

[Link to reference/abstract on Publisher site](#)

Running Title: PSYCHOPATHOLOGY, FAMILIAL FACTORS, AND SMOKING

Psychiatric Disorders, Familial Factors, and Cigarette Smoking:

II. Associations with Progression to Daily Smoking

Paul Rohde

Christopher W. Kahler

Peter M. Lewinsohn

Richard A. Brown

Paul Rohde, and Peter M. Lewinsohn, Oregon Research Institute, 1715 Franklin Blvd., Eugene, OR, 97403-1983; Christopher W. Kahler, Center for Alcohol and Addiction Studies, Brown University, Box G-BH, Providence, RI 02912; Richard A. Brown, Butler Hospital/Brown University School of Medicine, 345 Blackstone Blvd., Providence, RI 02906.

Correspondence to: Paul Rohde, Ph.D. Oregon Research Institute, 1715 Franklin Blvd., Eugene, OR, 97403-1983. Fax: 541-484-1108; E-mail: [paulr@ori.org](mailto:paulr@ori.org)

This research was supported by DA-11299 to P.R., and MH- 40501, MH-50522, and MH-52858 to P.M.L.

Total number of pages: 40

Word Count: 9,969

Psychiatric Disorders, Familial Factors, and Cigarette Smoking:

II. Associations with Progression to Daily Smoking

Paul Rohde, Christopher W. Kahler, Peter M. Lewinsohn, Richard A. Brown

Abstract

Aims of the study were to examine: (a) associations of progression to daily cigarette smoking with lifetime psychopathology, regular smoking by family members, and psychopathology in family members, (b) the degree to which disorders precede or follow progression to daily smoking, and (c) whether daily smokers differ as a function of nicotine dependence. Among 941 participants interviewed at three time points, 722 (77%) had experimented with cigarette smoking; 391 of whom (54%) progressed to daily smoking. Lifetime psychiatric diagnoses were obtained at each assessment. Biological parents and full siblings were interviewed for lifetime psychopathology and regular smoking. Progression to daily smoking was associated with lower parental education, major depression, alcohol and drug use disorders, ADHD/disruptive behavior disorders, antisocial personality disorder symptoms, regular smoking by father (but not mother or sibling), and one measure of psychopathology in family members (externalizing disorders, which consisted of attention-deficit/hyperactivity disorder [ADHD], conduct disorder, oppositional defiant disorder, and antisocial personality disorder). When composite measures of internalizing disorders, externalizing disorders, familial smoking, and familial psychopathology were examined in a single model, only the externalizing disorders composite remained associated with both daily smoking and with nicotine dependence. Only ADHD consistently preceded the onset of daily smoking. Nicotine dependence was associated with drug use disorders and alcohol use disorders. In conclusion, externalizing disorders had the

strongest associations with both progression to daily smoking among adolescents who initiate smoking, and with nicotine dependence among the daily smokers. Limitations to the present study and future research directions are noted.

Adolescence is a critical time to evaluate the factors associated with cigarette smoking. First, almost all tobacco use begins during this time (e.g., Chassin, Presson, Rose, & Sherman, 1996), with approximately two-thirds of U.S. adolescents trying smoking by age 18 (e.g., Johnston, O'Malley, & Bachman, 2001). Second, many adolescents who are experimenting with smoking become daily smokers during this time period (e.g., Stanton, McClelland, Elwood, Ferry, & Silva, 1996). Third, approximately three-fourths of adolescent daily smokers will continue to smoke as adults (e.g., Johnston, Bachman, & O'Malley, 1992). Finally, cessation programs for adolescent smokers have been unable to achieve high success rates (Moolchan, Ernst, & Henningfield, 2000).

The present study is the second in a series examining the associations between psychiatric and familial factors and cigarette smoking during adolescence and young adulthood. In the first study (Rohde, Lewinsohn, Brown, Gau, & Kahler, in press), we examined the associations of these factors with smoking initiation, finding that most categories of lifetime psychopathology were associated with smoking initiation (e.g., major depressive disorder [MDD]; alcohol and drug use disorders, disruptive behavior disorders, and elevated levels of antisocial and borderline personality disorder symptoms). Rates of initiation were especially elevated in participants with multiple disorders. Regular smoking by one's mother and a sibling (but not one's father) were associated with smoking initiation, as were two of four categories of mental disorders in relatives (substance use disorders and depression, but not anxiety or externalizing disorders). When all significant univariate variables were examined in a single model, drug use disorders, regular smoking by mother, and regular smoking by a sibling remained significantly associated with smoking initiation. Smoking initiation preceded

approximately half of the examined diagnostic categories (MDD, alcohol and drug use disorders, conduct disorder, and panic disorder). Eleven of the examined variables differentiated the early versus late smoking initiators. Throughout the analyses, six interactions with sex were found. In every instance, smoking initiation was more strongly associated with the risk factor for young women than for young men. To our knowledge, this paper was the first time that the combined associations of psychopathology, familial smoking, and familial psychiatric history with smoking initiation had been examined simultaneously or in this much detail.

The primary goal of the current study is to examine which individuals progress from smoking initiation to daily smoking. Cigarette smoking is a complex behavior influenced by multiple factors (Derzon & Lipsey, 1999; Moolchan et al., 2000) and the risk factors predicting transitions to various stages of smoking may differ (e.g., Chassin, Presson, Pitts, & Sherman, 2000; Chassis, Presson, Sherman, Corty, & Olshavsky, 1984; Harrell, Bangdiwala, Deng, Webb, & Bradley, 1998; Leventhal & Cleary, 1980; Rowe, Chassis, Presson, & Sherman, 1996). In the present study, we do not attempt to examine inclusively all of the potentially salient factors. Instead, we focus on the associations between progression to daily smoking and three categories of risk factors: (a) lifetime psychopathology in the individual, (b) regular smoking by family members (parents and siblings), and (c) psychopathology in family members.

#### Associations with Lifetime Psychopathology

Associations between most psychiatric disorders and daily cigarette smoking have been repeatedly shown for adults (e.g., Breslau, Kilbey, & Andreski, 1991; Covey, Glassman, & Stetner, 1998; Degenhardt & Hall, 2001; Lasser et al., 2000), and to a lesser extent, adolescents

(e.g., Brown, Lewinsohn, Seeley, & Wagner, 1996; McGee, Williams, & Stanton, 1998). For example, in the National Comorbidity Study, 55% of adults with a lifetime history of mental illness were daily smokers, compared to 39% of those with no mental disorder (Lasser et al., 2000).

Probably the strongest associations with regular smoking or nicotine dependence have been found for substance (alcohol and drug) use disorders (Breslau et al., 1991; Brown et al., 1996; Kendler et al., 1999; Riggs, Mikulich, Whitmore, & Crowley, 1999), followed by the category of attention-deficit/disruptive behavior disorders, which includes attention-deficit/hyperactivity disorder [ADHD], conduct disorder, and oppositional defiant disorder (Brown et al., 1996; Costello, Erkanli, Federman, & Angold, 1999; Pomerleau, Downey, Stelson, & Pomerleau, 1995; Riggs et al., 1999). The associations between regular smoking and substance use disorder appear to remain significant even when controlling for the presence of other psychiatric morbidity (e.g., Madden, Bucholz, Martin, & Heath, 2000).

Although smaller in magnitude, associations have also been reported for smoking with internalizing disorders. Compared to nonsmokers, adolescent and adult smokers have higher rates of MDD (Breslau et al., 1991; Breslau, Peterson, Schultz, Chilcoat, & Andreski, 1998; Brown et al., 1996; Covey, Glassman, & Stetner, 1990; Kendler et al., 1993; Kendler et al., 1999), although some exceptions have been noted (e.g., Kandel et al., 1997). The association between smoking and MDD remains significant even when controlling for the presence of other psychiatric disorders (Breslau et al., 1991; Kendler et al., 1993). Associations between anxiety disorders and regular smoking in adults also are evident (e.g., Johnson et al., 2000) but may be weaker in magnitude (Breslau et al., 1991; Kendler et al., 1999). Lastly, the strongest

associations with regular smoking may involve schizophrenia and certain personality disorders, especially antisocial personality disorder (Barry, Fleming, Manwell, & Copeland, 1997; Goff, Henderson, & Amico, 1992; Hughes, Hatsukami, Mitchell, & Dahlgren, 1986; Johnson, Hyler, Skodol, Bernstein, & Sherman, 1995; Tanskanen, Viinamaeki, Koivuma-Honkanen, Jaaeskelaeninen, & Lehtonen, 1998). Rates of regular smoking also may be very high among individuals with multiple psychiatric disorders (e.g., Breslau et al., 1991; Hughes et al., 1986; Milberger, Biederman, Faraone, Chen, & Jones, 1997; Miller-Johnson, Lockman, Coie, Terry, & Hyman, 1998; Riggs et al., 1999). For example, Milberger et al. (1997) reported that approximately 10% of male adolescents with pure (noncomorbid) ADHD were daily smokers, with rates increasing linearly to roughly 40% for those with ADHD plus three psychiatric comorbidities.

