A RAND NOTE

Do Teens Tell the Truth? The Validity of Self-Reported Tobacco Use by Adolescents

Michelle C. Freier, Robert M. Bell, Phyllis L. Ellickson
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Supported by the Conrad N. Hilton Foundation
PREFACE

This Note examines the reliability and validity of sensitive-topic survey data, in particular self-reported adolescent tobacco use. Investigators have long worried about the candor of such self-reports, particularly among adolescents. If adolescents do tend to misrepresent their use, it could seriously compromise investigators’ abilities to evaluate the efficacy of various intervention strategies.

Psychometric properties of self-reported tobacco use were assessed using questionnaire and physiological data collected under the auspices of Project ALERT. Funded by the Conrad N. Hilton Foundation, Project ALERT, a school-based smoking and drug prevention program, was conducted on over 7,000 adolescents in 30 West Coast schools. As part of the data collection procedure in this multi-year study, saliva samples were collected and analyzed for cotinine. This laboratory test, in conjunction with students’ reports on their tobacco use, allowed evaluation of the veracity of students’ self-reports.
SUMMARY

The validity of self-administered questionnaires to investigate sensitive topics, such as substance use, is controversial. Investigators worry that respondents may intentionally under- or overreport their actions or that they may conceal relevant behaviors. Thus, two major goals in substance use studies are to maximize the validity of self-reported use and to confirm that validity, thereby providing confidence that differences in observed patterns reflect true differences in use rather than response error. In Project ALERT, a drug prevention experiment for adolescents, we took several steps to enhance the validity of self-reports, including guaranteeing the confidentiality of responses and collecting samples of saliva from students. This Note looks at the prevalence of response errors to analyze the success of these steps.

The analysis uses an independent and objective measure of recent smoking—a laboratory test measuring the level of cotinine (a nicotine by-product) in respondents' saliva. Although investigators generally expect that adolescents will tend to underreport or conceal their use more frequently than they will overreport or exaggerate use, we find that the magnitude of underreporting is exceedingly low—less than 1 percent of the total responses at each of the four waves of data collection considered. Equally unexpected was the somewhat substantial level of apparent bragging or overreporting of tobacco use that emerged. Further investigation suggests that the overreporting phenomenon is an artifact of the lack of sensitivity of the lab test to the low levels of tobacco use characteristic of many adolescents.

Beyond the prevalence of under- and overreporting in this population, we addressed the question of nonresponse looking at the survey responses of students who refused only the saliva portion of data collection. We find that these students do not appear to refuse saliva testing as a means of concealing their use; nonparticipants were as likely as participants to report tobacco use.

We conclude that when proper data collection procedures are followed, students will provide accurate and valid reports of their tobacco use.
ACKNOWLEDGMENTS

We are grateful to the Conrad N. Hilton Foundation for its support of the Project ALERT experiment. Many people made important contributions to the research leading to this Note. Jennifer Hawes-Dawson supervised the data collection. Nancy Haley and others at the American Health Foundation performed the laboratory analyses of the physiological samples. Paul Honig and Robert Young provided computer support for the data management and data analysis. George Goldberg and Ronald Hays helped to guide our thinking during the planning and writing phases. Finally, David Murray of the University of Minnesota provided valuable comments on an earlier draft.
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I. INTRODUCTION

Project ALERT developed, implemented, and is evaluating a curriculum intended to reduce substance use among adolescents. The curriculum focuses on motivating students to resist pro-drug pressures and helping them to develop the skills to do so. The study’s primary data source was a self-administered survey, fielded several times while subjects were in the seventh through tenth grades. These student survey data will be used to evaluate the effectiveness of the prevention curriculum by quantifying differences between treatment and control students in their rates of substance use. But the ability to reliably estimate treatment effects is constrained by the quality of the data they are based on. Thus a key concern in the design of Project ALERT was maximizing the accuracy of students’ responses, in particular, those measuring their substance use.

Project ALERT supplemented the student self-report data by collecting and analyzing saliva samples for the presence of cotinine, a metabolite of nicotine. Saliva samples were collected for two reasons. First, they may permit the detection of survey response errors. Second, some previous investigations have reported that collecting (without necessarily analyzing) physiological specimens promotes self-report accuracy (e.g., Evans et al., 1977).

This Note describes the relationship between salivary cotinine concentrations and self-reported tobacco use for Project ALERT data. These saliva samples, in conjunction with the questionnaire data, enabled us to address the following four questions.

1. Do adolescents underreport or conceal tobacco use?
2. Do adolescents overreport or exaggerate tobacco use?
3. Is nonresponse or refusal to spit a strategy for concealing tobacco use?
4. Do the rates of underreporting, overreporting, and refusing relate to treatment condition?

Each question will be considered independently.
ACCURACY OF SELF-REPORTS ABOUT SUBSTANCE USE

Sensitive topics are generally investigated using self-administered questionnaires, which preserve the respondents' anonymity; however, the validity of such data is somewhat controversial (Single et al., 1975; U.S. Surgeon General Report, 1979). It is thought, for example, that respondents may exaggerate the extent of their socially desirable behavior and minimize (or even deny) their socially undesirable behavior.

On the other hand, some data suggest that survey responses are not substantially biased. For example, Marquis et al. (1981) reviewed several sensitive-topic studies containing independent, objective validity checks and found little evidence of systematic misrepresentation in the surveys. They concluded that, contrary to their initial expectations, respondents did not deny their socially undesirable attributes. They maintained that imprecision in the survey responses typically arose from lack of recall rather than intentional lying.

Nonetheless, several investigators have expressed particular concern about the candor of adolescents participating in smoking prevention programs (e.g., Evans et al., 1977; Pechacek et al., 1984). The general presumption is that underreporting is the primary threat to validity. Because smoking is viewed as an undesirable behavior for young teenagers, researchers hypothesize that adolescents may be reluctant to admit tobacco use (Single et al., 1975; Williams et al., 1979). Although most concern has been directed to potential underreporting, overreporting of tobacco use is also a logical possibility. Researchers have speculated that some adolescents might be tempted to exaggerate their use to appear older or to be uncooperative (Single et al., 1975; Murray et al., 1987).

REASONS TO COLLECT AND TEST PHYSIOLOGICAL SAMPLES

The bogus pipeline paradigm hypothesizes that subjects are more likely to respond accurately if they believe that another objective source will reveal the truth anyway (Jones and Sigall, 1971). Evans et al. (1977) introduced the collection of saliva samples to determine whether this technique would enhance the honesty of self-reports of smoking by adolescents. Using randomized assignment to the bogus pipeline condition or control, they concluded that the threat of detection resulted in a higher (and presumably more accurate) rate of reported cigarette use.

