A Survey of Adolescent Smoking Patterns

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Background: **Most adults who smoke regularly started during adolescence. To understand adolescent smoking trends better, we investigated smoking patterns, and habits among vocational high school students.**

Methods: **One hundred fifty-four students, aged 14 to 20 years from two vocational schools, completed a 23-item questionnaire. The 99 who were smokers further completed a 55-item questionnaire investigating smoking patterns, criteria for addiction, health concerns, and quitting experiences. All students were tested for objective laboratory measures of smoking, including exhaled carbon monoxide and salivary cotinine.**

Results: **Sixty-five percent of the student sample smoked at least 10 cigarettes a day, began smoking by 13 years, and easily purchased tobacco over-the-counter. Predictors for smoking included a close friend, parent, or sibling who was a smoker. Significantly poorer grade performance and higher use of alcohol and marijuana were found among smokers. Students' knowledge of health risks of smoking exceeded 95 percent but was of little concern for 70 percent of the smokers. More than one half of smokers had multiple unsuccessful quitting attempts. Exhaled carbon monoxide readings accurately detected smokers and proved more immediate, more sensitive, and less costly than salivary cotinine measurements.**

Conclusions: **The high association for poor school performance and alcohol and marijuana use among adolescent smokers is a growing trend. These issues carry immediate short-term health and social implications, which physicians should explore. Almost all the smokers had tried at least once to quit but relapsed rapidly. One third remain highly motivated to quit. Physicians should not hesitate to offer smoking cessation assistance; one third might be willing to listen. (J Am Board Fam Pract 1996; 9:7–13.)**

By the time of high-school graduation, 28 percent of the US senior class will be smoking cigarettes.[1] Among these seniors' peers who have dropped out of high school, frequency of smoking exceeds 70 percent.[2] Adolescents begin to inhale early in their smoking careers, and the pharmacological effects of nicotine are important in reinforcing smoking behaviors.[3] The average self-reported age at initiation of smoking has declined from 16 to 12 years in two decades.[4] It has been shown that the younger the age at which a person becomes nicotine-dependent, the greater the number of cigarettes that person will smoke as an adult.

Nicotine is among the most addictive of psychoactive chemical compounds. Two studies found that smoking as few as two to four cigarettes during adolescence imparted a greater than 66 percent risk for becoming a regular smoker.[5,6] The lag time from experimentation to daily smoking for teenagers averages from 2 to 3 years.[7]

If one were to design a model for the ideal addictive drug, it would be difficult to surpass nicotine packaged as a cigarette. It is in many ways the paradigm of a convenient, socially acceptable way to deliver a potent psychoactive drug to the brain. Nicotine tolerance and compulsive use of cigarettes develop rapidly. Fewer than 10 percent of smokers can limit their habit to five cigarettes or fewer a day.[8] The almost instantaneous contentment and relaxation provided by the nicotine, along with the unpleasant, long-lasting physical and psychological withdrawal symptoms, virtually guarantee an irresistible urge to continue smoking.

Studies about smokers, smoking habits, the effects of smoking, and the effectiveness of smoking-cessation techniques largely ignore the experience of adolescents, even though smoking usually begins during the teenage years. Little is known about adolescents who try to stop smoking, their motivation for doing so, withdrawal symptoms, and their success in smoking cessation.

We report the results of a survey of smoking patterns among middle- and upper-middle-class adolescents enrolled in vocational high schools in

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northern Virginia. In addition, we report on the results of two biochemical markers, exhaled carbon monoxide levels, and salivary cotinine levels, as objective measures to confirm self-reporting done on the questionnaire.

Methods

A 78-item questionnaire was developed to explore various aspects of smokers' habits. Questions covered demographic information, smoking history and experience, rate at which addiction developed, source of cigarettes, smoking cues and habits, social and health concerns related to smoking, signs and symptoms of addiction, and incentives to quit. The survey included items taken from several validated scales used to measure various aspects of cigarette smoking, including the Condiotte and Lichtenstein scale of smoking places,[9] the revised Fagerstrom Tolerance Questionnaire,[10] and the third revised edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-III-R) criteria for nicotine dependence.[11] Also used was the Prochaska and Diclemente Stages and Process of Self-Change of Smoking scale.[12] These instruments measure such variables as the situations and places where smoking occurs, nicotine dependence, and contemplation of quitting smoking.

