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APC-Modeling of Smoking Prevalence among US Adolescents and Young Adults

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Abstract

Objective—To investigate the association of age, period and cohort with the changing pattern of cigarette smoking among youth and young adults for better planning tobacco control in the United States.

Methods—Age-period-cohort analysis of the 1990-2005 National Survey on Drug Use and Health data.

Results—Rates of lifetime and 30-day smoking for adolescents fluctuated between 1990-96 before they declined; the same rates for young adults progressively increased until 2002 before declining. There were significant cohort effects on changes in the prevalence rates of cigarette smoking.

Conclusions—The cohort effects on smoking underscore the need for sustained tobacco control policies.

Keywords

tobacco control; adolescent smoking; APC Modeling; United States

INTRODUCTION

The first Surgeon General Report on tobacco and health in 1964 marked the beginning of the inclusion of tobacco prevention activities as part of disease prevention strategies of the United States (US).¹ The first legislative act requesting the labeling of cigarette packaging with health warnings was enacted in 1965 and followed by a ban on cigarette advertisement on radio and television in 1971,² progressive increases in tobacco taxes by states since 1965 and doubling of the federal tobacco tax in 1983,³ the nonsmokers' rights movement during the 1970s,⁴ and the subsequent national and local smoking bans in public and in workplaces, and the restrictions of tobacco sales to minors at the state level since the mid-1980s⁵ and at the national level in 1996.⁶

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Authors' Disclaimers:

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Educational programs for adolescents smoking prevention emerged at the beginning of the 1970s,⁷ including the pioneer work of behavioral intervention by Evans et al,⁸ empirical tests of educational curricula by Botvin,⁹ tobacco prevention trials conducted in California¹⁰ and Minnesota.¹¹ By the 1990s, an antismoking momentum had been established in the United States.⁷ In addition to the restrictions of tobacco sales to minors, restrictions of smoking in schools were endorsed by key educational organizations between 1987 and 1991,^{12,13} and a number of new school-based smoking prevention programs were adapted.¹⁴⁻¹⁶

In addition to school-based prevention, smoking prevention was also incorporated into many community-based programs, such as the Minnesota Heart Health Program,¹¹ the Community Intervention Trial for Smoking Cessation or COMMIT,¹⁷ and the American Stop Smoking Intervention Study for Cancer Prevention or ASSIST.² Paid anti-tobacco mass-media campaigns were also launched at the state level in the 1990s (eg, Arizona, California, Florida, and Massachusetts)¹⁸⁻²⁰ and at the national level after the 1990s (eg, the “Truth” campaign by American Legacy foundation).²¹ The Tobacco Master Settlement Agreement between the tobacco companies and the Attorney Generals of 46 US states in 1998 generated monetary sources for tobacco control in the subsequent years.²²

In response to these efforts, smoking rates among adults have declined progressively since 1965.^{23,24} However, no such declining pattern has been observed among adolescents. Data from the Tobacco Supplement to the Current Population Survey indicated that the incidence rate of cigarette smoking among adolescent females increased since 1965 to the same levels as males in 1975.²⁵ Data from the Youth Risk Behavior Survey indicated that the prevalence rate of lifetime smoking for high school students varied from 69.5% to 71.3% during 1991-1999 before it declined to 50.3% in 2007. With respect to current smoking (smoked at least on one day in the past 30 days), the prevalence rate increased from 27.5% in 1991 to 36.4% in 1997, then declined to 21.9% in 2003 and further to 20.2 in 2007.²⁶ A similar trend was also revealed from the Monitor the Future Study.²⁷

Relative to adolescents, studies regarding levels and patterns of tobacco use among young adults in the US are fewer. One study using the 1998-1999 Tobacco Use Supplement to the Current Population Survey data indicated that 26% of young adults 18-24 years old smoke cigarettes. Another studies using longitudinal data from the Coronary Artery Risk Development in Young Adults (CARDIA) data collected in 1985-86 and 1995-96 among young adults 18-30 years old indicated declines in current smoking among Whites and Black males but increases smoking among Black females.²⁸ Young adulthood represents a high risk period for tobacco use and they also represent a primary marketing target by tobacco industries after tobacco marketing that targeted adolescents were prohibited.^{29,30}