Several subsequent studies corroborated Evans and colleagues' (1977) original finding (Hill et al., 1981; Luepker et al., 1981; Bauman and Dent, 1982; Gillies et al., 1982). More recently, however, the bogus pipeline paradigm has become controversial with several
studies unable to replicate the original effect (Bauman et al., 1982; Lauer et al., 1982; Akers et al., 1983; Botvin et al., 1984; Hansen, 1983; Hansen et al., 1985). In an extensive reexamination of this procedure, the data of Murray et al. (1987) supported earlier reports of a pipeline effect. They concluded that methodological problems may underlie previous failures to replicate the original finding.

Since the original report (Evans et al., 1977), the majority of smoking prevention and evaluation studies have included the bogus pipeline procedure in their designs (Flay, 1985). Most investigations, however, do not make use of these physiological data. Rather than actually analyzing the specimens to provide independent, objective verification of the questionnaires, the samples are typically discarded because laboratory analyses are deemed too costly.

Studies that have performed laboratory analyses to ascertain the relationship between self-reports and biochemical measures of tobacco use have generally used either saliva thiocyanate (SCN) or expired air carbon monoxide (CO) levels (Luepker et al., 1981; Bauman et al., 1982; Pechacek et al., 1984; Murray et al., 1987). However, these two biochemical measures have drawbacks. SCN has many non-tobacco sources—including certain foods, marijuana, and environmental smoke—that result in false positives. CO has a very short half-life limiting its use among adolescents, who typically smoke episodically and infrequently.

The use of cotinine, a metabolite of nicotine, has been shown to circumvent some of the problems found with SCN and CO. Williams et al. (1979) reported a high concordance rate between self-reports of cigarette use and levels of plasma cotinine in adolescents. Moreover, Haley et al. (1983) found that salivary cotinine could reliably discriminate smokers from nonsmokers as well as plasma cotinine could, and that both cotinine measures were more specific than SCN.

OVERVIEW OF NOTE

In Sec. II, we describe the collection of substance use data and saliva in Project ALERT. We also describe the analysis methods for this Note. Section III presents the results and conclusions relating to each of the four research questions listed above. Section IV discusses these conclusions and their implications for other analyses of Project ALERT data.
II. METHODS

PROJECT ALERT DESIGN AND DATA COLLECTION

During the first two years of Project ALERT, survey and physiological data were
collected from participants four times.\(^1\) Wave 1 (baseline) data were collected before the
seventh grade prevention program began and thus constitute pretreatment information.
Wave 2 data were obtained three months later, following presentation of the seventh grade
curriculum. Similarly, data collection for Waves 3 and 4 occurred before and after delivery
of the three eighth grade booster sessions. The control group of students did not receive the
drug prevention curriculum but participated in the same data collection schedule.

In evaluating the effectiveness of Project ALERT, the Wave 1 and Wave 4
timepoints were considered especially important. Establishing the veracity of the baseline
(Wave 1) survey was critical to accurately estimate the prevalence of substance use before
any intervention occurred. Wave 4 was a significant outcome point for the study because it
occurred just after the formal program ended. With students aging and at increasing risk for
substance use, independent physiological verification of the existence of any Wave 4
treatment effects was considered important. For these reasons, much of the resources for
physiological testing was devoted to Waves 1 and 4. At Waves 2 and 3, saliva samples were
collected from all participants; we measured cotinine levels for only selected subsets of
students.

Saliva Collection

The saliva samples were collected just before students filled out the questionnaire.
Before saliva collection, students were informed that these samples would be used to detect
tobacco and marijuana use. This information was conveyed verbally and by drawings at the
front of the questionnaire. Confidentiality of the survey and saliva test information was
stressed, but it was made clear that the saliva test results would be compared with the
questionnaire responses to provide a means of confirming students' self-reports. Finally,
students were told that they could refuse the questionnaire, the saliva test, or both.

\(^1\)Ellickson et al. (1988) describe the Project ALERT design, curriculum, and data
collection in detail.
Saliva specimens were collected into sterile tubes marked at the 1 milliliter level, placed on dry ice within one to two hours after collection, shipped frozen to the laboratory within one day of collection, and stored frozen (-20 degrees C) until assayed. Storage times ranged from one week to four months.

**Cotinine Assay**

Cotinine concentrations were determined by a modification of Langone et al. 's (1973) radioimmunoassay procedure, which uses specific rabbit antiserum produced by the injection of albumin-bound trans-4-carboxycotinine. Samples with positive scores, at least 2.0 nanograms per milliliter (ng/ml), were automatically retested. Positive samples were reported as the mean of these multiple determinations. Inter- and intra-assay coefficients of variation have been reported to be less than 6 percent and results compare with those obtained by gas-liquid chromatography (Haley et al., 1983). Minimal detectable levels were 1.1 ng/ml.²

Cotinine is a relatively short-lived metabolite of nicotine. Following light tobacco use (e.g., smoking one cigarette) detectable levels of this compound have been observed for about one day (Haley, personal communication; DiGuisto and Eckhard, 1986). This somewhat narrow window of detectability means that in light smokers, the cotinine test can only expose lying about very recent use; it cannot uncover lying about use more than a day or so before specimen collection.

**Self-Reported Tobacco Use**

At each data collection wave, students answered a battery of questions about their own use of cigarettes. The responses provided information about recency of use, frequency of use, and dosage (Fig. 1 shows the questions asked at Wave 1). To correspond with the detection period of the cotinine test, question 13 asked whether the student had used cigarettes in the past two days. Very similar questions appeared on each of the later surveys.

We collected less detailed information about the use of chewing tobacco. When the students were in seventh grade (Waves 1 and 2), we asked only whether the students had ever used, and if so, whether they had used at all in the past month. At Waves 3 and 4, the

²About 20 percent of the Wave 1 assays and almost all the Wave 4 assays were performed using a pooling procedure. In stage 1, two specimens were mixed and assayed. The specimens were assayed individually only if the mixture scored at least 2 ng/ml. This procedure reduced the total assay cost substantially without any apparent loss in the ability to detect specimens with true values of 8 ng/ml or higher (Bell and Ellickson, 1989).
9. Have you EVER smoked a cigarette — even just a few puffs?
   Yes .... 1 ---» (Answer Questions 10-16)
   No .... 2 ---» (Skip to Question 17)

10. How many times have you smoked a cigarette in the LAST YEAR?
    None .... 1
    1 or 2 times ................. 2
    3 to 10 times .............. 3
    11 to 20 times ............ 4
    More than 20 times .... 5

11. On how many DAYS did you smoke a cigarette in the LAST MONTH?
    None ................. 1
    1 or 2 days in the last month ..... 2
    3 to 5 days in the last month .... 3
    6 to 19 days in the last month ... 4
    20 or more days in the last month ... 5

12. Have you smoked a cigarette in the LAST WEEK?
    Yes ................. 1
    No ................. 2

13. Have you smoked a cigarette in the LAST TWO DAYS?
    Yes ................. 1
    No ................. 2

14. On the days you smoke cigarettes, how many do you usually smoke?
    Less than 1 cigarette a day ........ 1
    1 or 2 cigarettes a day .......... 2
    3 to 7 cigarettes a day .......... 3
    About 1/2 a pack of cigarettes a day ... 4
    A pack or more of cigarettes a day .. 5
    I don’t smoke cigarettes .......... 6

15. Do you ever smoke cigarettes when you’re by yourself?
    Yes, often ................. 1
    Yes, sometimes ............. 2
    No, never ................. 3

16. Which of these statements best describes you now?
    I smoke cigarettes often ........ 1
    I smoke cigarettes sometimes ... 2
    I tried cigarettes once or twice ... 3
    I used to smoke but I quit .... 4

Fig. 1—Battery of cigarette questions at Wave 1
batteries for smokeless tobacco included corresponding versions of most questions in the cigarette battery.

