The Prevalence of Unrecognized Tobacco Use Among Young Adults

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Objective: To evaluate the prevalence of smoking among young adults and to describe their characteristics. *Methods*: Data were examined from the Minnesota Adult Tobacco Survey, a telephone survey of 8821 residents with a sample of 1205 young adults. *Results*: Prevalence was 39% using the adolescent definition and 32% using the adult definition. Nearly 1 in 5 young adult smokers may be considered a "previously unrecognized smoker" who would not have been identified as a cigarette user according to the standard adult definition. *Conclusions*: Future studies assessing prevalence should use both adolescent and adult measures.

Key words: tobacco, smoking, prevalence, survey methods, young adults

Young adulthood is a critical transition period in an individual's cigarette use.[1,2] For many individuals, the young adult years are marked by an increase in cigarette consumption as occasional adolescent smoking progresses to regular or established smoking.[3-6] At the same time, cigarette use during this period of life may be more fluid or mutable than in later years, and the young adult years may therefore represent a window of opportunity to encourage and assist smoking cessation.[7,8] Encouraging cessation early in life is particularly important because individuals who quit smoking early in life avoid much of the harm related to cigarette use.[9]

Given the importance of young adult tobacco use in terms of public health, it is critical to accurately assess smoking behavior in this population. Measuring smoking rates among young adults is complicated by transitions in smoking behavior as individuals pass from adolescence to adulthood. At present, it is unclear which criteria – those applied to adolescents or those applied to adults – are most appropriate when measuring rates of smoking in young adults. Yet these criteria yield different estimates of the prevalence of smoking among young adults, with potentially important implications for understanding smoking-related behavior and attitudes and for public

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health practice.

Most studies of adults identify individuals as smokers only if they report having smoked 100 or more cigarettes in their lifetimes and currently smoke every day or some days. Smoking rates reported by the Behavioral Risk Factor Surveillance System (BRFFS;[10]) and the National Health Interview Survey (NHIS;[11]) use this definition. The intent of this definition is to accurately reflect established smokers, those who have passed the experimental stage of smoking. In contrast, almost all studies of adolescents use definitions that rely on the frequency of recent use and do not require smoking 100 or more cigarettes in one's lifetime. The most common definition, used in the National Youth Tobacco Survey (NYTS;[12]) and Youth Risk Behavior Survey (YRBS;[13]), describes a current smoker as someone who has smoked one or more days in the past 30 days. The purpose of this definition is to plan for prevention, and it is therefore necessary to understand and measure the earliest stages of smoking.

The extent of the discrepancy in prevalence produced by the adolescent and adult measures of smoking prevalence among late adolescent and young adult populations is not well documented. Some studies of young adults, particularly college students, have departed from the standard adult definition to use the adolescent definition or one of its variations. The National College Youth Risk Behavior Survey[14] and the Harvard School of Public Health College Alcohol Study[15] use slightly different versions of the standard adolescent definition.[16,17] Although interesting, these studies measure prevalence only among a subset of all young adults (ie, those enrolled in colleges or universities) and cannot be directly compared with studies of the same age-group that use the conventional adult definition of smoking behavior. To date, only one study has directly compared rates of smoking in young adults (18- to 24-year-olds) using the adult as compared to the adolescent criteria for regular smoking. Delnevo and colleagues[18] evaluated rates of smoking among over 1000 participants in the New Jersey Adult Tobacco Survey. The results showed a substantial discrepancy in the prevalence of smoking when an "adult" (ie, lifetime greater than 100 cigarettes and current use) versus an "adolescent" (ie, any use in the previous month) defi-

nition of smoking was applied.

The purpose of this paper is to extend the findings of Delnevo et al by evaluating the differences in rates of smoking among young adults when measured using standard adult vs adolescent definitions and also to describe the characteristics and patterns of smoking behavior of those young adult smokers who are not included in the conventional adult definition (ie, previously unrecognized young adult smokers). To accomplish this goal, we analyzed the young adult subset of the 2003 Minnesota Adult Tobacco Survey (MATS), a statewide survey of a representative sample of adults aged 18 and older. As part of the MATS, 18- to 24-year-olds were administered both adult and adolescent measures of cigarette use.

