

Changes in Number of Cigarettes Smoked per Day: Cross-Sectional and Birth Cohort Analyses Using NHIS

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INTRODUCTION Smoking norms and behaviors have changed slowly and incompletely despite growing scientific evidence of adverse health effects and strong efforts to prevent continuance of tobacco use (U.S. DHHS 2000). Smoking prevalence has remained stable for much of the last decade, declining at the end with the increase in cost resulting from the Master Settlement Agreement (Giovino et al. 1995; Shiffman 1993). Data from the Current Population Survey (CPS) show a nationwide decline in cessation activity from 1992 to 1996 (NCI 2000). The question raised in this monograph is whether those smokers who can easily quit have done so, leaving behind a group of smokers who are more heavily addicted and more difficult to get to quit (Hughes 1993). Since smoking a high number of cigarettes per day is one characteristic of strongly addicted smokers, and since smoking higher numbers of cigarettes per day reduces the likelihood of successful cessation, one hallmark of a hardening population of smokers might be an increase over time in the mean number of cigarettes smoked per day by those smokers who remain current smokers.

Data from the series of National Health Interview Surveys (NHIS) conducted periodically since 1965 are used to examine changes in number of cigarettes smoked per day reported by smokers over the last four decades. These trends are examined in the cross-sectional surveys for individual calendar years. Birth cohort analyses are also constructed using data from all of the surveys combined in order to examine changes in number of cigarettes smoked per day by cohorts of smokers born during specified calendar years as they age. A birth cohort is a group of individuals born during the same calendar years (10 years in these analyses).

In a single cross-sectional survey, age-specific rates of smoking behaviors are often used to examine the changes in smoking behavior with age. However, the rate of ever-smoking is very different for populations of individuals born during different periods in the last century (Burns et al. 1997). As a result, individuals of different ages in cross-sectional surveys will have different rates of ever-smoking. Therefore, comparing the current smoking prevalence in a cross-sectional survey of smokers at age 30 with those at age 60 (individuals who had a much higher prevalence of smoking when they were age 30) will underestimate the impact of age on smoking

cessation. A similar concern exists for describing changes in number of cigarettes smoked per day, since age is also an important correlate of the number of cigarettes smoked per day.

This chapter describes changes in the number of cigarettes smoked per day and examines whether there has been a shift over time in the number of cigarettes smoked per day using both cross-sectional and birth cohort analyses.

METHODS The National Center for Health Statistics, through the annual National Health Interview Survey, has collected health information since 1964 from a probability sample of the civilian, noninstitutionalized population of the United States. With developmentally consistent methodology from 1965 onward, smoking supplements to the National Health Interview Survey were undertaken during the following 20 calendar years: 1965, 1966, 1970, 1974, 1976, 1977, 1979, 1980, 1983, 1985, 1987, 1988, 1990, 1991, 1992, 1993, 1994, 1995, 1997, and 1998. Sampling methods for these surveys changed over time. Details concerning the survey methodology are reported elsewhere (U.S. DHHS 1985; U.S. DHHS 1989).

Data

The NHIS is a cross-sectional survey of the civilian, noninstitutionalized U.S. population conducted mostly within households. Surveys prior to 1974 included smoking information on all the adult members of a household collected from a single adult from that household. However, from 1974 onward, smoking information was collected from a randomly selected member of the household with the survey undertaken by telephone only when the person was not present during the initial household interview. The mean response rate for the 1965 to 1991 NHIS was approximately 85% (U.S. DHHS 1994). The mean response rates for the 1993 to 1995 surveys were approximately 81% (CDC 1994; CDC 1996; CDC 1997). Survey weights were included with each data set. The weights were constructed to account for the probability that an individual is sampled and to adjust for nonresponse.

Measures These analyses are confined to adults aged 20 years and older. Respondents aged 19 years and younger were excluded from the analysis so that the age range of the sample would be uniform across all survey years. Two of the surveys, NHIS 1976 and 1977, interviewed only respondents aged 20 years and older. To be considered a current smoker, respondents must have smoked at least 100 cigarettes in their lifetime and smoked at the time of the survey. The sample sizes varied between 769 and 15,067 adult current smokers who reported number of cigarettes smoked per day. Of the 20 surveys used, 10 (1979, 1980, 1983, and 1991 to 1998) made a distinction between daily and occasional smokers when reporting number of cigarettes smoked per day.

Data gathered from the interviews provided information on demographics including age, gender, race/ethnicity, and month/year of birth. The number of cigarettes smoked per day (CPD) was obtained as a continuous measure. For the purpose of cross-sectional prevalence tables,

this continuous measure was categorized into the following six groups: occasional smoker, <1 cigarettes per day, 1 to 4 cigarettes /day, 5 to 14 cigarettes /day, 15 to 24 cigarettes /day, and 25-plus cigarettes per day. Because not all of the surveys asked about occasional smoking, some categories were not available in all surveys. The change in definition of smoking used in the surveys alters the prevalence of smoking reported. In order to prevent this change in definition from confusing the trends over time, the tabular presentations of number of cigarettes smoked per day are shown as a percentage of the entire population as well as a percentage of current smokers.