**ANALYSES OF SURVEY-LABORATORY CORRESPONDENCE**

**Sample of Students**
At each wave, the sample for analysis of survey-cotinine correspondence consisted of students who: (1) were part of the Project ALERT baseline population,\(^3\) (2) had taken the questionnaire, and (3) had a salivary cotinine level. Of the baseline population of 7,566 students, 6,308 (83 percent) had physiological and survey data available at Wave 1. Data for Waves 2 and 3 were collected three and twelve months following Wave 1 data collection and for these waves, only a subset of the saliva specimens was targeted for testing. Thus, there were 2,466 and 583 students with both laboratory and questionnaire data at Waves 2 and 3, respectively. Finally, the Wave 4 analysis sample was composed of 4,822 eighth graders, 64 percent of the baseline population.

**Classification of Survey-Laboratory Correspondence**
The analyses in Sec. III contrast subgroups of students classified by what their survey responses and laboratory results indicated about their recent tobacco use. For the laboratory results, we used a cotinine score of 10 ng/ml or greater to signify that a student had used tobacco recently. Ten ng/ml was used for two reasons. First, there is a consensus among researchers that a score of 10 ng/ml rules out false positive results resulting from passive exposure (Benowitz et al., 1983; Carey and Abrams, 1988; Jarvis et al., 1988). Second, compared with a higher cutoff such as 15 ng/ml, it improves our ability to detect underreporters.

In terms of the survey, we contrasted those who admitted very recent use that we would expect the cotinine to detect with those who admitted no recent use at all. We classified a student as a recent user, based on the survey, if he claimed to have used cigarettes or chewing tobacco in the two days before the questionnaire was administered.

---
\(^3\)The baseline population constitutes students who met the following four criteria: (1) were enrolled in a Project ALERT school at baseline, (2) were in seventh grade at the start of the study, (3) were in mainstream, as opposed to special education, classes, and (4) remained enrolled in their Project ALERT school through the first five sessions of the prevention curriculum. These five sessions were delivered in the five weeks following baseline data collection. The total seventh grade program was eight sessions—one session per week.
and, if a smoker, he reported use of at least one cigarette on the days when he smoked. A student was classified as a nonuser, based on the survey, if he did not admit tobacco (cigarettes or smokeless tobacco) use in the month, week, or two days before the questionnaire was administered. If truthful, such students should have no traces of cotinine attributable to personal use. The intermediate group of students—some use in the past month but not enough to clearly qualify as recent users—is omitted from the classifications.

Students were classified into one of four groups, on the basis of their survey and saliva user/nonuser statuses (Fig. 2). A student was considered to have concordant survey and laboratory data if these two sources agreed about the student’s recent tobacco use status (upper left and lower right cells of Fig. 2). Otherwise, the student was classified as either an apparent underreporter or apparent overreporter, based on temporarily taking the laboratory result as truth.

**Concordant nonusers.** Nonusers were defined as students whose surveys denied use of tobacco (cigarettes or smokeless tobacco) in the month, week, or two days before the questionnaire was administered and had a cotinine concentration less than 10 ng/ml.

**Concordant users.** Users were defined as those students who claimed to have used at least one cigarette or chewing tobacco in the two days before the questionnaire was administered and had a cotinine concentration of at least 10 ng/ml.

**Cotinine Score**

<table>
<thead>
<tr>
<th>Survey report</th>
<th>Less than 10 ng/ml</th>
<th>10 ng/ml or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>No reported tobacco use in past month</td>
<td>Concordant nonuser (NONUSER)</td>
<td>Apparent underreporter (UNDER)</td>
</tr>
<tr>
<td>Used tobacco in past two days and smoked one or more cigarettes on average</td>
<td>Apparent overreporter (OVER)</td>
<td>Concordant user (USER)</td>
</tr>
</tbody>
</table>

Fig. 2—Classifications based on survey reports and cotinine scores
Apparent underreporters. A student was labeled an apparent underreporter (UNDER) if the cotinine test identified him as a recent tobacco user but the student did not admit any use in the past month, week, or two days. This definition includes not only students who denied any recent use, but also those who may have tried to conceal use by leaving survey questions blank.

Apparent overreporters. A student was labeled an apparent overreporter (OVER) if the survey identified him as a recent tobacco user but the laboratory test did not. This occurred when a student claimed to have used at least one cigarette or chewing tobacco in the two days before the questionnaire was administered but had a cotinine concentration of less than 10 ng/ml.

Propensity Index

At several points in the analysis we used a propensity index (PI), a linear combination of survey items that predict recent cigarette use, to illuminate the cigarette use status of the apparent overreporters and underreporters. The index was created by regressing students’ most recent period of cigarette use, the dependent variable, on six non-use survey questions. The independent variables included questions on proximity to kids who smoke, best friend’s smoking status, cigarette attitudes, rebelliousness, deviance, and smoking behavior on a date. They were selected because the items correlated highly with cigarette use at Wave 1. Together, the six independent variables explained about 50 percent of the variance in the recency of use measure; the correlation between the propensity index and self-reported recency of cigarette use was 0.69 and 0.73 for Waves 1 and 4, respectively.

Exposure Index

An exposure index (EI), designed to estimate recent users’ level of exposure to cigarettes, was also constructed. This index described the relationship between varying amounts of tobacco exposure and resultant cotinine concentration. Analyses using the EI were confined to Wave 1 and Wave 4 respondents who claimed tobacco use in the past two days.