METHODS
Survey Design
Data used in this study were part of the 2003 Minnesota Adult Tobacco Survey (MATS), a telephone survey administered from November 2002 to June 2003 that was designed to estimate smoking prevalence rates and tobacco-related attitudes, beliefs, and behaviors. Using a complex survey design, the MATS was designed to provide estimates for adults (ages 18 and above) living in Minnesota and for members of the Blue Cross and Blue Shield of Minnesota health plan. The sampling design included a statewide random digit dial sample (RDD sample) of the state's telephone numbers and a stratified random sample drawn from a list of current adult enrollees of Blue Cross and Blue Shield of Minnesota (BCBS list sample). BCBS is the state's largest health plan, insuring approximately 24% of the state's adult population. The Blue Cross strata consisted of major underwriting pools of BCBS members; Senior Medicare supplemental insurance, prepaid Medicaid enrollees under age 65, MinnesotaCare enrollees (a state government subsidized program for low-income employed persons unable to qualify for Medicaid), and persons covered under commercial BCBS health plans. The BCBS list sample frame included 897,866 persons across all strata.

Because a major goal of the sampling design was to permit comparison of adolescent and adult measures of smoking prevalence in a representative statewide sample of young adults of ages 18-24, young adults (aged 18-24) were intention-

ally oversampled. In the RDD sample, households were screened, and those with an 18- to 24-year-old were slightly more likely to be selected than those without such a person. Where a household included an 18- to 24-year-old and one or more older persons, the 18- to 24-year-old was much more likely to be selected into the sample. In the BCBS list sample, each stratum (except Senior Medicare) was further divided into 18- to 24-year-olds and older persons, and the 18- to 24-year-old stratum was oversampled.

The complex sampling design and the different probabilities of selection for persons in each stratum required the application of weights for both the RDD and BCBS list samples. Weights developed for the RDD sample accounted for different probabilities of selection depending on whether there was an 18- to 24-year-old living in the household, whether the respondent was an 18- to 24-year-old, the number of phone lines in the household, and the number of adults living in a household. Poststratification adjustments were applied, based on the 2002 and 2001 Current Population Survey's annual demographic supplements (CPS-ADS) for the state of Minnesota, using 2 age categories (18-24 and 25 and older), gender, and 2 geographic groupings (Twin Cities Metropolitan area and non-Twin Cities Metropolitan area). The BCBS list sample was also weighted, with weights constructed by taking the inverse probability of selecting an individual within each stratum. The person weight was poststratified so that the survey totals for key variables were equal to the control totals from the BCBS sample frame, similarly relying on 2 age categories, gender, and geographic groupings.

The final sample was created by merging the RDD and BCBS list samples. A process of statistical matching was employed in order to account for the fact that everyone within the BCBS list sample was also eligible to be sampled through RDD, but it was not possible to know with any certainty if an RDD respondent was also a member of BCBS. The statistical matching procedure matched respondents in the BCBS list sample with similar persons in the RDD sample using a probabilistic matching algorithm. This algorithm required that a RDD respondent and a BCBS list respondent had to share the following characteristics: type of reported health insurance coverage (public, private, uninsured); Twin Cities metropolitan area residence (Twin Cities versus all else); gender (male versus female); listed telephone number (all BCBS list sample respondents had a listed telephone number and were matched only to RDD respondents with a listed number), age-group (18-24, 25-64, 65 and older); smoking status (current smoker versus former smoker/nonsmoker). Smoking status was used in the algorithm so that the matching process would not alter the RDD smoking rate prevalence. Survey-design-based estimates were used to adjust the standard errors of the estimates appropriately given the heterogeneity introduced by the poststratification weighting scheme. An examination of the standard errors for the prevalence of smoking demonstrated that, as expected, the standard error of the merged data set was lower than that of the RDD sample alone for both all adults and 18- to 24-year-olds. The final merged data set consisted of 8821 persons (RDD n=5527, BCBS list n=3294) and is representative of all adults in Minnesota. When the American Association for Public Opinion Research method was used, the overall weighted response rate for the final merged cases was 56.5%.[19] This analysis focuses on results from 1205 young adult respondents from within this total sample. All respondents were assured of confidentiality using standard methods, and the survey's design and confidentiality procedures were approved by institutional review boards at the University of Minnesota and the Minnesota Department of Health.

