariates; few included youth smoking history or parental factors [17,35,37,38].

This report extends an earlier article [39] that examined prospectively influences of psychiatric disorders and one ND criterion on each other's onset over one year among four groups of adolescent smokers (average age 15.7, $SD=1.4$) without either ND, mood, anxiety or disruptive disorders. Disruptive disorder predicted onset of one DSM-IV ND criterion; ND did not predict psychiatric disorder onset. Insufficient cases precluded examining full dependence or individual psychiatric disorders within classes. We here examine comorbidity in the larger sample of all smokers. We capture youths with earlier onset ages for ND and psychiatric disorders than in the earlier report, thereby reducing left censoring. We examine onset of full DSM-IV ND, in addition to one criterion, and individual psychiatric disorders, in addition to the three broad classes.

We investigate the following issues: (1) Are there bi-directional or only unidirectional influences between psychiatric disorders and ND onsets? (2) Do univariate associations persist controlling for covariates common to both behaviors, especially other psychiatric disorders? We hypothesize that psychiatric disorder will have a greater impact on onset of ND than the reverse.

METHODS

Sample

Data are from the Transition to Nicotine Dependence, a five-wave longitudinal study of a multi-ethnic cohort of 1,039 6th–10th graders from Chicago Public Schools (CPS) and one parent. A two-stage design was implemented to select the follow-up target sample and provide approximately equal numbers of non-Hispanic whites, non-Hispanic African-Americans, and Hispanics. In Phase I (2003), 15,763 6–10th graders were sampled from 43 CPS schools (completion rate 83.1%). Responses to a school survey were used to select the target sample: 1,106 tobacco users who reported having started using tobacco within the prior 12 months and 130 non-tobacco users susceptible of starting to smoke. Tobacco users included all non-Hispanic whites and non-Hispanic African-Americans who started using tobacco 0–12 months earlier, all Hispanics who started 0–6 months earlier, and 25% of Hispanics who started 7–12 months earlier, because there were more Hispanics than other racial/ethnic groups. A small number (8.2%) of susceptible non-smokers, who satisfied 2 of 3 criteria per Pierce et al. [40], were selected to preclude labeling the study as an exclusive study of smokers.

In Phase II, about nine weeks after the school survey, 1,039 youths (84.1% of target) (272 non-Hispanic white, 343 non-Hispanic African-American, 424 Hispanics) and one parent (86.8% mothers) agreed to participate in the two-year follow-up involving three annual 90 minute computerized household interviews with youths and parents (W1, W3, W5) and two 20 minute bi-annual interviews with youths (W2, W4). 922 youths reported in school using tobacco lifetime (832 used cigarettes); 117 were susceptible non-smokers. Completion rates at W2 to W5 were 96% of W1 sample. The National Opinion Research Center (NORC) conducted the fieldwork.

Compared with participants in household interviews, non-participants (N=197) did not differ on age or gender; a higher proportion of non-Hispanic whites and Hispanics than African Americans declined to participate. Non-participants were more likely than participants to report in school having ever smoked (92.8% versus 85.0%, $p<0.01$), having smoked 100+ cigarettes (11.1% versus 6.3%, $p<0.05$), and meet criteria for DSM-IV nicotine dependence (31.1% versus 24.4%, non-significant).

School and household smoking reports were inconsistent. Of 832 youths who reported lifetime smoking in school, 643 did so at W1. Underreporters (N=189) were younger, more likely to be African-American, lighter smokers, had more non-smoking parents and peers, and committed fewer deviant acts than consistent reporters [41]. Seventy-one additional youths started smoking between the school survey and W1; 100 started between W1 and W5.

The analytical sample included 814 youths reporting having ever smoked by W5; 332 used another tobacco product.

Human subjects procedures

Parental consent was obtained for the school survey and household interviews; adolescent assent for both. Procedures were approved by the Institutional Review Boards of New York State Psychiatric Institute, Columbia University, and NORC.

MEASURES

Selected DSM-IV psychiatric disorders were ascertained annually (W1,W3,W5) from youths and mothers. Youths reported at every wave (W1,W2,W3,W4,W5) about their

smoking, other tobacco use, and DSM-IV nicotine dependence symptoms, and annually about use and DSM-IV abuse and dependence on other substances. Mothers reported at W1 about their lifetime smoking, DSM-IV nicotine dependence symptoms, DSM-IV depression, and delinquency.

Time-constant (TC) and time-varying (TV) variables were measured from youths about themselves, and parents about themselves or youths. (See also supplementary material).