In addition to examining individual psychiatric disorders, we also examine two higher order composites of psychopathology. Krueger and colleagues (Krueger, Caspi, Moffitt, & Silva, 1998; Krueger et al., 2002) recently proposed that comorbidity between mental disorders is due to the fact that mental disorders recognized by the DSM nosology are indicators of latent higher order factors hypothesized to underlie these disorders. After evaluating several models, they found strong support for a two-factor structure, which they labeled internalizing (consisting of most mood and anxiety disorders) and externalizing (consisting of conduct disorder, antisocial personality disorder, alcohol dependence, and marijuana dependence).

We predict that cigarette smoking will be more strongly associated with the externalizing disorders composite. This hypothesis is based on previous research reviewed above and on the

Multiple Problem Behavior Index, proposed as part of Problem Behavior Theory (Jessor, Donovan, & Costa, 1991). This Index consists of five factors: problem drinking, marijuana use, other illicit drug use, general deviant behavior (e.g., lying, stealing, and aggression), and cigarette smoking. While Problem Behavior Theory is not linked to DSM diagnostic categories, it strongly suggests that daily smoking (and nicotine dependence in particular) should be most closely associated with substance use disorders, antisocial personality disorder, and disruptive behavior disorders (which are pathological levels of the concept of general deviance).

Cigarette smoking may also be linked to the internalizing disorders composite. Cooper, Agocha, & Sheldon (2000) proposed a model of risk-taking behaviors, which consists of two distinct pathways. The first pathway to risky behaviors (such as smoking) results from a desire to pursue or enhance positive affect and feelings of well-being (which they call Enhancement Motives). The second pathway is a desire to avoid or escape aversive emotional states (which they call Coping Motives). Neuroticism is proposed to drive the Coping Motive, whereas extraversion drives the Enhancement Motive. The first pathway corresponds more closely to the externalizing disorders composite, whereas the second pathway reflects a mechanism linking the internalizing disorders composite to smoking.

### Associations with Familial Smoking

Parent and child smoking may be related by several different processes, including genetics, modeling, parental control practices, and the parent-child bond (Brook & Whiteman, 1997; Kandel & Wu, 1995; White, Johnson, & Buyske, 2001). Parental smoking has been found

to be significantly associated with adolescent smoking in approximately half of the examined studies (e.g., Brook & Whiteman, 1997; Griesler & Kandel, 1998; Najem, Batuman, Smith, & Feuerman, 1997; Rose, Chassis, Presson, & Sherman, 1999), with estimates of the heritability for regular smoking and nicotine dependence (i.e., the proportion of variance attributable to genetic sources) averaging approximately 60% (e.g., Madden et al., 1999; Maes et al., 1999; Swan, Carmelli, & Cardon, 1997; True et al., 1999; True, Heath, & Tsuang, 1997). Studies also indicate that smoking by one's siblings is significantly predictive of regular smoking in young people (e.g., Beirut et al., 1998; Wang, Fitzhugh, Westerfield, & Eddy, 1995; West, Sweeting, & Ecob, 1999). Because we examine two higher order composites of individual psychopathology, a comparable higher order composite of family smoking is also created that provides an indicator of the "density" of smoking within first-degree relatives (defined as the number of mothers, fathers, and siblings who smoke).

#### Associations with Familial Psychopathology

Only a few studies have examined the role of familial psychopathology in relation to smoking. The offspring of parents treated for substance use disorders have been found to be at elevated risk for regular tobacco use and nicotine dependence, compared to offspring of either parents with anxiety disorders or parents with no mental illness (Dierker, Avenevoli, Merikangas, Flaherty, & Stolar, 2001; Merikangas, Dierker, & Szatmari, 1998). Kendler and associates (1993) reported that adult women with a family history of MDD had a greater likelihood of smoking, even after controlling for personal history of MDD. In the one study that

did not find a significant relationship between cigarette smoking and parental psychopathology (Costello et al., 1999), parental mental illness was assessed by mental health treatment, history of suicide attempts, and current maternal depression symptoms. To our knowledge, no theoretical models have linked familial psychopathology to cigarette smoking, although two hypotheses could be proposed. First, family psychopathology may increase the risk of smoking independent of psychopathology in the individual. An alternative hypothesis is that the impact of familial psychopathology is accounted for by psychopathology in the individual. In addition to examining four diagnostic categories of affective disorders, anxiety disorders, drug and alcohol use disorders, and externalizing disorders in family members, a composite score of familial psychopathology is created to serve as an indicator of the density of mental disorders within the family.

### The Present Study

The present study makes use of data from the Oregon Adolescent Depression Project (OADP; Lewinsohn, Hops, Roberts, Seeley, & Andrews, 1993). As part of this longitudinal study of depression and other psychopathology, extensive information regarding smoking status of a large, randomly-selected representative sample of older adolescents was assessed twice in adolescence ( $T_1$  and  $T_2$ ) and at a third point ( $T_3$ ) after age 24. More recently, all participants who reported any periods of daily smoking in the  $T_1$ ,  $T_2$ , or  $T_3$  interviews were invited to participate in a telephone interview that collected detailed information on lifetime smoking history. In previous papers, we have reported the cross-sectional and prospective relationships between

cigarette use and psychopathology in adolescence (i.e., T<sub>1</sub> and T<sub>2</sub>; Brown et al., 1996; Lewinsohn, Brown, Seeley, & Ramsey, 2000), and the progression from cigarette smoking in adolescence (T<sub>1</sub>/T<sub>2</sub>) to the development of substance use disorders by young adulthood (i.e., T<sub>3</sub>; Lewinsohn, Rohde, & Brown, 1999). In the current paper, we extend our previous research by using the three waves of psychiatric assessments from the OADP in conjunction with data obtained from family members.

In addition to examining daily smoking as an outcome, we also examine the temporal order of daily smoking versus psychopathology, and the associations of psychopathology and familial factors with the development of nicotine dependence. Both of these analyses are restricted to the participants who became daily cigarette smokers. The first issue – temporal order of co-occurring problems – may provide important clues regarding etiology (e.g., one problem may be a risk factor for, or an early manifestation of, the second problem). The second issue – nicotine dependence – may be associated with greater smoking persistence (e.g., Breslau, Johnson, Hiripi, & Kessler, 2001; Prokhorov et al., 2001) and with stronger associations with some psychiatric disorders (e.g., MDD, anxiety, illicit drug use disorders) compared to less heavy smoking (Breslau, Kilbey, & Andreski, 1990).

Throughout the analyses, we consider sex differences. While current smoking prevalence rates for U.S. men and women are roughly comparable (Escobedo & Peddicord, 1997; US Department of Health and Human Services, 2001), the pathways into smoking initiation and maintenance may vary as a function of sex (e.g., File, Fluck, & Leahy, 2001; Martin, Milich, Martin, Hartung, & Haigler, 1997; Skara, Sussman, & Dent, 2001). For example, Kandel et al.

(1997) found that daily smoking was associated with substance use, disruptive behavior, and anxiety disorders (but not mood disorders) for male adolescents, but was associated with only substance use disorders in the female adolescents. In other research (Costello et al., 1999), depression was associated with daily smoking for male but not female adolescents.

## Method

### Participants and Procedures

OADP participants. A total of 1,709 adolescents, randomly selected from nine high schools in western Oregon (mean age = 16.6, range = 14-18 years of age; 61% participation) completed the initial ( $T_1$ ) assessments between 1987 and 1989 (see Lewinsohn et al., 1993 for additional details). Approximately one year later ( $T_2$ ), 1,507 participants (88%) returned for a re-administration of the interview and questionnaire (mean  $T_1$ - $T_2$  interval = 13.8 months,  $SD = 2.3$ ). Higher attrition from  $T_1$  to  $T_2$  was associated with male sex (46% of  $T_2$  participants vs. 60% of  $T_2$  non-completers), lower parental education level, a history of disruptive behaviors disorders (11% vs. 17%) and, for only young men, a history of substance abuse (14% vs. 26%). Regarding smoking, lifetime daily smoking by  $T_1$  was associated with failure to complete  $T_2$  (18% of participants vs. 29% of non-completers);  $\chi^2(1, 1709) = 11.88, p < .001$ . Rates of  $T_1$  lifetime psychopathology for the two groups did not significantly differ (30% of participants vs. 35% of non-completers).

Between 1993 and 1999, all individuals with a history of psychopathology and a randomly selected set of participants with no history of mental disorder ( $N = 1,101$ ) were invited to the  $T_3$  interview after turning 24 years of age. Sampling of the no-disorder comparison group was proportional to age and sex within age; all participants with non-White race were retained in the sample. Given our under-sampling of individuals with no history of psychopathology, the selected  $T_3$  sample had a much higher proportion of individuals with lifetime psychopathology at  $T_2$  (47% vs. 0%);  $\chi^2(1, 1507) = 291.92, p < .001$ , and contained a slightly larger proportion of daily smokers compared to  $T_2$  participants who were not invited to complete the  $T_3$  interview (78% vs 61%);  $\chi^2(1, 1507) = 11.85, p < .001$ .