Definitions

The MATS included measures of smoking that have typically applied to both adults and adolescents. An individual is considered an established smoker according to the adult criteria if he or she answered "yes" to the question "Have you smoked at least 100 cigarettes in your entire life?" and responded "every day" or "some days" to the question "Do you now smoke cigarettes every day, some days, or not at all?". An individual is considered a smoker by the adolescent definition if he or she reported any cigarette use in the prior 30 days. A previously unrecognized smoker is an individual who is identified as a smoker by the adolescent

Figure 1
Flow of Survey Items Combining Adolescent and Adult Measures of Cigarette Use
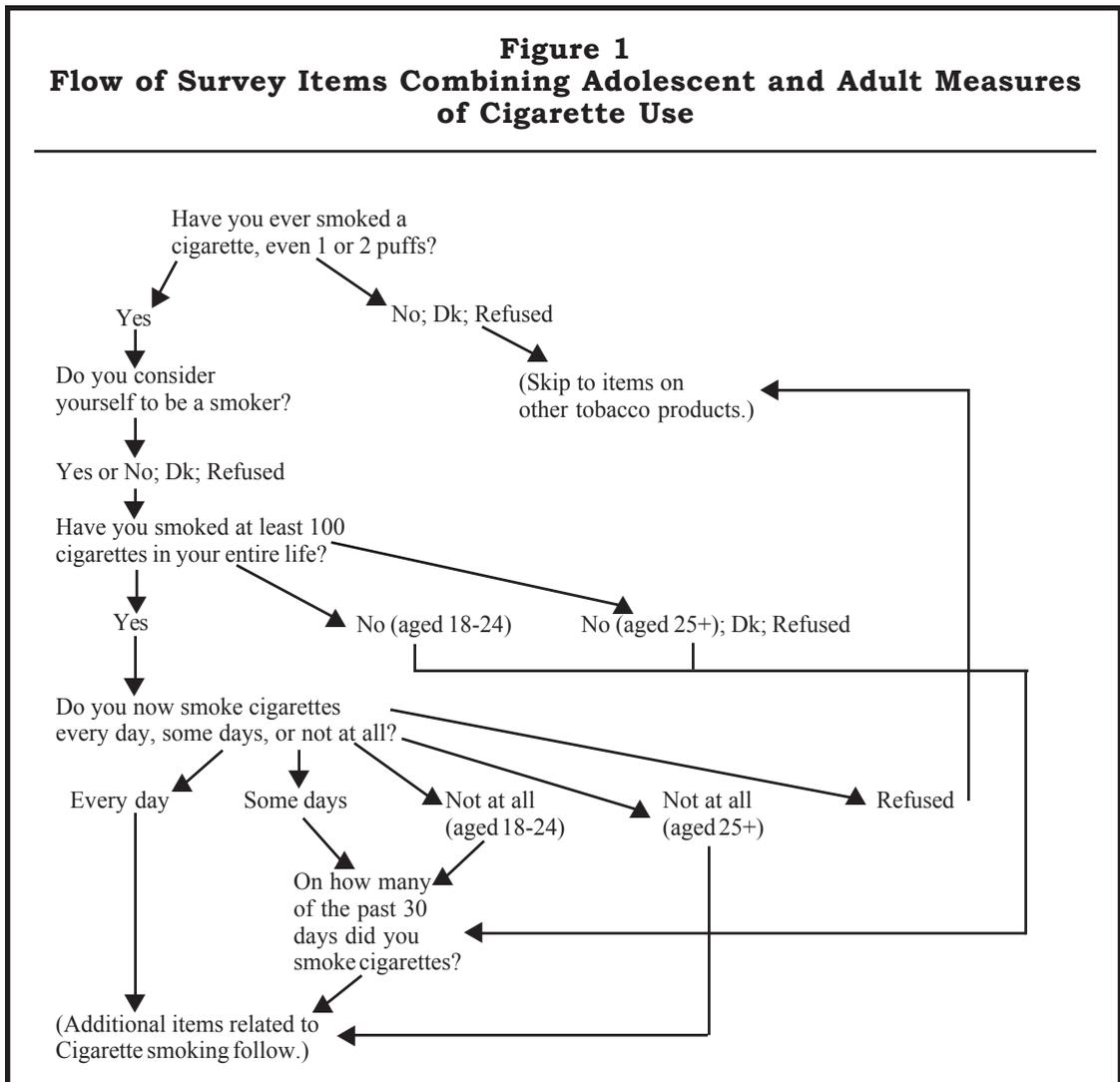
measure but not by the standard adult measure.

Demographic information (eg, age, gender, level of education, etc) was collected using standard survey items.[10] To determine income, respondents were first asked if they were primarily supported by themselves or by their parents or some other person. Respondents who reported that they primarily supported themselves were asked to report their annual income (<$25,000; $25,000-49,999; $50,000-74,999; or ≥$75,000). Respondents who reported that they were primarily supported by their parents (or others) were asked to report the income of the household. Additional items regarding smoking behavior (eg, age of first cigarette use, purchasing behavior, etc), the social environment with regard to smoking (eg, living with other smokers, proportion of friends that smoke, offers to smoke, alcohol use, etc), and physical and mental health (ie, US Center for Disease Control's Health-Related Quality of Life measures[20]) were used to further characterize similarities and differences between nonsmokers, previously unrecognized young adult smokers, and established smokers.