Youth variables

Psychiatric disorders (TV)—Assessed by DISC-IV-Y/P [42]. Anxiety (social phobia; panic attacks; panic disorder; generalized anxiety), mood (major depressive disorder [MDD]; dysthymia), and disruptive behavior disorders (attention deficit hyperactivity disorder [ADHD]; oppositional defiant disorder [ODD]; conduct disorder [CD]) were ascertained from parents and youths, except ADHD (parents). Mood disorders were measured at W1, W3, W5, anxiety and disruptive disorders at W3, W5, with last year and whole life modules. Youths were assigned a diagnosis if met criteria on the parent, youth or combined informant scores. Impairment was not applied because impairment algorithms are unavailable for combined informant diagnosis [43].

Onset age psychiatric disorders (TV)—For each disorder, onset was the earliest age reported by parent or youth and could predate Wave 1; for each disorder class, onset was the age of the earliest class-specific disorder. Age at the earliest symptom dated CD onset; age at first panic attack dated panic disorder onset.

Nicotine dependence (TV)—Measured per DSM-IV [44,45]. Eleven-item scale measured last 12 month symptoms, which defined the seven dependence criteria: tolerance, withdrawal, impaired control, unsuccessful quit attempts, great deal of time spent using, neglect important activities, use despite physical or psychological problems ($\alpha=0.85$). Full dependence=3+ criteria.

Onset age tobacco use (TC)—Month/year first used any tobacco minus birthdate.

Onset age ND (TV)—Month/year reported experiencing first (any) criterion and full dependence; each minus birthdate.

Tobacco use/first ND criterion (TV)—Not yet used tobacco; used, no ND criteria; one ND criterion.

Tobacco use/full ND (TV)—Not yet used tobacco; used, <3 ND criteria; ≥ 3 ND criteria.

Initial sensitivity at first tobacco use (TC: nicotine dependence analysis; TV: psychiatric disorders analysis)[46]—Two scales averaged pleasant ($\alpha=0.71$) and unpleasant ($\alpha=0.78$) experiences.

Alcohol and illicit substance use and abuse/dependence (TV)—Assessed by DISC-IV-Y. Use and DSM-IV abuse/dependence on alcohol or illicit drugs: never used alcohol or illicit drugs; used, no abuse/dependence; alcohol abuse/dependence only; illicit drug abuse/dependence only; alcohol and illicit drug abuse/dependence.

Race/ethnicity (TC)—Non-Hispanic white=0; non-Hispanic African-American=1; Hispanic=2.

Gender (TC)—Male=0; female=1.

Parent variables

Education (TC)—High school or less=0; greater than high school=1.

Smoking/nicotine dependence (TC)—Ever smoked and DSM-IV ND, measured by the same scale as youths [34]($\alpha=0.80$): never smoked; ever smoked, no ND; lifetime ND.

Depression (TC)—DSM-IV major depressive disorder per CIDI 2.1 [47].

Delinquency (TC)—Count of 11 delinquent activities: [48]($\alpha=0.89$).

Statistical analysis

Rates of psychiatric disorder, ND, and covariates were estimated. Cox proportional hazards models estimated effects of psychiatric disorders on ND onset, and ND on disorders. Chronological age defined time and spanned 3 to 18 years. Time-varying lifetime ND and psychiatric disorders were measured at least one year prior to outcomes of interest: onsets of two ND outcomes and three psychiatric disorders, specifically first DSM-IV ND criterion, full dependence; anxiety, mood, disruptive behavior disorders. Relevant time-varying variables were included when they occurred prior to the outcome of interest. Onset of events could have occurred during or prior to the study period. Specific disorders within anxiety, mood, and two disruptive (ODD, CD) disorders were examined in additional models. ADHD was analyzed as a predictor but not an outcome because ADHD cases predated ND. Panic attacks and disorder were classified as: 0=neither; 1=panic attacks only; 2=panic disorder. As outcomes, each was estimated in two separate models, each contrasted with 0.

Multivariate models controlled for psychiatric comorbidity and factors associated with ND and psychiatric disorders (See Tables 4 & 5). Models were estimated in the total sample and gender subgroups. Statistically significant gender-specific predictors were entered as interaction terms in total sample models; only statistically significant interactions were retained. Weighted analyses were conducted in SAS V9.2 [49].

RESULTS

Sample characteristics

At W5, adolescents were on average 16.7 years old ($SD=1.3$, range 12–19 years). Table 1 presents distributions of covariates; Table 2 rates of ND and psychiatric disorders. Rates of dependence were similar by gender. Anxiety, mood disorder, and ODD rates were higher among females than males. Disorders were comorbid, especially anxiety and mood ($OR=5.7$, $CI=3.7-8.8$). Comorbidity of disruptive with anxiety and mood disorder was lower ($ORs=2.9$, $CI's=1.9-4.3$, $2.0-4.2$). More new cases of ND than psychiatric disorders occurred after baseline. By W5, rates increased by 48% for one ND criterion, 60% for full dependence, 39.0% for anxiety, 27.5% for disruptive, and 20.2% for mood disorders.

