Nicotine Dependence Among Adolescent Smokers

Neal L. Rojas; Joel D. Killen, PhD; K. Farish Haydel; Thomas N. Robinson, MD, MPH

Objectives: To assess nicotine dependence among adolescents to determine whether quitting smoking is associated with the emergence of nicotine withdrawal symptoms and craving, and to identify the factors associated with these symptoms.

Design: Cross-sectional survey.

Participants: We studied 2197 10th-grade students in 6 San Jose, Calif, high schools.

Main Outcome Measures: Smoking status; history of quitting smoking; Modified Fagerstrom Tolerance Questionnaire (mFTQ) scores; subjective nicotine withdrawal symptoms from the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; Center for Epidemiologic Studies Depression Scale (CES-D); and saliva cotinine levels.

Results: Of the 485 participants who reported having smoked during the past 30 days, 249 reported previous attempts to quit smoking. Among the participants who had attempted to quit, the self-reported frequencies of subjective withdrawal symptoms were a strong need to smoke (45.4%), nervous and tense (31.8%), restless (29.4%), irritable (28.7%), hungry (25.3%), unable to concentrate (21.7%), miserable and sad (15.3%), and trouble sleeping (12.8%). The total number of withdrawal symptoms was correlated with the mFTQ score (Spearman $r=0.51$; $P<.001$). In a stepwise linear regression analysis, the mFTQ score and the CES-D score accounted for approximately 35% of the variance in total number of withdrawal symptoms ($R^2=0.35$; $P<.001$). Males smoked significantly more and had significantly higher mFTQ scores than did females, while female smokers had significantly higher CES-D scores than did their male counterparts.

Conclusions: Considerable levels of nicotine dependence were present among adolescent smokers. Use of mFTQ scores; withdrawal symptoms including nicotine craving; CES-D scores; and saliva cotinine levels may be helpful in designing cessation programs targeted to nicotine-dependent adolescents.


Editor’s Note: With all of the other problems associated with just getting through adolescence, teenagers certainly do not need to add nicotine withdrawal symptoms. Now how do we get that message to preteens?

Catherine D. DeAngelis, MD

The ranks of adolescent smokers are growing. In 1995, about 63.5% of high school seniors reported having smoked, and 34% reported smoking cigarettes during the previous 30 days. Daily smoking prevalence was reported as 10%, 18%, and 22% in grades 8, 10, and 12, respectively. These rates would be higher if high school dropouts were included in study samples. Even more disconcerting is evidence indicating that the percentage of 8th and 10th graders who report having smoked during the past 30 days increased almost 50% from 1991 to 1995. Estimates derived from this recent finding indicate that about 5 million persons aged 0 to 17 years in 1995 will die prematurely of a smoking-related illness.

In response, researchers are revisiting basic questions about the factors that influence smoking among adolescents. In general, social and environmental factors, such as peer and parental smoking and tobacco advertising, are probably the most important variables affecting smoking onset. Indeed, research on the social factors that mediate smoking onset has provided the primary conceptual framework on which state-of-the-art smoking prevention programs are based. However, the effects of smoking prevention programs tend to be short-lived. Thus, it is surprising that comparatively little attention has been given to the factors that maintain smoking or affect the transition from experimental smoking to regular use. In particular, the possible influence of nico-
PARTICIPANTS AND METHODS

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During May 1996, 10th graders (N=2246) enrolled in 6 northern California high schools were asked to complete a survey designed to detect the presence of physical characteristics and behaviors related to the risk for coronary heart disease. Because of their limited English proficiency, 49 participants were excluded from the study, resulting in 2197 total participants. The study included slightly more males (52.4%) than females (47.6%). The ethnic grouping of participants was as follows: Hispanic, 35.7%; Asian (including Cambodian, Vietnamese, Chinese, Japanese, and Thai), 32.5%; white, 17.1%; black, 5.8%; Native American, 0.9%; multietnic, 4.9%; and other, 3.1%. The percentage of students with at least 1 parent who had completed at least some college was 50% (80% responded to this item).