Data Analysis

Analyses were performed using the

Figure 2
Comparison of Adult and Adolescent Smoking Measures

		Adult measure: Smoked 100 cigarettes in lifetime?			
		NO	YES		
			Now smoke every day, some days, or not at all?		
			NOT AT ALL	SOME DAYS	EVERY DAY
Adolescent Measure:	ZERO DAYS	Never smoker	Former smoker	n/a	n/a
Smoked in past 30 days?	1 OR MORE DAYS	Previously Unrecognized Smoker	Previously Unrecognized Smoker	Current Smoker	Current Smoker

SPSS 16.0 statistical software package with appropriate sample weights to account for the complex survey design in determination of both frequency and variance estimates. The smoking-related attitudes and behaviors of established smokers and previously unrecognized smokers were examined using t-tests or appropriate nonparametric tests for continuous variables and the Pearson chi-square test for categorical variables. Pairwise comparisons of differences between nonsmokers, established smokers, and previously unrecognized smokers were performed using Tukey tests.

RESULTS
Smoking Prevalence
Using the adolescent definition of smoking (ie, any cigarette use in the prior 30 days), the prevalence of smoking among young adults in Minnesota was 38.7%. This percentage equates to approximately 178,000 young adult Minnesotans. This compares to a prevalence of 31.7% (146,000 persons) when prevalence among young adults was measured using the adult definition (ie, ever smoked at least 100 cigarettes and currently smoke some days or every day). Thus 7.0% of all young adults and 18.1% of young adult smokers may be considered previously unrecognized smokers who would not have been identified as cigarette users according to the

standard adult definition. These young adults reported that they smoked in the previous 30 days but were not established smokers according to the adult definition primarily because they reported that they have not smoked at least 100 cigarettes in their lifetimes.

Demographics
Table 1 shows the demographics of the survey respondents included in this analysis. Among young adults, established smokers, previously unrecognized smokers, and nonsmokers did not differ in terms of gender, age, residence in major metropolitan vs greater Minnesota, or percent employed for wages. The groups did differ, however, in educational enrollment at the time of the survey (overall P=.002). The majority of established smokers were not enrolled in school, whereas nearly half of the previously unrecognized smokers were enrolled in some postsecondary program. In this respect, the previously unrecognized smokers more closely resembled the nonsmokers than the established smokers.

The groups also differed significantly in terms of the primary source of financial support (overall P<.001). Significantly more established smokers were financially self-sufficient as compared to either previously unrecognized smokers (pairwise comparison P=.003) or nonsmok-

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Table 1
Demographic Characteristics of Smokers and of Previously
Unrecognized Smokers (Aged 18-24)

	Established Smoker N=295 (%)	Previously Unrecognized Smoker N=88 (%)	NOT Current Smoker N=816 (%)	P value
Gender				ns
Male	56.3	49.0	49.4	
Female	43.7	51.0	50.6	
Mean age	20.7	20.5	20.8	ns
Region				ns
Twin Cities Metro	56.6	66.7	57.9	
Outside Twin Cities Metro	43.4	33.3	42.1	
Current educational enrollment				.002
Any postsecondary school	34.1	47.9	44.9	
High school	11.2	17.1	9.6	
Not enrolled in school	54.7	34.9	45.6	
Financially supported primarily by				<.001
Self	76.4	59.2	63.9	
Parent or other	23.6	40.8	36.1	
Employed for wages or self-employed	78.0	72.8	79.6	ns
Household income				.002
<$25,000	44.7	25.3	34.5	
$25,000 - $49,999	30.7	38.7	35.2	
$50,000 - $74,999	12.7	20.2	16.8	
≥ $75,000	11.9	15.9	13.4	

ers (pairwise P<.001). Established smokers were also more likely than other respondents to report having an income of less than $25,000 (overall P=.002). With respect to enrollment in postsecondary education, primary source of financial support, and income level, previously unidentified smokers more closely resemble nonsmokers than they resemble established smokers.

Smoking Behavior
Table 2 provides greater details regarding cigarette use by established young adult smokers compared with previously unrecognized young adult smokers. Not surprisingly, there is a dramatic difference in the proportion of established smokers who report daily cigarette use compared to previously unrecognized

smokers (78.3% vs 6.6%, respectively). In contrast, a large majority of previously unrecognized smokers used cigarettes on 5 or fewer days per month (77.6% vs 6.4% established smokers; P<.001). On days when respondents did smoke, the average number of cigarettes smoked was also significantly higher for the established smokers (11.9) than for previously unrecognized smokers (2.0; P<.001). Consistent with these differences in cigarette consumption, established smokers were much more likely to report smoking within the first hour of awakening (55.7%) compared to previously unrecognized smokers (7.9%, P<0.001).