Different patterns of association with ND levels were observed across psychiatric disorders (Table 3). For anxiety disorder, youths with full ND had at least twice the risk as those with 1–2 or zero criteria. For mood disorder, risk among dependent youths did not vary with number of positive symptoms but was twice that of asymptomatic youths. For disruptive disorder, risk increased at each successive dependence level. Youths reporting 3 or more criteria were over twice as likely as those reporting 1–2 criteria and 15 times as likely as those without criteria to be diagnosed with all three psychiatric disorder classes.

Temporal ordering of psychiatric disorders and nicotine dependence

On average, psychiatric disorders began at a younger age than tobacco use (1.3–2.4 years lower) and first ND criterion (2.5–3.7 years lower). Mean onset ages were: anxiety 10.7 years (SD=4.0, N=100), mood 11.7 (SD=2.9, N=149), disruptive behavior 10.6 (SD=3.3, N=244), tobacco use 13.0 years (SD=2.1, N=814), first dependence criterion 14.3 years (SD=1.6, N=429), third criterion 14.7 years (SD=1.5, N=207). Three groups were defined for each ND outcome (first criterion, full ND): onset of psychiatric disorder before, after, and same age as dependence. For disruptive disorder, 80.6% preceded the first criterion, 14.3% followed, 5.1% were tied; the percentages were 86.4%, 9.2%, 4.4%, respectively, for full dependence. For mood disorder the percentages were 76.6%, 12.8%, 10.6% for first criterion; 82.8%, 11.0%, 6.2% for full dependence. For anxiety disorder the percentages were 70.0%, 17.0%, 13.0% for first criterion; 79.4%, 7.3%, 13.3% for full dependence.

Psychiatric disorders as predictors of nicotine dependence

Cox proportional hazards models estimated the risk from psychiatric disorders for onset of first criterion and full ND among smokers. At the univariate level, except for anxiety disorder, each psychiatric disorder class predicted onset of the first criterion; all three psychiatric disorder classes predicted full dependence (Table 4). Controlling for comorbidity among disorders and other covariates, only disruptive disorder predicted onset of the first dependence criterion; disruptive and anxiety disorder predicted full dependence. Mood disorder no longer predicted dependence. Disruptive disorder and initial pleasant sensitivity accounted for the effect of mood on the first criterion; disruptive disorder did for full dependence.

Additional statistically significant common predictors of first criterion and full dependence included earlier onset age of tobacco use, initial pleasant tobacco experiences, alcohol or illicit drug use, particularly abuse or dependence. Parental ND predicted full ND. Initial negative tobacco experiences and parental depression reduced onset of first dependence criterion. Males with a delinquent parent, and white and Hispanic females were more likely to develop a dependence criterion.

Specific psychiatric disorders as predictors of nicotine dependence

Models were re-estimated disaggregating the broad classes of psychiatric disorders into nine specific disorders. For onset of first ND criterion, MDD (HR=1.5, CI=1.2–2.0), ADHD (HR=2.5, CI=1.5–4.2), ODD (HR=2.3, CI=1.7–3.0), and CD (HR=1.6, CI=1.3–2.1) were statistically significant univariate predictors. Controlling for covariates, only ADHD (HR=2.4, CI=1.4–4.0) and ODD (HR=1.6, CI=1.2–2.2) remained significant. For onset of full dependence, the same diagnoses as for the first criterion, MDD (HR=1.7, CI=1.2–2.3), ADHD (HR=2.5, CI=1.3–4.7), ODD (HR=2.4, CI=1.6–3.4), CD (HR=2.0, CI=1.5–2.8), plus panic disorder (HR=2.9, CI=1.7–4.9), were statistically significant univariate predictors. Controlling for covariates, only panic disorder predicted full dependence (HR=2.2, CI=1.2–3.9).

Nicotine dependence as predictor of psychiatric disorders

Two sets of Cox proportional hazards models estimated influence of time-varying ND (first criterion, full dependence) on onsets of anxiety, mood, or disruptive behavior disorders. First, tobacco users at the time they experienced their first ND criterion were compared with users without ND criteria. Second, tobacco users at the time they experienced three ND criteria were compared with users with 0–2 criteria. Coefficients for periods prior to tobacco use are not shown.

Since multivariate results for both outcomes are similar, Table 5 presents models for full ND. With control for other covariates, ND, whether first criterion or full syndrome, predicted only disruptive disorder. Psychiatric disorders were strong and consistent predictors of each other's onset. Abuse or dependence on illicit drugs was the strongest predictor of anxiety disorder. Parental depression predicted youth mood disorder; parental delinquency predicted youth mood and disruptive disorders. Females were more likely than males to develop an anxiety or mood disorder; African-Americans were less likely than whites to develop a mood disorder but more likely to develop a disruptive disorder.