Epidemiologically, the prevalence rates of adolescent smoking over time can be decomposed into 3 important time-related factors or effects: (a) chronological age, (b) year when smoking rates are assessed, and (c) year of birth.^{31,32} It has been well established that the likelihood of smoking increases with age - the “age effect”.^{33,34} In addition to age, variations in smoking rates over time may be a reflection of changes in pro- and anti-tobacco effort from year to year - the “period effect”. Lastly, year of birth may also affect the annual smoking rates due to different accumulative exposures to pro- and anti-tobacco efforts - the “cohort effect”. For example, if a tobacco control program is implemented for several consecutive years, adolescents who are 12 years of age or younger will be exposed to the prevention program continuously from 12 years of age and up. However, for adolescents who are older than 12, the years of exposure to prevention program will be inversely proportionate to their age. For example, youth who are 17 will have only one year of

potential exposure to the prevention program before turning 18, while youth who are 13 will have 5 years.

The age-period-cohort (APC) analysis^{31,32} provides a method to disentangle the age, period and cohort effects using multi-year prevalence data by age. Instead of speculating computed rates, APC method models the data using chronological age, time period and birth cohort as the 3 predictor variables. APC modeling is often used in investigating vital rates such as morbidity and mortality of cancers, cardiovascular and infectious diseases.³⁵⁻³⁷ One study reported the use of the APC method in analyzing adolescent smoking in California.³⁸ Results from the study demonstrated a significant program effect in delaying smoking initiation among adolescents from the California Tobacco Control Program, although other studies using the same data but different methods indicated the lack of program effect.³⁹

In this study, we applied the APC method to examine effect from chronological age, time period and birth cohort on time trends of cigarette smoking among adolescents and young adults during the 1990-2005 period. We hypothesized that there were significant period and cohort effects on the observed trend in the prevalence rates of cigarette smoking. The purpose is to advance our understanding of the trend of tobacco smoking and to provide data supporting evidence-based planning for more effective tobacco control.

MATERIALS AND METHODS

Data Source and Sample

Data from the National Survey on Drug Use and Health (NSDUH, formerly the National Household Survey on Drug Use) from 1990 to 2005 were acquired from the data management agency, the Inter-University Consortium for Political and Social Research. NSDUH is sponsored by the Substance Abuse Management and Health Services Administration and has been carried out by the Research Triangle Institute since 1988. Annual data collection typically started in January and ended in December of the same year. A multi-stage random cluster sampling scheme was used to select participants representing all civilian and non-institutionalized individuals 12 years of age and older in the nation. Trained data collectors were sent to the sampled households to administrate the survey. Personal interview and self-report (drug use) had been employed for data collection up to 1998 before they were replaced by Computer-Assisted Personal interviewing (CAPI) and Audio Computer-Assisted Self-Interviewing (ACASI) in 1999.

The sample size of NSDUH varied from 3,176 in 1990 to 28,181 in 2005 (Table 1) and the response rate varied from 68.6% in 1999 to 80.6% in 1995. Data by single year of age for participants 12 -21 years old were analyzed. Although young adulthood is typically extended from 18 to 24 years of age, we did not include those older than 21 because single-year age data beyond 21 are not available from the public NSDUH dataset.

We selected data from the NSDUH because this is the only source that contains annual data on smoking behavior by single year of age for adolescents and young adults. Although, changes were made to the NSDUH, including the increases of sample size and the adaption of the CAPI and ACASI since 1999, provision of incentives to adolescent participants since 2002, and revisions of smoking questions in 1994 and 1999;⁴⁰ results from our analysis indicated that most changes showed limited impact on the overall smoking trends. Even if a change resulted in significant impact, such impacted can be assessed and adjusted (see the sections that follow on Smoking Rate Calculation and Results, including Figure 1). Multi-year data are available from other sources in which little or no change has been made to data collection method, such as the Monitoring the Future Study (MTF) and the Youth Risk Behavior Survey (YRBS). However, the MTF only covered adolescents in grades 8, 10 and

12 and the YRBS collected data every other year, inadequate for APC modeling analysis to simultaneously detect age, period and cohort effects.

