Association Between Cigarette Smoking and Anxiety Disorders During Adolescence and Early Adulthood

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Context Cigarette smoking is associated with some anxiety disorders, but the direction of the association between smoking and specific anxiety disorders has not been determined.

Objective To investigate the longitudinal association between cigarette smoking and anxiety disorders among adolescents and young adults.

Design The Children in the Community Study, a prospective longitudinal investigation.

Setting and Participants Community-based sample of 688 youths (51% female) from upstate New York interviewed in the years 1985-1986, at a mean age of 16 years, and in the years 1991-1993, at a mean age of 22 years.

Main Outcome Measure Participant cigarette smoking and psychiatric disorders in adolescence and early adulthood, measured by age-appropriate versions of the Diagnostic Interview Schedule for Children.

Results Heavy cigarette smoking (>20 cigarettes/d) during adolescence was associated with higher risk of agoraphobia (10.3% vs 1.8%; odds ratio [OR], 6.79; 95% confidence interval [CI], 1.53-30.17), generalized anxiety disorder (20.5% vs 3.7%; OR, 5.53; 95% CI, 1.84-16.66), and panic disorder (7.7% vs 0.6%; OR, 15.58; 95% CI, 2.31-105.14) during early adulthood after controlling for age, sex, difficult childhood temperament; alcohol and drug use, anxiety, and depressive disorders during adolescence; and parental smoking, educational level, and psychopathology. Anxiety disorders during adolescence were not significantly associated with chronic cigarette smoking during early adulthood. Fourteen percent and 15% of participants with and without anxiety during adolescence, respectively, smoked at least 20 cigarettes per day during early adulthood (OR, 0.88; 95% CI, 0.36-2.14).

Conclusion Our results suggest that cigarette smoking may increase risk of certain anxiety disorders during late adolescence and early adulthood.

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disorder among young adults. West and Hajek\textsuperscript{11} have reported that cessation of cigarette smoking was associated with a decline in anxiety over a 4-week period of smoking abstinence.

Prospective epidemiologic research can investigate both types of hypotheses by investigating whether anxiety disorders predict risk for future cigarette smoking and/or whether chronic smoking is associated with risk for subsequent anxiety disorders.\textsuperscript{11} Because both cigarette smoking and anxiety disorders become prevalent during adolescence and early adulthood, it is important to investigate the association between anxiety disorders and cigarette smoking during adolescence and early adulthood in a large community-based sample. We report such longitudinal findings from the Children in the Community Study.\textsuperscript{14,15}

**METHODS**

**Participants and Study Procedures**

Six hundred eighty-eight youths (51\% female) were interviewed in their homes. Participants’ mean (SD) age in 1983 was 14 (3) years, in 1985-1986 was 16 (3) years, and in 1991-1993 was 22 (3) years.\textsuperscript{14,15} The participating families were a subset of 976 families, randomly sampled on the basis of residence in upstate New York, with whom maternal interviews had been conducted in 1975 when the mean (SD) age of the youths was 3 (3) years. Written informed consent was obtained from participants at each assessment after study procedures were fully explained. The study procedures were approved by the New York State Psychiatric Institute’s institutional review board.

The families in this study generally represented families in the northeastern United States in socioeconomic status and most demographic variables, but they reflected the sampled region with high proportions of those taking the 1983 survey being Catholic (54\%) and white (91\%).\textsuperscript{14} Participating families did not differ from the remainder of the original sample with regard to offspring temperament or maternal psychopathology, although paternal substance abuse in 1975 was less prevalent than in the remainder of the original sample.

Child psychiatric disorders and cigarette smoking were assessed in the 1983 and the 1985 through 1986 surveys by parental and offspring interviews using the Diagnostic Interview Schedule for Children,\textsuperscript{16} and in the 1991 through 1993 survey through offspring interviews using a modified and age-appropriate version of the Diagnostic Interview Schedule for Children. Parental psychopathology was assessed with the Disorganizing Poverty Interview\textsuperscript{15} and with items adapted from The New York High Risk Study Family Interview.\textsuperscript{17} Offspring childhood temperament was assessed in 1975 with the Disorganizing Poverty Interview. The respondents were interviewed separately by extensively trained and supervised lay interviewers who were blind to the responses of the other informant. Additional information on methods used is available elsewhere.\textsuperscript{14,15}