Nicotine dependence as predictor of specific psychiatric disorders

Models predicting onset of specific psychiatric disorders within a class were estimated (except ADHD). At the univariate level, the first criterion and full dependence predicted onsets of ODD (HRs=2.1, CI=1.1–4.0 and 3.0, CI=1.3–7.0, respectively) and CD (HR=2.3, CI=1.2–4.3, HR=3.1, CI=1.3–7.3). Full dependence also predicted onset of panic attacks without disorder (HR=4.0, CI=1.0–15.9). Controlling for covariates, including specific psychiatric disorders other than the one being predicted, the first criterion and full ND predicted ODD onset (HR=2.0, CI=1.0–4.0 and HR=3.7, CI=1.4–9.5)

DISCUSSION

Comorbidity between ND and psychiatric disorders characterized these adolescent smokers. Nicotine dependent adolescents had higher rates of anxiety, mood, disruptive, and multiple disorders than non-dependent smokers. The study elucidates these associations. Foremost, comorbidity between ND and psychiatric disorders in adolescence results from the fact that psychiatric disorders increase the risk of ND, controlling for common underlying factors. ND increases the risk of psychiatric disorders to a much weaker extent. This partially is due to the fact that, on average, psychiatric disorders onset ND by at least two and a half years, as reported by others [32,50], and in most cases psychiatric disorders precede ND. With control for covariates, we demonstrated a bidirectional association between disruptive disorder and ND, a unidirectional association between anxiety and ND, and no association between mood disorder and ND. Comorbidity of ND with mood disorders is explained by a common etiology.

Anxiety disorders increase the risk of nicotine dependence: unidirectional effect

Anxiety disorder, in particular panic disorder, predicted onset of full dependence. ND did not predict anxiety disorder. However, Isensee et al. [34] reported bi-directional influences between panic attacks with and without panic disorder and ND. Panic disorder may be a risk factor for ND because of the anxiolytic effects of nicotine [51,52].

Disruptive disorders and nicotine dependence: bi-directional influences

Disruptive disorder predicted onset of the first criterion and full dependence; ODD and ADHD each predicted onset of the first dependence criterion, controlling for CD. This confirms findings from unidirectional studies that childhood and adolescent ODD or ADHD symptoms predict onset as well as progression from experimental to daily and dependent smoking with [32,33] and without [17,30] control for CD. Correlatively, the first dependence criterion and full dependence predicted ODD onset. This observation is novel but applies only to adolescents who developed ODD at an older age. Nicotine dependent youths may defy parental norms against smoking, thereby increasing levels of parent-child conflict and behaviors meeting criteria for ODD.

Mood disorders and nicotine dependence: comorbidity is explained by common underlying factors

The effects of mood disorder on onset of the first criterion and full ND disappeared with control for disruptive disorder and covariates. ND did not predict mood disorder. Karp et al. [35] reported that depressive symptoms increased risk of ND onset among adolescent smokers, but they did not control for comorbid psychiatric symptoms. In contrast, influence of ND on depression onset and of depression on ND was reported among young adult smokers, with control for anxiety disorder [2]. The link between depression and ND may be weaker in adolescence than early adulthood.

Common etiological factors

Common etiological factors [51–54] underlie comorbidity of psychiatric disorders with ND. Parental factors were common predictors of youth psychiatric disorders and ND and remained significant in multivariate models. Parental antisocial behavior had a wider effect on offspring than parental depression or ND. Parental antisocial behavior predicted adolescent mood and disruptive disorder, and, among males, the first ND criterion. Parental ND predicted offspring full ND and parental depression predicted offspring depression. Parental antisocial behavior as a shared risk factor for child disruptive disorder and ND is consonant with the intergenerational transmission of externalizing disorders through genetic and environmental processes [55–56].

Predictors of nicotine dependence: diagnostic implications

More common than specific predictors of the first criterion and full ND were identified. Common predictors included disruptive disorder, earlier onset age of tobacco use, initial pleasant tobacco experiences and the use, and especially abuse and dependence, of other substances. Predictors unique to full dependence included panic disorder and parental ND. Parental depression (negative) was a unique predictor of first criterion. The commonality of predictors raises questions regarding the appropriateness of specifying three criteria as the DSM diagnostic threshold for ND among adolescents. A lower threshold may be more appropriate for adolescents, who report dependence symptoms very soon after tobacco onset and after low use levels [57–60]. Progression to the second and third criteria occurs rapidly after onset of the first criterion [59]. Common factors may predict onset of the first and third criterion because of the temporal proximity of onset of symptoms.

