Changes in Adolescent Smoking Behaviors in Sequential Birth Cohorts

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INTRODUCTION   Never starting to smoke is the best way to avoid the disease consequences of smoking, and preventing initiation of smoking among adolescents is a goal of almost all tobacco control campaigns. Success in reducing adolescent initiation is described in several other chapters in this monograph, using changes in adolescent prevalence derived from multiple cross-sectional surveys over time. One of these chapters discusses the longest series of survey data collection, the Monitoring the Future study (see Chapter 2).

The focus of this chapter is to examine past changes in past smoking initiation rates at various ages. Recent cross-sectional survey data on adults were used to reconstruct the adults' rates of initiation in the past. This technique is subject to recall and other biases, but allows examination of smoking initiation that occurred prior to the availability of cross-sectional data.

Initiation of cigarette smoking varies dramatically by year of age and has varied substantially across calendar year as well (see Chapter 2). The changes in adolescent initiation over time may have occurred uniformly across all ages, may be larger at some ages than at others, or may change in different directions at different ages. In order to examine initiation trends by both age and calendar year, age-specific initiation rates were estimated for successive birth cohorts of the U.S. population. A birth cohort is a group of individuals born during specific calendar years; in these analyses, a birth cohort consisted of 5-calendar-year groups. Five-year birth cohorts from 1926–30 through 1981–85 were examined, which allowed examination of changes in age-specific initiation rates over a span of approximately 60 years. By examining initiation rates at specific ages (*i.e.*, initiation at age 15) across sequential cohorts born during different calendar years, it is possible to examine changes over time in smoking initiation rates at each year of age. In addition, these age-specific initiation rates by birth cohort can be examined by gender, and for different race and ethnic groups, in order to define differences among these groups in smoking initiation.

METHODS   The principal data source used for these analyses was the Tobacco Supplement to the Current Population Surveys of September, 1992; January and May, 1993; September, 1995; and January and May, 1996. Data from 417,116 self-respondents between 15 and 84 years of age were available for analysis. Ever-smokers were defined as those who had smoked at least 100 cigarettes in their lifetime. Among ever-smokers, age and year of initiation were obtained from the year of the survey, age at the time of the survey, and the answer to the question, "When did you first start smoking fairly

regularly?" Each person's ever-smoking status for each calendar year prior to the date of the survey was reconstructed based upon the respondent's recollection of starting smoking.

All respondents were grouped into sequential 5-year birth cohorts, beginning with those born between the calendar years 1926 and 1930 and extending to those born between 1981 and 1985. Age-specific initiation rates were constructed within each birth cohort by defining those who began the year of age as never-smokers as the population at risk for initiation (denominator for the initiation rate). Those who initiated during that year of age formed the numerator of the rate. Details of the CPS methodology are published elsewhere (see Chapter 9; Bureau of the Census, 1978).

Determination of the smoking status of respondents in any given year was based on the survey administration date, the reported initiation age, and the age given in the survey. The age of initiation was subtracted from the age at the time of the survey, and the result was subtracted from the survey year to define the calendar year in which the respondent began to smoke. The respondent was considered a smoker from that year forward. The survey administration date was represented as a partial year, using both the year and month of the survey in this calculation (*e.g.*, September 1992 became 1992.75). Additionally, 6 months were added to all age responses to account for the distribution of birthdays occurring over the entire calendar year.

The distribution of ages reflected in the original sample was preserved while calculating the initiation rates for each calendar year. Since the distribution of 12- to 17-year-olds varied between calendar years, each initiation rate for each calendar year was standardized to the birth-year distribution of all respondents who would have been between the ages of 12 and 17 in that calendar year. Likewise, in order to make similar comparisons between ethnically diverse samples, the rates for each calendar year were standardized by ethnicity to the ethnic distribution of the United States represented by the 1995/1996 CPS.

HAVE AGE-SPECIFIC ADOLESCENT INITIATION RATES CHANGED OVER TIME?

Figure 8-1 presents initiation rates at single years of age for sequential 5-year birth cohorts of males born between 1926 and 1980. The age-specific initiation rate for each 5-year birth cohort was constructed by using the number of individuals born during the 5 calendar years of a birth cohort who began smoking during a specified age as the numerator. The denominator consisted of the number of individuals who began the same specified age as never-smokers. For example, the initiation rate at age 12 for the 1926–1930 birth cohort between the years 1926 and 1930 used the number of those who began smoking during their 12th year of age (which would have occurred between 1938 and 1942 for this birth cohort) as the numerator and the number of individuals who began their 12th year of age as never-smokers as the denominator. This measure averaged initiation rates at age 12 years for those born during the 5 calendar years that defined the birth cohort. The average age-specific initiation rate for each sequential cohort represented a calendar year period 5 years later than the initiation