PROCEDURES

Assessments were conducted during regular classroom periods by trained staff during 2 days in each of the 6 schools. Passive parental consent was used. Parents were informed in advance by mail and given the opportunity to withdraw their child from participation at any time, without prejudice. Students were given the opportunity to decline participation at the time of assessments. School personnel did not participate in any part of the data collection. Confidentiality was maintained by using unique identification numbers. Each survey contained 2 cover sheets, the first with a label printed with the student's name and the second with a label containing only the identification number. Students were instructed to remove the cover sheet that included their name.

MEASURES

Smoking Prevalence

Participants reported the number of cigarettes they had smoked during the past 30 days according to the following categories: none, only 1 puff, part or all of 1 cigarette, 2 to 4 cigarettes, 5 to 20 cigarettes, and more than 1 pack.

History of Attempts to Quit Smoking

Participants were asked whether they had "ever tried stopping smoking for good." Answers were recorded as yes or no, and all who responded yes were then queried about withdrawal symptoms.

Modified Fagerstrom Tolerance Questionnaire

The Fagerstrom Tolerance Questionnaire was developed to help researchers and clinicians categorize smokers according to their degree of nicotine dependence. In general, nicotine dependence can be characterized as the compulsive use of cigarettes to achieve pleasurable effects and to avoid withdrawal symptoms. We modified the Fagerstrom Tolerance Questionnaire (mFTQ) by rescaling the items to provide more response choices and by analyzing daily cigarette consumption separately. The 5 questions included in our modification refer to the following aspects of cigarette consumption patterns:

1. Difficulty refraining from smoking where it is forbidden;

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5. Difficulty refraining from smoking where it is forbidden;
Of the 249 smokers who reported a previous attempt to quit smoking, 94% to 96% responded to the items about nicotine withdrawal. The group of 249 who had attempted to quit smoking constitutes our study sample.

Characteristics of the study sample are given in Table 1. National data show comparable 30-day smoking rates for 10th graders. Within our sample, males smoked significantly more during the past 30 days than did females (41.1% of the males vs 23.2% of females smoked more than a pack of cigarettes; \( \chi^2(3) = 11.79 \text{ [n=249]}, P=.008 \)).

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CORRELATION ANALYSIS

The Spearman rank correlations among study variables are given in Table 2. With the exception of the body mass index, the withdrawal symptoms index covaried significantly with all other variables measured. The mFTQ scores correlated significantly with the number of cigarettes smoked during the past 30 days, the withdrawal symptoms index, and the saliva cotinine levels. Saliva cotinine levels were most highly correlated with the number of cigarettes smoked during the past 30 days.
NICOTINE WITHDRAWAL SYMPTOMS

The reported rates of nicotine withdrawal symptoms are given in the following tabulation:

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Percentage Reporting*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Craving</td>
<td>45.4</td>
</tr>
<tr>
<td>Nervous and tense</td>
<td>31.8</td>
</tr>
<tr>
<td>Restless</td>
<td>29.4</td>
</tr>
<tr>
<td>More irritable</td>
<td>28.7</td>
</tr>
<tr>
<td>Hungry</td>
<td>25.3</td>
</tr>
<tr>
<td>Unable to concentrate</td>
<td>21.7</td>
</tr>
<tr>
<td>Miserable and sad</td>
<td>15.3</td>
</tr>
<tr>
<td>Trouble sleeping</td>
<td>12.8</td>
</tr>
</tbody>
</table>

*The maximum possible sample size was 249. Sample sizes changed for each variable because of missing data. The range was 235 to 238.

Of the 249 participants, 34.9% reported more than 2 symptoms, and 30.5% reported no withdrawal symp-
toms during previous attempts to quit smoking. Craving was the most frequently reported symptom, while trouble sleeping was the least frequently reported symptom. No significant differences were found in the mean number of withdrawal symptoms or in the frequency of specific withdrawal symptoms between males and females.