$T_3$  data were obtained from 941 individuals (85% participation of selected  $T_2$  sample; 55% of original  $T_1$  sample), with a mean interval between  $T_2$  and  $T_3$  of 6.8 years ( $SD = 1.4$ ). A total of 57% of the  $T_3$  participants were female, 89% were White, 54% had lived with both biological parents at  $T_1$ ; and 45% had one or more parents with a college education. Attrition at  $T_3$  was associated with male sex (43% of  $T_3$  participants were male versus 58% of  $T_3$  non-participants);  $\chi^2(1, 1101) = 13.54, p < .001$ , and with younger age at  $T_2$  ( $T_3$  participants  $M = 17.8$  [ $SD = 1.3$ ] versus  $T_3$  non-participants  $M = 17.5$  [ $SD = 1.2$ ] years old);  $t(1095) = 2.64, p < .01$ , but was unrelated to race/ethnicity, maximum parental education, or residing with both biological parents at  $T_2$ . Of the 1,101  $T_2$  participants selected for  $T_3$ , completion of the  $T_3$  was associated with neither  $T_2$  daily smoking (24% of participants vs. 24% of non-completers) nor  $T_2$  lifetime psychopathology (48% of participants vs. 45% of non-completers).

Family members. As a separate project, biological parents and full siblings of the T<sub>3</sub> participants were recruited and interviewed between 1995 and 1998 for lifetime psychopathology and smoking, with the goal of obtaining two sources of data for each family member (either direct and informant interviews or two informant interviews). Data were obtained on 806 families (86% of T<sub>3</sub> interviewed participants), which represented 2,646 individuals (803 mothers, 788 fathers, and 1,055 siblings). Mean age of the siblings at the time of their assessment was 25.2 years (SD = 5.7).

#### Assessment of Psychopathology and Daily Smoking in the OADP Participant

Psychiatric disorders. Participants were interviewed at T<sub>1</sub> with a version of the Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS; Orvaschel, Puig-Antich, Chambers, Tabriz, & Johnson, 1982) designed to assess all major disorders as per DSM-III-R criteria. Participants at T<sub>2</sub> and T<sub>3</sub> were interviewed using the Longitudinal Interval Follow-up Evaluation (LIFE; Keller et al., 1987), which provided detailed information about the onset and course of disorders since the T<sub>1</sub> interview.

Almost all diagnostic interviewers had advanced degrees in psychology or social work and all completed a 70-hour training in diagnostic interviewing. Prior to conducting interviews, interviewers were required to demonstrate a minimum kappa (Cohen, 1960) of .80 across all symptoms for two consecutive training interviews. Interviews were recorded and a randomly-selected 12% were reviewed by a second interviewer. With few exceptions, inter-rater kappas for current and lifetime diagnoses at T<sub>1</sub> and T<sub>2</sub> exceeded .80 (Lewinsohn et al., 1993).

The T<sub>3</sub> interview repeated the T<sub>2</sub> procedures, assessing all disorders as per DSM-IV criteria. Because a significant proportion of participants no longer resided in the area, we shifted to a telephone assessment format for the T<sub>3</sub> diagnostic assessments. We previously showed that diagnostic agreement between the telephone and face-to-face assessment formats was very good to excellent (Rohde, Lewinsohn, & Seeley, 1997).

Antisocial and borderline personality disorders were assessed in the T<sub>3</sub> interview using relevant portions of the Personality Disorder Examination (PDE; Loranger, 1988). Because the rates of antisocial and borderline personality disorders were very low (1.3% each), the PDE dimensional scores were dichotomized at approximately the 90<sup>th</sup> percentile (antisocial cutoff score  $\geq 7$ ; borderline cutoff score  $\geq 4$ ) and used as an indicator of Axis II psychopathology. Inter-rater reliability of the PDE dimensional scores (i.e., summation of partial and full symptom criteria) was excellent (Interclass correlations  $> .80$ ).

On the basis of adequate prevalence rates (5% or greater), eight diagnostic categories of lifetime (to T<sub>3</sub>) psychopathology were examined: (1) MDD ( $\underline{n} = 487, 52\%$ ); (2) dysthymia ( $\underline{n} = 47, 5\%$ ); (3) alcohol use disorders (ALCOHOL;  $\underline{n} = 310, 33\%$ ) (4) drug (other than alcohol) use disorders (DRUG;  $\underline{n} = 216, 23\%$ ), (5) anxiety disorders ( $\underline{n} = 194, 21\%$ ), (6) ADHD and disruptive behavior disorders (ADHD/DIS;  $\underline{n} = 102, 11\%$ ); (7) elevated antisocial personality disorder symptomatology ( $\underline{n} = 88, 9\%$ ), and (8) elevated borderline personality symptomatology ( $\underline{n} = 50, 5\%$ ). Prevalence rates reflect the oversampling of those with a history of mental illness at T<sub>3</sub>.

Smoking data. As part of the T<sub>1</sub>-T<sub>3</sub> interviews, information was obtained regarding smoking initiation, which was defined by the K-SADS as having smoked five or more cigarettes. Initiation by age 24 was reported by 722 of the 941 T<sub>3</sub> participants (77%). Information also was gathered about current frequency of tobacco use and greatest frequency of tobacco use in their lifetime. Of the 722 participants reporting smoking initiation by T<sub>3</sub>, 381 (53%) reported using tobacco on a daily basis (for a month or more) at some point prior to age 24.

As part of a separate project, all T<sub>3</sub> participants were invited to complete a mailer questionnaire assessing smoking behavior and related factors. An additional 21 daily smokers were identified by the Smoking Questionnaire for a total of 402 daily smokers. We attempted to reach all of the daily smokers to complete a telephone-administered Smoking Interview, which gathered information on (a) age of smoking initiation, (b) age of first daily smoking, and (c) symptoms of nicotine dependence. Nicotine dependence was assessed using relevant sections from the National Institute of Mental Health-Diagnostic Interview Schedule (NIMH-DIS), which previously has been shown to be reliable (Anthony et al., 1985). In total, 263 participants completed the Smoking Interview. Of these, 11 indicated that although they had been daily users of smokeless tobacco, they had never smoked cigarettes on a daily basis; these were reclassified as non-daily smokers for the analyses. Therefore, 391 participants were classified as daily smokers, of whom 252 (65%) completed the Smoking Interview, which was used only for the analyses regarding onset of daily smoking and progression to nicotine dependence. Completion of the Smoking Interview was associated with female sex (61% of Smoking Interview participants were female versus 40% of non-participants;  $\chi^2(1, 391) = 16.7, p < .001$ ), but was

not significantly related to any of the other variables examined from the T<sub>1</sub>-T<sub>3</sub> interviews (i.e., race/ethnicity, parental education, intact home at T<sub>1</sub>, any category of psychiatric disorders, parental and sibling smoking, family history of psychiatric disorders).

#### Assessment of Psychopathology and Regular Smoking in Family Members

Parents and siblings over the age of 18 were interviewed with the Structured Clinical Interview for DSM-IV, nonpatient version (SCID-NP; Spitzer, Williams, Gibbon, & First, 1992) and the Antisocial and Borderline Personality Disorders sections of the SCID-II. Siblings between the ages of 14 and 18 received the version of the K-SADS employed in the T<sub>1</sub> OADP assessment, updated to assess disorders as per DSM-IV criteria. The SCID was augmented to include assessments of childhood disorders (e.g., ADHD, conduct disorder).

Wherever possible, two sources of lifetime psychiatric information for each family member are obtained. OADP participants or other family members provided diagnostic information about their first degree relatives as per the Family Informant Schedule and Criteria (FISC; Mannuzza & Fyer, 1990). Interviews were conducted blind to OADP participant diagnoses and each interviewer evaluated no more than two members of any family. Inter-rater reliabilities have previously been shown to be very good to excellent (Lewinsohn, Rohde, Klein, & Seeley, 1999). Best-estimate diagnoses (Leckman, Sholomskas, Thompson, Belanger, & Weissman, 1982) were derived for all relatives using all available data by four doctoral-level diagnosticians.

Family psychopathology, defined as having one or more family members with the disorder of interest, was examined for the following categories: (1) affective disorders (62% of participants had one or more family members with a mood disorder), (2) drug and alcohol use disorders (71% of participants), (3) anxiety disorders (32% of participants), and (4) externalizing disorders, which included ADHD, conduct disorder, oppositional defiant disorder, and elevated antisocial personality disorder scores (22% of participants). Again, it should be noted that these rates are higher than would be expected in a randomly selected community sample because participants with a history of mental illness were oversampled at T<sub>3</sub>.

Regular smoking among family members. Tobacco use by family members was assessed as part of the diagnostic interview. Three variables were created based on whether the mother, the father, or a sibling (one or more) had ever been a regular smoker, which was defined as smoking 10 or more cigarettes a day for at least one month. Lifetime rates of regular smoking were 44% for mothers, 59% for fathers, and 10% for one or more siblings.