Figure 8-1
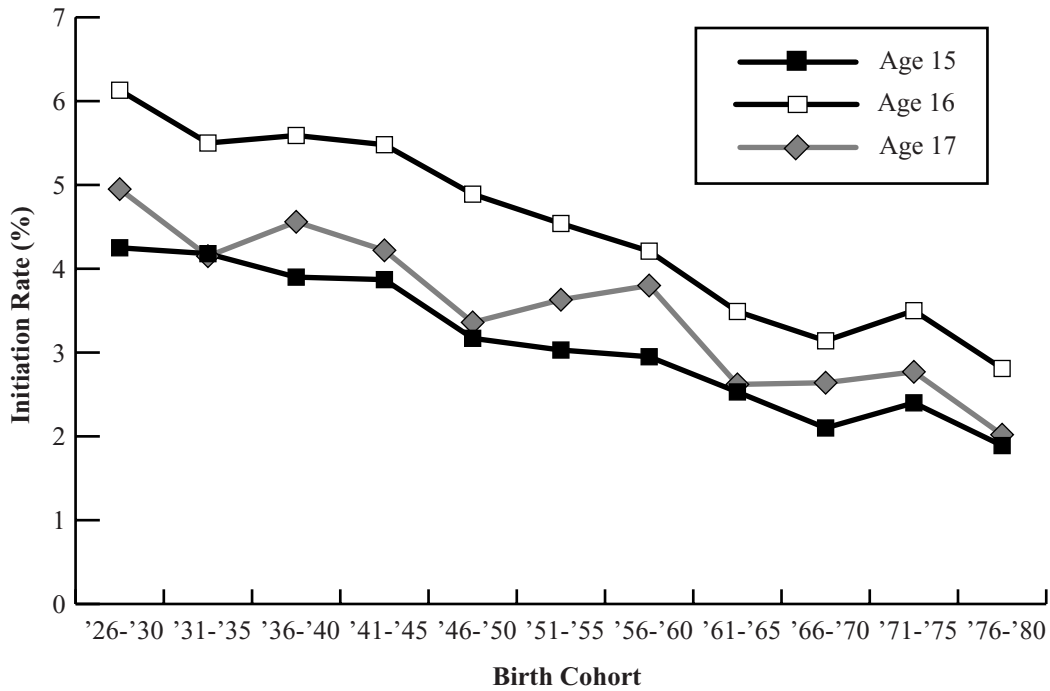**Age-Specific Cigarette Smoking Initiation Rates with 95% Confidence Intervals by 5-Year Birth Cohorts, United States—Males**
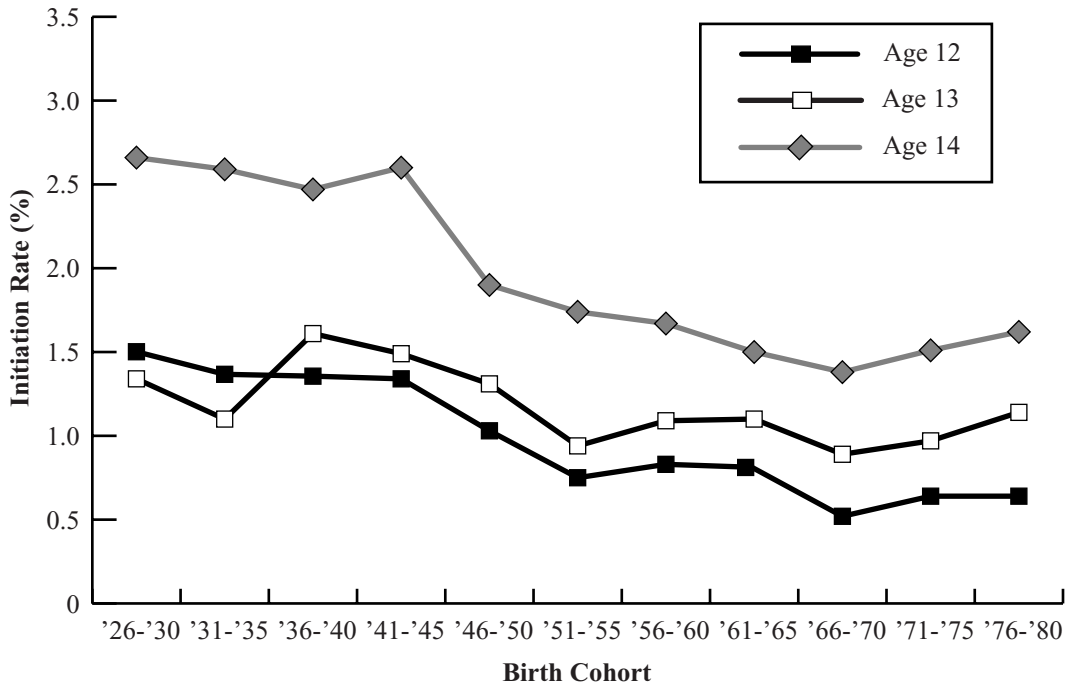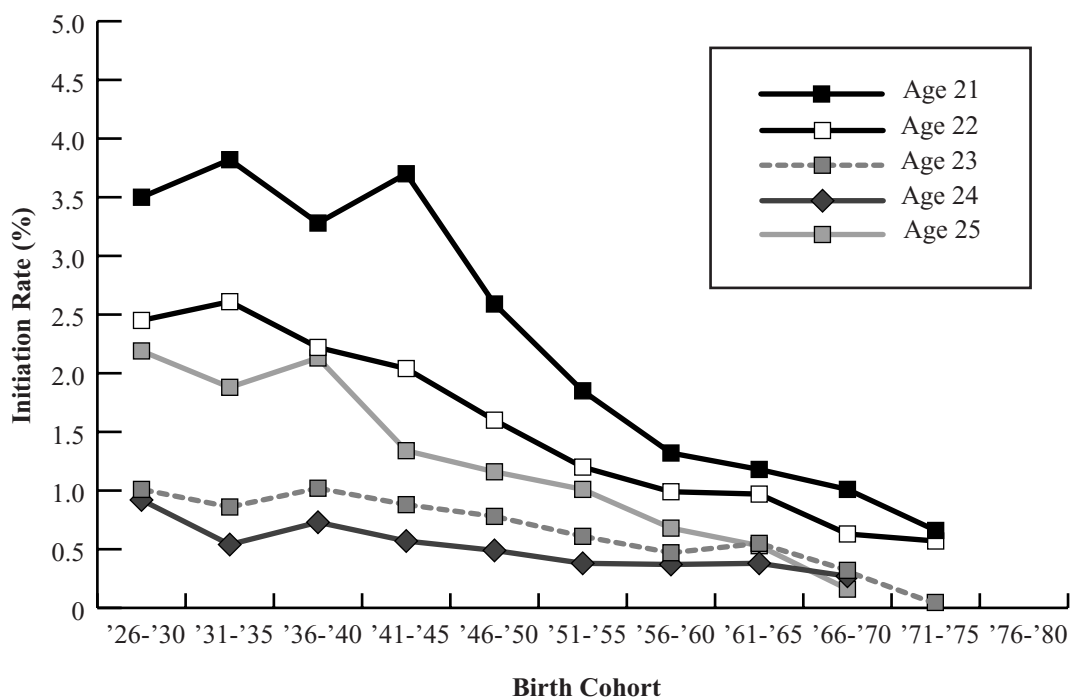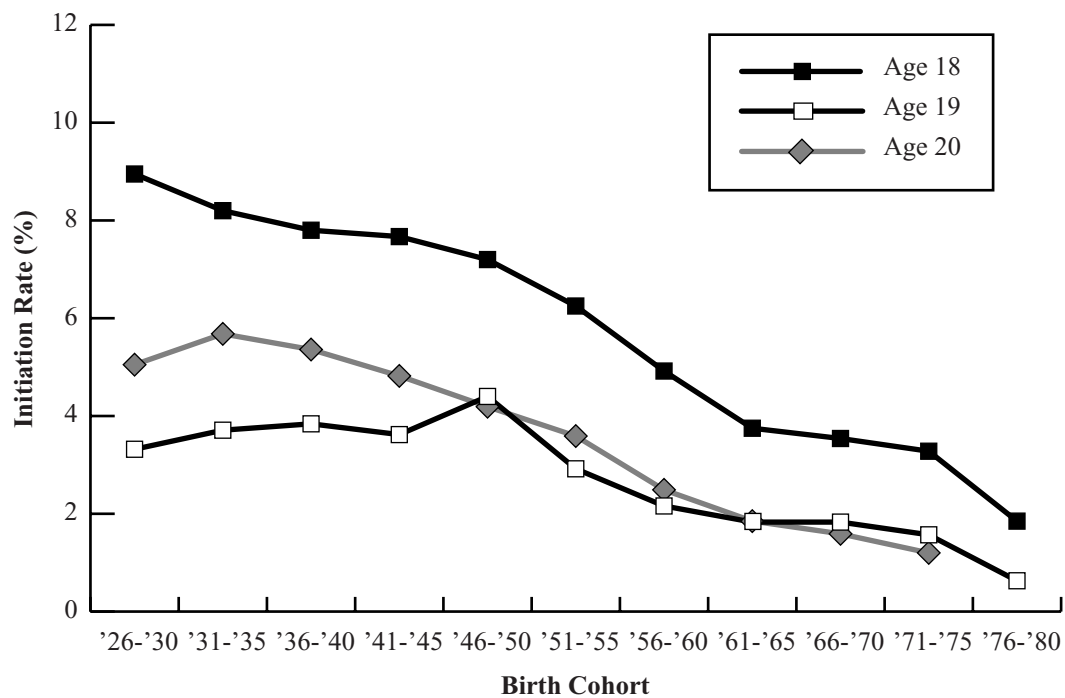
Figure 8-1 (continued)

rate for the cohort that preceded it. Thus, by examining initiation rates for these sequential birth cohorts, a measure of the change (or lack of change) in rates of initiation at specific ages is obtained over a range of calendar years from about 1940 onward.