Those who reported experiencing strong cravings during a previous quit attempt had significantly higher mFTQ scores ($t_{213}=-6.6, P<.001$), higher scores on the CES-D ($t_{217}=-2.2, P=.03$), and higher saliva cotinine levels ($t_{207}=-2.6, P=.01$).

FACTORS ASSOCIATED WITH NICOTINE WITHDRAWAL SYMPTOMS

To identify factors associated with nicotine withdrawal, we conducted a stepwise multiple regression analysis with
Nicotine dependence and withdrawal symptoms were present among adolescent smokers by 16 years of age. The mFTQ scores and symptoms of depression accounted for approximately 35% of the variance in the withdrawal symptoms index. This finding helps to validate self-reported measures of nicotine dependence among adolescent smokers. In addition, despite previous reports by other investigators, we found no significant differences between males and females in the reporting of specific withdrawal symptoms.

Our results indicate that adolescent smokers, like their adult counterparts, report a range of withdrawal symptoms associated with quitting. However, the relative likelihood to experience a specific withdrawal symptom may be different between adults and adolescents. Findings from our study and other research suggest that craving is usually reported more frequently than other symptoms and is often the symptom most closely related to failed smoking cessation. For these reasons, despite its absence in the DSM-IV, we included craving in the withdrawal symptoms index.

Despite the controversial nature of craving, it was clearly a frequent result of quitting among adolescents in our sample (45.4%). In addition, craving was significantly associated with greater cotinine levels, symptoms of depression, and mFTQ scores. The prevalence of other symptoms may vary widely among different samples according to age and smoking levels, but craving is consistently reported as the most frequent withdrawal symptom among adolescents. On the whole, the evidence from this study suggests that nicotine dependence among adolescents exists as a measurable psychophysiologic construct and a highly subjective but meaningful affect that includes strong motivational desires to smoke.

Comment

Evidence is increasing that smoking and depression covary more than would be expected by chance. Our finding that CES-D scores were significantly associated with the number of reported withdrawal symptoms among adolescents adds to this database. Overall, mean CES-D scores among adolescent smokers who attempted to quit were higher than the mean scores of nonsmokers in the sample. The significantly higher level of depression symptoms among female smokers who attempted to quit warrants further investigation.

While substantial levels of nicotine dependence and withdrawal symptoms were reported in our sample of adolescents, more refinement of the diagnostic criteria is needed. Prospectively designed studies that clarify the nature of nicotine withdrawal and craving among young smokers may improve smoking cessation programs for adolescents. In our sample, the significant association of saliva cotinine levels with all other variables except the body mass index strengthens the validity of our findings but does not support temporal relationships between other smoking variables and cotinine levels, owing to the cross-sectional design of the study.
significantly lower rates of maintained abstinence from smoking among those with higher baseline levels of dependence and withdrawal. To date, only 1 cessation trial involving nicotine replacement has been reported for adolescent smokers. That trial showed only a slight reduction in withdrawal symptoms with the use of a nicotine patch for 8 weeks, and only 1 of 22 adolescent smokers remained abstinent after 6 months of the trial. The small reduction in withdrawal symptoms may have contributed to the low level of maintained smoking abstinence at the end point of the study. Combined with our data and the data from others, these results demonstrate that highly nicotine-dependent adolescent smokers may require better preparation before challenging the difficulty of smoking cessation.

Although our results are limited by the cross-sectional design of the study, we found that a measure of nicotine dependence was strongly correlated with withdrawal symptoms in adolescent smokers and at least suggested a higher susceptibility to withdrawal symptoms and a higher rate of failure to quit smoking. While cigarette consumption levels are typically used to indicate the level of dependence, the mFQT score and specific withdrawal symptoms may be more sensitive and specific to nicotine-related dependence phenomena among adolescent smokers. More common use of these measures may help future smoking cessation programs to identify adolescent smokers who are likely to fail at attempts to quit smoking and to place them in more aggressive treatment regimens.

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REFERENCES