In addition to smoking fewer cigarettes, previously unrecognized smokers were much more likely to report smoking their first cigarette at age 18 or older (28.0% of

Table 3
Social Contacts and Milieu of Established Smokers, of Previously Unrecognized Smokers and of Nonsmokers (Aged 18-24)

Behavior	Established Smoker N=295 (%)	Previously Unrecognized Smoker N=88 (%)	NOT Current Smoker N=816 (%)	P value
Offered a cigarette in the past 30 days	71.3	70.1	19.6	<.001
Gave away a cigarette to friend or acquaintance in the past 30 days	90.8	32.5		<.001
Lives with another adult who smokes or uses tobacco	67.1	43.5	24.6	<.001
Spouse or someone close to them smokes or uses tobacco	80.7	63.3	43.5	<.001
"How many people close to you smoke or use tobacco?"				<.001
None	19.3	36.7	56.5	
A few	11.7	23.7	24.7	
Less than half	8.2	18.9	6.4	
About half	24.8	14.4	8.2	
Most or all	36.1	6.3	4.2	
Drank alcohol in the past 30 days	77.2	73.2	52.1	<.001
Engaged in binge drinking at least once in the past 14 days	48.4	49.0	14.9	<.001

previously unrecognized smokers vs 3.9% of established smokers, P<.001). Unlike established smokers, the majority of whom reported smoking regularly before the age of 18, most previously unrecognized smokers reported that they never smoked regularly or that they began smoking regularly at age 18 or older.

A large majority of established smokers (91.7%) purchased their own cigarettes, whereas only a minority (39.1%) of previously unrecognized smokers did so (P<.001). Similarly, more established smokers (90.8%) than previously unrecognized smokers (32.5%) had given away a cigarette in the past 30 days (P<.001). A difference in brand preference is also evident, with a greater percentage of previously unrecognized smokers smoking Marlboro and Camel (89.8%) compared to established smokers (76.3%; P=.0042).

Consistent with consumption and pur-chasing behavior, 14.7% of previously unrecognized smokers identified themselves as "smokers," as compared to nearly 88.1% of established smokers (P<.001). Finally, approximately 62.8% of established smokers, as compared to 47.5% of previously unrecognized smokers, attempted to quit smoking in the previous 12 months (P=.011).

Social Environments

As shown in Table 3, there were a number of differences between groups in terms of the social environment with regard to smoking. Significantly more established and previously unrecognized smokers were offered a cigarette in the past 30 days (71.3% and 70.1%) compared to nonsmokers (19.6%; P<.001 for both smoking groups vs nonsmokers). In terms of living with another smoker, having a spouse or someone close to them who

Table 4
Physical and Mental Health Status of Established Smokers, of Previously Unrecognized Smokers and of Nonsmokers (Aged 18-24)

Behavior	Established Smoker N=295 (%)	Previously Unrecognized Smoker N=88 (%)	NOT Current Smoker N=816 (%)	P value
General health is				<.001
Excellent or very good	52.6	66.2	76.2	
Good	37.2	27.5	20.2	
Fair or poor	10.3	6.3	3.6	
Number of days of "not good" physical health in the past 30 days				.025
None	50.2	40.1	59.9	
1 or 2	24.2	18.9	21.4	
3 to 9	16.6	32.2	14.2	
10 or more	9.0	8.8	4.5	
Number of days of "not good" mental health in the past 30 days				<.001
None	35.9	30.6	56.5	
1 or 2	13.6	19.6	17.9	
3 to 9	25.6	25.2	16.1	
10 or more	24.8	24.5	9.4	

smokes, and having a high proportion of close acquaintances who smoke, results for previously unrecognized smokers indicated substantial levels of exposure to smoking in their social environment with values intermediate between established smokers and nonsmokers.

In terms of alcohol use, comparisons reveal a greater similarity between established and previously unrecognized smokers as compared to nonsmokers. For example, established (77.2%) and previously unrecognized (73.2%) smokers reported drinking alcohol at least once in the past 30 days; both had significantly higher rates than nonsmokers (52.1%; P<.001 vs established smokers and P=.006 vs previously unrecognized smokers; overall ANOVA P<.001). A similar pattern emerged for the percentage of established smokers, previously unrecognized smokers, and nonsmokers who engaged in binge drinking at least once in the past 14 days (48.4%, 49.0% and 14.9%, respectively; overall P<.001; both groups of smokers vs nonsmokers pairwise comparisons P<.001).