Figure 8-1 contains initiation rates for males at each single year of age from age 12 through age 25 for 5-year birth cohorts beginning with the 1926–1930 birth cohort and including the 1976–1980 birth cohort. The data are limited to the 1971–1975 birth cohort for those age 20 years and older, since individuals born during the years 1976–1980 would not have reached age 20 by the time of the most recent survey (1995/1996). In general, rates of smoking initiation have declined over time at every age, but the proportionate rate of decline is somewhat greater at older ages than it is at younger ages for males.

Initiation rates for females at each single year of age from age 12 through age 25 are presented in Figure 8-2. Rates of initiation among earlier birth cohorts of females are generally lower than for age- and cohort-matched males, but this difference disappears among more recent cohorts. The pattern of initiation over time appears to be quite different for females. Initiation rates at ages 12–14 appear to increase steadily from earlier birth cohorts to more recent ones, in contrast to the decline over time observed for male initiation rates at these ages. There is a suggestion that this trend of increasing female initiation at ages 12–14 is moderating or disappearing among the more recent cohorts. Initiation rates at ages 15 and 16 among females increase prior to the 1956–60 birth cohort, and then level off or decline slightly in more recent birth cohorts. Female initiation rates at ages 17–20 years show a pattern of increasing rates among earlier birth cohorts, but show a marked decline beginning with those born after 1955. The pattern of initiation rates over time at older ages among females born after 1945 are similar to the pattern over time among males, with a steep decline evident for most cohorts.

Tables 8-1 and 8-2 present the initiation rates estimated for each birth cohort by single year of age of initiation. The results of a linear regression of the rates over time are also presented for both the absolute value of the rate and for the proportional change in rates over time. Among males, there is a statistically significant decline in rates of initiation across sequential cohorts for all ages from age 8 through age 25, with the exception of age 11. The absolute and proportional differences are greatest at ages 18 and 19. Among females, however, there is not a statistically significant decline in initiation for most of the ages under age 16, with the exception of a statistically significant decline for the 11-year-old age group. There are statistically significant declines among females over the age of 16 years (except age 23). When median values for slopes of the proportional change across cohorts are compared for ages 12–17 and ages 18–25, there is a statistically significantly greater set of slopes among the older group compared to the younger group for both males ($P = 0.0005$) and females ($P = 0.0017$). This confirms the impression derived from the differences in absolute rates of initiation that older adolescents have had a greater decline in initiation over time compared to younger adolescents.

Figure 8-2

Age-Specific Cigarette Smoking Initiation Rates with 95% Confidence Intervals by 5-Year Birth Cohorts, United States—Females
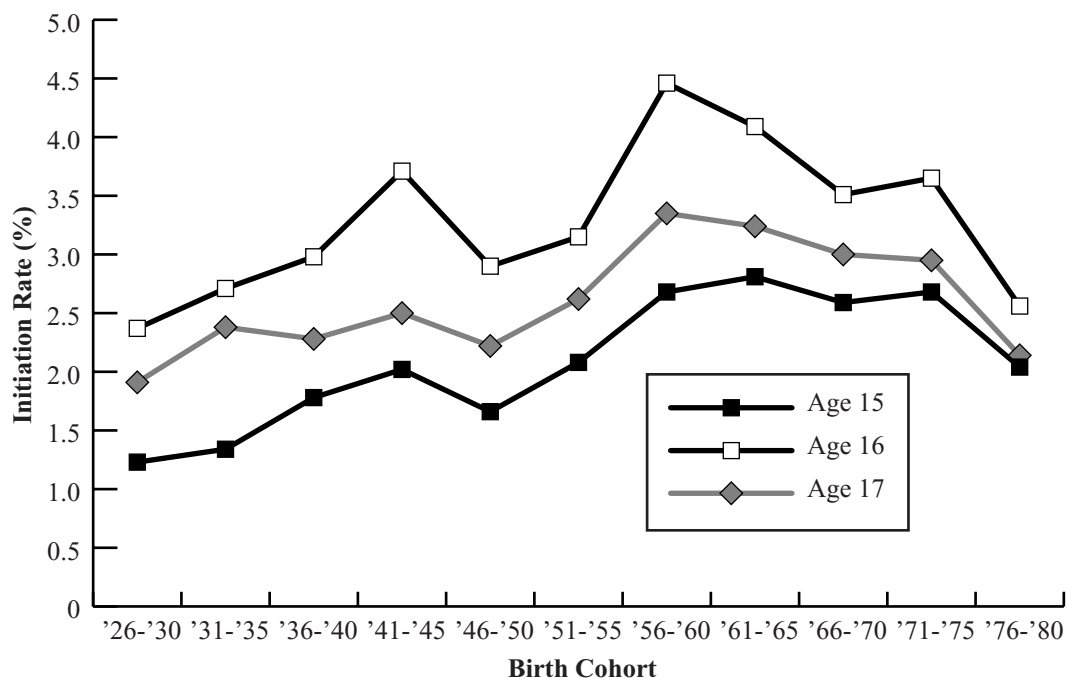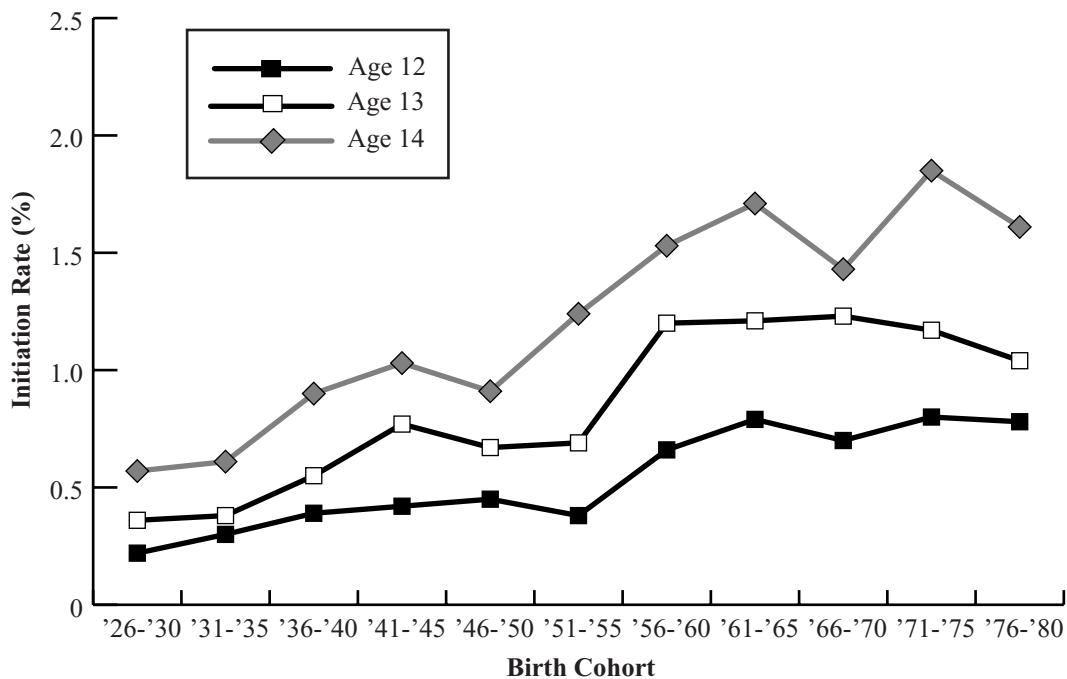
Figure 8-2 (continued)

