Identification of Adolescent Tobacco Users in a Pediatric Practice

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Context: Though prevention of adolescent tobacco use is a major public health goal, there is little information on the ability of pediatricians to identify adolescents experimenting with tobacco and regular tobacco users.

Objectives: To pilot use of a short questionnaire and analysis of urinary cotinine level to identify adolescent smokers in a pediatric practice, and to determine characteristics of tobacco users.

Setting: Suburban pediatric practice.

Method: Consecutive high school students completed a short questionnaire and urine cotinine assessment. Three groups were defined: smokers (urine cotinine level >100 ng/mL), experimenters (smoked within the last year; urine cotinine level ≤100 ng/mL), and nonsmokers. Logistic regression was used to examine characteristics of experimenters.

Results: One hundred twenty-four adolescents were enrolled throughout 3 months: 83 nonsmokers (67%), 28 experimenters (23%), and 13 smokers (10%). The questionnaire alone identified 92% of regular smokers. Smoking frequency increased by grade level. Smoking initiation occurred with peers. Compared with nonsmokers, smokers and experimenters were more likely to be older and have a majority of friends who smoked. Smokers were more likely to have a family member who smoked. A majority of smokers and experimenters had tried to quit and understood the adverse health effects of tobacco use.

Conclusions: Adolescent smokers and experimenters were identified using a brief questionnaire. This method will allow pediatricians the opportunity to identify at-risk adolescents before they become regular smokers. Further studies at primary care offices are needed to examine identification of adolescents at highest risk and examine methods to initiate smoking cessation before addiction is established.


During the last decade, the prevalence of tobacco use by teenagers has increased. This has occurred despite the proliferation of educational programs and heightened media attention concerning adverse health effects of tobacco use.\(^1,2\) During this same period, adult tobacco use has declined. Several factors have been associated with teen smoking.\(^3,5\) These include peer pressure, exposure to tobacco advertisements and promotions, and having a parent or other family member who smokes.\(^4\) Teenagers who smoke are more likely than those who do not to exhibit poor school performance and to not accept health concerns about the harmful effects of tobacco.\(^5\)

Although many organizations and individuals have stressed the importance of incorporating antismoking and smoking cessation counseling into pediatric practice, there is a paucity of information on this topic.\(^3,7,8\) Recommendations for how to obtain information on tobacco use from teenagers during office visits do not exist. There are no studies on whether biomarkers of tobacco exposure are helpful in confirming reported exposure. This study piloted a method for pediatricians to characterize tobacco use among adolescents (9th-12th grades) at health maintenance visits. We used a self-completed survey to assess tobacco use, and urine cotinine level to validate the self-report. Further, this study characterized 3 groups of teenagers: habitual users (regular smokers), experimenters, and nonusers. Successful stratification would allow targeted intervention strategies.

RESULTS

Throughout the 3-month recruitment period, 124 consecutive high school students enrolled in the study. The subjects...
SUBJECTS AND METHODS

High school students aged 14 through 18 years visiting for health maintenance were sequentially recruited during a 3-month period in the summer at a suburban pediatric practice. After a routine physical examination by one author (I.B.), participants completed a 26-item questionnaire pertaining to tobacco use and attitudes. A urine specimen was also collected for cotinine analysis to validate questionnaire responses. Only students accompanied by parents and with parental consent were enrolled. Data were obtained anonymously from students and with the parent’s knowledge that they would not receive study results. The study was approved by a local institutional review board.

DATA INSTRUMENT

The questionnaire was developed specifically for this study and included items on demographics, tobacco use (onset, how often, circumstances of smoking, smoking habits of friends and family), attitudes about smoking and its health effects, and physical activity. Those who had ever smoked were asked to characterize their smoking: why, how, and with whom they began smoking; whether they had ever tried to quit smoking; and if their parents knew they smoked, and if so, how their parents found out. Those who tried to quit smoking were asked if they were successful at quitting and what methods they used to try to quit. To assess attitudes and beliefs about smoking, Likert scale responses (5-point scale; strongly disagree = 1, strongly agree = 5) were requested to 3 statements: “Smoking will shorten my life,” “Smoking is fun,” and “Smoking is an adult activity.”