Physical and Mental Health
Comparison of general, physical, and mental health symptoms show greater similarities between established and previously unrecognized smokers as compared to nonsmokers (Table 4). For ratings of general health (excellent or very good, good, fair or poor), the overall significance test showed significant differences between groups (P<.001). Although pairwise comparisons between all groups are significant (established vs previously unrecognized P=.025; both groups of smokers vs nonsmokers P<.001), absolute differences are much greater between either group of smokers compared with nonsmokers. This is consistent with the findings with regard to the number of days of "not good" physical or mental health, where the 2 groups of smokers did not differ from each other whereas both groups of smokers differed significantly from nonsmokers.

DISCUSSION
The results of this analysis indicate

that the prevalence of smoking among young adults is substantially higher when measured using adolescent as compared to adult criteria. These findings are consistent with those of the New Jersey study in underscoring a discrepancy in smoking rates among young adults using 2 methods of identifying smokers.[18] Although it may be unsurprising that a more stringent adolescent measure produces a higher prevalence estimate, our findings suggest that use of the adult criteria for defining a smoker (ie, smoking 100 or more cigarettes in their lifetime) may underestimate the prevalence of young adult smoking by as much as 18%. In Minnesota this equates to an additional 32,000 young adult smokers. If a similar discrepancy was found on a national scale, this would translate into an undercounting of more than 2 million young adult smokers.

Several characteristics of previously unrecognized smokers merit further discussion. It has long been accepted that as many as 90% of smokers initiate smoking behavior prior to the age of 18.[21] Our results, however, suggest that this trend is changing; in our sample more than one in 4 of the previously unrecognized smokers tried the first cigarette after turning 18. Concerns regarding increased uptake of smoking by young adults have been raised previously.[1,5,22-24] In a recent report, Tercyak et al reported that in the first year after high school, 25% of never smokers had begun smoking.[24] The finding here that nearly 90% of the previously unrecognized smokers prefer the 2 most heavily advertised brands suggests that increased tobacco industry targeting of this segment of the population may contribute in part to initiation among this age-group.[25,26] Additional research on the connections between advertising and other promotional efforts and tobacco uptake among young adults is clearly needed.

With respect to smoking behavior it is also noteworthy that previously unrecognized smokers smoke substantially less than established smokers. In fact, most previously unrecognized smokers smoke only 1 or 2 cigarettes on only a few days each week or month. In this regard, the cigarette use of previously unrecognized smokers in this study resembles that of tobacco "chippers."[27] Like chippers, many young adult smokers (30%) smoke in social situations.[28] In many respects, the previously unrecognized young adult smokers identified here resemble "social smokers" identified by Moran et al in their analysis of national college survey data.[29]

Perhaps because most smoke infrequently and mostly socially, fewer than 1 in 6 previously unrecognized young adult smokers even consider themselves to be "smokers". An additional 11.9% of established smokers also denied they were "smokers". This phenomenon of denial of smoking status among young adults who smoke, also reflected in a recent study among college students, holds important implications for tobacco control as well as for measurement.[30] Taken together, these characteristics raise a concern that tobacco control messages that are targeted to "smokers" may be ignored by these individuals. Additional research is needed to identify messages that will resonate with this group.

Further, lower intensities of smoking may not translate into higher cessation rates. Social smokers tend to have less interest in quitting and are less likely to attempt to quit compared to more established smokers. Chippers similarly have low cessation rates despite low levels of cigarette consumption. Recent work by Lawrence et al and Fagan et al suggests that sociodemographic factors (eg, gender, ethnicity, income, and education) are particularly important influences on quit attempts and on the intention to quit among nondaily young adult smokers.[31,32] In this regard, it is noteworthy that nearly half of all previously unrecognized smokers in this sample tried to quit in the previous 12 months. These disparities need to be carefully considered in developing interventions targeting young adult cigarette use.[32-34]

Data on the social environment of young adult smokers demonstrate that many of them are surrounded by others who smoke and, often, who binge drink. This suggests that tobacco is an important aspect of social interaction among young adults and that altering the social context of tobacco use, such as through smoke-free ordinances, may be especially helpful to reduce the social cues that encourage smoking among previously unrecognized smokers. Recent declines in the prevalence of smoking in New York City after the implementation of comprehensive tobacco control policies, which were

greater for young as compared with older adults, highlight the importance of this approach.[35]