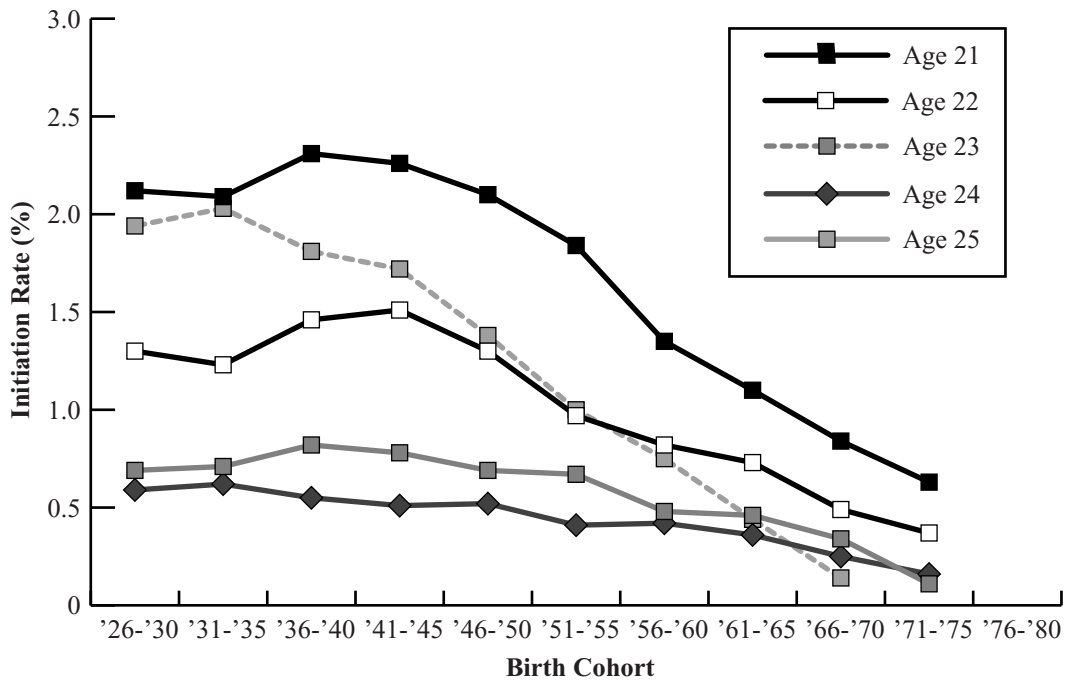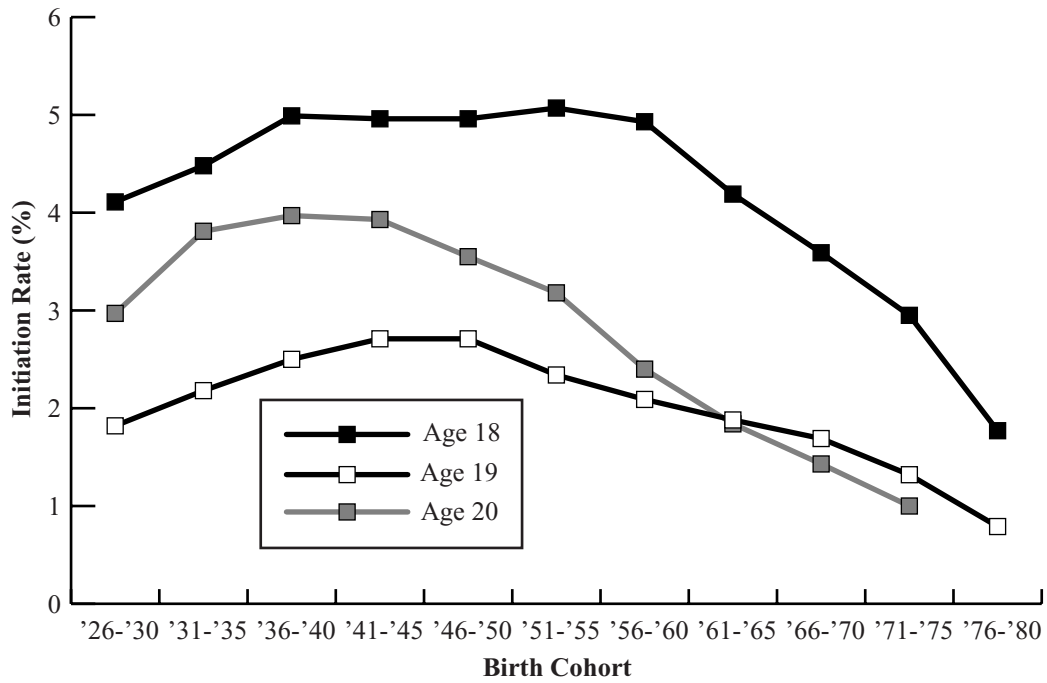
Birth Cohort

Birth Cohort

Table 8-1

Cigarette Smoking Initiation Rates with 95% Confidence Intervals, by 5-Year Birth Cohorts and Age, for CPS 1992/1993 and CPS 1995/1996: United States—Males

Birth Cohort	Age 8 Rate ± CI (%)		Age 9 Rate ± CI (%)		Age 10 Rate ± CI (%)		Age 11 Rate ± CI (%)		Age 12 Rate ± CI (%)		Age 13 Rate ± CI (%)		Age 14 Rate ± CI (%)		Age 15 Rate ± CI (%)		Age 16 Rate ± CI (%)	
'26-'30	0.67	0.16	0.25	0.10	0.51	0.14	0.28	0.10	1.50	0.24	1.34	0.23	2.66	0.33	4.25	0.42	6.13	0.53
'31-'35	0.59	0.15	0.29	0.11	0.53	0.14	0.41	0.13	1.37	0.23	1.10	0.21	2.59	0.33	4.18	0.43	5.50	0.51
'36-'40	0.66	0.15	0.27	0.10	0.49	0.13	0.27	0.10	1.36	0.22	1.61	0.25	2.47	0.31	3.90	0.40	5.59	0.49
'41-'45	0.48	0.12	0.22	0.08	0.39	0.11	0.28	0.09	1.34	0.20	1.49	0.21	2.60	0.28	3.87	0.35	5.48	0.43
'46-'50	0.36	0.09	0.19	0.06	0.31	0.08	0.23	0.07	1.03	0.15	1.31	0.17	1.90	0.21	3.14	0.27	4.89	0.35
'51-'55	0.25	0.07	0.16	0.06	0.23	0.07	0.17	0.06	0.75	0.12	0.94	0.14	1.74	0.19	3.03	0.25	4.54	0.31
'56-'60	0.20	0.06	0.12	0.05	0.21	0.06	0.21	0.06	0.83	0.12	1.09	0.14	1.67	0.18	2.95	0.24	4.21	0.29
'61-'65	0.21	0.06	0.11	0.05	0.24	0.07	0.25	0.07	0.80	0.13	1.10	0.15	1.50	0.18	2.53	0.23	3.49	0.28
'66-'70	0.19	0.07	0.08	0.04	0.18	0.07	0.15	0.06	0.52	0.11	0.89	0.15	1.38	0.19	2.10	0.23	3.41	0.29
'71-'75	0.28	0.10	0.09	0.05	0.22	0.09	0.25	0.09	0.64	0.15	0.97	0.18	1.51	0.23	2.40	0.29	3.50	0.36
'76-'80	0.15	0.08	0.06	0.05	0.16	0.09	0.22	0.10	0.64	0.17	1.14	0.23	1.62	0.27	1.89	0.30	2.81	0.45
Slope	-0.05*		-0.02*		-0.04*		-0.01		-0.10*		-0.05*		-0.15*		-0.25*		-0.34*	
Scaled Slope	-0.08*		-0.08*		-0.07*		-0.04		-0.07*		-0.03*		-0.05*		-0.05*		-0.05*	