### Statistical Analyses

Within the sample of 722 OADP participants reporting smoking initiation, associations between progression to daily smoking and the lifetime occurrence of psychiatric disorders, family smoking, and family psychopathology were examined using logistic regression (LR) models. The presence or absence of daily smoking and psychiatric disorder category by age 24 was calculated by combining data from the T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub> waves of assessment. Four T<sub>1</sub> demographic variables were examined as potential confounds: Male gender (Yes/No), White

race (Yes/No), Non-intact home (was the participant living with both biological parents at T<sub>1</sub>? Yes/No), and Low parental education (had either parent completed college at T<sub>1</sub>? Yes/No). The statistical significance of effects was determined by odds ratios (OR), with 99% confidence interval (CI).

Due to multicollinearity between variables assessed within the same domains (i.e., internalizing disorders, externalizing disorders, familial smoking, and familial psychopathology), we created a composite score for each domain by summing the number of positive responses. The univariate associations of these composites with progression to daily smoking were then tested. Finally, to assess the relative effects of these domains on smoking progression, we entered the four composite scores along with relevant demographic characteristics into a multiple logistic regression (MLR) to determine significant associations controlling for other effects.

The chi-square test for equal proportions was used to examine the temporal ordering between onset age of daily smoking and onset age of psychiatric disorders. We also compared daily smokers who did not progress to nicotine dependence ( $n = 95$ ) to those who did ( $n = 156$ ), using LR and MLR analyses. In each set of LR analyses, the interactions between predictor variables and sex were tested to determine whether sex moderated the observed associations. Given the number of comparisons, an alpha level of  $p < .01$  was set to determine the significance of the associations tested.

## Results

### Univariate Associations with Progression to Daily Smoking

Univariate associations with progression to daily smoking were examined in a series of LR analyses. In each model, the independent variable was entered, followed by sex, and the interaction with sex. Significant unadjusted associations (odds ratio; OR) are shown in Table 1. As can be seen, one of the four demographic variables – low parental education – was associated with progression to daily smoking at the  $p < .01$  level.

---

Insert Table 1 about here

---

Regarding lifetime psychopathology, four of the six DSM-IV diagnostic categories and one of the personality disorder summary categories were associated with progression from initiation to daily smoking: MDD, ALCOHOL, DRUG, ADHD/DIS, and the antisocial personality disorder summary score. Nonsignificant associations included dysthymia ( $p = .34$ ), anxiety disorders ( $p = .25$ ), and the borderline personality disorder summary score ( $p = .06$ ). None of diagnostic categories interacted significantly with sex in their association with daily smoking.

To examine the impact of the higher order categories of internalizing and externalizing disorders, we ran LRs predicting smoking progression with these two composite scores. The internalizing disorders composite consisted of the number of diagnoses in the categories of MDD, dysthymia, anxiety disorders, and elevated borderline personality disorder scores (range =

0 to 5); the externalizing disorders composite consisted of the number of diagnoses in the categories of ALCOHOL, DRUG, ADHD/DIS, and elevated antisocial personality disorders scores (range = 0 to 4). Results are shown in Table 1. The internalizing disorders composite was significantly associated with smoking progression with the odds of progression increasing about 30% (OR = 1.27) with each additional internalizing disorder. The association between progression to daily smoking and externalizing disorders was significantly stronger, with odds of progression more than doubling (OR = 2.12) with each externalizing diagnosis.

Daily smoking by fathers, but not by mothers or siblings, was associated with significantly greater odds of progression to daily smoking in the participants. The density of family smoking (i.e., total number of family members who were smokers, ranging from 0 to 3) was associated with significantly greater odds of smoking progression.

Regarding familial psychopathology, a significant association with smoking progression was present for one of the four diagnostic categories of psychopathology in the relatives (i.e., externalizing disorders). The density of family psychopathology (i.e., total number of diagnostic categories met by family members, ranging from 0 to 4) also was associated with significantly greater odds of progression.

### Multivariate Associations with Progression to Daily Smoking

To examine the effects of the composite scores for each domain, we entered the four composites simultaneously into an MLR controlling for sex and parental education. The correlations among the composites were positive but small in size, ranging from .09 to .19,

suggesting that multicollinearity was not a significant problem in these analyses. Only the externalizing disorders composite was significant in MLR, adjusted OR [AOR]= 2.08,  $p < .0001$ , (99% CI = 1.62 – 2.73). In a second step of MLR, we entered all possible interactions with sex; none were significant at  $p < .01$ .

Because the effects of family smoking and psychopathology were nonsignificant in the MLR and reduced the sample size due to missing data on family interviews, the MLR was re-run dropping these variables, which increased the sample size from 581 in the prior analyses to 686. Results indicated again that only the externalizing disorders composite was significant.

#### Temporal Ordering of Daily Smoking and Psychopathology

Given that four categories of Axis I psychiatric disorders were associated with smoking progression (i.e., MDD, ALCOHOL, DRUG, and ADHD/DIS), temporal patterns between progression to daily smoking and onset of psychiatric disorder were examined using participants who both were lifetime daily smokers and had developed the psychiatric disorder of interest. Participants were divided into those who began daily smoking first versus those who developed the psychiatric disorder first. A small number of participants ( $n = 13$ ) developed the psychiatric disorder and progressed to daily smoking during the same month; they were included in “disorder first” category, based on the assumption that some symptoms of the psychiatric disorder probably were present prior to the individual meeting full diagnostic criteria. Given that diagnoses in the ADHD/DIS categories included disorders that had a required childhood onset (e.g., ADHD), individual disorders (ADHD, conduct disorder, and oppositional defiant disorder)

were examined in addition to the summary category. Whether daily smoking preceded or followed disorder onset was examined using the chi-square test for equal proportions. Results are shown in Table 2.

---

Insert Table 2 about here

---

As can be seen, the timing of daily smoking had no clear temporal association with first onset of MDD, ALCOHOL, and DRUG; occurring before the disorder approximately half of the time. Daily smoking began after the development of ADHD/DIS disorders, which is not surprising given the diagnostic requirement of a childhood onset. For example, progression to daily smoking occurred after the onset of ADHD in all cases.

#### Univariate Associations with Nicotine Dependence Among Daily Smokers

Univariate associations with nicotine dependence were examined in a series of LR analyses. In each model, the independent variable was entered, followed by sex, and the interaction with sex (none of the interactions with sex were significant). Significant unadjusted associations (odds ratio; OR) are shown in Table 3.

---

Insert Table 3 about here

---

As can be seen in Table 3, only two diagnostic categories – ALCOHOL and DRUG – were associated with greater odds of nicotine dependence among the daily smokers. The externalizing disorders composite also was associated with a greater odds of dependence. Because only this composite was associated with nicotine dependence, we did not conduct an MLR analysis with the four composites simultaneously.

## Discussion

### Lifetime Psychopathology

As expected, participants with lifetime psychopathology were more likely to progress from smoking initiation to daily cigarette use. Four of the six examined Axis I diagnostic categories were associated with smoking progression, with odds ratios ranging from 1.5 (major depressive disorder) to 4.4 (drug use disorders).

Associations with daily smoking were nonsignificant for dysthymia and anxiety disorders. While others have found that dysthymia is strongly associated with cigarette use at the level of heavy smoking (> 20 cigarettes per day) (Dierker, Avenevoli, Solar, & Merikangas, in press), the low lifetime prevalence rate of dysthymia in our sample (5%) may have limited statistical power to detect differences. Regarding the role of anxiety disorders, several studies have reported highly significant associations between smoking and specific anxiety disorders, especially panic disorder (e.g., Breslau & Klein, 1999; Johnson et al., 2000). Evaluating the association of smoking with a higher order category of anxiety disorders may be compromised by the fact that the category includes so many different disorders and the exact composition of disorders in any study is both age- and sample-specific (e.g., the most common anxiety disorder

diagnosis in the OADP was separation anxiety). Consistent with the present study, Cornelius, Lynch, Martin, Cornelius, and Clark (2001) reported that current smoking (at any level) was most strongly related to drug (OR = 4.1) and alcohol use (OR = 1.8) disorders, depression (OR = 1.7), and conduct disorder (OR = 1.5) (associations with anxiety disorders were nonsignificant).

Of the two personality disorder categories that were examined, elevated levels of antisocial personality disorder symptoms were highly associated with daily smoking. Among the participants who were elevated on this dimensional score, almost all (94%) were daily smokers. The other personality disorder category – borderline personality disorder – was not associated with which smoking experimenters went on to daily smoking.

When the two higher order composite scores of internalizing and externalizing disorders were examined, the externalizing, but not internalizing, composite was retained as a predictor of progression to daily smoking. In addition, only externalizing disorders were identified as predictors of which daily smokers developed nicotine dependence. Perhaps the main conclusion of the present study is that externalizing disorders were the best predictors both of becoming a daily smoker and of progressing to nicotine dependence once becoming a daily smoker. All of the other examined variables played more minor roles in both of these outcomes. Consistent with the present study, Black, Zimmerman, and Coryell (1999) found that smoking was associated with most psychiatric disorders in univariate analyses but only alcohol and drug use disorders were independently associated with smoking after controlling for comorbidity among disorders.

The fact that daily smoking was most strongly associated with drug use disorders and with antisocial personality disorder symptoms is consistent with theories proposing a syndrome

of problem behaviors (e.g., Jessor & Jessor, 1977) or general deviance (McGee & Newcomb, 1992). Both of these theories suggest that cigarette smoking, alcohol and drug use, social nonconformity, risky sexual involvement, criminal behaviors, and low academic orientation load on a higher order factor in both adolescents and adults.