Limitations

Study limitations must be acknowledged. Tobacco use and dependence, based on youths' reports, were subject to errors of recall and denial. For psychiatric disorders, this bias may have been lessened by ascertainment from multiple informants, although these did not include mental health professionals. Despite assessment of ND and psychiatric disorders within a longitudinal design, reports were subject to retrospective reporting bias since a large proportion of youths had experienced these behaviors by baseline. Small samples reduced statistical power of the analysis. Some of the heavy smokers in the target school sample elected not to participate in the household cohort.

Study strengths included the assessment of three broad classes of psychiatric disorders and ND, use of an analytical approach that established temporal ordering among covariates, and consideration of bi-directional influences between psychiatric disorders and ND.

Overall Implications

Psychiatric disorders have a stronger influence on onset of ND than dependence has on onset of psychiatric disorders. Disruptive disorder emerged as an important precursor and

consequence of ND. Controlling for other psychiatric disorders, disruptive and anxiety disorder predict full dependence. Parental factors, particularly antisocial behavior, predicted the onset of youth disruptive disorder and ND; parental ND predicted offspring ND. Processes were mostly similar by gender. Thus, improving the mental health of families and children and promoting smoking cessation among parents would have long-term benefits by reducing youth addictive smoking and its associated negative health consequences.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This research was partially supported by DA12697, DA026305 and K-5 DA0081 from the National Institute on Drug Abuse; and ALFCU51672301 and ALF6814 from Legacy to Denise Kandel.

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Table 1

Prevalence and means of adolescent covariates by wave 5 and of parental self-reported covariates by wave 1 among lifetime smokers (n=814)

| Covariates | <i>M</i> (SD) or % |
|---|---------------------------|
| Male (%) | 47.1 |
| Race/ethnicity | |
| White (%) | 28.0 |
| African-American (%) | 30.9 |
| Hispanic (%) | 41.1 |
| Onset age of any tobacco use (<i>M</i> (SD)) ^a | 12.91 (2.14) |
| Initial sensitivity to tobacco ^a | |
| Pleasant experiences (<i>M</i> (SD)) | 1.38 (0.52) |
| Unpleasant experiences (<i>M</i> (SD)) | 1.65 (0.54) |
| Alcohol and other illicit drug (OID) use or abuse/dependence ^a | |
| Never used alcohol or OID (%) | 10.2 |
| Alcohol or OID use, no abuse/dependence (%) | 56.2 |
| Alcohol abuse/dependence only (%) | 13.1 |
| OID abuse/dependence only (%) | 10.5 |
| Alcohol and OID abuse/dependence (%) | 9.9 |
| Parent education lifetime ^b | |
| High school or less (%) | 51.8 |
| Greater than high school (%) | 48.2 |
| Parent smoked/nicotine dependent lifetime ^b | |
| Never smoked (%) | 28.4 |
| Smoked, never dependent (%) | 46.4 |
| Ever dependent (%) | 25.2 |
| Parent depression lifetime (%) ^b | 12.0 |
| Parent delinquency lifetime (<i>M</i> (SD)) ^b | 0.66 (1.35) |

^aBy Wave 5;

^bBy Wave 1.

Table 2

Rates of adolescent lifetime psychiatric disorders and nicotine dependence at baseline and by wave 5 by gender (lifetime smokers by wave 5, n=814)

| | Baseline % | By Wave 5 | | |
|--|---------------|-------------|-------------|---------------|
| | | Total % | Male % | Female % |
| Nicotine Dependence^b | | | | |
| Ever 1 ⁺ criterion | 27.9 | 53.7 | 53.4 | 54.0 |
| Ever 3 ⁺ criteria | 10.4 | 26.1 | 25.5 | 26.8 |
| Total N ≤ | (714) | (814) | (384) | (430) |
| Anxiety^a | | | | |
| Social phobia | 3.7 | 6.3 | 4.6 | 7.7 |
| Panic | | | | |
| Attacks, no disorder | 2.2 | 3.8 | 2.9 | 4.6 |
| Disorder | 2.6 | 3.4 | 3.2 | 3.6 |
| Generalized anxiety | 2.3 | 4.1 | 2.8 | 5.3 |
| Any Anxiety | 8.6 | 14.1 | 10.4 | 17.3** |
| Mood^b | | | | |
| Major depression | 14.5 | 17.9 | 11.4 | 23.7*** |
| Dysthymia | 1.0 | 1.7 | 1.7 | 1.7 |
| Any Mood | 15.0 | 18.8 | 12.3 | 24.6*** |
| Disruptive^a | | | | |
| Attention-deficit hyperactivity | 2.1 | 2.9 | 4.0 | 2.0 |
| Oppositional defiant | 11.4 | 14.2 | 11.2 | 16.8* |
| Conduct | 14.2 | 21.2 | 22.6 | 19.9 |
| Any Disruptive | 21.4 | 29.5 | 29.4 | 29.6 |
| Total N | (814) | (814) | (384) | (430) |
| Any Psychiatric Disorder | 33.9 | 43.2 | 37.5 | 48.2** |

^aBaseline=W3 reports.