Birth Cohort	Age 17 Rate ± CI (%)		Age 18 Rate ± CI (%)		Age 19 Rate ± CI (%)		Age 20 Rate ± CI (%)		Age 21 Rate ± CI (%)		Age 22 Rate ± CI (%)		Age 23 Rate ± CI (%)		Age 24 Rate ± CI (%)		Age 25 Rate ± CI (%)	
'26-'30	4.95	0.52	8.95	0.72	3.32	0.50	5.05	0.64	3.50	0.57	2.45	0.50	1.01	0.33	0.92	0.32	2.19	0.50
'31-'35	4.15	0.47	8.20	0.68	3.71	0.52	5.68	0.66	3.82	0.59	2.61	0.51	0.86	0.31	0.54	0.24	1.88	0.46
'36-'40	4.56	0.48	7.81	0.64	3.84	0.51	5.36	0.62	3.28	0.52	2.22	0.45	1.02	0.31	0.73	0.27	2.13	0.46
'41-'45	4.22	0.41	7.67	0.57	3.62	0.44	4.82	0.52	3.70	0.49	2.04	0.38	0.88	0.26	0.57	0.21	1.34	0.32
'46-'50	3.36	0.31	7.20	0.46	4.04	0.38	4.19	0.41	2.59	0.34	1.60	0.28	0.78	0.20	0.49	0.16	1.16	0.24
'51-'55	3.63	0.30	6.25	0.40	2.92	0.30	3.59	0.34	1.85	0.26	1.20	0.21	0.61	0.15	0.38	0.12	1.01	0.20
'56-'60	3.80	0.29	4.92	0.35	2.12	0.24	2.49	0.27	1.32	0.20	0.99	0.18	0.47	0.12	0.37	0.11	0.68	0.15
'61-'65	2.62	0.25	3.75	0.31	1.83	0.23	1.85	0.23	1.18	0.19	0.96	0.17	0.55	0.13	0.38	0.11	0.53	0.13
'66-'70	2.64	0.27	3.54	0.33	1.83	0.25	1.59	0.23	1.01	0.19	0.63	0.15	0.32	0.12	0.27	0.11	0.16	0.09
'71-'75	2.77	0.33	3.28	0.40	1.57	0.31	1.20	0.30	0.66	0.26	0.57	0.31	0.00	0.00	0.00	0.00	0.00	0.00
'76-'80	2.02	0.56	1.85	0.72	0.63	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Slope	-0.25*		-0.72*		-0.31*		-0.57*		-0.40*		-0.25*		-0.09*		-0.06*		-0.25*	
Scaled Slope	-0.05*		-0.07*		-0.07*		-0.08		-0.09*		-0.09*		-0.08*		-0.08*		-0.10*	

*Indicate significance at 0.05 level.

Table 8-2

Cigarette Smoking Initiation Rates with 95% Confidence Intervals, by 5-Year Birth Cohorts and Age, for CPS 1992/1993 and CPS 1995/1996: United States—Females

| | Initiation Rate (%) by Age | | | | | | | | | | | | | | | | | |
| Birth | Age 8 | | Age 9 | | Age 10 | | Age 11 | | Age 12 | | Age 13 | | Age 14 | | Age 15 | | Age 16 | |
Cohort	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)
'26-'30	0.08	0.05	0.02	0.02	0.03	0.03	0.07	0.04	0.22	0.08	0.36	0.10	0.57	0.13	1.23	0.19	2.37	0.26
'31-'35	0.11	0.06	0.08	0.05	0.11	0.06	0.10	0.05	0.30	0.09	0.38	0.11	0.61	0.14	1.34	0.20	2.71	0.29
'36-'40	0.14	0.06	0.06	0.04	0.07	0.04	0.07	0.04	0.39	0.10	0.55	0.12	0.90	0.16	1.78	0.22	2.98	0.29
'41-'45	0.07	0.04	0.06	0.04	0.09	0.04	0.11	0.05	0.42	0.10	0.77	0.13	1.03	0.15	2.02	0.21	3.71	0.29
'46-'50	0.07	0.03	0.04	0.03	0.07	0.04	0.13	0.05	0.45	0.09	0.67	0.11	0.91	0.13	1.66	0.17	2.90	0.23
'51-'55	0.08	0.03	0.04	0.03	0.09	0.04	0.10	0.04	0.38	0.08	0.69	0.10	1.02	0.13	2.08	0.18	3.15	0.23
'56-'60	0.11	0.04	0.05	0.03	0.10	0.04	0.15	0.05	0.64	0.09	1.20	0.13	1.53	0.15	2.68	0.20	4.46	0.26
'61-'65	0.09	0.04	0.09	0.04	0.12	0.04	0.19	0.05	0.79	0.11	1.21	0.13	1.71	0.16	2.81	0.21	4.09	0.26
'66-'70	0.12	0.05	0.12	0.05	0.10	0.04	0.23	0.06	0.70	0.11	1.23	0.15	1.43	0.16	2.59	0.22	3.51	0.27
'71-'75	0.11	0.05	0.11	0.05	0.12	0.06	0.23	0.08	0.80	0.14	1.17	0.17	1.85	0.22	2.68	0.27	3.65	0.32
'76-'80	0.12	0.07	0.06	0.05	0.13	0.07	0.27	0.10	0.78	0.18	1.04	0.21	1.61	0.26	2.04	0.30	2.56	0.40
Slope	0.01		0.01		0.01		0.03*		0.03		-0.03		0.03		-0.11		-0.39*	
Scaled Slope	-0.06		0.15		0.06		0.22*		0.05		-0.02		0.02		-0.04		-0.08	

| | Initiation Rate (%) by Age | | | | | | | | | | | | | | | | | |
| Birth | Age 17 | | Age 18 | | Age 19 | | Age 20 | | Age 21 | | Age 22 | | Age 23 | | Age 24 | | Age 25 | |
Cohort	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)	Rate	± CI (%)
'26-'30	1.91	0.24	4.11	0.36	1.82	0.25	2.97	0.33	2.12	0.29	1.30	0.23	0.69	0.17	0.59	0.16	1.94	0.29
'31-'35	2.38	0.28	4.48	0.39	2.18	0.29	3.81	0.38	2.09	0.30	1.23	0.23	0.71	0.18	0.62	0.17	2.03	0.31
'36-'40	2.28	0.27	4.99	0.40	2.50	0.30	3.97	0.38	2.31	0.31	1.46	0.25	0.82	0.19	0.55	0.16	1.81	0.29
'41-'45	2.50	0.25	4.96	0.36	2.71	0.28	3.93	0.35	2.26	0.28	1.51	0.23	0.78	0.17	0.51	0.14	1.72	0.26
'46-'50	2.22	0.21	4.96	0.31	2.71	0.24	3.55	0.29	2.10	0.23	1.30	0.19	0.69	0.14	0.52	0.12	1.38	0.20
'51-'55	2.62	0.21	5.07	0.30	2.34	0.22	3.18	0.26	1.84	0.21	0.97	0.15	0.67	0.13	0.41	0.10	1.00	0.16
'56-'60	3.35	0.24	4.93	0.30	2.09	0.21	2.40	0.22	1.35	0.17	0.82	0.14	0.48	0.11	0.42	0.10	0.75	0.13
'61-'65	3.24	0.24	4.19	0.28	1.88	0.20	1.84	0.20	1.10	0.16	0.73	0.13	0.46	0.11	0.36	0.09	0.44	0.10
'66-'70	3.00	0.25	3.59	0.29	1.69	0.21	1.43	0.19	0.84	0.15	0.49	0.12	0.34	0.10	0.25	0.09	0.14	0.08
'71-'75	2.95	0.30	2.95	0.33	1.32	0.24	1.00	0.23	0.63	0.21	0.37	0.21	0.11	0.14	0.16	0.23	0.00	0.00
'76-'80	2.14	0.52	1.77	0.62	0.79	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Slope	-0.20*		-0.37*		-0.25*		-0.47*		-0.23*		-0.16*		-0.09		-0.08*		-0.31*	
Scaled Slope	-0.05*		-0.12*		-0.11*		-0.16*		-0.16*		-0.16*		-0.15		-0.16*		-0.29*	