Although a history of major depressive disorder and the internalizing disorders composite were associated with significantly greater odds of progressing from experimentation to daily smoking in univariate analyses, the magnitude of the associations was much lower than for externalizing disorders. Others have suggested that the association of internalizing disorders with cigarette smoking may apply to only the subset of young people with comorbid depression (e.g., Miller-Johnson et al., 1998) or may be mediated by other factors, such as child abuse and deviant peer affiliations (Fergusson & Woodward, 2002; Patton et al., 1998).

Although a consensus is emerging that the associations with psychopathology may be stronger for substance use at heavier or more problematic levels (e.g., Breslau, 1995; Costello, Armstrong, & Erkanli, 2000; Dierker et al., 2001), we found that the associations between psychopathology and daily smoking were almost identical to the associations previously reported for smoking initiation in our first paper of this series (Rohde et al., in press). As in the present study, MDD, alcohol, drug, ADHD/DIS, and antisocial personality disorder were significantly associated with smoking initiation; dysthymia and anxiety disorders were nonsignificant. The only difference in the two reports is that borderline personality disorder symptoms predicted initiation but not progression to daily smoking, although the association with daily smoking approached statistical significance. The pattern of findings suggests that either the presence of

psychopathology or the risk factors that predispose an individual to psychopathology are equally relevant for these two stages of smoking behavior.

Our second aim was to describe the degree to which the psychiatric disorder consistently preceded or followed onset of daily smoking. The interview procedure dated the onset of a psychiatric disorder as the point in time at which the person met full diagnostic criteria. Therefore, we cannot determine the duration of prodromal symptoms or if prodromal symptoms were associated with daily smoking prior to the person meeting full diagnostic criteria. While these data may have revealed some interesting associations between individual symptoms and daily smoking, we believe that one strength of the present study is our focus on episodes of psychiatric disorder, as opposed to elevated but subthreshold symptomatology. With these caveats in mind, it was interesting that no diagnostic category (even alcohol and drug use disorders) consistently developed after the onset of daily smoking. The lack of a clear temporal patterning between daily smoking and comorbid alcohol and drug use disorders would seem to suggest other factors might be antecedents for both outcomes. Not surprising, the category of childhood disruptive behavior disorders tended to precede daily smoking. Dierker et al. (2001) examined whether nicotine dependence preceded or followed the onset of psychiatric disorders and found somewhat similar results; anxiety disorders and ADHD tended to precede nicotine dependence, alcohol use disorders tended to follow, and no consistent pattern emerged for affective, conduct and oppositional defiant, and drug use disorders.

Finally, we examined predictors of nicotine dependence among the daily smokers. Only two measures of individual psychopathology – alcohol and drug use disorders – were associated

with the development of nicotine dependence among the daily smokers, which resulted in the externalizing disorders composite also being significant. These findings highlight the strong degree of comorbidity across various categories of substance abuse and dependence. It should be noted that several of the nonsignificant odds ratios with nicotine dependence were comparable in magnitude to significant odds ratios with daily smoking. Results might have been significant with a larger sample of nicotine dependent smokers (95 of our 251 daily smokers, or 38%, met diagnostic criteria for nicotine dependence).

### Familial Smoking

Study participants with a father who regularly smoked were significantly more likely to become daily smokers. Conversely, we reported in our previous study that regular smoking by one's mother and by a sibling were associated with smoking initiation (Rohde et al., in press). The association between parent cigarette use and adolescent cigarette use has been inconsistent, found in some studies (e.g., Brook & Whiteman, 1997) but not others (e.g., Andrews, Hops, Ary, Tildesley, & Harris, 1993; Wang et al., 1999; Wang et al., 1995). In addition, family and peer smoking appears to have a stronger impact in predicting the onset of regular smoking in adolescents than in young adults (Wang et al., 1999; West et al., 1999). The present findings suggest the hypothesis that the impact of smoking by one's relatives may vary as a function of the specific relative and the specific stage of smoking behavior. There was no indication that our measures of familial smoking were associated with progression to nicotine dependence.

### Familial Psychopathology

Progression to daily smoking was associated with one of the four diagnostic categories of psychopathology in the relatives (i.e., externalizing disorders); this association presumably contributed to the significance of the familial psychopathology composite. No category of familial psychopathology was associated with nicotine dependence among those who smoked daily. Conversely, Dierker et al. (2001) reported that the adolescent offspring of adults treated for substance use disorders were more likely to be regular smokers and to develop nicotine dependence. Regarding the associations of familial psychopathology with smoking initiation from our previous research, both drug/alcohol use disorder and affective disorders had significant univariate (but not multivariate) associations. Longitudinal, prospective research examining the temporal associations between psychopathology and smoking in the parents in relation to psychopathology and smoking in the offspring would be particularly informative.

#### Sex and Other Demographic Differences

Demographic differences were minimal. Only one of the four examined demographic variables – low parental education level – was associated with progression to daily smoking, and none were associated with nicotine dependence. In addition, none of the interactions with sex attained statistical significance. The lack of sex interactions in the present study suggests that the associations between mental disorders and daily smoking were generally the same for young women and men. Kandel et al. (1997) examined associations between psychiatric disorder and smoking levels separately for male and female adolescents rather than computing interactions with sex and reported several notable differences: the strongest associations with daily smoking

were with substance use disorders for the females and with attention-deficit/disruptive behavior disorders for the males.

### Limitations and Conclusions

The present study has a number of limitations that need to be noted. First, attrition occurred at all of the follow-up assessments and daily smokers were more likely to drop out of the study between T<sub>1</sub> to T<sub>2</sub>; participation rates in the Smoking Interview were lower than preferred, especially for male smokers. Thus, the observed associations might be influenced by participation biases, and all findings need to be interpreted cautiously pending independent replication.

Second, the examined variables consisted of lifetime risk factors. Thus, we were not prospectively predicting the progression to daily smoking among individuals. To have conducted a truly prospective study, we would have needed to begin with a younger sample.

Third, the participants who progressed to daily smoking varied in the quantity and duration of their daily smoking. We tried to handle this issue by conducting the secondary analyses examining factors specifically associated with the more narrowly defined category of nicotine dependence.

Fourth, we did not assess all of the potentially relevant factors predictive of daily smoking. Instead, our focus was on a subset of potential risk factors which we attempted to assess as thoroughly and rigorously as possible. Multivariate analyses examining an even broader set of variables would be informative. Specifically, the inclusion of smoking behavior

among peers and the role of school performance would be particularly valuable (e.g., Dierker, Avenevoli, Goldberg, & Glantz, under editorial review; Tyas & Pederson, 1998).

Fifth, retrospective self-report was used to determine smoking classification. Fortunately, research suggests that adolescent self-reports of tobacco use generally are reliable and valid, especially when steps such as those used in our study are taken to ensure comprehension and confidentiality (Dolcini, Adler, & Ginsberg, 1996; Stanton et al., 1996). While some data suggest that adolescent recall of smoking behavior beyond a one-year period is inconsistent (Stanton et al., 1996), most of our participants were assessed in relatively close proximity to the onset of daily smoking. In addition, our primary analyses focused on the occurrence of daily smoking or nicotine dependence, rather than the specific onset dates.

The use of telephone assessments of smoking at T<sub>3</sub> may be a potential limitation, given that telephone interviews sometimes result in a small degree of under-reporting of smoking behavior (Luepker, Pallonen, Murray, & Pirie, 1989). However, we previously reported that telephone and face-to-face interviews of psychopathology yielded basically comparable reports (Rohde et al., 1997), and almost all daily smoking had occurred by the time of the T<sub>1</sub> and T<sub>2</sub> interviews, which were conducted in-person.

Sixth, the sample was predominantly White and the pattern of associations may be different for other race/ethnicity groups. For example, parental smoking may have a stronger association with offspring smoking for White children than for African-American or Hispanic children (Griesler & Kandel, 1998).

A limitation regarding the analyses involving nicotine dependence is that many of the daily smokers may not have yet developed dependence. Breslau et al. (2001) found that almost all daily smoking had developed by age 25, whereas the onset of nicotine dependence continued until participants were in their forties. Thus, we may have incorrectly classified some participants as non-dependent smokers.

The present study also has a number of strengths. Results are based on a large community sample, and standardized procedures for assessing smoking and lifetime psychopathology were used. Our use of reliably-assessed DSM diagnostic categories represents an important strength of the study. Most research in the area of smoking has assessed lower levels of substance use or has assessed symptoms of psychopathology by self-report questionnaire.

Given that many young adults who progress to daily smoking also experience numerous psychiatric disorders, smoking prevention and cessation efforts probably need to take the assessment and treatment of psychiatric disorders into consideration. It is also quite likely that children and adolescents who become regular smokers are at elevated risk for developing various forms of psychopathology and could be selected for secondary prevention efforts aimed at the prevention of psychiatric disorders. This recommendation would appear to be particularly salient in the prevention of future drug and alcohol use disorders.