Statistical Analyses The mean CPD was calculated for each survey year after standardizing each year's population to the age and race distribution of the nation as indicated in the 1965 NHIS. The mean CPD for the total population as well as gender-specific means were calculated. In order to explore the differences in mean reported number of cigarettes per day produced by the use of different questions to record smoking intensity, the gender-specific mean number of cigarettes was calculated both for all smokers (daily and occasional) and for all daily smokers in the surveys in which that information was available. Surveys prior to 1991 define current smokers with the question, "Do you smoke some days, every day, or not at all?" and later surveys ask, "Do you smoke now?" followed by a question asking whether the respondent smokes daily or occasionally.

The cross-sectional change in number of cigarettes smoked per day was examined by calculating the prevalence of current smokers for six categories of CPD for each survey year. Because demographics of the population changed between 1965 and 1998, data from each survey was standardized according to the age and race distribution as indicated by the 1965 NHIS using the direct method for weighted prevalence.

The smoking patterns of heavy smokers are evaluated using 10-year birth cohorts. For the purpose of this chapter, a heavy smoker is defined as an individual who smokes 25 or more cigarettes per day. The birth cohort analyses were restricted to persons born between 1890 and 1969, who were 20 years or older at the time of the survey, and for whom smoking status could be ascertained. Birth year, which was present for every respondent, was used to categorize each respondent into one of eight 10-year birth cohorts (1890 to 1899, 1900 to 1909, 1910 to 1919, 1920 to 1929, 1930 to 1939, 1940 to 1949, 1950 to 1959, and 1960 to 1969). Gender-specific birth cohort analyses were performed. The percentage of smokers reporting 25-plus cigarettes per day per birth cohort was calculated for each of the survey years after adjusting for race. These percentages were plotted by survey year. A smoothing procedure was then applied to the rates to minimize the effect of sampling variability. The "Loess" smoother, available in the statistical software package S-PLUS, is a local regression model that was set to use a quadratic fit over the span of calendar years (Chambers and Hastie 1992). The rates were weighted by the denominator sample size at each specific calendar year. By smoothing, we make the assumption that changes occurring in the population are continuous.

The weights of the responses for the above analyses were scaled so that, after weighting, the number of responses added up to the sample size. The scaled weight was obtained by dividing each individual's original weight by the sum of all the original weights. This quotient was then multiplied by the total sample size.