Following questionnaire and methodology development, the study was granted approval through the local hospital institutional review board (IRB) and the county school administration board and their IRB process. Permission and cooperation to participate in the study were then obtained at two local vocational county high schools in suburban northern Virginia.

The questionnaire was administered in 1992 to a convenience sample of smoking and nonsmoking students. The samples were selected from student volunteers who were excused temporarily from class to complete the questionnaire. Teachers were asked to select more smokers than nonsmokers who volunteered to complete the questionnaire, because the study's focus was to understand the experiences of smokers. The cost of measuring the cotinine levels also limited the total number of students that could be enrolled in the study. Participants completed the questionnaire at a single sitting. Nonsmokers completed only the 23-question demographic and general information section, whereas the smokers completed the remaining smoking-related items.

Following completion of the questionnaire, two biochemical markers for smoking were measured. Measurements served as objective validation of self-reported smoking habits. The first test was a carbon monoxide breath analyzer (Mini CO™, Carbon Monoxide Breath Analyzer Kit, Catalyst Research, Baltimore). Because this method is accurate for only up to 4 hours after the last cigarette, salivary cotinine levels were measured by enzyme-linked immunosorbent assay, which can detect the nicotine metabolite cotinine for up to 48 hours after smoking.

Demographic data were summarized separately for all 154 subjects and the subgroups of 99 smokers and 55 nonsmokers. Results are reported as frequencies and percentages for each item. Pearson chi-square analysis was used to test the association among smoking, sex, and risk factors. Carbon monoxide and cotinine values were compared using analysis of variance (ANOVA) techniques. Biomedical Data Processing (BMDP) statistical software was used for all analyses.[13] Critical alpha for significance was set at 0.05.

Results

Smokers Versus Nonsmokers

Of 154 evaluable questionnaires received, 99 (65 percent) were from smokers (61 percent male, 39 percent female) and 55 were from nonsmokers (83 percent male, 17 percent female). Students' ages ranged from 13 to 19 years (median 17 years). There were no statistically significant differences between the smoking experiences of male and female respondents. A majority of the respondents were white (76 percent); Hispanics, Asians, and African-Americans made up 10 percent, 8 percent, and 6 percent of the group, respectively. None of the African-American students smoked. Of the smokers, 92 percent self-rated their family income to be middle-class or above; 37 percent had fathers with at least a college degree. Twice as many nonsmokers as smokers maintained A or B averages in school (42 percent and 21 percent, respectively, P=0.01.)

Smokers were statistically more likely than nonsmokers to have smoking friends or siblings. The highest associative risk for smoking was a best friend who smoked, found among 81 percent of the smokers. Smoking parents appeared to increase the associative risk for smoking (P=0.004).

Table 1. Associations of Smoking with Family and Friends and Personal Use of Tobacco and Drugs.

Associations	Percent of Smokers	Percent of Nonsmokers	*P* Value
Parent(s) smoke	65	40	<0.024
Sibling(s) smoke	40	2	<0.001
Best friend smokes	81	26	<0.001
Has been drunk	82	29	<0.001
Uses marijuana	67	21	<0.001

The use of alcohol and marijuana was significantly higher among smokers than nonsmokers (Table 1). Among smokers 32 percent used alcohol one to three times a week. Six percent of the group used it daily, and 28 percent claimed to have "been drunk or really intoxicated" at least 25 times. While 81 percent of smokers had become inebriated at least once as a result of alcohol abuse, only 29 percent of nonsmokers made this claim.

Sixty-seven percent of the smokers had used marijuana; 20 percent claimed to use marijuana daily. Among nonsmokers, 21 percent reported having used marijuana; 2 percent used it daily. The questionnaire did not explore other drugs of abuse.

Smoking History and Source of Cigarettes

Sixty percent of the smokers had begun to smoke by the age of 13 years; by age 15 years 89 percent were smoking. Within 6 months of starting, one half of smokers were smoking up to 10 cigarettes a day. Seventy-one percent of smokers averaged more than 11 cigarettes a day. Twenty-three percent smoked more than one pack a day.

Most youth purchased their cigarettes at a local store, and 68 percent claimed they were never or only infrequently challenged or asked about their age. Friends were the source of cigarettes for 21 percent of those who smoked before the age of 16 years. Vending machines and parents provided regular sources for cigarettes for 12 percent of respondents. The young smokers demonstrated strong brand loyalty. Ninety-eight percent smoked Marlboro, Camel, or Newport brands.