---

4Recency of use could range from never to within the two days before the survey. Specific values were: never (0), lifetime (1), past year (2), past month (3), past week (4), and past two days (5). To reduce the skewness of this variable it was transformed for the regression by adding 1 and taking the square root of the result. These analyses were performed both on all Wave 1 and Wave 4 students and on the subset of students who did not have any inconsistent cigarette use data; the resultant regression coefficients did not differ much across these two analysis samples.
The exposure index combined a subject's reported number of days of use in the past month with the amount used on an average day. Subjects claiming to have used cigarettes in the past two days were assigned to one of four mutually exclusive dose/frequency categories, namely: (1) 1-2 days/month and less than 1 cig/day, (2) 3-5 days/month and 1-2 cigs/day, (3) 6-19 days/month and 3-7 cigs/day, and (4) 20-30 days/month and 10 or more cigs/day. Some students who reported use in the past two days—those with high frequency and low dosage, or vice versa—were not classified by this scheme and have been excluded from analyses of the exposure index.
III. RESULTS AND CONCLUSIONS

This section presents data to answer the four questions posed in the introduction. Each question is followed by relevant findings and interpretation.

DO KIDS CONCEAL?

Prevalence of Apparent Concealing

Concealing the use of tobacco does not appear to have been a widespread phenomenon among the students surveyed. The number of putative underreporters at Waves 1 and 4 was at most 17 students, only 0.3 percent of the tested students (Table 1).\(^1\) Expressed differently, the level of concealing represents a relatively small proportion of students with positive scores (≥10 ng/ml). At Waves 1 and 4, apparent underreporters constituted 5.4 percent and 4.0 percent of students who had physiological evidence of tobacco use.

Table 1

SURVEY-LABORATORY CONCORDANCE AND DISCORDANCE AT WAVES 1 AND 4

<table>
<thead>
<tr>
<th>Category</th>
<th>Wave 1</th>
<th>Wave 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Agreement</td>
<td>6169</td>
<td>97.8</td>
</tr>
<tr>
<td>Underreport</td>
<td>17</td>
<td>0.3</td>
</tr>
<tr>
<td>Overreport</td>
<td>122</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td>6308</td>
<td>100.0</td>
</tr>
</tbody>
</table>

NOTE: The category column classifies subjects’ questionnaire data relative to their laboratory results. Waves 2 and 3 are excluded because previous overreporters were specifically targeted for saliva testing.

\(^1\)If we exclude students classified as concealers only because they had missing data, the counts drop to 12 and 14 at Waves 1 and 4.
Longitudinally, prior underreporting of tobacco use does not predict subsequent concealment. Table 2 shows that overlap between underreporters across waves is nearly nonexistent. Despite specific targeting of prior underreporters for testing in Waves 2 and 3, the probability of detecting an underreporter at either wave was low. Further, 94 percent of so-called underreporters had admitted to tobacco use on another survey. In fact, the majority of apparent underreporters had previously classified themselves as users (77 percent) and more than half (57 percent) admitted tobacco use (more than one month ago) on the wave in which they were labeled underreporters.

Underreporters: Demographic and Substance Use Characteristics

As shown in Tables 3 and 4, putative concealers (UNDER) generally fell between users and nonusers in their response patterns. Because there were very few apparent underreporters, they did not differ statistically from concordant nonusers or users in terms of gender distribution, racial composition, or parental education. On grades, they differed from nonusers at one wave and from users at the other; the latter difference due to 3 students. They resembled users and differed from nonusers in the proportion who claimed that an important adult smoked cigarettes. Finally, in their responses to the substance use items, apparent underreporters differed from users on alcohol use, from nonusers on other drug use, and from both concordant groups on marijuana use.

Table 2

UNDERREPORTING OVER TIME: FIRST OCCURRENCE AND SUBSEQUENT RESPONSES

<table>
<thead>
<tr>
<th>Wave of initial underreporting</th>
<th>No.</th>
<th>Subsequent Underreporting at:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Wave 2</td>
<td>Wave 3</td>
<td>Wave 4</td>
</tr>
<tr>
<td>1</td>
<td>17</td>
<td>1/15 (7%)</td>
<td>0/10 (0%)</td>
<td>0/12 (0%)</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>—</td>
<td>0/6 (0%)</td>
<td>0/11 (0%)</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>0/1 (0%)</td>
</tr>
</tbody>
</table>

NOTE: This table shows the number of underreporters detected at Waves 1 to 3 and their status at subsequent waves. Thus, at Wave 1, 17 respondents were found to be underreporting their recent tobacco use. Of these 17 students, 15 were retested at Wave 2, 10 at Wave 3, and 12 at Wave 4. One of the 15 students underreported again at Wave 2 (7 percent). There were no other recurrences of underreporting.
Table 3

DEMOGRAPHIC CHARACTERISTICS OF APPARENT UNDERREPORTERS
(Percentage)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Wave 1</th>
<th>Wave 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONUSER UNDER</td>
<td>USER</td>
</tr>
<tr>
<td></td>
<td>(5,037)</td>
<td>(145)</td>
</tr>
<tr>
<td>Female</td>
<td>48</td>
<td>53</td>
</tr>
<tr>
<td>Racial/ethnic minority</td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td>Urban setting</td>
<td>44</td>
<td>59*</td>
</tr>
<tr>
<td>High grades (As and Bs)</td>
<td>75</td>
<td>33*</td>
</tr>
<tr>
<td>Low father’s education</td>
<td>50</td>
<td>73</td>
</tr>
<tr>
<td>Low mother’s education</td>
<td>51</td>
<td>70</td>
</tr>
<tr>
<td>Important adult smokes</td>
<td>44**</td>
<td>82</td>
</tr>
</tbody>
</table>

NOTE: This table compares the frequency of several demographic traits among apparent underreporters, concordant nonusers, and concordant users at Wave 1 and Wave 4. The total number of respondents within each survey-lab grouping is shown in the parentheses heading each column. These entries are percentages of the total.

* Differs from UNDER group at P < 0.05 (chi-square, 1 d.f.).
** Differs from UNDER group at P < 0.01 (chi-square, 1 d.f.).

Table 4

LIFETIME SUBSTANCE USE AMONG APPARENT OVERREPORTERS
(Percentage)

<table>
<thead>
<tr>
<th>Substance</th>
<th>Wave 1</th>
<th>Wave 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONUSER UNDER</td>
<td>USER</td>
</tr>
<tr>
<td></td>
<td>(5,037)</td>
<td>(145)</td>
</tr>
<tr>
<td>Alcohol</td>
<td>70</td>
<td>96</td>
</tr>
<tr>
<td>Marijuana</td>
<td>11</td>
<td>92***</td>
</tr>
<tr>
<td>Other drugs</td>
<td>1**</td>
<td>16</td>
</tr>
</tbody>
</table>

NOTE: This table shows the lifetime level (%) of alcohol, marijuana, and other drug use reported by apparent underreporters, concordant nonusers, and concordant users at Wave 1 and Wave 4.

** Differs from UNDER group at P < 0.01 (chi-square, 1 d.f.).
*** Differs from UNDER group at P < 0.001 (chi-square, 1 d.f.).
Finally, we used the propensity index (PI) to illuminate the tobacco use status of suspected concealers. Table 5 shows average PI scores for various recency of use categories employed as standards. The average PI score for apparent underreporters for Waves 1 and 4 was 53 and 54. This pattern of responses is closest to students who stated that their most recent use was in the past year.