Key questions from the survey are displayed in the Figure. The complete survey is available on request from the authors. Test-retest was not conducted.

Urine samples were refrigerated and then shipped to a commercial laboratory for cotinine assessment (capillary gas chromatography technique; Agilent Corp, Little Falls, Del). The minimum value of cotinine detection was 10 ng/mL. Cotinine is a metabolite of nicotine and is present in the urine at a concentration of greater than 100 ng/mL after tobacco use at a frequency of more than 7 cigarettes per day. Regular smokers generally have levels greater than 200 ng/mL, while those heavily exposed to smoke (20-80 h/wk) have a mean urine cotinine level of approximately 30 ng/mL. In this study, levels at or above 100 ng/mL were considered indicative of habitual smokers.

ANALYSES

Participants were stratified into 3 groups according to cotinine results and questionnaire responses: (1) smoker (urine cotinine level at >100 ng/mL, regardless of questionnaire responses); (2) experimenter (urine cotinine level not detectable and reported tobacco use in the past year, or cotinine ≤100 ng/mL); and (3) nonsmoker (urine cotinine level not detectable and no reported tobacco use in the past year). Descriptive statistics by smoking group were calculated for characterization of responses to items of interest on the questionnaire. χ² Tests or t tests, as appropriate, were used to examine differences between groups. Trends across grade level and smoking groups were examined using linear-by-linear association (LLA). Using information provided on average number of cigarettes smoked per day, week, month, or year, the average number of cigarettes smoked per month was computed. Kruskal-Wallis 1-way analysis of variance (KW) was used to examine differences between groups for attitudes about smoking. Logistic regression was used to examine characteristics associated with experimentation with tobacco. Factors associated with tobacco use were entered into a logistics regression model using a forward stepwise approach. All interaction terms were examined. The model was tested using the method of Hosmer and Lemeshow. Because of low sample size, models examining characteristics of smokers are not presented. Data analyses were performed using SPSS for Windows (Statistical Product and Service Solutions 10.0; SPSS Inc, Chicago, Ill).

Survey questions.

were 71% male (mean age, 15.2 years; SD, 1.3 years) and 100% white. There were 83 nonsmokers (67%), 28 experimenters (23%), and 13 smokers (10%). The range of urine cotinine levels for smokers was 110 ng/mL to 2000 ng/mL. Two smokers had a cotinine level between 100 ng/mL and 200 ng/mL. Two subjects classified as experimenters had measurable cotinine levels (49 ng/mL and 98 ng/mL, respectively).

Smoking rates did not differ by sex. Tobacco use significantly increased by grade (LLA, P<.001). There were 15%, 17%, 29%, and 37% of subjects in 9th, 10th, 11th, and 12th grades, respectively, who were experimenters, and 0%, 12%, 14%, and 23%, respectively, who were smokers.

Twelve of 13 subjects classified as smokers reported smoking within the past week on the questionnaire (ie, sensitivity of the survey to screen for smokers was 92%). Twenty-nine percent of experimenters reported cigarette use within the past week, 18% within the past month, and 46% within the past year. Of the 2 subjects who were classified as experimenters because of measurable cotinine levels, 1 denied ever smoking, and 1 reported last smoking more than 1 year ago. There was wide variation in the number of cigarettes smoked per month for both smokers and experimenters (with 13
sibling smoking varied significantly across groups (12.5 years vs 13.2 years, respectively; P <.001). The majority of teenagers who had tried other forms of tobacco had tried cigars (26 [84%] of 31); pipe and smokeless tobacco use were less frequent (pipes, 13%; smokeless tobacco, 29%).

Most subjects disagreed with the statement, “Smoking is an adult activity.” Sixty-two percent of smokers, 57% of experimenters, and 38% of nonsmokers disagreed or strongly disagreed with this statement. This did not significantly differ between groups (KW, P = .06). Ninety-six percent of nonsmokers disagreed or strongly disagreed with the statement “Smoking is fun,” while this was true for only 46% of smokers and 57% of experimenters (median response [range]: smokers, 3 [1-5]; experimenters, 2 [1-4]; nonsmokers, 1 [1-3]; KW, P < .001). Most subjects strongly agreed with the statement “Smoking will shorten my life,” (strongly agree: smokers, 46%; experimenters, 54%; nonsmokers, 74%). This differed significantly between groups (median result [range]: smokers, 4 [2-5]; experimenters, 5 [1-5]; nonsmokers, 5 [1-5]; KW, P = .02).