It is interesting to note that the association between smoking and health effects is already evident among young adult smokers. As a group, previously unrecognized young adult smokers are less likely to report good health. These findings are consistent with a substantial body of literature documenting the negative consequences of smoking early in life.[21] Young adult smokers are also more likely to report more poor mental health days than nonsmokers are. The relationship between smoking and mental health symptoms is complex and likely bidirectional.[36] Given the role of negative mood and affect as a well-recognized barrier to smoking cessation, the similarity between established and previously unrecognized smokers in terms of mental health symptoms raises additional concerns regarding the risk of persistent smoking in this population. Despite evident health effects of smoking among young adults, younger smokers are less likely to use evidence-based treatments when trying to quit and less likely to be advised to quit by health professionals than are older smokers.[37] Helping all young smokers to quit early in life is an important challenge for the entire tobacco control community.

A limitation of our subject sample is the lack of racial and ethnic diversity (nearly all subjects were white), which precluded us from examining possible ethnic group differences in the prevalence of previously unrecognized smoking. In the Delnevo et al study, previously unrecognized smokers were most commonly found among African American men and Hispanic women.[18] A further limitation of this study is the lack of longitudinal follow-up data. Thus we are not able to determine if the previously unrecognized smokers identified here will progress to established smoking, continue to smoke at a low level, or stop smoking over time. Prior work by Kenford et al with a college sample found substantial persistence of cigarette use over a 4-year period.[8] Cohort studies involving the full range of young adult smokers are clearly warranted.

The results of this study underscore the importance of using the appropriate criteria when assessing the prevalence of smoking among young adults. Our findings indicate that the adult definition of smoking significantly underestimates prevalence when applied to a young adult population. Although most previously unrecognized smokers are occasional smokers who most likely do not consider themselves to be "smokers," at least at this time they do smoke cigarettes. By excluding them from being counted as smokers, the standard adult measure renders them invisible and fails to provide information on this substantial group that could be used to develop more effective interventions to prevent them from progressing to daily smoking.

This descriptive overview indicates that although previously unrecognized smokers differ substantially from established smokers in terms of the intensity of cigarette use, they already resemble established smokers a great deal in terms of social exposure to smoking and related risk factors such as alcohol use. Despite lower levels of smoking, it further appears that previously unrecognized smokers also experience health symptoms related to their cigarette use. Future efforts to measure smoking prevalence among young adults should strongly consider the use of both adolescent and adult measures of cigarette use in order to capture the full range of young adult smoking behavior.

REFERENCES
1. Lantz PM. Smoking on the rise among young adults: implications for research and policy. *Tob Control*. 2003 Jun;12 Suppl 1:i60-i70.
2. Backinger CL, Fagan P, Matthews E, Grana R. Adolescent and young adult tobacco prevention and cessation: current status and future directions. *Tob Control*. 2003 Dec;12 Suppl 4:IV46-53.
3. Chen K, Kandel DB. The natural history of drug use from adolescence to the mid-thirties in a general population sample.[see comment]. *Am J Public Health.* 1995;85(1):41-47.

4. Chassin L, Presson CC, Rose JS, Sherman SJ. The natural history of cigarette smoking from adolescence to adulthood: demographic predictors of continuity and change. *Health Psychol*. 1996 Nov;15(6):478-484.

5. Chassin L, Presson CC, Pitts SC, Sherman SJ. The natural history of cigarette smoking from adolescence to adulthood in a midwestern community sample: multiple trajectories and their psychosocial correlates. *Health Psychol.* 2000;19:223-231.

6. Orlando M, Tucker JS, Ellickson PL, Klein DJ. Developmental trajectories of cigarette smoking and their correlates from early adolescence to young adulthood. *J Consult Clin Psychol.* 2004;72(3):400-410.

7. Wetter DW, Kenford SL, Welsch SK, et al. Prevalence and predictors of transitions in smoking behavior among college students. *Health Psychol*. 2004 Mar;23(2):168-177.

8. Kenford SL, Wetter DW, Welsch SK, et al. Progression of college-age cigarette samplers: what influences outcome. *Addict Behav*. 2005 Feb;30(2):285-294.

9. Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors.[see comment]. *BMJ*. 2004;328(7455):1519.

10. CDC. 2009 Behavioral Risk Factor Surveillance System Questionnaire. December 30, 2008. Available at: http://www.cdc.gov/brfss/questionnaires/pdf-ques/2009brfss.pdf. Accessed May 24, 2009.

11. CDC. National Health Information Survey. NHIS Questionnaire 2007. Available at: ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Survey_Questionnaires/NHIS/2007/English/qadult.pdf. Accessed May 24, 2009.