Conclusions

The evidence indicates that underreporting of tobacco use is not a significant problem for Project ALERT. First and foremost, the frequency of this phenomenon is exceedingly low. Of course, the small number of concealers limits our ability to draw robust conclusions about the actual tobacco use status of these kids. The distribution of sociodemographic and substance use characteristics supports the notion that at least some of these students have used tobacco in the recent past. However, their answers to the tobacco use items across all four waves suggest that they may have simply disremembered more recent tobacco bouts rather than intentionally lied about them. Another possibility, especially for those who admitted use at baseline and met the underreporter definition at follow-up, is that they hesitated to report recent tobacco use after having gone through the smoking prevention program. However, it is puzzling that these students did not refuse the saliva test as well, since they were told that this test could detect recent use.

Table 5

DESCRIPTIVE DATA ON THE PROPENSITY INDEX SCORES AT WAVES 1 AND 4, BY MOST RECENT CIGARETTE USE

<table>
<thead>
<tr>
<th>Most Recent Use</th>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>25%</th>
<th>75%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W1</td>
<td>W4</td>
<td>W1</td>
<td>W4</td>
<td>W1</td>
</tr>
<tr>
<td>Never</td>
<td>3012</td>
<td>1954</td>
<td>21</td>
<td>25</td>
<td>13</td>
</tr>
<tr>
<td>Lifetime</td>
<td>862</td>
<td>935</td>
<td>35</td>
<td>37</td>
<td>29</td>
</tr>
<tr>
<td>Past year</td>
<td>1018</td>
<td>704</td>
<td>54</td>
<td>59</td>
<td>52</td>
</tr>
<tr>
<td>Past month</td>
<td>514</td>
<td>368</td>
<td>69</td>
<td>80</td>
<td>70</td>
</tr>
<tr>
<td>Past week</td>
<td>147</td>
<td>165</td>
<td>85</td>
<td>85</td>
<td>88</td>
</tr>
<tr>
<td>Past two days</td>
<td>330</td>
<td>507</td>
<td>91</td>
<td>105</td>
<td>94</td>
</tr>
</tbody>
</table>

NOTE: This table presents the propensity index mean, median, first, and third quartiles for the Wave 1 and Wave 4 samples.
DO KIDS BRAG?

Prevalence of Apparent Bragging

Table 1 depicted the frequency of apparent overreporting across the first two years of Project ALERT. The prevalence of apparent overreporting ranged from approximately 2 percent of the study subjects in Wave 1 to 6 percent in Wave 4.

Table 6 shows the distribution of cotinine scores as a function of self-reported recency of use. Only about half of all students who claimed tobacco use in the two days before survey administration had salivary cotinine levels of 10 ng/ml or above. It seems, then, that either exaggerating tobacco use was fairly widespread—much more so than concealing its use—or that the physiological test did not accurately reflect actual use.

Table 6

SURVEY-LABORATORY CORRESPONDENCE: WAVES 1 AND 4

<table>
<thead>
<tr>
<th>Most Recent Self-Reported Tobacco Use</th>
<th>Wave</th>
<th>N</th>
<th>Percent N.D. (&lt; 2.0)</th>
<th>Percent between 2.0 - 9.9</th>
<th>Percent 10 ng/ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>1</td>
<td>2,838</td>
<td>94.6</td>
<td>5.2</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1,718</td>
<td>97.5</td>
<td>2.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Ever</td>
<td>1</td>
<td>1,196</td>
<td>90.2</td>
<td>9.2</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1,119</td>
<td>96.2</td>
<td>3.1</td>
<td>0.6</td>
</tr>
<tr>
<td>Past year</td>
<td>1</td>
<td>1,020</td>
<td>90.1</td>
<td>9.4</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>641</td>
<td>96.4</td>
<td>3.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Past month</td>
<td>1</td>
<td>726</td>
<td>78.1</td>
<td>14.2</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>454</td>
<td>95.4</td>
<td>3.7</td>
<td>0.9</td>
</tr>
<tr>
<td>Past week</td>
<td>1</td>
<td>167</td>
<td>74.9</td>
<td>18.6</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>229</td>
<td>94.8</td>
<td>3.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Past 2 days</td>
<td>1</td>
<td>361</td>
<td>38.2</td>
<td>17.5</td>
<td>44.3</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>661</td>
<td>44.6</td>
<td>8.6</td>
<td>46.7</td>
</tr>
</tbody>
</table>

NOTE: This table shows the frequency of agreement between students' self-reported recency of tobacco use and the objective measure of tobacco exposure—cotinine level in the students' saliva for Waves 1 and 4.
Table 7 shows the number of overreporters detected at each wave and the percentage of this group detected at subsequent waves. There is substantially more overlap across waves among overreporters than among underreporters. The percentage of students found to be overreporting their recent tobacco use at more than one wave ranged from 11 percent to 27 percent.

**Apparent Overreporters: Demographic and Substance Use Characteristics**

For nearly all the sociodemographic and substance use characteristics examined, the distribution of apparent overreporters (OVER) fell between that of concordant nonusers and users. Tables 8 and 9 illustrate the similarities and differences between these groups.²

Table 8 contrasts the distribution of responses in the overreporter group with that in the nonuser and user groups. For the first three variables—gender, race, and setting—apparent overreporters did not differ consistently from either comparison group. For the remaining four variables in the table, they tended to resemble users and differ from nonusers although on the adult smoker measure, apparent braggarts lay between nonusers and users and differed from both groups.

<table>
<thead>
<tr>
<th>Wave of Initial Overreporting</th>
<th>No.</th>
<th>Subsequent Overreporting at:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Wave 2</td>
</tr>
<tr>
<td>1</td>
<td>122</td>
<td>20/90 (22%)</td>
</tr>
<tr>
<td>2</td>
<td>58</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>—</td>
</tr>
</tbody>
</table>

NOTE: This table shows the number of overreporters detected at Waves 1 to 3 and their status at subsequent waves. Thus, at Wave 1, 122 respondents were found to be overreporting their recent tobacco use. Of these 122 students, 90 were retested at Wave 2. Of these 90 students, 20 (22 percent) were found to be overreporting again.