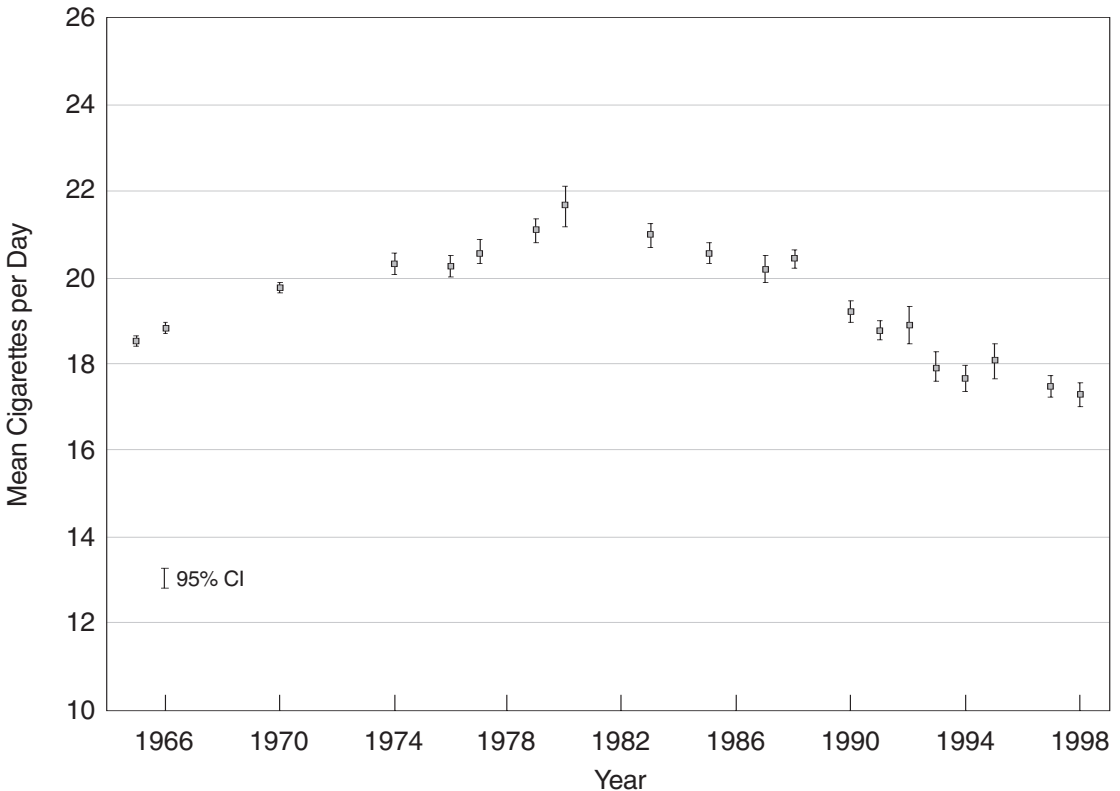
RESULTS

Average Number of Cigarettes Per Day

The mean number of cigarettes smoked per day reported by all current smokers, while controlling for age and race, has changed over time in the NHIS. The mean increased from 1965 to 1980 and then declined significantly through the late 1990s (Figure 7-1). This trend is evident for both males and females (Figure 7-2).

However, much of the decline occurs during the 1990s, and the definition used to identify a current smoker shifted between the 1990 and 1991 surveys. Participants in the 1965 to 1990 surveys were asked if they "smoke cigarettes now." In the 1991 to 1998 surveys, participants were asked whether they "currently smoke every day, some days, or not at all."

Figure 7-1
Mean Number of Cigarettes per Day* for All Current Smokers in Each NHIS Survey Year

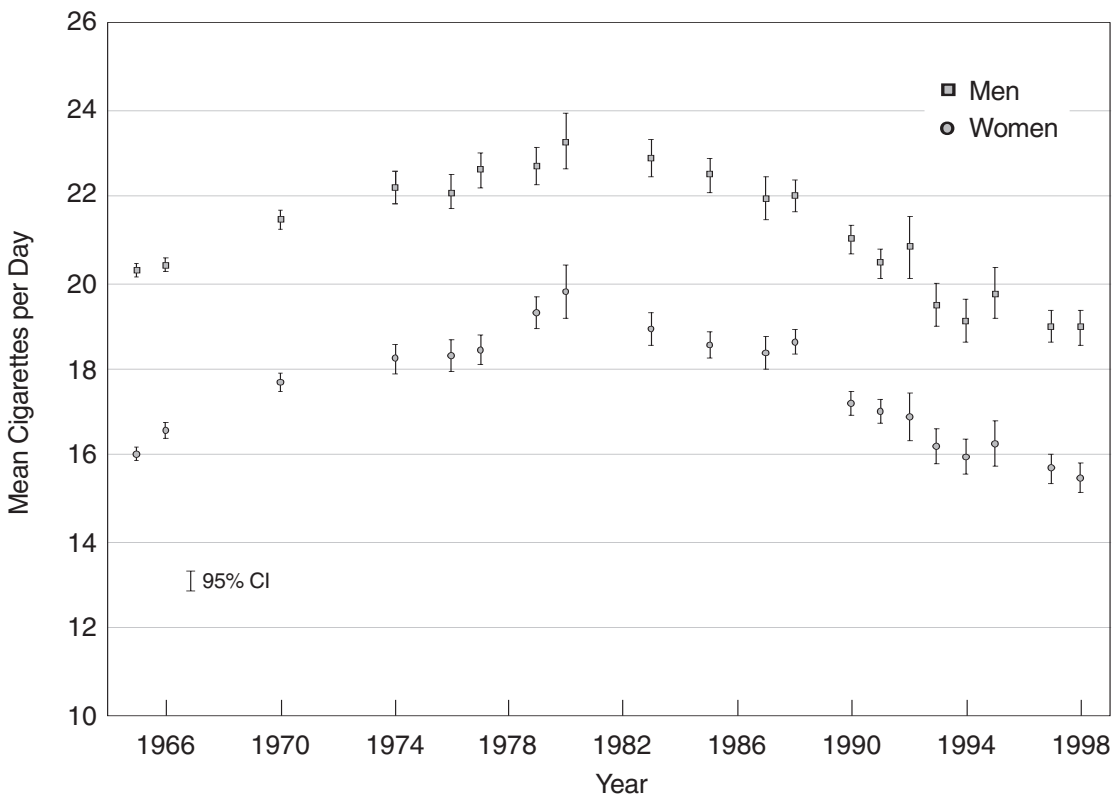


*Average number of cigarettes per day standardized to the age and race distribution of NHIS 1965. Brackets indicate 9% confidence intervals on the estimates.