Another unique contribution of the present study was the inclusion of familial smoking and psychopathology data, generally obtained by direct report (as opposed to the more commonly used informant report). As pointed out in our review of the literature, with the exception of family psychopathology, all of the variables in this study have been examined

previously as individual risk factors for smoking. However, to our knowledge, this is the first time that psychopathology and familial factors have been examined simultaneously or in this much detail. By examining this array of variables simultaneously, our findings illustrate the particularly strong associations between progression to regular smoking, certain forms of psychopathology, and parental smoking. The causal nature of these associations and the degree to which modification of one factor reduces the incidence of related outcomes deserve further attention.

References

- Andrews, J. A., Hops, H., Ary, D., Tildesley, E., & Harris, J. (1993). Parental influence on early adolescent substance use: Specific and nonspecific effects. *Journal of Early Adolescence, 13*, 285-310.
- Anthony, J. C., Folstein, M., Romanoski, A. J., Von Korff, M. R., Nestadt, G. R., Chahal, R., Merchant, A., Brown, C. H., Shapiro, S., & Kramer, M. (1985). Comparison of the Lay Diagnostic Interview Schedule and a standardized psychiatric diagnosis. *Archives of General Psychiatry, 42*, 666-675.
- Barry, K. L., Fleming, M. F., Manwell, L. B., & Copeland, L. A. (1997). Conduct disorder and antisocial personality in adult primary care patients. *Journal of Family Practice, 45*, 151-158.
- Bierut, L. J., Dinwiddie, S. H., Begleiter, H., Crowe, R. R., Hesselbrock, V., Nurnberger, J. I., Porjesz, B., Schuckit, M. A., & Reich, T. (1998). Familial transmission of substance dependence: Alcohol, marijuana, cocaine, and habitual smoking. *Archives of General Psychiatry, 55*, 982-988.
- Black, D. W., Zimmerman, M., & Coryell, W. H. (1999). Cigarette smoking and psychiatric disorder in a community sample. *Annals of Clinical Psychiatry, 11*, 129-136.
- Breslau, N. (1995). Psychiatric comorbidity of smoking and nicotine dependence. *Behavior Genetics, 25*, 95-101.

- Breslau, N., Johnson, E. O., Hiripi, E., & Kessler, R. (2001). Nicotine dependence in the United States: Prevalence, trends, and smoking persistence. *Archives of General Psychiatry*, *58*, 810-816.
- Breslau, N., Kilbey, M., & Andreski, P. (1991). Nicotine dependence, major depression, and anxiety in young adults. *Archives of General Psychiatry*, *48*, 1069-1074.
- Breslau, N., Kilbey, M. M., & Andreski, P. (1990). DSM-III-R nicotine dependence in young adults: Prevalence, correlates, and associated psychiatric disorders. *Addiction*, *89*, 743-754.
- Breslau, N., & Klein, D. F. (1999). Smoking and panic attacks: An epidemiologic investigation. *Archives of General Psychiatry*, *56*, 1141-1147.
- Breslau, N., Peterson, E. L., Schultz, L. R., Chilcoat, H. D., & Andreski, P. (1998). Major depression and stages of smoking: A longitudinal investigation. *Archives of General Psychiatry*, *55*, 161-166.
- Brook, J. S., & Whiteman, M. (1997). Cigarette smoking in young adults: Childhood and adolescent personality, familial, and peer antecedents. *Journal of Genetic Psychology*, *158*, 172-189.
- Brown, R. A., Lewinsohn, P. M., Seeley, J. R., & Wagner, E. F. (1996). Cigarette smoking, major depression and other psychiatric disorders among adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry*, *35*, 1602-1610.

- Chassin, L., Presson, C. C., Pitts, S. C., & Sherman, S. J. (2000). The natural history of cigarette smoking from adolescence to adulthood in a Midwestern community sample: Multiple trajectories and their psychosocial correlates. *Health Psychology, 19*, 223-231.
- Chassin, L., Presson, C. C., Rose, J. S., & Sherman, S. J. (1996). The natural history of cigarette smoking from adolescence to adulthood: Demographic predictors of continuity and change. *Health Psychology, 15*, 478-484.
- Chassin, L., Presson, C. C., Sherman, S. J., Corty, E., & Olshavsky, R. W. (1984). Predicting the onset of cigarette smoking in adolescents: A longitudinal study. *Journal of Applied Social Psychology, 14*, 224-243.
- Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 20*, 37-46.
- Cooper, M. L., Agocha, V. B., & Sheldon, M. S. (2000). A motivational perspective on risk behaviors: The role of personality and affect regulatory processes. *Journal of Personality, 68*, 1059-1088.
- Cornelius, J. R., Lynch, K., Martin, C. S., Cornelius, M. D., & Clark, D. B. (2001). Clinical correlates of heavy tobacco use among adolescents. *Addictive Behaviors, 26*, 273-277.
- Costello, E. J., Erkanli, A., Federman, E., & Angold, A. (1999). Development of psychiatric comorbidity with substance abuse in adolescents: Effects of timing and sex. *Journal of Clinical Child Psychology, 28*, 298-311.

- Costello, J. E., Armstrong, T. D., & Erkanli, A. (2000). *Report on the Developmental Epidemiology of Comorbid Psychiatric Substance Use Disorders*. Washington, DC: NIDA
- Covey, L. S., Glassman, A. H., & Stetner, F. (1990). Depression and depressive symptoms in smoking cessation. *Comprehensive Psychiatry*, *31*, 350-354.
- Covey, L. S., Glassman, A. H., & Stetner, F. (1998). Cigarette smoking and major depression. *Journal of Addictive Diseases*, *17*, 35-46.
- Degenhardt, L., & Hall, W. (2001). The relationship between tobacco use, substance-use disorders and mental health: Results from the National Survey of Mental Health and Well-being. *Nicotine & Tobacco Research*, *3*, 225-234.
- Derzon, J. H., & Lipsey, M. W. (1999). Predicting tobacco use to age 18: A synthesis of longitudinal research. *Addiction*, *94*, 995-1006.
- Dierker, L. C., Avenevoli, S., Goldberg, A., & Glantz, M. (under editorial review). Defining homogeneous subgroups at risk for experimental and regular smoking: Findings from a nationally representative sample of adolescents.
- Dierker, L. C., Avenevoli, S., Merikangas, K. R., Flaherty, B. P., & Stolar, M. (2001). Association between psychiatric disorders and the progression of tobacco use behaviors. *Journal of the American Academy of Child and Adolescent Psychiatry*, *40*, 1159-1167.
- Dierker, L. C., Avenevoli, S., Stolar, M., & Merikangas, K. R. (In Press). Smoking and depression: An examination of mechanisms of comorbidity. *American Journal of Psychiatry*.

- Dolcini, M. M., Adler, N. E., & Ginsberg, D. (1996). Factors influencing agreement between self-reports and biological measures of smoking among adolescents. *Journal of Research on Adolescence, 6*, 515-542.
- Escobedo, L. G., & Peddicord, J. P. (1997). Long-term trends in cigarette smoking among young U.S. adults. *Addictive Behaviors, 22*, 427-430.
- Fergusson, D. M., & Woodward, L. J. (2002). Mental health, educational, and social role outcomes of adolescents with depression. *Archives of General Psychiatry, 59*, 225-231.
- File, S. E., Fluck, E., & Leahy, A. (2001). Nicotine has a calming effects on stress-induced mood changes in females, but enhances aggressive mood in males. *International Journal of Neuropsychopharmacology, 4*, 371-376.
- Goff, D. C., Henderson, D. C., & Amico, E. (1992). Cigarette smoking in schizophrenia: Relationship to psychopathology and medication side effects. *American Journal of Psychiatry, 149*, 1189-1194.
- Griesler, P. C., & Kandel, D. B. (1998). Ethnic differences in correlates of adolescent cigarette smoking. *Journal of Adolescent Health, 23*, 167-180.
- Harrell, J. S., Bangdiwala, S. I., Deng, S., Webb, J. P., & Bradley, C. (1998). Smoking initiation in youth: The roles of gender, race, socioeconomics, and developmental status. *Journal of Adolescent Health, 23*, 271-279.
- Hughes, J. R., Hatsukami, D. K., Mitchell, J. E., & Dahlgren, L. A. (1986). Prevalence of smoking among psychiatric outpatients. *American Journal of Psychiatry, 143*, 993-997.