²The problem with using this approach to investigate sensitive survey items in which respondent candor is doubtful is that answers to other questions used to explore tobacco status may also be inaccurate. If adolescents were to give invalid answers to non-drug questions, differences between the user and nonuser groups would tend to be obscured. Others have found little evidence of this (Single et al., 1975).
Table 8
DEMOGRAPHIC CHARACTERISTICS OF APPARENT OVERREPORTERS (Percentage)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Wave 1</th>
<th>Wave 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONUSER (5,037)</td>
<td>OVER (122)</td>
</tr>
<tr>
<td>Female</td>
<td>48</td>
<td>55</td>
</tr>
<tr>
<td>Minority</td>
<td>32</td>
<td>36</td>
</tr>
<tr>
<td>Urban setting</td>
<td>44***</td>
<td>68</td>
</tr>
<tr>
<td>High grades (As and Bs)</td>
<td>75***</td>
<td>47</td>
</tr>
<tr>
<td>Low father’s education</td>
<td>50</td>
<td>58</td>
</tr>
<tr>
<td>Low mother’s education</td>
<td>51**</td>
<td>64</td>
</tr>
<tr>
<td>Important adult smokes</td>
<td>44***</td>
<td>61</td>
</tr>
</tbody>
</table>

NOTE: This table compares the frequency of several demographic traits among apparent overreporters, concordant nonusers and concordant users at Wave 1 and Wave 4. The total number of respondents within each survey-lab grouping is shown in the parentheses heading each column.

* Differs from OVER group at P < 0.05 (chi-square, 1 d.f.).
** Differs from OVER group at P < 0.01 (chi-square, 1 d.f.).
*** Differs from OVER group at P < 0.001 (chi-square, 1 d.f.).

As shown in Table 9, apparent overreporters generally resembled users and differed from nonusers on these substance use measures. In the case of marijuana use, the OVER group differed from both nonusers and users with the nonuser-over differences being substantially greater. On the adrenochrome item, a fictitious drug included specifically to pinpoint bragging, putative overreporters differed from nonusers but resembled concordant users.

Finally, overreporters and users did not differ in their average scores on the propensity index. At Waves 1 and 4, users had average PI scores of 88 and 103, respectively, and overreporters had corresponding values of 98 and 94. As shown in Table 5, these values are compatible with recent use.

Table 10 presents the distribution of cotinine scores as a function of the exposure index for recent cigarette smokers at Wave 1.3 Subjects in four exposure categories were compared on: (1) the percentage of students with nondetectable (N.D.) cotinine scores, (2)

---

3We controlled for use of smokeless tobacco by eliminating from the analysis all students who had used smokeless tobacco within the past month.
Table 9

SUBSTANCE USE OF APPARENT OVERREPORTERS (Percentage)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Wave 1</th>
<th></th>
<th>Wave 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONUSER</td>
<td>OVER</td>
<td>USER</td>
<td>NONUSER</td>
</tr>
<tr>
<td></td>
<td>(5,037)</td>
<td>(122)</td>
<td>(145)</td>
<td>(3,463)</td>
</tr>
<tr>
<td>Alcohol</td>
<td>70***</td>
<td>95</td>
<td>96</td>
<td>74***</td>
</tr>
<tr>
<td>Marijuana</td>
<td>11***</td>
<td>70</td>
<td>92***</td>
<td>16***</td>
</tr>
<tr>
<td>Other drugs</td>
<td>1***</td>
<td>12</td>
<td>16</td>
<td>2***</td>
</tr>
<tr>
<td>Adrenochromes</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>.06***</td>
</tr>
</tbody>
</table>

NOTE: This table shows the level (%) of substance use obtained by self-report for each of three groups: putative overreporters, concordant users, and concordant nonusers. The survey items ask about lifetime use of alcohol, marijuana, and drugs other than tobacco, alcohol, marijuana, cocaine, barbiturates, amphetamines, and prescription medicine. The Wave 4 other drug item excluded inhalants, PCP, and LSD in addition to the aforementioned drugs. Adrenochromes do not exist; this question was inserted as a further check on the validity of self-reported substance use. The total number of students within each survey-lab grouping is shown in the parentheses heading each column.

***Differs from OVER group at P < 0.001 (chi-square, 1 d.f.).

the percentage of students with cotinine scores between 2 and 9.9 ng/ml, (3) the percentage of students with cotinine scores ≤ 10 ng/ml, and (4) the mean cotinine score for those with

Table 10

COTININE CONCENTRATION AMONG STUDENTS WHO REPORTED SMOKING IN THE PAST TWO DAYS BEFORE WAVE 1, AS A FUNCTION OF EXPOSURE INDEX CATEGORY

<table>
<thead>
<tr>
<th>Category</th>
<th>Days/Month</th>
<th>Cigs/Day</th>
<th>No.</th>
<th>N.D.</th>
<th>2.0-9.9</th>
<th>≥10</th>
<th>Mean (ng/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1-2</td>
<td>&lt;1</td>
<td>41</td>
<td>56</td>
<td>37</td>
<td>7</td>
<td>13.4</td>
</tr>
<tr>
<td>B</td>
<td>3-5</td>
<td>1-2</td>
<td>46</td>
<td>52</td>
<td>28</td>
<td>20</td>
<td>34.2</td>
</tr>
<tr>
<td>C</td>
<td>6-19</td>
<td>3-7</td>
<td>36</td>
<td>39</td>
<td>14</td>
<td>47</td>
<td>94.3</td>
</tr>
<tr>
<td>D</td>
<td>20-30</td>
<td>10+</td>
<td>61</td>
<td>13</td>
<td>8</td>
<td>79</td>
<td>128.3</td>
</tr>
</tbody>
</table>

NOTE: This table presents the category, the criteria in terms of frequency of use in days/month and dosage in terms of cigarettes smoked per day, the sample size, % N.D., low, and high, and the mean of the positive values for Wave 1 users in the past two days. Only smokers are represented here.
positive scores. The table shows that cotinine scores related strongly to the exposure index. Thus, with increasing exposure, the percentage of N.D. and low (2-9.9) values declines. For example, the proportion of N.D. scores decreases from 56, to 52, to 39, to 13 percent. Also, as the exposure level increases both the proportion of scores of 10 ng/ml or higher and the mean cotinine concentration for the positive scores increase. This pattern repeated at Wave 4.

**Cotinine Elimination**

The rate of elimination of cotinine from saliva in adult nonsmokers provides additional evidence about apparent bragging. Observations were obtained from three adult subjects to measure the level of saliva cotinine following acute, light tobacco use (Table 11). We investigated the rate of decay of cotinine following exposure to one cigarette. To this end, saliva samples were collected from three nonsmoking adults (one ex-cigarette smoker and two never-smokers) at several timepoints, ranging from immediately after smoking a single cigarette to 48 hours later. In all, seven separate time series were obtained from the three subjects (two or three from each). For each time series, the cotinine half-life was determined by calculating the linear regression of the log of salivary cotinine concentration from its peak value against time.