Demographic Variables

Demographic variables were age (in years), gender (male and female) and race (African American, Caucasian, and other). Data for these variables were directly acquired from the NSDUH database. The NSDUH contained data with single year of age for respondents up to 21 years old. Such data were used to estimate age-specific prevalence rates that are required for APC modeling. Gender and race were included to describe the study sample.

Lifetime Smokers

Participants were classified as lifetime smokers if they reported having ever smoked a cigarette, including those who smoked a few puffs or part of a cigarette. Due to changes in survey questions regarding ever smoking, for the 1990-98 period, participants were coded as lifetime smokers if they responded positively to the question: "Have you ever smoked a cigarette, even one or two puffs? (yes/no)" For the 1999-2005 period, subjects were coded as lifetime smokers if they responded positively to a revised but similar question "Have you ever smoked part or all of a cigarette? (yes/no)"

Current Smokers

Current smokers were defined according to self-reported smoking behavior during the 30 days prior to the survey. Two slightly different questions were used by NSDUH to assess 30-day smoking. For the surveys conducted before 1993, the question, "How long has it been since you last smoked a cigarette?" Participants in this period were therefore classified as current smokers if they reported the most recent smoking was "within the past 30 days". Beginning in 1994, a question was specifically employed to assess smoking during the past 30 days: "Now think about the past 30 days -- that is, from [DATEFILL] up to and including today. During the past 30 days, have you smoked part or all of a cigarette? (yes/no)" Participants in this period were classified as current smokers if they responded positively to the question.

Smoking Rate Calculation

Prevalence rates of lifetime smoking and current smoking were computed as the weighted ratio of the number of smokers over the total number of participants. We computed the annual smoking rates, overall and stratified by single year of age, and age groups 12-17 (adolescents) and 18 -21 (young adults) respectively. The rates were computed using the PROC SURVEYMEAN from SAS 9.2 (SAS Institute Inc, Cary, NC), capable of estimating sample rates with data collected using multi-stage cluster samples.

To assess impact of the changes made to the NSDUH that may affect the estimated smoking trends, we compared the calculated rates of lifetime smoking and current smoking for the years before and after a change was made. Results from the analysis indicated no significant increases or declines in these 2 rates pre- and post-1999 when the sample size was increased, the survey question on 30-day smoking was revised and the computerized survey method was introduced; and pre- and post-2002 when incentives for the adolescent participants were introduced (Figure 1 and Table 2). However, there was a discontinuation of the pattern of the current smoking rate pre- and post- 1994 when the 30-day smoking question was revised. The prevalence rates were systematically higher post-1994 than 1990-93. This finding was consistent with that from previous analysis.⁴¹ To obtain data adequate for APC modeling, we quantified the impact of this change on reported levels of smoking by first assessing the reported smoking rates in 1993 and in 1995, and then derived a set of adjusting

factors (dividing the rates of 1995 by the rates of 1993) to inflate the self-reported smoking in 1990-93. Prior to adjustment, the overall smoking rates were 19.2%, 19.2%, 18.2% and 17.0% in 1990, 1991, 1992, and 1993 respectively; after adjustment, these rates became 21.6%, 21.6%, 20.6% and 19.8% respectively. The adjusted changes were close to the reported data.⁴¹

APC Modeling Analysis

We conducted APC modeling analysis using the computed smoking rates and the SAS procedure PROC GENMOD. To handle the non-identifiability problem associated with APC modeling, we assumed that the cohort effect was resulted from the interaction between the age and the period.⁴² We then fitted an age-period effect (AP) model to the data and computed the “residuals” (eg, differences between the observed and the AP model predicted smoking rates). We further plotted the “residuals” against birth years of the subjects to visually assess the existence of cohort effect. We then fitted a “cohort-effect-only” model to the “residuals” data to quantify the cohort effect, if any. Although using this method will not solve the identifiability problem, it provides a practical modeling method. We selected this analytical approach than others, because (1) it is epidemiologically plausible to conceive that cohort effect is resulted from the interaction between age effect and period effect;^{31,38} (2) the method is easy to follow; and (3) reported studies on the solution of APC modeling that compared various methods and concluded that results estimated using this approach are close to very advanced methods, such as the mechanism-based approach.⁴³