Nonsmokers, experimenters, and smokers reported similar rates of participation on school sports teams (nonsmokers, 64%; experimenters, 64%; smokers, 39%) and other sports not affiliated with a school (nonsmokers, 48%; experimenters, 44%; smokers, 54%). However, smokers reported a lower frequency of intense activity (“a physical activity where you work up a sweat”); 58% of nonsmokers, 61% of experimenters, and 15% of smokers reported doing such activities at least 5 days per week (x^2, P = .01).

This study has demonstrated the feasibility of routine assessment of smoking status in a private practice setting. The biomarker for tobacco use confirmed that adolescent regular smokers were generally truthful in filling out a questionnaire on smoking habits when assured anonymity. Those we defined as experimenters either smoked at levels too low to produce detectable urinary cotinine levels or had low detectable urinary cotinine levels from infrequent smoking or smoke exposure. Information about tobacco use gleaned in this study was generally similar to that obtained in national surveys about tobacco use with regard to the items sampled including age at initiation, risk factors, and attitudes.1,2,4 A short question-

### Table 1. Characteristics of Nonsmokers, Experimenters, and Smokers*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Nonsmokers</th>
<th>Experimenters</th>
<th>Smokers</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friends smoke</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n = 122)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50%</td>
<td>70 (86)</td>
<td>16 (57)</td>
<td>1 (6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>&gt;50%</td>
<td>11 (14)</td>
<td>12 (43)</td>
<td>12 (92)</td>
<td></td>
</tr>
<tr>
<td>Grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9th or 10th</td>
<td>63 (76)</td>
<td>13 (46)</td>
<td>4 (31)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>11th or 12th</td>
<td>20 (24)</td>
<td>15 (54)</td>
<td>9 (69)</td>
<td></td>
</tr>
<tr>
<td>Parent smokes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>67 (81)</td>
<td>22 (79)</td>
<td>4 (31)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Yes</td>
<td>16 (19)</td>
<td>6 (21)</td>
<td>9 (69)</td>
<td></td>
</tr>
<tr>
<td>Sibling smokes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>77 (93)</td>
<td>23 (82)</td>
<td>7 (54)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Yes</td>
<td>6 (7)</td>
<td>5 (18)</td>
<td>6 (46)</td>
<td></td>
</tr>
</tbody>
</table>

*All values are presented as a number (percentage). P values for “Friends smoke” and “Grade” are arrived at using linear-by-linear association.

smokers and experimenters answered this question). One smoker reported smoking less than 1 cigarette per month, 6 (46%) reported smoking 9 to 43 cigarettes per month, and the remaining 6 smokers reported smoking a range of 150 to 600 cigarettes per month. A majority of experimenters (65%) reported smoking less than 1 cigarette per month, and the rest reported smoking 2 to 87 cigarettes per month.

The average age at initiation of tobacco use did not significantly differ between smokers and experimenters (12.5 years vs 13.2 years, respectively; P = .29). Parent and sibling smoking varied significantly across groups (Table 1). Twenty-seven percent of nonsmokers, 39% of experimenters, and 85% of smokers reported having a family member who smoked (LLA, P <.001). However, according to questionnaire responses, only 62% of smokers’ parents (8 of 13) and 35% of experimenters’ parents (7 of 20) knew the subject had smoked. The first cigarette was almost always taken in the company of siblings or friends (nonsmokers, 64%; experimenters, 64%; smokers, 39%)

A logistic regression model was developed to compare experimenters with nonsmokers. Factors considered in analyses are displayed in Table 2. Only grade and friends smoking were significant in the logistic regression (Table 2). Variables in the model did not significantly interact.

The majority of smokers and experimenters had tried to quit smoking (7 [58%] of 12 smokers; 16 [76%] of 21 experimenters). Three current smokers and 13 experimenters said that they were successful in quitting smoking. Among those who tried to quit, 20 (91%) of 22 attempted quitting without help; 2 subjects were aided by school programs. Six (7%) of the 83 nonsmokers admitted to smoking, but did not fit our definition of experimenter because their last cigarette use was more than 1 year ago.