**Table 11**

**CHARACTERISTICS OF SEVEN SALIVARY COTININE TIME SERIES**
**AFTER SMOKING ONE CIGARETTE**

<table>
<thead>
<tr>
<th>Subject-Trial</th>
<th>Peak Level</th>
<th>Peak Time</th>
<th>Half-Life</th>
<th>Time Last Detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>8</td>
<td>8</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>A-2</td>
<td>6</td>
<td>5 min</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>A-3</td>
<td>11</td>
<td>1</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>B-1</td>
<td>11</td>
<td>8</td>
<td>40</td>
<td>48</td>
</tr>
<tr>
<td>B-2</td>
<td>9</td>
<td>6</td>
<td>51</td>
<td>42</td>
</tr>
<tr>
<td>C-1</td>
<td>0</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C-2</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>

**NOTE:** Peak level is measured in ng/ml. All other entries are times measured in hours (unless noted otherwise).
Two of the three subjects obtained detectable cotinine levels in each of the five time series that they provided. The other subject, a lifelong nonsmoker, had nondetectable cotinine concentrations in every one of the ten samples that he provided in his first time series, probably because of his lack of experience in how to inhale. He did have measurable cotinine in his saliva on the second occasion. Thus, the combination of low exposure and immature inhalation techniques could well account for the apparent phenomenon of overreporting tobacco use.

Further, we found that light use rarely led to the persistence for 24 hours of salivary cotinine levels of 10 ng/ml or greater. In six of the seven time series conducted, detectable saliva cotinine persisted for at least eight hours after smoking. However at this time point, cotinine concentrations ranged from 4 to 10.5 ng/ml with all but one of the eight hour specimens having levels less than 10 ng/ml, the level we set to indicate active tobacco use. Only two of the seven time series peaked as high as 10 ng/ml.

Conclusions

Virtually all of the data that we examined suggested that bragging about tobacco use is not widespread and that apparent braggars are probably light users. On most of the survey measures, apparent overreporters differed from nonusers and resembled users. Moreover, our data suggest that the cotinine test may not be sensitive at the low levels of tobacco use characteristic of teenagers who are experimenting. The elimination observations indicated that salivary cotinine may be poorly suited to detect experimental smokers and it may be inappropriate to regard people who claim to be recent smokers, yet have negligible cotinine concentrations, as overreporting their smoking. Most results indicated that for this type of respondent, questionnaire information portrayed tobacco use more accurately than physiological data.

NONRESPONSE: A STRATEGY FOR CONCEALING USE?

Prevalence of Nonresponse

The saliva refusal rate for each of the four waves is shown in Table 12. Students who refused to give saliva never constituted more than 9 percent of the sample. Of those who refused to provide saliva, most did fill out the survey. Refusals of both the survey and saliva constituted 24 percent of the saliva refusals at Wave 1 and fell to only 12 percent at Wave 4.
Table 12

SALIVA REFUSALS, BY WAVE

<table>
<thead>
<tr>
<th>Wave</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.7</td>
</tr>
<tr>
<td>2</td>
<td>5.6</td>
</tr>
<tr>
<td>3</td>
<td>7.0</td>
</tr>
<tr>
<td>4</td>
<td>9.0</td>
</tr>
</tbody>
</table>

There was a strong relationship between refusing at one wave and the probability of refusing at another wave. As shown in Table 13, this probability ranged from 40.7 percent to 62.3 percent. From the longitudinal trend for the Wave 1 refusals, it appears that students are less likely to continue refusing with each successive wave of data collection.

Table 14 presents selected demographic and substance use measures for the students who refused to provide saliva specimens. Compared with students who provided saliva, those who refused to spit at one or more of the first four waves of data collection tended to be: (1) female, (2) nonwhite, (3) from an urban setting, (4) getting lower grades, (5)

Table 13

REFUSALS OVER TIME: FIRST OCCURRENCE AND SUBSEQUENT REFUSAL STATUS

<table>
<thead>
<tr>
<th>Wave of Initial</th>
<th>Subsequent Refusal at:</th>
<th>Wave 2</th>
<th>Wave 3</th>
<th>Wave 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refusal</td>
<td>No.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>175</td>
<td>78/144 (54%)</td>
<td>52/114 (46%)</td>
<td>46/113 (41%)</td>
</tr>
<tr>
<td>2</td>
<td>349</td>
<td>112/254 (44%)</td>
<td>107/244 (44%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>385</td>
<td>215/345 (62%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: This table shows the frequency with which subjects refused to provide saliva given that they had refused in a previous wave. The number of people who refused in a given wave appears in the left-hand-most column for each row. Thus, 175, 349, and 385 students refused in Waves 1, 2, and 3, respectively. The other columns indicate the recurrence rate of these respondents in subsequent waves. Thus of the 175 students who refused to spit in Wave 1, 78 or 54.2 percent of the 144 students available refused again in Wave 2. Of the 175 Wave 1 refusals, 52 or 45.6 percent of those available to spit at Wave 3 refused and 46 of these 175 students also refused at Wave 4.
Table 14
DEMOGRAPHIC AND SUBSTANCE USE ATTRIBUTES, 
BY SALIVA REFUSAL STATUS AND WAVE 
(Percentage)

<table>
<thead>
<tr>
<th></th>
<th>Wave 1</th>
<th>Wave 2</th>
<th>Wave 3</th>
<th>Wave 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Refusals (175)</td>
<td>Others (6,363)</td>
<td>Refusals (349)</td>
<td>Others (5,839)</td>
</tr>
<tr>
<td>Female</td>
<td>61.3</td>
<td>47.7</td>
<td>55.5</td>
<td>47.8</td>
</tr>
<tr>
<td>Minority</td>
<td>49.1</td>
<td>32.2</td>
<td>40.2</td>
<td>32.2</td>
</tr>
<tr>
<td>Urban</td>
<td>77.7</td>
<td>45.8</td>
<td>73.1</td>
<td>45.3</td>
</tr>
<tr>
<td>GPA</td>
<td>2.6</td>
<td>2.9</td>
<td>2.6</td>
<td>2.8</td>
</tr>
<tr>
<td>Tobacco</td>
<td>57.9</td>
<td>54.9</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Alcohol</td>
<td>73.2*</td>
<td>74.4</td>
<td>75.9*</td>
<td>73.7</td>
</tr>
<tr>
<td>Pot</td>
<td>32.7</td>
<td>19.7</td>
<td>31.7</td>
<td>20.6</td>
</tr>
<tr>
<td>Other drug</td>
<td>4.3</td>
<td>1.5</td>
<td>6.1</td>
<td>2.3</td>
</tr>
<tr>
<td>Control</td>
<td>40.6</td>
<td>29.8</td>
<td>24.6</td>
<td>30.4</td>
</tr>
<tr>
<td>HEC</td>
<td>36.6</td>
<td>34.3</td>
<td>47.9</td>
<td>33.1</td>
</tr>
</tbody>
</table>

NOTE: This table compares various attributes of students who refused saliva with those of students who did not. It shows the grade point averages for the refusals and others. It also depicts the proportion of refusals compared with other students who were in the control group, received the health educator curriculum (HEC), and admitted ever using tobacco, alcohol, marijuana, and other drugs. The Wave 3 grade point averages are computed based on Wave 4 survey data. These data are not corrected for overlap in the refusal group across the four waves.