^bBaseline=W1 reports.

* p<0.05;

** p<0.01;

*** p<0.001.

Table 3

Rates of lifetime psychiatric disorders by level of nicotine dependence among lifetime smokers by wave 5 (n=814)

| | No Dependence Criteria % | 1–2 Dependence Criteria % | 3+ Dependence Criteria % |
|---------------------------------|--------------------------------|---------------------------------|--------------------------------|
| Anxiety | | | |
| Social phobia | 4.3 ^a | 5.3 ^a | 10.8 ^{b**} |
| Panic | | | |
| Attack, no disorder | 2.8 | 3.1 | 6.4 |
| Disorder | 0.7 ^a | 2.4 ^a | 9.2 ^{b***} |
| Generalized anxiety | 2.9 | 5.7 | 4.6 |
| Any Anxiety | 9.1 ^a | 12.7 ^a | 24.3 ^{b***} |
| Mood | | | |
| Major depression | 11.0 ^a | 21.0 ^b | 26.8 ^{b***} |
| Dysthymia | 0.8 | 2.6 | 2.3 |
| Any Mood | 11.6 ^a | 22.3 ^b | 28.0 ^{b***} |
| Disruptive | | | |
| Attention-deficit hyperactivity | 1.2 ^a | 3.8 ^{a,b} | 5.1 ^{b*} |
| Oppositional defiant | 6.5 ^a | 16.4 ^b | 25.5 ^{c***} |
| Conduct | 11.7 ^a | 24.0 ^b | 35.2 ^{c***} |
| Any Disruptive | 16.8 ^a | 32.2 ^b | 49.4 ^{c***} |
| Any Disorder | 30.3 ^a | 46.6 ^b | 62.5 ^{c***} |
| Three Disorders | 0.7 ^a | 4.5 ^b | 10.4 ^{c***} |
| N ≤ | (364) | (229) | (221) |

* p<0.05;

** p<0.01;

*** p<0.001.

Note. Groups with different superscripts are statistically different from each other.

Proportional hazards models of psychiatric disorders as predictors of the onset of the first nicotine dependence criterion and full nicotine dependence (life time smokers by wave 5, n=814)

Table 4

| Predictors | First nicotine dependence criterion (Model 1) | | | Full nicotine dependence (Model 2) | | | | |
|--|---|-----------|--------------|------------------------------------|--------------|------------|---------|------------|
| | Unadjusted | | Adjusted | Unadjusted | | Adjusted | | |
| | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | | |
| Anxiety | 1.30 | 0.94–1.80 | 1.10 | 0.78–1.55 | 1.86** | 1.27–2.72 | 1.68* | 1.12–2.52 |
| Mood | 1.56*** | 1.20–2.03 | 1.16 | 0.86–1.55 | 1.66** | 1.18–2.33 | 0.93 | 0.63–1.38 |
| Disruptive | 1.92*** | 1.54–2.39 | 1.46** | 1.15–1.86 | 2.51*** | 1.88–3.33 | 1.51* | 1.10–2.07 |
| Female (vs. male) | 1.03 | 0.85–1.25 | | | 1.06 | 0.82–1.38 | 1.34 | 1.00–1.81 |
| Race/ethnicity (vs. white) | | | | | | | | |
| African American | 0.88 | 0.69–1.12 | | | 0.88 | 0.64–1.21 | 0.78 | 0.54–1.12 |
| Hispanic | 0.70** | 0.56–0.89 | | | 0.64** | 0.47–0.88 | 0.74 | 0.51–1.08 |
| Race/ethnicity × gender (vs. male) | | | | | | | | |
| White female | | | 1.89** | 1.28–2.80 | | | | |
| African American female | | | 1.03 | 0.69–1.53 | | | | |
| Hispanic female | | | 1.55* | 1.09–2.21 | | | | |
| Onset age of any tobacco use | 0.94** | 0.90–0.98 | 0.89*** | 0.85–0.93 | 0.92** | 0.87–0.98 | 0.90 | 0.84–0.96 |
| Initial sensitivity to tobacco | | | | | | | | |
| Pleasant sensations | 1.95*** | 1.68–2.26 | 2.01*** | 1.68–2.39 | 2.64*** | 2.20–3.17 | 2.52*** | 2.02–3.15 |
| Unpleasant sensations | 0.94 | 0.79–1.12 | 0.76** | 0.63–0.92 | 1.18 | 0.95–1.45 | 0.99 | 0.77–1.27 |
| Alcohol and other illicit drugs (OID) (vs. never used) | | | | | | | | |
| Alcohol or OID use, no abuse/dependence | 2.01*** | 1.56–2.58 | 1.75*** | 1.36–2.26 | 2.79*** | 1.87–4.15 | 2.55*** | 1.71–3.79 |
| Alcohol abuse/dependence only | 2.95*** | 1.90–4.57 | 2.30*** | 1.46–3.64 | 4.13*** | 2.28–7.45 | 3.95*** | 2.16–7.23 |
| OID abuse/dependence only | 4.03*** | 2.53–6.41 | 2.52*** | 1.55–4.10 | 6.91*** | 3.94–12.13 | 3.97*** | 2.21–7.15 |
| Alcohol and OID abuse/dependence | 5.48*** | 3.18–9.44 | 3.00*** | 1.68–5.35 | 11.32*** | 6.20–20.65 | 6.40*** | 0.32–12.07 |
| Parent education lifetime (vs. ≤ high school) | 1.18 | 0.98–1.43 | 0.97 | 0.78–1.20 | 1.34* | 1.04–1.74 | 1.17 | 0.87–1.57 |