RESULTS

Sample Characteristics

Table 1 summarizes the basic characteristics of the study sample. A total of 270,738 subjects aged 12 to 21 years from the 1990-2005 NSUDH were included, of whom 181,296 (68.5 %) were 12-17 years old and 89,442 (31.5%) were 18-21 years old with the mean age varying from 15.8 to 16.2. Among the sample, 49.7% were male, 59.6% White, 16.2% Black and 24.2% others.

Prevalence of Cigarette Smoking

Figure 1 and Table 2 presents the prevalence rates of lifetime and current smoking. Among adolescents, the prevalence of lifetime smoking fluctuated between 33.3% and 39.7% during 1990 - 1997, and reached the lowest level of 26.9% in 2005. Current smoking showed a similar time trend despite its relatively low level. Furthermore, no discontinuation was observed in the levels of current smoking between 1990-93 and 1994-2005 when the NSDUH revised its survey item on past 30-day smoking in 1994, suggesting the appropriateness of the adjustment we made in reducing the impact from such methodological change as previously described in the Method section. In addition, no peculiar change in the trends of adolescent smoking was observed around 1999 when the NSDUH increased its sample size and in 2002 when the NSDUH started to provide monetary incentives to adolescent participants.

Among young adults 18-21 years old, the prevalence rate of lifetime smoking varied between 65% and 68% between 1990 and 2002, followed by a declining trend thereafter. The ratio of lifetime smoking among young adults to that of adolescents increased from 1.65 in 1990 to 2.37 in 2005. Current smoking among young adults showed a progressively increasing trend from 29.8% in 1993 to 40.2% in 2001 before it declined gradually. Likewise, the ratio of current smoking between young adults and adolescents was 2.01 in 1990 and 3.54 in 2005.

Age, Period and Cohort Effects

Data in the left panel of Figure 2 indicates that both life time smoking (the dashed line) and current smoking (the solid line) were positively associated with age. As age advanced, the likelihood of smoking progressively increased. Compared to the age effect, the period effect was less dramatic (the mid-panel of Figure 2). First, it is worth noting that no significant “period effect” was associated with current smoking in 1994 when the survey question on past 30-day smoking was revised; no significant period effect on both lifetime and current smoking in 1999 when the sample size was increased, the life-time smoking question was revised and the computerized data collection method was introduced; and a noticeable positive “period effect” for the 2 smoking measures in 2002 when incentives to adolescents were first introduced. Despite fluctuations in the estimate period effect due to changes in methods and other unknown factors, data in the figure showed a overall progressive declining trend in the period effect with regard to lifetime smoking since 1994 and current smoking since 1997.

The cohort effect was striking with regard to the likelihood of both lifetime smoking and current smoking (right panel of Figure 2). For participants born between 1969 and 1980, the level of lifetime smoking was positively associated with birth year; among participants born between 1980 and 1985, the level of lifetime smoking did not vary much with year of birth; and among participants born between 1986 and 1991, the level of lifetime smoking was negatively associated with year of birth. The downward cohort effect for lifetime smoking fluctuated for participants born in 1991-93 (the last 3 birth cohorts).

A similar pattern of cohort effect was observed for current smoking with 3 distinctions: The increment segment of the association between current smoking and birth year was steeper and shorter (for participants born between 1969 and 1976), the plateau was higher and wider (for participants born between 1976 and 1981), and there was an upward trend for participants who were born in 1991-93.