- Jessor, R., Donovan, J. E., & Costa, F. M. (1991) *Beyond adolescence: Problem behavior and young adult development*. New York: Cambridge University Press.
- Jessor, R., & Jessor, S. L. (1977). Problem behavior and psychosocial development: A longitudinal study of youth. New York: Academic Press.
- Johnson, J. G., Cohen, P., Pine, D. S., Klein, D. F., Kasen, S., & Brook, J. S. (2000). Association between cigarette smoking and anxiety disorders during adolescence and early adulthood. *Journal of the American Medical Association, 284*, 2348-2351.
- Johnson, J. G., Hyler, S. E., Skodol, A. E., Bornstein, R. F., & Sherman, M. (1995). Personality disorder symptomatology associated with adolescent depression and substance abuse. *Journal of Personality Disorders, 9*, 318-329.
- Johnston, L., Bachmann, J., & O'Malley, P. (1992). *Monitoring the future: Questionnaire responses from the nation's high school seniors 1989*. Ann Arbor: University of Michigan Institute for Social Research
- Johnston, L. D., O'Malley, P. M., & Bachman, J. G. (2001). Cigarette smoking among American teens declines sharply in 2001. *University of Michigan News and Information Services: Ann Arbor, MI [on-line]* [On-line]. Available: [www.monitoringthefuture.org](http://www.monitoringthefuture.org).
- Kandel, D. B., Johnson, J. G., Bird, H. R., Canino, G., Goodman, S. H., Lahey, B. B., Regier, D. A., & Schwab-Stone, M. (1997). Psychiatric disorders associated with substance use among children and adolescents: Findings from the Methods for the Epidemiology of Child and Adolescent Mental Disorders (MECA) Study. *Journal of Abnormal Child Psychology, 25*, 121-132.

- Kandel, D. B., & Wu, P. (1995). The contributions of mothers and fathers to the intergenerational transmission of cigarette smoking in adolescence. *Journal of Research on Adolescence, 5*, 225-252.
- Keller, M. B., Lavori, P. W., Friedman, B., Nielsen, E., Endicott, J., & McDonald-Scott, P. A. (1987). The Longitudinal Interval Follow-up Evaluation: A comprehensive method for assessing outcome in prospective longitudinal studies. *Archives of General Psychiatry, 44*, 540-548.
- Kendler, K. S., Neale, M. C., MacLean, C. J., Heath, A. C., Eaves, L. J., & Kessler, R. C. (1993). Smoking and major depression: A causal analysis. *Archives of General Psychiatry, 50*, 36-43.
- Kendler, K. S., Neale, M. C., Sullivan, P., Corey, L. A., Gardner, C. O., & Prescott, C. A. (1999). A population-based twin study in women of smoking initiation and nicotine dependence. *Psychological Medicine, 29*, 299-308.
- Krueger, R. F., Caspi, A., Moffitt, T. E., & Silva, P. A. (1998). The structure and stability of common mental disorders (DSM-III-R): A longitudinal – epidemiological study. *Journal of Abnormal Psychology, 107*, 216-227.
- Krueger, R. F., Hicks, B. M., Patrick, C. J., Carlson, S. R., Iacono, W. G., & McGue, M. (2002). Etiologic connections among substance dependence, antisocial behavior, and personality: Modeling the externalizing spectrum. *Journal of Abnormal Psychology, 111*, 411-424.

- Lasser, K., Boyd, J. W., Woolhandler, S., Himmelstein, D. U., McCormick, D., & Bor, D. H. (2000). Smoking and mental illness: A population-based prevalence study. *Journal of the American Medical Association, 284*, 2606-2610.
- Leckman, J. F., Sholomskas, D., Thompson, D., Belanger, A., & Weissman, M. M. (1982). Best estimate of lifetime psychiatric diagnosis: A methodological study. *Archives of General Psychiatry, 39*, 879-883.
- Leventhal, H., & Cleary, P. D. (1980). The smoking problem: A review of the research and theory in behavioral risk modification. *Psychological Bulletin, 88*, 370-405.
- Lewinsohn, P. M., Brown, R. A., Seeley, J. R., & Ramsey, S. E. (2000). Psychosocial correlates of cigarette smoking abstinence, experimentation, persistence and frequency during adolescence. *Nicotine & Tobacco Research, 2*, 121-131.
- Lewinsohn, P. M., Hops, H., Roberts, R. E., Seeley, J. R., & Andrews, J. A. (1993). Adolescent psychopathology: I. Prevalence and incidence of depression and other DSM-III-R disorders in high school students. *Journal of Abnormal Psychology, 102*, 133-144.
- Lewinsohn, P. M., Rohde, P., & Brown, R. A. (1999). Level of current and past adolescent cigarette smoking as predictors of future substance use disorders in young adulthood. *Addiction, 94*, 913-921.
- Lewinsohn, P. M., Rohde, P., Klein, D. N., & Seeley, J. R. (1999). Natural course of adolescent major depressive disorder: I. Continuity into young adulthood. *Journal of the American Academy of Child and Adolescent Psychiatry, 38*, 56-63.

- Loranger, A. W. (1988). *Personality disorder examination (PDE) manual*. Yonkers, New York: DV Communications
- Luepker, R. V., Pallonen, U. E., Murray, D. M., & Pirie, P. L. (1989). Validity of telephone surveys in assessing cigarette smoking in young adults. *American Journal of Public Health, 79*, 202-204.
- Madden, P. A. F., Bucholz, K. K., Martin, N. G., & Heath, A. C. (2000). Smoking and the genetic contribution to alcohol-dependence risk. *Alcohol Research and Health, 24*, 209-214.
- Madden, P. A. F., Heath, A. C., Pedersen, N. L., Kaprio, J., Koskenvuo, M. J., & Martin, N. G. (1999). The genetics of smoking persistence in men and women: A multicultural study. *Behavior Genetics, 29*, 423-431.
- Maes, H. H., Woodard, C. E., Murrelle, L., Meyer, J. M., Silberg, J. L., Hewitt, J. K., Rutter, M., Simonoff, E., Pickles, A., Carbonneau, R., Neale, M. C., & Eaves, L. J. (1999). Tobacco, alcohol and drug use in eight-to sixteen-year-old twins: The Virginia Twin Study of Adolescent Behavioral Development. *Journal of Studies on Alcohol, 60*, 293-305.
- Mannuzza, S., & Fyer, A. J. (1990). *Family informant schedule and criteria (FISC), July 1990 revision*. New York: Anxiety Disorders Clinic, New York State Psychiatric Institute
- Martin, C. A., Milich, R., Martin, W. R., Hartung, C. M., & Haigler, E. D. (1997). Gender differences in adolescent psychiatric outpatient substance use: Associated behaviors and feelings. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 486-494.

- McGee, L., & Newcomb, M. D. (1992). General deviance syndrome: Expanded hierarchical evaluations at four ages from early adolescence to adulthood. Journal of Consulting and Clinical Psychology, *60*, 766-776.
- McGee, R., Williams, S., & Stanton, W. (1998). Is mental health in childhood a major predictor of smoking in adolescence? *Addiction*, *93*, 1869-1874.
- Merikangas, K. R., Dierker, L. C., & Szatmari, P. (1998). Psychopathology among offspring of parents with substance abuse and/or anxiety disorders: A high-risk study. *Journal of Child Psychology and Psychiatry*, *39*, 711-720.
- Milberger, S., Biederman, J., Faraone, S. V., Chen, L., & Jones, J. (1997). ADHD is associated with early initiation of cigarette smoking in children and adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry*, *36*, 37-44.
- Miller-Johnson, S., Lochman, J. E., Coie, J. D., Terry, R., & Hyman, C. (1998). Comorbidity of conduct and depressive problems at sixth grade: Substance use outcomes across adolescence. *Journal of Abnormal Child Psychology*, *26*, 221-232.
- Moolchan, E. T., Ernst, M., & Henningfield, J. E. (2000). A review of tobacco smoking in adolescents: Treatment implications. *Journal of the American Academy of Child and Adolescent Psychiatry*, *39*, 682-693.
- Najem, G. R., Batuman, F., Smith, A. M., & Feuerman, M. (1997). Patterns of smoking among inner-city teenagers: Smoking has a pediatric age of onset. *Journal of Adolescent Health*, *20*, 226-231.

- Orvaschel, H., Puig-Antich, J., Chambers, W. J., Tabrizi, M. A., & Johnson, R. (1982). Retrospective assessment of prepubertal major depression with the Kiddie-SADS-E. *Journal of the American Academy of Child Psychiatry*, *21*, 392-397.
- Patton, G. C., Carlin, J. B., Coffey, C., Wolfe, R., Hibbert, M., & Bowes, G. (1998). Depression, anxiety, and smoking initiation: A prospective study over 3 years. *American Journal of Public Health*, *88*, 1518-1522.
- Pomerleau, O. F., Downey, K. K., Stelson, F. W., & Pomerleau, C. S. (1995). Cigarette smoking in adult patients diagnosed with attention deficit hyperactivity disorder. *Journal of Substance Abuse*, *7*, 373-378.
- Prokhorov, A. V., Hudmon, K. S., deMoor, C. A., Kelder, S. H., Conroy, J. L., & Ordway, N. (2001). Nicotine dependence, withdrawal symptoms, and adolescents' readiness to quit smoking. *Nicotine & Tobacco Research*, *3*, 151-155.
- Riggs, P. D., Mikulich, S. K., Whitmore, A. E., & Crowley, T. J. (1999). Relationship of ADHD, depression and non-tobacco substance use disorders to nicotine dependence in substance-dependent delinquents. *Drug and Alcohol Dependence*, *54*, 195-205.
- Rohde, P., Lewinsohn, P. M., Brown, R. A., Gau, J. M., & Kahler, C. W. (In Press). Psychiatric disorders, familial factors, and cigarette smoking: 1. Associations with smoking initiation. *Nicotine & Tobacco Research*.
- Rohde, P., Lewinsohn, P. M., & Seeley, J. R. (1997). Comparability of telephone and face-to-face interviews assessing Axis I and II disorders. *American Journal of Psychiatry*, *154*, 1593-1598.