| Predictors | First nicotine dependence criterion (Model 1) | | | | Full nicotine dependence (Model 2) | | | |
|--|---|-----------|--------------|--------------|------------------------------------|-----------|--------------|--------------|
| | Unadjusted | | Adjusted | | Unadjusted | | Adjusted | |
| | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI |
| Parent smoked/nicotine dependent lifetime (vs. never smoked) | | | | | | | | |
| Smoked, never dependent | 1.23 | 0.97–1.55 | 1.11 | 0.85–1.44 | 1.49* | 1.06–2.10 | 1.22 | 0.83–1.78 |
| Ever dependent | 1.54*** | 1.19–2.00 | 1.30 | 0.96–1.74 | 2.31*** | 1.62–3.31 | 1.95** | 1.28–2.97 |
| Parent depression lifetime (vs. never) | 0.91 | 0.68–1.22 | 0.70* | 0.50–0.99 | 1.08 | 0.74–1.57 | 0.80 | 0.51–1.25 |
| Parent delinquency life time | 1.07* | 1.01–1.14 | | | 1.10* | 1.02–1.19 | 1.02 | 0.92–1.12 |
| Parent delinquency life time × gender | | | | | | | | |
| Female | | | 0.94 | 0.85–1.05 | | | | |
| Male | | | 1.11* | 1.01–1.23 | | | | |
| –2 log L (df) | | | | 4631.77 (21) | | | | 2323.84 (18) |

* p<0.05;
 ** p<0.01;
 *** p<0.001

Table 5

Proportional hazards models of nicotine dependence as a predictor of onset of psychiatric disorders (lifetime smokers by wave 5, n=814)