12. CDC. 2006 National Youth Tobacco Survey and Key Prevalence Indicators. Available at: http://www.cdc.gov/tobacco/data_statistics/surveys/NYTS/00_pdfs/indicators.pdf. Accessed May 24, 2009.

13. Grunbaum J, Kahn L, Kinchen S, et al. Youth Risk Behavior Surveillance. *MMWR*. 2002;51(SS04):1-64.

14. CDC. Youth Risk Behavior Surveillance: National College Youth Risk Behavior Survey. *MMWR*. 1995;46(SS-6):1-54.

15. Rigotti N, Lee J, Wechsler H. US college students' use of tobacco products. Results of a national survey. *JAMA*. 2000;284:699-705.

16. Emmons K, Wechsler H, Dowdall G, Abraham M. Predictors of smoking among US college students. *Am J Public Health.* 1998;88:104-107.

17. Everett S, Husten C, Kann L, et al. Smoking initiation and smoking patterns among US college students. *J Am Coll Health.* 1999;48:55-60.

18. Delnevo C, Lewis M, Kaufman I, Abatemarco D. Defining cigarette smoking status in young adults: a comparison of adolescent vs. adult measures. *Am J Health Behav.* 2004;28:374-380.

19. Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys. 4th ed. Lenexa, Kansas: The American Association for Public Opinion Research 2006.

20. Measuring Healthy Days: Population Assessment of Health-Related Quality of Life. Atlanta, Georgia: Centers for Disease Control and Prevention; 2000 November, 2000.

21. Preventing Tobacco Use Among Young People: A Report of the Surgeon General.: Health and Human Services PHS, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office of Smoking and Health; 1994.

22. Hammond D. Smoking behaviour among young adults: beyond youth prevention. *Tob Control*. 2005 Jun;14(3):181-185.

23. Rigotti NA, Lee JE, Wechsler H. US college students' use of tobacco products: results of a national survey. *JAMA*. 2000;284(6):699-705.

24. Tercyak KP, Rodriguez D, Audrain-McGovern J. High school seniors' smoking initiation and progression 1 year after graduation. *Am J Public Health*. 2007 Aug;97(8):1397-1398.

25. Ling PM, Glantz SA. Why and how the tobacco industry sells cigarettes to young adults: evidence from industry documents. *Am J Public Health*. 2002 Jun;92(6):908-916.

26. Ling PM, Glantz SA. Using tobacco-industry marketing research to design more effective tobacco-control campaigns. *JAMA*. 2002 Jun 12;287(22):2983-2989.

27. Shiffman S. Tobacco chippers - individual differences in tobacco dependence. *Psychopharmacology. 1989;97:539-547.*

28. Gilpin E, White V, Pierce J. How effective are tobacco industry bar and club marketing efforts in reaching youth? *Tob Control. 2005;14:186-192.*

29. Moran S, Wechsler H, Rigotti NA. Social smoking among US college students. *Pediatrics*. 2004 Oct;114(4):1028-1034.

30. Levinson AH, Campo S, Gascoigne J, et al. Smoking, but not smokers: identity among college students who smoke cigarettes. *Nicotine & Tobacco Research*. 2008 Jan;9(8): 845-852.

31. Fagan P, Augustson E, Backinger CL, et al. Quit attempts and intention to quit cigarette smoking among young adults in the United States. *Am J Public Health*. 2007 Aug;97(8):1412-1420.

32. Lawrence D, Fagan P, Backinger CL, et al. Cigarette smoking patterns among young adults aged 18-24 years in the United States. *Nicotine & Tobacco Research*. 2007 Jun;9(6):687-697.

33. Solberg LI, Asche SE, Boyle R, et al. Smoking and cessation behaviors among young adults of various educational backgrounds.[see comment]. *Am J Public Health*. 2007 Aug;97(8):1421-1426.

34. Green MP, McCausland KL, Xiao H, et al. A closer look at smoking among young adults: where tobacco control should focus its attention. *Am J Public Health*. 2007 Aug;97(8):1427-

1433.

35. Frieden TR, Mostashari F, Kerker BD, et al. Adult tobacco use levels after intensive tobacco control measures: New York City, 2002-2003. *Am J Public Health.* 2005 Jun;95(6):1016-1023.

36. Breslau N, Peterson EL, Schultz LR, et al. Major depression and stages of smoking. A longitudinal investigation. *Arch Gen Psychiatry.* 1998;55(2):161-166.

37. Curry SJ, Sporer AK, Pugach O, et al. Use of tobacco cessation treatments among young adult smokers: 2005 National Health Interview Survey. *Am J Public Health.* 2007 Aug;97(8):1464-1469.