DISCUSSION AND CONCLUSIONS

In this research, we used the age-period-cohort method and the 1990-2005 NSDUH data to investigate the associations between the likelihood of smoking (lifetime and past 30 days) and chronological age, time period and birth cohort among a national random sample of adolescents and young adults in the United States. The NSDUH provides a unique and useful data source for tobacco research because of its multi-year annual surveys, national representative sample, completed coverage of subjects by age and well-devised questions on smoking behavior. Despite the methodological changes to the NSDUH in 1994 (revision of the 30-day smoking question), 1999 (revision of lifetime smoking question and increase of sample size and adaption of computer-assisted survey method) and 2002 (introduction of incentives to adolescents), results from our analysis, including direct visual inspection and in-depth APC modeling, indicated that the impact from these changes is either limited or can be detected and adjusted using appropriate methodologies so that the NSDUH data can be safely used to examine long-term trends in smoking at the national level.

The 1990-2005 represents a period with substantial efforts on tobacco control at the local and national levels. During this period, smoking prevalence rates showed a declining trend for adolescents and young adults in general. The prevalence rate of lifetime smoking among adolescents declined from approximately 40% in 1990 to 27% in 2005 with some fluctuations during 1990 - 1999. The prevalence rate of current smoking also declined from 15.4% in 1990 to 10.5% in 2005 with some fluctuations during 1994 -1997. In contrast to adolescent, the prevalence rates for young adults increased during 1990-2002 before they started to gradually decline. The lack of reduction in young adults smoking since the later

1990s could be due to the shift in tobacco marketing to this population after the Master Settlement Agreement in 1998 that prohibited tobacco industries to target adolescents.^{29, 30}

Significant Age and Cohort Effect

Despite limited declines in cigarette smoking among adolescents and young adults during the 1990-2005, age effect and cohort effect were substantial. Results from the APC analysis confirmed the conclusion from other studies that increases in age are associated with increased likelihood of smoking.^{33,34} Findings from our analysis confirmed the observations from others that cigarette smoking appears to be more explainable by age and cohort effects than by period effects.^{44,45} For participants born between 1978 and 1989, their levels of current smoking were negatively associated with year of birth. Participants born since 1978 were aged 12 in 1990 and later, corresponding to the period with increased tobacco prevention efforts.^{7,13,15,16} The cohort effect on current smoking was leveled off for participants born since 1991. Participants born in 1991 and later were 12 years of age in 2003, corresponding to the period when substantial cut in funding for tobacco control at the national and state levels, particularly the funding from the Master Settlement Agreement.⁴⁶

Birth Cohort as a Risk Factor for Smoking

Compared to participants born after 1985, the cohort effect for participants born during 1969 - 1985 was associated with a generally increased risk of lifetime smoking. Various factors may explain this risky cohort effect, particularly the intensive marketing by tobacco industries. Chronologically, participants who were born in 1969 - 1985 were passed through 12-21 years of age in 1980-1997. This was the period when adolescent tobacco control efforts started to grow and tobacco industries strengthened their advertising strategies to recruit adolescent smokers after the declines in adult smoking.^{47,48} The expenditure for advertisement by tobacco industries increased from approximately \$0.5 billion in 1975 to \$1.2 billion in 1980, and further to \$2.5 billion in 1985.⁴⁹ In addition to directly targeting your adults,^{29, 30} studies have shown that tobacco marketing targeted adults also showed a significant effect in recruiting adolescents to smoke.⁵⁰

Recommendation

Findings of this study, particularly the cohort effect on lifetime and past 30-day smoking, underscore the need for sustained tobacco control policies to effectively prevent US adolescents and young adults from using tobacco.^{27,28} Every year there are approximately 4 million children entering adolescence and furthering through young adulthood. Although a declining trend in adolescent smoking has appeared in the US since 1996-97, such declining trend could be due to the persistent tobacco control effect since the early 1990s. Giving the weakening of the cohort effect associated with funding reduction since 2003,⁴⁶ the observed declining trend in smoking among adolescents and young adults may disappear if no additional action is taken. Although it is illegal to target adolescents, tobacco industries shifted their strategies to target young adults to recruit smokers.^{29,30} Tobacco marketing targeting older adults also shown to recruit adolescents to smoke.⁵⁰ Regardless of our tobacco control efforts, tobacco industries progressively expanded their strategies for tobacco advertisement by adding new venues such as internet, cell phones to promote tobacco sales to all Americans, including adolescents with advertising and promotion expenditure totaled \$13.5 billion in 2006.^{48,49}