**Data Analytic Procedure**

Analyses of contingency tables were conducted to investigate bivariate associations between adolescent smoking and anxiety disorders, assessed when the mean age was 16 years, and early adulthood smoking and anxiety disorders, assessed when the mean age was 22 years. Complete data sets were available for all 688 participants. A power analysis indicated that there was sufficient statistical power to detect an association with a modest effect size. Nevertheless, because there were few cases with some specific anxiety disorders, these statistical analyses were repeated using an index of threshold or subthreshold anxiety disorders. For an individual to be diagnosed with a subthreshold anxiety disorder, the number of symptoms of that anxiety disorder was required to be at least 2 SDs above the sample mean. Inclusion of subthreshold anxiety disorders increased the prevalence of threshold or subthreshold anxiety disorders by 143\% when the mean age was 16 years and by 48\% when the mean age was 22 years. The results of the statistical analyses were not affected by the inclusion of subthreshold cases. Therefore, the analyses reported herein were conducted using the standard threshold anxiety disorder diagnoses.

Logistic regression analyses were conducted to investigate whether these associations remained significant after controlling simultaneously for age; sex; difficult childhood temperament; alcohol and/or drug use and anxiety and depressive disorders during adolescence; and parental smoking, education, and psychopathology. Statistical analyses were conducted to investigate associations between anxiety disorders and heavy cigarette smoking, defined as smoking at least 20 cigarettes per day. Additional analyses were conducted to investigate associations between anxiety disorders and daily but less frequent cigarette smoking, defined as smoking 1 to 19 cigarettes per day.

**RESULTS**

At mean age 16 years, 39 adolescents (6\%) smoked at least 20 cigarettes per day, and 44 (6\%) had anxiety disorders. At mean age 22 years, 104 young adults (15\%) smoked at least 20 cigarettes per day, and 68 (10\%) had anxiety disorders. Twenty-two participants (3\%) smoked at least 20 cigarettes per day during both adolescence and early adulthood. The other 17 participants (2\%) who smoked at least 20 cigarettes per day during adolescence continued to smoke cigarettes at least occasionally during early adulthood. Fourteen adolescents (2\%) had anxiety disorders during adolescence and early adulthood.\textsuperscript{18} Maternal and offspring reports of daily cigarette smoking during adolescence were significantly correlated ($r=0.71; P<.0001$). Anxiety disorders during adolescence were not significantly associated with cigarette smoking during early adulthood. Six (14\%) of the 44 adolescents with anxiety disorders and 98 (15\%) of the 644 adolescents without anxiety disorders smoked at least 20 cigarettes per day during early adulthood (odds ratio [OR], 0.88; 95\% con-
CIGARETTE SMOKING AND ANXIETY DISORDERS

Table. Cigarette Smoking in Adolescence and Risk for Anxiety Disorders in Early Adulthood*

<table>
<thead>
<tr>
<th>Anxiety Disorder</th>
<th>Prevalence of Anxiety Disorders in Young Adults, No. (%)</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Smoked &lt;1 Pack Per Day During Adolescence (n = 649)</td>
<td>Smoked ≥1 Pack Per Day During Adolescence (n = 39)†</td>
</tr>
<tr>
<td>Agoraphobia</td>
<td>12 (1.8)</td>
<td>4 (10.3)</td>
</tr>
<tr>
<td>Generalized anxiety disorder</td>
<td>24 (3.7)</td>
<td>8 (20.5)</td>
</tr>
<tr>
<td>Obsessive-compulsive disorder</td>
<td>9 (1.4)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Panic disorder</td>
<td>4 (0.6)</td>
<td>3 (7.7)</td>
</tr>
<tr>
<td>Social anxiety disorder</td>
<td>23 (3.5)</td>
<td>1 (2.6)</td>
</tr>
</tbody>
</table>

*Ellipses indicate not applicable; OR, odds ratio; CI, confidence interval.
†Controlled for age, sex, difficult childhood temperament; parental educational level, smoking, and psychopathology; and adolescent alcohol and drug use and anxiety and depressive disorders.

...fidence interval [CI], 0.36-2.14). Supplemental analyses indicated that anxiety disorders at mean age of 14 years were not significantly associated with the onset of cigarette smoking during adolescence or early adulthood.