Parental disapproval of smoking was found among 26 percent of respondents. Only 9 percent smoked without their parents' knowledge. Fifty-one percent of smokers felt that their parents approved of smoking or at least said nothing about it.

Reasons to Smoke

Smokers were asked to select the top three reasons why they smoke. Two of the most common reasons involved dealing with uncomfortable feelings (reduction of tension or stress, 77 percent, and coping with boredom, 38 percent). Addiction to nicotine was the second most common reason offered for smoking by 52 percent of the students. Not surprisingly, 38 percent of female smokers chose weight control as an important reason why they smoked compared with only 7 percent of male smokers.

Despite the strong association found that smokers usually have a best friend who smokes, only 6 percent acknowledged that an important reason was to "fit in" with friends or to help them look older.

Other reasons reported to be important for smoking were to improve concentration (21 percent), enjoy the taste of cigarette smoke (28 percent), and engage in rebellious behavior (7 percent).

Smoking Cues and Signs of Addiction

Feelings of frustration, tension, worry, or discomfort consistently produced smoking urges in more than 70 percent of the group. Only 25 percent of smokers responded that they were able to "do something else besides smoke" when they felt stressed. Powerful situational smoking cues were driving to and from school (70 percent), parties (68 percent), school breaks (53 percent), and feelings of boredom (54 percent). From a list of 10, the three top reasons for smoking were the need for relaxation and reduction of tension or stress (77 percent), self-defined addiction to nicotine (52 percent), and coping with boredom (39 percent).

Self-reported signs of addiction included the conviction that they were addicted to nicotine (76 percent), inhaling deeply (82 percent), smoking at least one half of each cigarette (91 percent), and smoking within 1 hour of awakening (84 percent).

Quitting Incentives and Experience

Most smokers (72 percent) had attempted to quit at least once; 53 percent had attempted to quit at least three times. Symptoms experienced while quitting included nicotine craving (84 percent), irritability or anger (76 percent), anxiety or nervousness (65 percent), and a strong temptation to smoke when around smoking cues (70 percent). As a result 72 percent were unable to abstain for

longer than 4 days. Sixty-five percent were so discouraged after giving in to their first cigarette after trying to quit that they returned to smoking. Female students noticed weight gain during quitting attempts almost three times as often as male students (46 percent versus 17 percent). We do not know how important this factor was in returning to smoking.

Health concerns were the strongest reason to quit for 71 percent of the group. Ninety-seven percent acknowledged the health hazards of smoking. Smoking-related cough, colds, or sinus troubles had been experienced by 42 percent of the young smokers; 38 percent had noted fatigue in sports. Nonetheless, 71 percent claimed that they were not concerned enough about health hazards to stop smoking. Eighty percent of both male and female smokers thought smoking should be stopped during pregnancy; however, 66 percent believed that a return to smoking following delivery was acceptable (Figure 1).

Other motivators to quit included disappointment in themselves for smoking (50 percent), quarrels with friends or family about smoking (38 percent), and cost (average of $10 a week). A strong motivation to quit "right now" remained in 26 percent of the group. Another 11 percent said they were close to making an attempt to quit.

Biochemical Markers

Exhaled carbon monoxide and salivary cotinine levels were measured on all smokers to validate self-reports of recent smoking. The strongest relation was found in the carbon monoxide levels of students who claimed to have smoked within the past 24 hours. Those individuals had a mean carbon monoxide level of 9.4 units; the mean value among respondents who said they had not smoked within the past 24 hours was 3.25 units ($P = 0.001$)

Mean salivary cotinine levels were measured by the Serex nicotine metabolite assay (NiMA). Smokers who had and had not used tobacco within the past 24 hours were 0.274 µg/mL and 0.115 µg/mL, respectively. Nonsmokers had a mean level of 0.110 µg/mL (P=0.048).

Discussion

Among the adolescent smoking surveys our study has several unique characteristics. Two vocational high schools rather than standard high schools were surveyed, because less is reported in the literature about this sample group of teenagers. Our study sites were located in a middle- to upper-middle-class suburban area outside Washington, DC, considered among the most affluent counties in the United States. Students volunteered to complete the questionnaire; all knew they would be tested for biochemical markers for smoking. This method not only increased the probability of self-reporting accuracy but also allowed a means of objectively distinguishing recent smokers. Because of cost limitations on the cotinine biochemical marker, we preferentially chose smokers more frequently than nonsmokers to complete the study. Any other sample bias is unknown and unintentional.