*Indicate significance at 0.05 level.

Have Race/Ethnic-Specific Initiation Rates Changed in Recent Cohorts?

Initiation rates for the different race/ethnic groups are presented in Chapter 2 and show that initiation is markedly different over time for adolescents from different racial/ethnic backgrounds. In this section, age-specific initiation rates by race/ethnicity for the three most recent birth cohorts are examined. Age- and race-specific initiation rates are presented for these birth cohorts in Figure 8-3 (males) and Figure 8-4 (females). In general, age-specific initiation rates were lower for Hispanic and African American adolescents of both genders compared to those of non-Hispanic White adolescents. There were no clear differences between age-specific initiation rates for Hispanic and African American adolescents, but there was a suggestion that Hispanic females were somewhat more likely to initiate smoking at ages greater than 15 years than were African American females.

These lower age-specific initiation rates among African American adolescents are in apparent contrast with the higher adult smoking prevalences among African Americans compared to non-Hispanic White adults. An explanation of this anomaly is presented in Figures 8-5 and 8-6. These two figures present the prevalence of ever-smoking by attained age for non-Hispanic White and African American males (Figure 8-5) and females

Figure 8-3
Age-Specific Initiation Rates for Recent Birth Cohorts of White, African American, and Hispanic Males
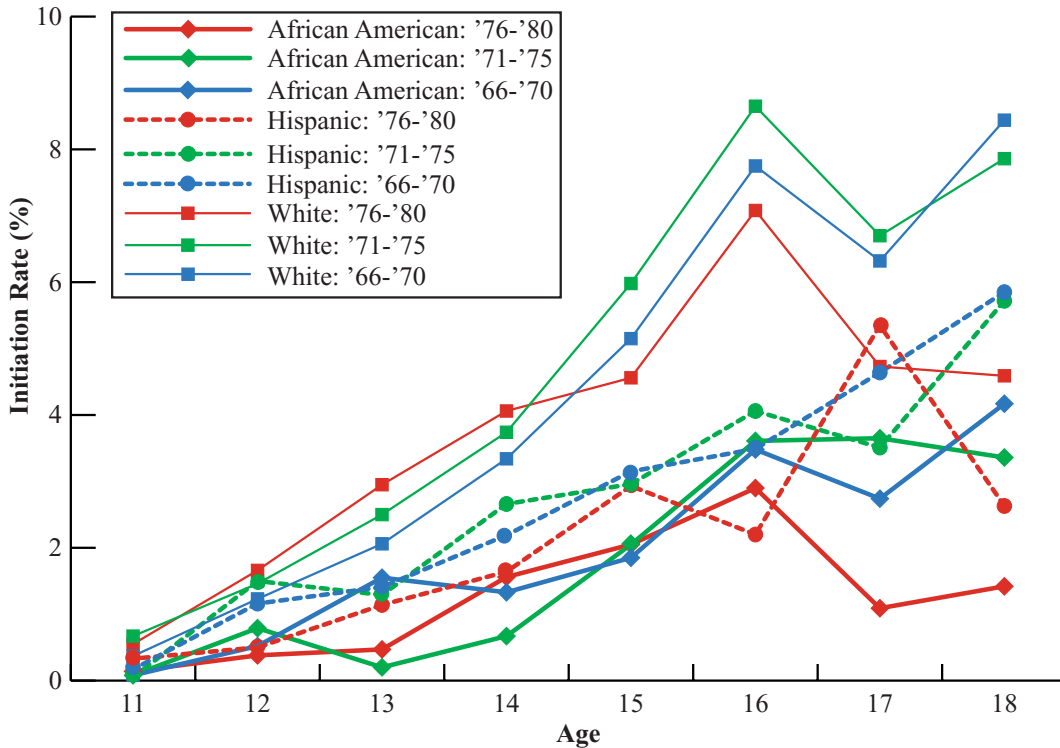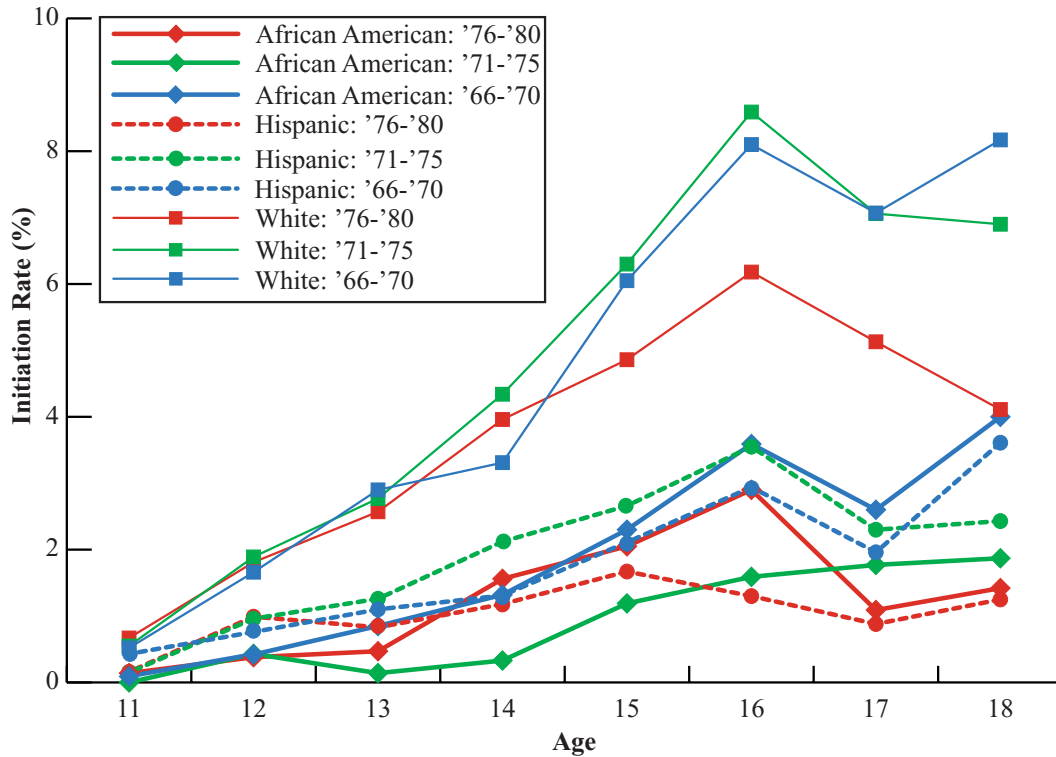
Figure 8-4
Age-Specific Initiation Rates for Recent Birth Cohorts of White, African American, and Hispanic Females

(Figure 8-6). African American ever-smoking prevalence lags behind that of non-Hispanic White males during adolescence, but increases much more rapidly during young adulthood. By age 25 years, the more rapid increase in ever-smoking prevalence among African American young adults results in the rates of ever-smoking prevalence that exceed those of non-Hispanic Whites.