- Rose, J. S., Chassin, L., Presson, C. C., & Sherman, S. J. (1999). Peer influences on adolescent cigarette smoking: A prospective sibling analysis. *Merrill-Palmer Quarterly*, 45, 62-84.
- Rowe, D. C., Chassin, L., Presson, C., & Sherman, S. J. (1996). Parental smoking and the "epidemic" spread of cigarette smoking. *Journal of Applied Social Psychology*, 26, 437-454.
- Skara, S. N., Sussman, S., & Dent, C. W. (2001). Predicting regular cigarette use among continuation high school students. *American Journal of Health Behavior*, 25, 147-156.
- Spitzer, R. L., Williams, J. B. W., Gibbon, M., & First, M. B. (1992). The Structured Clinical Interview for DSM-III-R (SCID): I. History, rationale, and description. *Archives of General Psychiatry*, 49, 624-629.
- Stanton, W. R., McClelland, M., Elwood, C., Ferry, D., & Silva, P. A. (1996). Prevalence, reliability and bias of adolescents' reports of smoking and quitting. *Addiction*, 91, 1705-1714.
- Swan, G. E., Carmelli, D., & Cardon, L. R. (1997). Heavy consumption of cigarettes, alcohol and coffee in male twins. *Journal of Studies on Alcohol*, 58, 182-190.
- Tanskanen, A., Viinamaeki, H., Koivuma-Honkanen, H. T., Jaaeskelaeinen, J., & Lehtonen, J. (1998). Smoking among psychiatric patients. *European Journal of Psychiatry*, 12, 109-118.
- True, W. R., Heath, A. C., & Tsuang, M. T. (1997). Genetic and environmental contributions to smoking. *Addiction*, 92, 1277.

- True, W. R., Xian, H., Scherrer, J. F., Madden, P. A. F., Bucholz, K. K., Heath, A. C., Eisen, S. A., Lyons, M. J., Goldberg, J., & Tsuang, M. (1999). Common genetic vulnerability for nicotine and alcohol dependence in men. *Archives of General Psychiatry*, *56*, 655-661.
- Tyas, S. L., & Pederson, L. L. (1998). Psychosocial factors related to adolescent smoking: A critical review of the literature. *Tobacco Control*, *7*, 409-420.
- U.S. Department of Health and Human Services. (2001). Overweight and obesity: A major public health issue. *Prevention Report*, *16*, 1-16.
- Wang, M. Q., Fitzhugh, E. C., Green, B. L., Turner, L. W., Eddy, J. M., & Westerfield, R. C. (1999). Prospective social-psychological factors of adolescent smoking progression. *Journal of Adolescent Health*, *24*, 2-9.
- Wang, M. Q., Fitzhugh, E. C., Westerfield, R. C., & Eddy, J. M. (1995). Family and peer influences on smoking behavior among American adolescents: An age trend. *Journal of Adolescent Health*, *16*, 200-203.
- West, P., Sweeting, H., & Ecob, R. (1999). Family and friends' influences on the uptake of regular smoking from mid-adolescence to early adulthood. *Addiction*, *94*, 1397-1411.
- White, H. R., Johnson, V., & Buyske, S. (2001). Parental modeling and parenting behavior effects on offspring alcohol and cigarette use: A growth curve analysis. *Journal of Substance Abuse*, *12*, 287-310.

Table 1

Univariate Associations with Progression to Daily Smoking Among Smoking Initiators

Variable	% Smoking Progression		Odds Ratio	99% Confidence Interval
	Variable Present	Variable Absent		
<u>T1 Demographics</u>				
Male gender	59.5	50.2	1.45	NS
White race	53.5	59.5	0.78	NS
Non-intact home	57.8	50.9	1.32	NS
Low parental education	58.3	47.8	1.53*	1.03 – 2.28
<u>Lifetime Psychopathology</u>				
MDD	58.5	48.8	1.48*	1.01 – 2.19
Dysthymia	61.5	53.7	1.38	NS
Anxiety disorders	58.2	53.0	1.23	NS
Borderline PD scores	67.4	53.1	1.83	NS
Internalizing Disorders Composite	---	---	1.28*	1.02 – 1.61
ALCOHOL	66.8	46.2	2.35**	1.56 – 3.55
DRUG	78.1	44.7	4.40**	2.73 - 7.31
ADHD/DIS	79.6	50.4	3.83**	1.98 – 8.03

Antisocial PD scores	93.9	48.6	16.27**	5.73 – 69.99
Externalizing Disorders Composite	---	---	2.12**	1.72 – 2.69

(table continues)

% Smoking Progression

Variable	Variable Present	Variable Absent	Odds Ratio	99% Confidence Interval
<u>Familial Smoking</u>				
Maternal smoking	58.4	50.0	1.41	NS
Paternal smoking	60.5	46.6	1.61*	1.04 – 2.49
Any sibling smoking	59.1	51.3	1.38	NS
Family Smoking Composite	---	---	1.34*	1.03 – 1.76
<u>Familial Psychopathology</u>				
Affective	54.8	51.6	1.14	NS
Anxiety	58.7	51.3	1.35	NS
Drug and alcohol	56.5	45.6	1.35	NS
Externalizing <sup>a</sup>	65.5	49.9	1.91*	1.16 – 3.20
Family Psychopathology Composite	---	---	1.23*	1.04 – 1.49

---

Note. MDD = major depressive disorder; ALCOHOL = alcohol use disorders; DRUG = drug use disorders; ADHD/DIS = ADHD and disruptive behavior disorders; PD = personality disorder; NS = nonsignificant. Composites formed by summing variables within each category.

<sup>a</sup>This category consisted of ADHD, conduct disorder, oppositional defiant disorder, and antisocial personality disorder.

\* $p < .01$ ; \*\* $p < .001$ .

Table 2

Temporal Order of Disorder versus Smoking Progression for Psychopathology Variables with Significant Univariate Association

Disorder	% Daily Smoking before Disorder	$\chi^2$ test for equal proportions (df = 1)
MDD ( <u>n</u> =158)	47.5	0.41
ALCOHOL ( <u>n</u> =111)	56.8	2.03
DRUG ( <u>n</u> =107)	47.7	0.23
ADHD/DIS ( <u>n</u> =41)	22.0	12.90**
ADHD( <u>n</u> =13)	0.0	---
Conduct disorder ( <u>n</u> =21)	33.3	2.33
Oppositional defiant disorder ( <u>n</u> =14)	21.4	4.57

---

Note. MDD = major depressive disorder; ALCOHOL = alcohol use disorders; DRUG = drug use disorders; ADHD/DIS = ADHD and disruptive behavior disorders; ADHD = attention-deficit/hyperactivity disorder.

\*\* $p < .001$ .

Table 3

Univariate Associations with Nicotine Dependence among Daily Smokers

Variable	% Nicotine Dependent		Odds Ratio	99% Confidence Interval
	Variable Present	Variable Absent		
<u>T1 Demographics</u>				
Male gender	67.3	58.8	1.44	NS
White race	60.1	75.8	0.48	NS
Non-intact home	63.2	61.0	1.19	NS
Low parental education	64.2	57.7	1.32	NS
<u>Lifetime Psychopathology</u>				
MDD 65.6	56.0	1.50	NS	
Dysthymia	50.0	63.2	0.58	NS
Anxiety disorders	56.2	64.2	0.72	NS
Borderline PD scores	65.0	61.5	1.16	NS
Internalizing Disorders composite	---	---	1.03	NS
ADHD/DIS	65.6	61.4	1.21	NS
ALCOHOL	71.9	54.0	2.18**	1.10- 4.43
DRUG	75.0	52.5	2.72**	1.35 – 5.68

Antisocial PD scores	72.1	59.6	1.75	NS
Externalizing Disorders composite	---	---	1.45*	1.09 – 1.99

(table continues)

% Nicotine Dependent

Variable	Variable Present	Variable Absent	Odds Ratio	99% Confidence Interval
----------	------------------	-----------------	------------	-------------------------

Familial Smoking

Maternal smoking	62.0	61.2	1.03	NS
Paternal smoking	65.2	50.7	1.82	NS
Any sibling smoking	60.3	62.8	0.90	NS
Family Smoking Composite	---	---	1.17	NS

Familial Psychopathology

Affective	61.4	62.2	0.93	NS
Anxiety	63.9	60.9	1.14	NS
Drug and alcohol	64.0	54.4	1.49	NS
Externalizing <sup>a</sup>	55.2	64.9	0.66	NS
Family Psychopathology Composite	---	---	0.99	NS

---

Note. MDD = major depressive disorder; ALCOHOL = alcohol use disorders; DRUG = drug use disorders; ADHD/DIS = ADHD and disruptive behavior disorders; PD = personality disorder; NS = nonsignificant. Composites formed by summing variables within each category.

<sup>a</sup>This category consisted of ADHD, conduct disorder, oppositional defiant disorder, and antisocial personality disorder.

\* $p < .01$ ; \*\* $p < .001$ .