School administration estimated student smoking frequency to be 50 percent, based on observation alone. Rates of smoking frequency in the schools cannot be extrapolated in our study because smokers were preferentially selected. Comparisons between the two sample groups in the schools (smokers versus nonsmokers) are still possible.

The findings of our survey are consistent with those published in "The Report of the Surgeon General: Preventing Tobacco Use among Young People."[14] The adolescents in our study began smoking at an early age. These smokers were more likely than nonsmokers to have smoking friends, siblings, or parents. Marijuana use and alcohol intoxication were about three times more common among smokers than nonsmokers. Smokers were far less likely to have received A or B grade-point averages than nonsmokers. The comparative differences between smokers and nonsmokers in this group of adolescents closely parallel trends reported in well-documented national studies.[15-20]

We found that parents' smoking is strongly associated with increased smoking risk to their children. This associative risk is not without controversy in the literature.[21] Other studies, however, have found that the influence of parents doubles the risk for smoking, particularly when adolescents feel less attached to their parents or when parents have little involvement in supervising their teenagers.[22,23]

There is increasing awareness of higher prevalence levels of sexual activity, violence, and cocaine use among smokers than nonsmokers.[13,16,24] We did not elicit this information in our study.

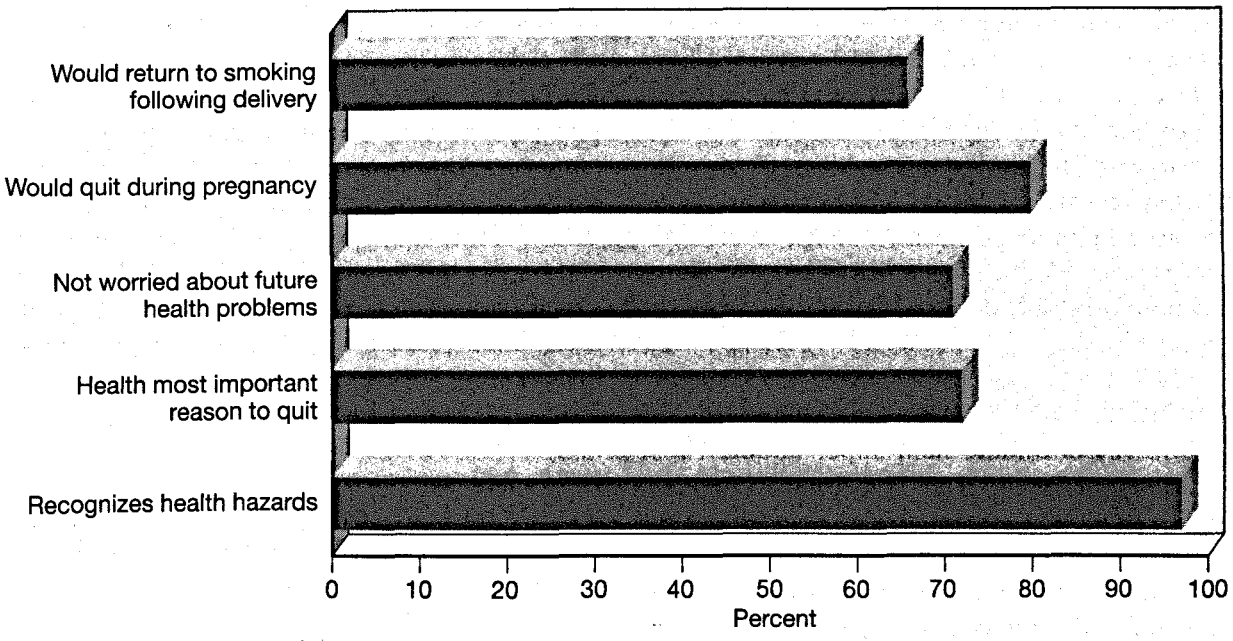

Figure 1. Health concerns: knowledge with ambivalence among smokers.