Strengths and Limitations

Although, findings of this study indicate that the method we used to solve the APC model appears to be valid, it depends on the assumption that cohort effect is resulted from an interaction between age and period (see the APC Modeling Analysis in Methods section of

this paper).⁴² Despite the positive results from this study, validity of this method for other data may not be warranted without further testing. It is also worth noting that the identification of cohort effect through APC modeling cannot replace program effect evaluation for tobacco control and risk factor analysis for causal conclusions. In addition, data used for this study were collected through in-home surveys. Smoking rates estimated using such data often tend to be lower than those estimated using data collected in classroom settings such as those for MTF and YRBSS. Despite these limitations, findings of this study add new data advancing our understanding of the levels and patterns of cigarette smoking among US adolescents and young adults, and provide new evidence for tobacco control planning and decision-making at the national level.

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Figure 1.
Prevalence Rates of Cigarette Smoking in Lifetime and Past Month among Adolescents and Young Adults, United States, 1990-2005

Note: The prevalence rates were estimated using data from the National Survey on Drug Use and Health (formerly known as the National Household Survey on Drug Abuse). The prevalence rates for subjects during 1990-93 were adjusted to account for the impact of changes in the questions to collect data on cigarette smoking in the past month (e.g., 30 days prior to the survey) (see text for explanation in detail).

Figure 2.
Age, Period, Cohort Effect (Regression Coefficients) of Lifetime and Current Cigarette Smoking among Adolescents and Young Adults, 1990-2005

Table 1

Basic Characteristics of the NSDUH Sample, 1990-2005

Year	Sample size	Gender (%)		Race/ethnicity (%)				Age	
		Male	Female	White	Black	Others	<17 (%)	Mean (SD)	Mean (SD)
1990	3176	48.8	51.2	52.8	20.7	26.5	68.5	16.1 (2.7)	16.1 (2.7)
1991	12065	48.7	51.3	45.5	25.6	28.9	66.3	16.2 (2.8)	16.2 (2.8)
1992	11071	48.8	51.2	45.5	25.6	28.9	65.5	16.2 (2.8)	16.2 (2.8)
1993	9678	49.9	50.1	43.1	23.9	33.0	72.1	15.8 (2.7)	15.8 (2.7)
1994	6543	49.8	50.2	47.8	22.6	29.6	71.8	15.8 (2.7)	15.8 (2.7)
1995	6530	49.0	51.0	46.7	23.8	29.5	70.4	15.9 (2.7)	15.9 (2.7)
1996	6701	47.9	52.1	44.4	24.9	30.7	67.7	16.1 (2.7)	16.1 (2.7)
1997	10972	48.8	51.2	49.9	17.0	33.1	71.5	15.9 (2.7)	15.9 (2.7)
1998	10586	48.5	51.5	43.7	22.1	34.2	64.0	16.2 (2.8)	16.2 (2.8)
1999	27654	50.0	50.0	67.6	13.3	19.1	67.6	16.1 (2.8)	16.1 (2.8)
2000	28680	50.0	50.0	67.2	13.2	19.6	67.7	16.1 (2.8)	16.1 (2.8)
2001	26446	49.7	50.3	66.7	13.4	19.9	65.9	16.2 (2.8)	16.2 (2.8)
2002	26865	50.0	50.0	66.4	13.5	20.1	65.9	16.1 (2.8)	16.1 (2.8)
2003	27708	50.6	49.4	63.1	13.9	23.0	65.7	16.2 (2.8)	16.2 (2.8)
2004	27882	49.9	50.1	63.6	13.3	23.1	65.6	16.2 (2.8)	16.2 (2.8)
2005	28181	49.7	50.3	62.1	13.5	24.4	66.3	16.2 (2.8)	16.2 (2.8)
Total	270738	49.7	50.3	59.6	16.2	24.2	68.5	16.1 (2.8)	16.1 (2.8)

Note:

NSDUH: National Survey on Drug Use and Health, formerly known as the National Household Survey on Drug Abuse.