All differences are statistically significant (P < 0.01) except those marked with an asterisk.

admitting to more lifetime tobacco, marijuana, and other drug use, and (6) less likely to be in the control group (and more likely to have received the Health Educator Curriculum).

Conclusions

In conclusion, it does not appear that students who refused only the saliva test did so as a strategy for concealing tobacco use. As a group, they willingly reported levels of substance use that were higher than those of saliva compliers.

Also, if students refused because they were concealing use and were concerned about a possible breach of confidentiality, then the refusal rate should probably be highest in Wave 1 because they would not have previous experience with completing the questionnaire and seeing confidentiality maintained. However the refusal rate was lowest at Wave 1.

Furthermore, refusing the saliva test actually became more prevalent with each wave of data collection suggesting that as students aged they may have simply become more interested in
challenging authority. Finally, several data collectors reported that junior high school students regarded spitting into a test tube as uncivilized ("yucky") and that comments of this nature often tended to precede instances of refusing to spit.

The possibility remains that refusers of all data collection did so to conceal use. However, the rate of survey refusals remained consistently low at or below 1.0 percent of the sample.

DO APPARENT UNDERREPORTING, OVERREPORTING, AND REFUSING TO SPIT COMPROMISE ESTIMATES OF TREATMENT EFFECT?

Table 15 shows the rate of occurrence of apparent under- and overreporting and refusing to spit by treatment condition. The proportion of apparent under- and overreporters did not differ from the concordant groups with respect to distribution among treatment or control groups. Given that these "problem" cases are equally distributed with respect to treatment condition, their occurrence should not compromise estimation of Project ALERT's efficacy. In contrast, the distribution of students who refused the saliva test did differ from those who complied. However, in an analysis of refusals at Wave 1, Bell et al. (1990) found that the difference could be explained by school-to-school variation in saliva refusal rates. And, since the students who refused the saliva test did not appear to be misrepresenting their tobacco use, this would not complicate tobacco use comparisons between treatment and control subjects.

Table 15

SURVEY-LABORATORY CONCORDANCE AND DISCORDANCE AT WAVES 1 AND 4, BY TREATMENT CONDITION (Percentage)

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Nonuser</th>
<th>User</th>
<th>UNDER</th>
<th>OVER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W1</td>
<td>W4</td>
<td>W1</td>
<td>W4</td>
</tr>
<tr>
<td>Teen leader</td>
<td>94.6</td>
<td>85.5</td>
<td>3.0</td>
<td>7.6</td>
</tr>
<tr>
<td>Health educator</td>
<td>94.1</td>
<td>85.7</td>
<td>2.8</td>
<td>6.8</td>
</tr>
<tr>
<td>Control</td>
<td>95.4</td>
<td>83.6</td>
<td>2.4</td>
<td>7.7</td>
</tr>
<tr>
<td>Overall</td>
<td>94.7</td>
<td>85.0</td>
<td>2.7</td>
<td>7.3</td>
</tr>
</tbody>
</table>

NOTE: This table shows the proportion of students at Waves 1 and 4 who were concordant nonusers, users, apparent underreporters, and apparent overreporters by treatment condition. Teen leader and health educator groups both received the smoking and drug prevention program with a slightly altered method of presentation.
IV. DISCUSSION AND IMPLICATIONS

APPARENT UNDERREPORTERS

Across the four waves of Project ALERT, underreporting was rare. At each wave, the rate of underreporting never exceeded 0.007, seven cases per thousand; and this rate was found in a wave where suspected underreporters were specifically oversampled. When all collected saliva specimens were analyzed (Waves 1 and 4), the prevalence of underreporting was 0.003, three students per thousand.

Underreporters are a difficult group to evaluate. Students in this subset were heterogeneous in terms of their cotinine levels; about two-thirds had cotinine concentrations that were low-positive (i.e., between 10 and 20 ng/ml) and the remainder had high scores (i.e., greater than 50 ng/ml). Moreover, this group did not display a consistent pattern of responses on the demographic and substance use items. Thus, on some measures, underreporters resembled users (mother’s education, proportion reporting smoking by an important adult, and adrenochrome use), and on others they were similar to nonusers (gender, environmental setting, father’s education, and alcohol and other drug use); on still others they resembled a different group in one wave than they did in the other (grades and marijuana use).

Much, if not all, of this lack of a discernible pattern is probably due to the very small size of this group. Further analyses to characterize the underreporters would be hampered by the small number of subjects. For example, it would be useful to determine whether underreporters with cotinine levels less than 20 ng/ml are subject to passive exposure and if such a subset had a lower mean PI score than underreporters with high cotinine levels. In such a case, some of the underreporters could, in fact, have false positive cotinine scores.

In sum, this group of students is too small to present a significant threat to the validity of Project ALERT’s questionnaire. Underreporters are not more highly represented in the two treatment conditions as opposed to the control group. This suggests that underreporting is not reflective of a socially desirable response set bias. Finally, these findings suggest that the widespread concern that students tend to conceal use may not be justified.
APPARENT OVERREPORTERS

Although overreporting was more common, our analyses suggest that the majority of apparent exaggerators were actual tobacco users. This conclusion is supported by Williams and Gillies (1984), who found that physiological measures did not satisfactorily validate self-reported smoking in their study. Using saliva thiocyanate, they concluded that the failure of this test was likely due to its lack of sensitivity at the low levels of cigarette consumption found among adolescents.

Our data suggest that the survey self-reports are better than the laboratory data for classifying adolescents’ tobacco use. Furthermore, these analyses imply that the primary reason for the apparent bias found in the Project ALERT survey data is likely to be an artifact of the cotinine test’s lack of sensitivity for low levels of use. Thus, using questionnaire data from the so-called overreporters does not compromise response validity.

REFUSALS

Refusals may, on the face of it, present a potential problem for Project ALERT because of their magnitude of occurrence. They represent about 3 percent of respondents in Wave 1, but by Wave 4 they have tripled to 9 percent of the sample. The extent of refusing increased with time.

However, the attributes of students who refuse to spit argue against this representing an attempt to conceal tobacco use. The preponderance of saliva refusers did fill out the survey, and these students admitted to more use of tobacco and other substances than did their compliant counterparts. Corroboration of the veracity of these students’ self-reports comes from the propensity index. Students who refused to spit and claimed that they had never used tobacco had average PI scores of 29 and 33 at Waves 1 and 4, respectively. In contrast, refusers who admitted tobacco use had average PI scores of 66 and 71 for the two waves. These scores track well with their self-report status; so that refusals who denied use had PI scores reflecting nonuse and self-admitted users, who refused, had PI scores corroborating their use.

In sum, these analyses indicate that adolescents report truthfully about their tobacco use when proper data collection procedures are followed.
REFERENCES


Haley, N. J., personal communication.