Nevertheless, based on the lower academic scores and higher alcohol and marijuana use patterns alone, the personal and social consequences of these behaviors in the short and medium term might outweigh and strongly influence the long-term health risks. Figure 1 demonstrates the classic denial of personal health consequences that is characteristic for this age-group. Most teenagers know the major smoking health risks are decades away and fully believe they can quit before they experience irreversible consequences. As evidenced by the increasing trends in teenage smoking patterns, using the health agenda as a means of deterrence has met with limited success.

Most of our smokers purchased their cigarettes over-the-counter. The ease of purchase implies that vendors have trouble recognizing adolescents at appropriate times. Even when fines for selling cigarettes to adolescents existed, 68 percent of smokers were easily able to buy cigarettes at stores. This ease of tobacco purchase is typical of national trends.[25] While vending machines were not commonly used among our students, they remain popular with teenagers, because purchase success rates approach 100 percent. The use of locking devices on vending machines has been shown to reduce teenage access.[26]

Teenagers remain extremely vulnerable to cigarette advertising. Our study group was no exception. Of the many brands that are on the market, 98 percent were smoking the three most heavily advertised brands: Marlboro, Camel, and Newport.[27] After the introduction of Joe Camel in 1988, the market share of Camel cigarettes sold to the under-18-year-old population increased from 0.5 percent to 32.8 percent in only 3 years.[28] Teenagers in our study rated advertising as the least influential reason for their brand selection, illustrating their lack of awareness of the power of advertising.

Three quarters of smokers had attempted to quit at least once. More than one third remained interested in quitting. Most had experienced at least one problem caused by smoking, from health problems, such as upper respiratory tract infections and fatigue in sports, to loss of self-esteem and quarrels with parents. Students trying to quit were largely unable to abstain longer than 4 days, suggesting they were unable to abstain once the classic symptoms of nicotine withdrawal began. Female students trying to quit frequently noticed weight gain, which remains an important inhibitor to quitting.

The carbon monoxide breath analyzer used in the study gave immediate and statistically accurate levels that differentiated smokers from nonsmokers. This inexpensive and rapid procedure could be added in offices as a screening tool, a monitor, or a motivator to encourage smokers to quit.

The long-term nicotine metabolite cotinine has a half-life of 18 to 20 hours. Cotinine can be measured through urine, plasma, or salivary lev-

els.[29,30] In our study we attempted to measure salivary cotinine level. We found this procedure to be expensive and less immediate than measuring carbon monoxide breath levels. Additionally, salivary cotinine levels were unable to distinguish nonsmokers from smokers who claimed to have not smoked for longer than 24 hours, most likely because the nicotine metabolite assay procedure had been originally designed for measuring urine cotinine levels.

Conclusions

Our survey of middle- and upper-middle-class vocational high school students found that adolescents have easy access to cigarettes and rapidly become addicted to nicotine at a median age of 13 years. It is likely that antismoking strategies need to begin in the preteen years and be constantly reinforced.

Society needs to acknowledge its complicity in promoting teenage smoking through easy access, family role models, and powerful media advertising. Strategies are needed to limit access to tobacco products, promote nonsmoking norms, and give preteenagers the message that tobacco is a highly addictive drug and difficult to quit once started.

We believe that adolescent smoking can be seen as a warning sign of a high-risk behavior syndrome which, in the short and medium term, is a far more pressing and compelling problem than the long-term health problems that become manifest at least 20 years later. Teenagers are aware that they are in no immediate health danger from smoking. They also believe, statistically wrongly so, that they will not smoke for too many years and will be able to quit well before any of the serious smoking-related health problems begin. Regardless of the initiating circumstances to start smoking, these teenagers clearly believed that nicotine use was driven by its addictive and psychoactive properties, which relieved uncomfortable feelings and enhanced moods. The patterns that lead to higher marijuana and alcohol use, poor school performance, and other high-risk behaviors are poorly understood and are cause for at least as much, if not more immediate, concern as health implications from smoking.

Physicians should try to become aware of these at-risk patients and develop strategies for early intervention. Youth at risk for smoking are generally those who have parents, family members, or friends who smoke. Parents who smoke should be given information about the associated risks to teenagers who smoke and be made aware of the higher risk for smoking they impart to their children. Parents could provide role models for their children by quitting smoking. Finally, physicians should caution children and preadolescents about the risks of smoking and offer support and smoking cessation interventions to all adolescents who smoke. Many of them want to quit.

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