A similar pattern is evident when African American female ever-smoking prevalence rates are compared to those of non-Hispanic White females. There is an even more pronounced lag in the rise of ever-smoking prevalence rates among African American females during adolescence, and the rates of rise in prevalence are also higher during young adulthood compared to non-Hispanic White females. However, among females, the more rapid rise in smoking prevalence during young adulthood does not result in smoking prevalences that exceed those of non-Hispanic White females.

What these analyses suggest is that the period of vulnerability to smoking initiation is longer for African American populations; it extends beyond adolescence and well into young adulthood. These data also suggest that the recent gains in lowering African-American smoking prevalence among

Figure 8-5
Delayed Onset Only among the Most Recent Cohort of Black Males
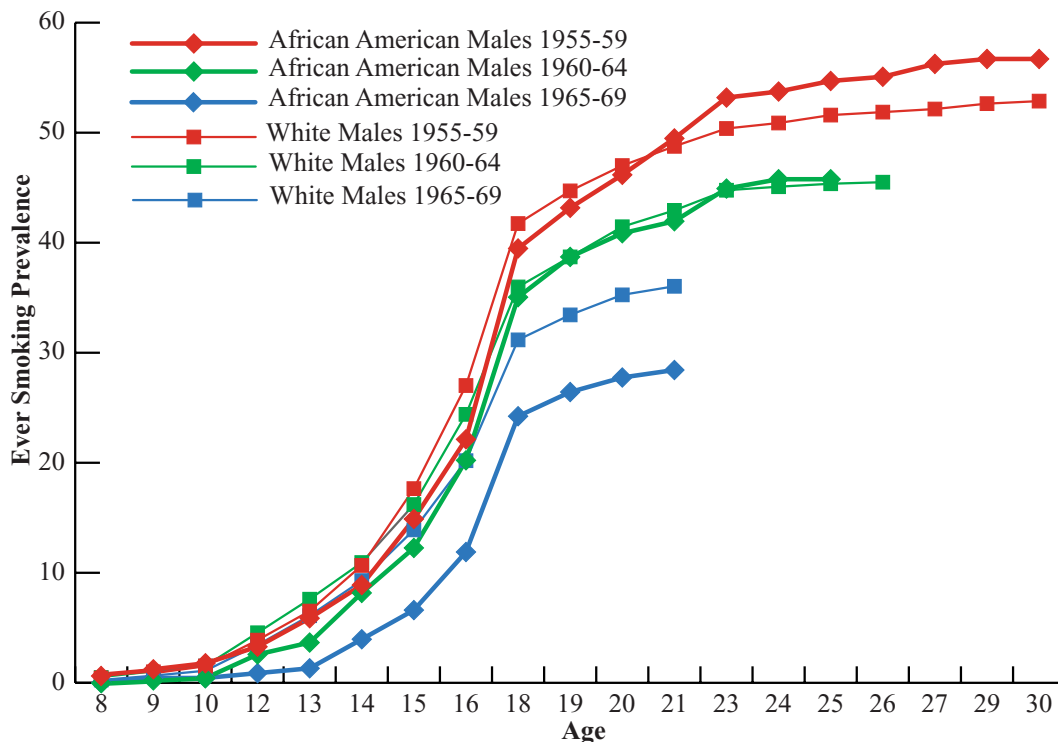

adolescents should be observed well into the early adult years before they can be counted as successful reductions in the fraction of African Americans who become cigarette smokers.

Are Age-Specific Initiation Rates Different by Level of Educational Attainment?
Age-specific initiation rates by birth cohort are presented for those with less than 12 years of education compared to those with at least 12 years of education. Among males with more than 12 years of education (Figure 8-7), initiation rates are higher for each birth cohort at each age compared to those who completed less than 12 years of education. The pattern among females is more complicated (Figure 8-8). For ages 16 and below, the pattern is similar to that for males, with those with 12 or more years of education showing a marked difference in rates of initiation for each birth cohort at each age compared to those who completed less than 12 years of education. However, initiation rates at ages 17 and 18 show no clear relationship to level of educational attainment. These analyses suggest that level of educational attainment may remain an important determinant of adolescent male initiation throughout adolescence, but that it is only an important determinant of adolescent initiation for females during early and mid-adolescence (age 16 and younger).

Figure 8-6
Delay Onset of Initiation among Black Females
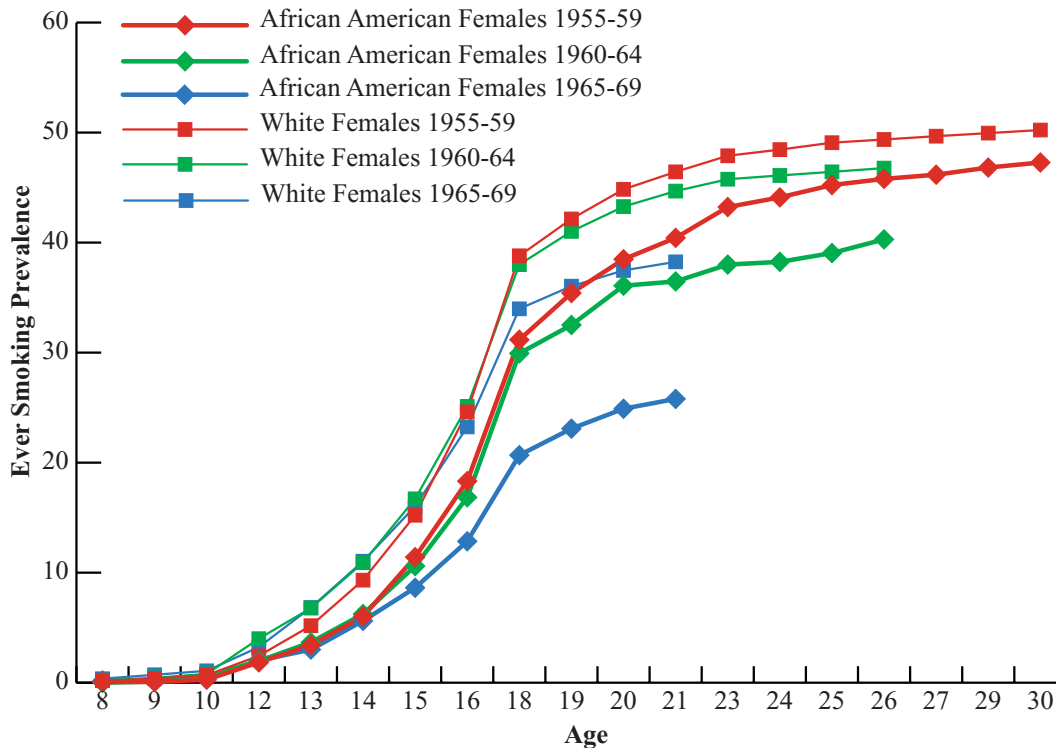
DISCUSSION   The data presented in this chapter are derived from surveys of adults using the adult definition of smoking and, therefore, are measures of initiation and prevalence among those who have actually become cigarette smokers as defined for most tobacco control programs. The questions raised by the use of a very sensitive adolescent definition of smoking (any smoking in the last month), and by the wide differences in prevalence estimates from school-based and telephone surveys, do not influence these measures. These estimates of initiation over time can, therefore, be used to compliment the cross-sectional survey data derived from individuals during adolescence. Issues of differential recall over time, differential mortality for smokers and never-smokers, and demographic changes in the population over time can bias these reconstructed estimates; therefore, the estimates that result may not match those that would be generated from a cross-sectional sample of the population taken in the year of the estimate.