After controlling for covariates, adolescents who smoked 20 cigarettes or more per day were at elevated risk for agoraphobia, generalized anxiety disorder (GAD), or panic disorder during early adulthood (Table). Furthermore, the quantity and frequency of cigarette smoking during adolescence was also associated with risk for agoraphobia (adjusted OR, 1.47; 95% CI, 1.06-2.02), GAD (adjusted OR, 1.36; 95% CI, 1.07-1.71), and panic disorder (adjusted OR, 1.65; 95% CI, 1.05-2.62) during early adulthood. Chronic smoking during adolescence was significantly more strongly associated with agoraphobia, GAD, and panic disorder than with obsessive-compulsive disorder and social anxiety disorder, for which no increased risk was observed.

Overall, 12 (31%) of the 39 adolescents who smoked at least 20 cigarettes per day had anxiety disorders during early adulthood. In comparison, 56 (9%) of the 649 adolescents who were not chronic smokers had anxiety disorders during early adulthood. There were 69 participants who smoked every day and had an anxiety disorder during adolescence and/or early adulthood. Of these, 29 (42%) began smoking before they were diagnosed with an anxiety disorder, and 13 (19%) were diagnosed with anxiety disorders before they reported daily smoking ($\chi^2 = 6.61; P = 0.04$).

After controlling for covariates, heavy smoking during both adolescence and early adulthood was associated with elevated risk for early adulthood GAD (adjusted OR, 3.28; 95% CI, 1.42-7.61) and panic disorder (adjusted OR, 7.55; 95% CI, 1.55-36.86). Adolescents who smoked less than 20 cigarettes per day were not at elevated risk for anxiety disorders during early adulthood after the covariates were controlled. Among the 475 youths who did not smoke cigarettes and who did not have anxiety disorders at mean age 14 years, heavy smoking at mean age 16 years was associated with risk for anxiety disorders during early adulthood (OR, 10.78; 95% CI, 1.48-78.55). Anxiety disorders at mean age 16 years did not predict heavy cigarette smoking during early adulthood in this subsample.

Statistically significant associations were obtained with the following covariates: age ($r_{unt} = 0.17; P = .0001$), female sex (OR, 3.51; 95% CI, 1.64-7.52), difficult childhood temperament (OR, 2.49; 95% CI, 1.09-5.65), alcohol or drug abuse during adolescence (OR, 9.95; 95% CI, 4.15-23.83), and depressive disorders during adolescence (OR, 4.07; 95% CI, 1.57-10.53) were significantly associated with heavy cigarette smoking during adolescence, and female sex (OR, 2.80; 95% CI, 1.61-4.87) and depressive disorders during adolescence (OR, 6.88; 95% CI, 3.23-14.58) were significantly associated with anxiety disorders during early adulthood.

COMMENT

Our review of the literature indicates that these are the first findings from a community-based longitudinal study to demonstrate that heavy cigarette smoking during adolescence is associated with increased risk for agoraphobia, GAD, and panic disorder during early adulthood. Our findings are consistent with research suggesting that cigarette smoking may increase risk for certain anxiety disorders. At the same time, our findings indicate that cigarette smoking may not be associated with risk for obsessive-compulsive disorder or social anxiety disorder. Of considerable interest, previous research has indicated that impaired respiration may be associated with agoraphobia, GAD, and panic disorder, but not with obsessive-compulsive disorder or social anxiety disorder. It will be of interest for future research to investigate whether different mechanisms, including impaired respiration, and the potentially anxiogenic effects of sustained nicotine intake may underlie the associations between cigarette smoking and agoraphobia, GAD, and panic disorder. It will also be important to investigate possible biological or psychological vulnerability factors that may increase risk for both cigarette smoking and certain anxiety disorders.

Although some previous studies have suggested that some types of anxiety symptoms during adolescence may be associated with increased risk for initiation of cigarette smoking or nicotine dependence, our findings suggest that adolescents with anxiety disorders may not be at increased risk for chronic smoking during early adulthood. Further research will be needed to investigate whether some types of anxiety disorders may increase risk for cigarette smoking under certain circumstances or in specific populations.

Our findings provide health care professionals with additional evidence regarding the harmful consequences of cigarette smoking. By providing ado-
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REFERENCES


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