Ever trying other forms of tobacco (pipes, cigars, smokeless tobacco) was more commonly reported among experimenters and smokers than among nonsmokers (69% smokers, 46% experimenters, and 11% nonsmokers; P <.001). The majority of teenagers who had tried other forms of tobacco had tried cigars (26 [84%] of 31); pipe and smokeless tobacco use were less frequent (pipes, 13%; smokeless tobacco, 29%).

Most subjects disagreed with the statement, “Smoking is an adult activity.” Sixty-two percent of smokers, 57% of experimenters, and 38% of nonsmokers disagreed or strongly disagreed with this statement. This did not significantly differ between groups (KW, P = .06). Ninety-six percent of nonsmokers disagreed or strongly disagreed with the statement “Smoking is fun,” while this was true for only 46% of smokers and 57% of experimenters (median response [range]: smokers, 3 [1-5]; experimenters, 2 [1-4]; nonsmokers, 1 [1-3]; KW, P < .001). Most subjects strongly agreed with the statement “Smoking will shorten my life,” (strongly agree: smokers, 46%; experimenters, 54%; nonsmokers, 74%). This differed significantly between groups (median result [range]: smokers, 4 [2-5]; experimenters, 5 [1-5]; nonsmokers, 5 [1-5]; KW, P = .02).

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### Table 2. Logistic Regression Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Nonsmokers</th>
<th>Experimenters</th>
<th>Smokers</th>
<th>Unadjusted Odds Ratios (95% Confidence Intervals)</th>
<th>Adjusted Odds Ratios (95% Confidence Intervals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friends smoke</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;50%/Almost all</td>
<td>4.8 (1.8-12.7)</td>
<td>1.0 ( . . . .)</td>
<td>5.9 (2.0-17.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None/&lt;30%</td>
<td>1.0 ( . . . .)</td>
<td>1.0 ( . . . .)</td>
<td>1.0 ( . . . .)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11th or 12th grade</td>
<td>3.6 (1.5-8.9)</td>
<td>1.0 ( . . . .)</td>
<td>4.3 (1.6-11.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9th or 10th grade</td>
<td>1.0 ( . . . .)</td>
<td>1.0 ( . . . .)</td>
<td>1.0 ( . . . .)</td>
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</tbody>
</table>

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naire taking 3 to 5 minutes to complete and inquiring about smoking history, smoking habits of family members, and smoking habits of friends should be sufficient to stratify adolescents with regard to tobacco use. In particular, 3 to 4 brief questions that ask about smoking frequency, smoking status of family members, and whether more than half of the patient’s friends smoke are sufficient to identify someone who either smokes or experiments, or is at high risk. Use of this instrument in an open fashion, so that the physician can identify and validate responses, is needed.

Perhaps the most important finding in this study is that pediatricians have the ability to identify adolescents in the experimenter stage, before nicotine addiction has developed. A questionnaire alone is satisfactory for this purpose. However, the pediatrician may be misled if he or she bases a categorization of experimenter vs smoker on number of cigarettes smoked per day. A biological marker of tobacco use is critical to separate heavier smokers from experimenters or causal smokers, as some smokers with positive urine cotinine levels reported few cigarettes smoked per day. Urinary cotinine levels are subject to dilution effects and measurable levels may be attributable to secondhand smoke exposure. However, because of the strong relationship of smoking with associating with friends that smoke, a misclassification in the direction of identifying the teenager as an experimenter or smoker when determining need for intervention would be prudent.

Many classification systems can be devised to stratify adolescent smokers into groups ranging from “never smokers” through intermediate groups to regular smokers. Our data suggest that pediatricians in suburban practice may be able to reliably tell smokers from never smokers by questionnaire alone. The younger adolescent, or the adolescent who reports low cigarette use or last cigarette use more than 1 week ago is more likely to be an experimenter or irregular unaddicted smoker. Biologic measures of nicotine exposure are useful if the pediatrician plans to consider referral for intervention based on measures of nicotine exposure. Research initiatives directed toward teaching experimenters to quit might be a way to incorporate pediatricians into the national effort to stop the rising prevalence of habitual smoking in teenagers.

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