Table 2
Age Specific Prevalence Rates (%) of Lifetime Smoking and Current Smoking, United States, 1990-2005

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Lifetime smoking																
12	16.9	15.9	14.0	14.5	17.0	14.2	15.4	13.9	12.8	11.4	10.3	9.8	8.8	8.1	7.4	5.8
13	23.7	26.3	22.2	21.4	26.6	25.2	20.6	25.7	20.9	21.7	18.7	17.5	18.2	15.3	14.6	14.3
14	39.2	32.8	29.4	30.2	31.4	37.1	30.3	33.2	30.0	34.4	29.2	28.8	29.9	26.0	25.9	20.7
15	43.1	41.9	41.0	42.0	43.1	48.2	44.2	45.7	44.2	43.9	43.5	40.4	40.0	38.0	34.6	30.8
16	51.3	49.3	46.4	46.3	54.8	47.1	50.1	52.8	50.3	51.9	50.3	48.6	48.1	46.1	43.9	40.0
17	60.0	57.3	48.8	52.0	55.4	58.2	55.2	59.7	58.4	58.0	55.8	54.4	57.0	54.2	50.9	48.8
18	57.3	64.0	59.2	58.1	61.8	61.7	62.5	62.5	63.5	62.4	61.8	60.8	65.5	60.7	59.5	56.9
19	66.8	68.6	63.7	58.2	69.8	65.2	64.7	64.9	66.9	70.1	67.1	67.2	66.8	68.0	64.9	63.1
20	66.1	67.9	65.9	64.0	70.2	69.0	66.0	67.9	68.5	69.0	69.4	69.3	71.2	71.9	68.9	68.2
21	71.5	71.4	72.5	69.5	68.9	68.5	67.6	70.9	70.8	71.2	69.9	72.9	73.9	70.8	71.9	67.9
Past 30-day smoking																
12	1.3	1.4	1.1	1.0	3.6	4.8	2.8	4.9	4.3	1.9	1.7	1.7	1.6	1.8	1.1	1.2
13	2.5	3.6	2.7	3.4	6.8	9.8	5.7	9.0	6.9	4.9	4.7	3.9	4.3	3.2	4.2	3.3
14	10.2	6.4	5.2	5.8	10.2	13.5	10.8	12.1	9.6	9.3	8.0	7.1	8.7	9.1	7.9	6.1
15	17.6	11.2	13.6	11.7	16.1	18.6	18.2	18.2	18.0	15.6	14.6	15.1	13.9	13.5	13.4	11.6
16	15.8	17.1	16.5	15.9	23.0	21.8	22.6	22.8	22.0	22.4	20.7	20.5	21.4	19.6	18.2	16.9
17	20.2	25.3	19.7	20.7	23.9	26.7	26.9	29.3	27.6	27.3	27.9	26.9	27.5	25.8	24.8	23.9
18	25.8	25.9	21.3	25.5	27.6	31.8	36.4	36.7	36.8	36.0	35.0	35.5	34.7	34.0	35.0	32.0
19	27.4	29.6	31.0	30.5	32.7	35.3	31.9	35.2	37.7	40.8	40.4	40.3	38.3	37.3	38.8	36.5
20	31.8	32.2	32.0	27.7	31.7	30.9	37.8	41.4	44.5	43.0	41.7	42.2	41.5	45.1	40.3	39.9
21	34.3	34.5	37.5	29.1	31.1	30.0	32.0	40.1	38.8	41.0	40.2	43.3	46.7	41.5	41.6	41.1

Note: Lifetime smoking was referred to the behavior smoking even a few puffs or only part of a cigarette in life, and past 30-day smoking was referred to having smoked at least on one day in the 30 days prior to the survey. The prevalence rates were estimated using data from the National Survey on Drug Use and Health (formerly known as the National Household Survey on Drug Abuse). The prevalence rates for subjects during 1990-93 were adjusted to account for the impact of changes in the questions to collect data on cigarette smoking in the past month (eg, 30 days prior to the survey) (see text for explanations in detail).