In general, the estimates presented in this chapter mirror the cross-sectional data presented in other chapters in this volume, supporting the legitimacy of adolescent definitions of smoking as predictors of adult smoking behavior.

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Figure 8-7
Age-Specific Initiation Rates for Males by Education Level and Birth Cohort
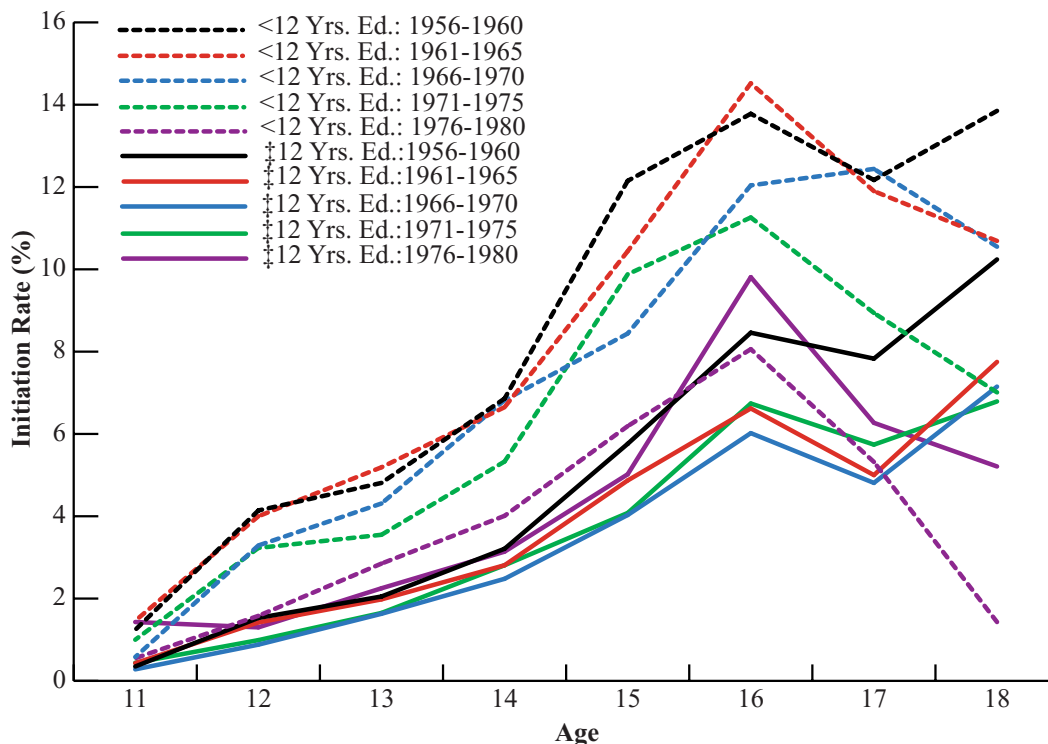
SUMMARY   Age-specific rates of smoking initiation during adolescence derived from sequential birth cohorts of adults show that initiation rates have declined over time at all ages for males, with a steeper rate of decline across cohorts for initiation rates at ages over 16 years. Initiation rates among females rose across sequential cohorts with little evidence for a decline in initiation over time for ages and 16 years and under. At ages 16 and older, there is a trend of increasing rates of initiation for cohorts that were born prior to the early 1960s with a decline for subsequent cohorts.

Initiation rates during adolescence are lower for African American and Hispanic adolescents at all ages. However, initiation continues much later into young adulthood among African American adolescents with the result that they ultimately reach—and exceed, for African American males—the ever-smoking prevalence rates of non-Hispanic White populations.

Initiation rates among those with 12 or more years of education, compared to those with less educational attainment, are lower at all ages for males. The same trend is evident for females aged 16 years and younger. However, for initiation at ages 17 and 18 among females, there is little difference in rates of initiation evident for the two categories of educational attainment.

Figure 8-8
Age-Specific Initiation Rates for Females by Education Level and Birth Cohort
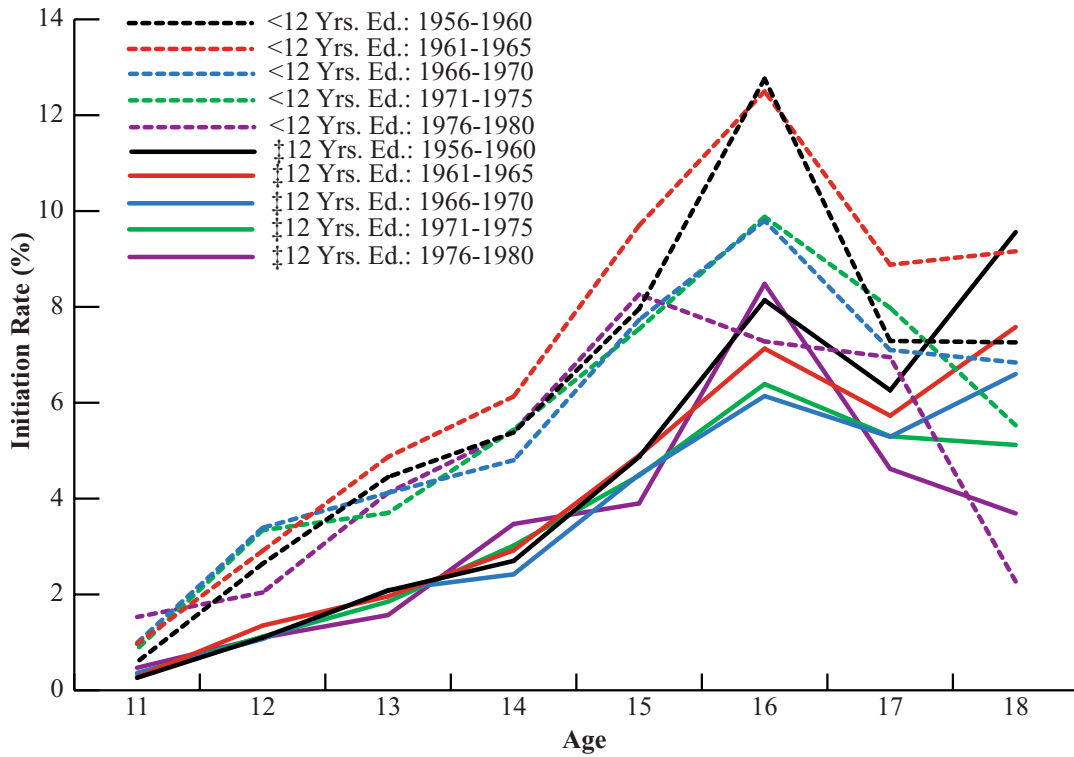
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