| Predictors | Anxiety | | | Mood | | | Disruptive | | | | | |
|--|--------------|------------|-----------------------|------------|--------------|-----------------------|--------------|-----------|-----------------------|-----------|---------|-----------|
| | Unadjusted | | Adjusted ^a | Unadjusted | | Adjusted ^a | Unadjusted | | Adjusted ^a | | | |
| | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | | |
| Used tobacco/nicotine dependence (vs. used, no dependence criteria) ^a | | | | | | | | | | | | |
| 1 dependence criterion | 1.85 | 0.91–3.76 | 1.12 | 0.52–2.39 | 1.24 | 0.61–2.49 | 1.10 | 0.54–2.26 | 2.81*** | 1.66–4.74 | 2.74*** | 1.55–4.84 |
| Used tobacco/nicotine dependence (vs. used, <3 dependence criteria) | | | | | | | | | | | | |
| 3 dependence criteria | 1.60 | 0.56–4.77 | 0.76 | 0.23–2.49 | 2.02 | 0.77–5.29 | 1.82 | 0.67–4.96 | 3.55*** | 1.75–7.21 | 2.83* | 1.27–6.29 |
| Anxiety | | | | | 4.67*** | 3.08–7.08 | 3.68 | 2.40–5.66 | 1.85* | 1.16–2.97 | 1.68* | 1.02–2.74 |
| Mood | 4.82*** | 2.90–8.01 | 3.33*** | 1.92–5.76 | | | | | 1.43 | 0.86–2.38 | 1.13 | 0.66–1.93 |
| Disruptive | 2.91*** | 1.82–4.64 | 2.21** | 1.34–3.63 | 2.37*** | 1.63–3.45 | 2.15*** | 1.46–3.16 | | | | |
| Female (vs. male) | 1.70** | 1.14–2.57 | 1.66* | 1.10–2.52 | 2.14*** | 1.52–3.02 | 2.31*** | 1.62–3.29 | 0.95 | 0.74–1.23 | 0.90 | 0.69–1.16 |
| Race/ethnicity (vs. white) | | | | | | | | | | | | |
| African American | 0.93 | 0.55–1.57 | 0.93 | 0.54–1.60 | 0.65* | 0.42–0.99 | 0.57* | 0.36–0.88 | 1.53* | 1.09–2.15 | 1.48* | 1.04–2.09 |
| Hispanic | 1.17 | 0.73–1.88 | 1.20 | 0.72–1.98 | 0.91 | 0.63–1.31 | 0.95 | 0.64–1.41 | 1.16 | 0.83–1.63 | 1.29 | 0.91–1.84 |
| Initial sensitivity to tobacco | | | | | | | | | | | | |
| Pleasant sensations | 1.39* | 1.01–1.92 | 1.37 | 0.89–2.12 | 1.31* | 1.02–1.67 | 1.29 | 0.90–1.85 | 1.31* | 1.06–1.62 | 1.11 | 0.79–1.54 |
| Unpleasant sensations | 1.06 | 0.79–1.42 | 0.77 | 0.49–1.20 | 1.21 | 0.98–1.48 | 1.07 | 0.79–1.46 | 1.21* | 1.01–1.44 | 1.15 | 0.87–1.52 |
| Alcohol and other illicit drugs (OID) (vs. never used) | | | | | | | | | | | | |
| Alcohol or OID use, no abuse/dep | 1.57 | 0.83–2.99 | 1.34 | 0.68–2.64 | 1.15 | 0.73–1.82 | 1.14 | 0.71–1.84 | 1.23 | 0.81–1.87 | 1.10 | 0.71–1.71 |
| Alcohol abuse/dependence only | 4.38** | 1.61–11.95 | 2.79 | 0.96–8.12 | 0.91 | 0.23–3.59 | 0.82 | 0.20–3.31 | 2.18 | 0.89–5.31 | 2.00 | 0.79–5.03 |
| OID abuse/dependence only | 6.44*** | 2.50–16.58 | 5.03*** | 1.84–13.74 | 1.72 | 0.58–5.05 | 1.13 | 0.36–3.49 | 2.25 | 0.74–6.79 | 1.59 | 0.50–5.02 |
| Alcohol and OID abuse/dependence | 2.65 | 0.54–13.08 | 1.48 | 0.25–8.72 | | | | | 1.98 | 0.43–9.22 | 0.85 | 0.16–4.46 |
| Parent education lifetime | | | | | | | | | | | | |
| (vs. ≤ high school) | 0.96 | 0.65–1.41 | 0.97 | 0.64–1.45 | 1.21 | 0.88–1.65 | 1.23 | 0.88–1.73 | 1.01 | 0.78–1.30 | 1.02 | 0.78–1.34 |
| Parent smoked/nicotine dependent lifetime (vs. never smoked) | | | | | | | | | | | | |

| Predictors | Anxiety | | | | | | Mood | | | | | | Disruptive | | | | | | | |
|--|--------------|-----------|-----------------------|-----------|--------------|-----------|-----------------------|-----------|--------------|-----------|-----------------------|-----------|--------------|--------|-----------------------|--------|--------------|--------|-----------------------|--------|
| | Unadjusted | | Adjusted ^a | | Unadjusted | | Adjusted ^a | | Unadjusted | | Adjusted ^a | | Unadjusted | | Adjusted ^a | | Unadjusted | | Adjusted ^a | |
| | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI |
| Smoked, never dependent | 0.89 | 0.56–1.42 | 0.80 | 0.49–1.31 | 1.00 | 0.68–1.48 | 0.90 | 0.60–1.36 | 1.09 | 0.79–1.51 | 1.02 | 0.73–1.44 | | | | | | | | |
| Ever dependent | 1.19 | 0.72–1.97 | 1.02 | 0.59–1.78 | 1.39 | 0.91–2.11 | 1.01 | 0.63–1.62 | 1.69** | 1.20–2.37 | 1.44 | 0.99–2.09 | | | | | | | | |
| Parent depression lifetime (vs. never) | 1.91** | 1.17–3.11 | 1.50 | 0.90–2.50 | 2.59*** | 1.78–3.76 | 1.91** | 1.28–2.84 | 1.37 | 0.96–1.96 | 1.25 | 0.86–1.81 | | | | | | | | |
| Parent delinquency lifetime | 1.09 | 0.97–1.23 | 1.05 | 0.92–1.20 | 1.19*** | 1.10–1.29 | 1.18*** | 1.08–1.29 | 1.13** | 1.05–1.21 | 1.09* | 1.01–1.19 | | | | | | | | |
| -2 log L (df) | | | | | 1258.34 (18) | | | | | | 1843.15 (18) | | | | | | 2965.23 (18) | | | |

* p<0.05;

** p<0.01;

*** p<0.001

^a Adjusted coefficients for covariates shown only for model with 3 nicotine dependence criteria as a predictor.