This change in definition increases the prevalence of current smokers, largely by increasing the number of individuals who report smoking occasionally. This increase in occasional smokers would be expected to have a substantial effect on the mean number of cigarettes smoked since the mean is calculated across all current smokers, including those who report smoking only occasionally.

Tables 7-1 through 7-3 present the percentages of current smokers who smoke different numbers of cigarettes per day. It is clear from the table that a substantial proportion of current smokers using the new definition are classified as occasional smokers, and that fraction has been increasing during the decade of the 1990s. The current percentage of occasional smokers is more than twice the percentage estimated in the 1979 to 1983 surveys, but it is not clear whether this difference is due to the difference in the question used to define current smokers or due to trends over time in the frequency of occasional smoking. However, there appears to be a trend toward an increasing percentage of occasional smoking after 1991, and the

Figure 7-2
Mean Number of Cigarettes per Day* for All Current Smokers in Each NHIS Survey Year



*Average number of cigarettes per day standardized to the age and race distribution of NHIS 1965. Brackets indicate 9% confidence intervals on the estimates.

Table 7-1
Cross-Sectional Number of Cigarettes Smoked per Day for Current Smokers by Year

| NHIS | Cigarettes per Day | | | | | | | | | | | | Population | Sample |
|------|--------------------|------|-----|------|--------|------|---------|------|----------|------|------|------|------------|--------|
| | Occasional | | < 1 | | 1 to 4 | | 5 to 14 | | 15 to 24 | | 25+ | | | |
| | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | | |
| 1965 | * | * | 1.7 | 0.14 | 8.4 | 0.29 | 24.7 | 0.46 | 44.6 | 0.53 | 20.6 | 0.43 | 47,020,967 | 34,298 |
| 1966 | * | * | 2.1 | 0.15 | 7.8 | 0.28 | 23.6 | 0.45 | 45.1 | 0.53 | 21.5 | 0.43 | 48,003,483 | 34,455 |
| 1970 | * | * | 0.6 | 0.09 | 7.0 | 0.31 | 22.6 | 0.51 | 42.9 | 0.59 | 23.7 | 0.51 | 44,567,267 | 25,706 |
| 1974 | * | * | * | * | 7.1 | 0.56 | 22.5 | 0.91 | 43.2 | 1.07 | 26.5 | 0.94 | 46,295,102 | 8,198 |
| 1976 | * | * | * | * | 7.6 | 0.59 | 21.5 | 0.92 | 43.8 | 1.10 | 25.9 | 0.96 | 45,456,439 | 7,678 |
| 1977 | * | * | 0.4 | 0.14 | 6.7 | 0.58 | 22.0 | 0.96 | 43.0 | 1.13 | 27.1 | 1.01 | 44,616,055 | 7,272 |
| 1979 | 6.6 | 0.55 | 0.3 | 0.11 | 5.4 | 0.50 | 19.3 | 0.88 | 39.6 | 1.07 | 27.3 | 0.96 | 47,662,861 | 7,457 |
| 1980 | 6.3 | 0.81 | 0.3 | 0.19 | 5.4 | 0.76 | 18.8 | 1.32 | 39.5 | 1.63 | 28.4 | 1.49 | 48,847,313 | 3,237 |
| 1983 | 1.6 | 0.30 | 0.1 | 0.08 | 5.0 | 0.53 | 21.3 | 0.99 | 44.0 | 1.18 | 27.6 | 1.05 | 50,319,264 | 6,652 |
| 1985 | * | * | 1.6 | 0.25 | 5.7 | 0.47 | 22.1 | 0.83 | 41.8 | 0.97 | 28.1 | 0.88 | 48,370,474 | 9,725 |
| 1987 | * | * | 1.7 | 0.32 | 5.9 | 0.60 | 22.7 | 1.06 | 41.8 | 1.23 | 27.4 | 1.10 | 47,724,640 | 6,134 |
| 1988 | * | * | 1.5 | 0.22 | 4.9 | 0.40 | 21.9 | 0.75 | 43.1 | 0.88 | 26.7 | 0.78 | 46,944,920 | 11,936 |
| 1990 | * | * | 1.7 | 0.25 | 6.9 | 0.50 | 24.1 | 0.83 | 42.8 | 0.96 | 24.2 | 0.82 | 44,202,813 | 10,243 |
| 1991 | 13.3 | 0.64 | * | * | 2.9 | 0.32 | 18.7 | 0.74 | 41.7 | 0.92 | 22.7 | 0.77 | 44,155,778 | 10,800 |
| 1992 | 14.6 | 1.27 | * | * | 3.0 | 0.62 | 19.5 | 1.43 | 39.5 | 1.72 | 23.1 | 1.47 | 45,969,845 | 2,994 |
| 1993 | 17.9 | 1.05 | * | * | 2.5 | 0.45 | 19.5 | 1.10 | 39.7 | 1.34 | 19.7 | 1.07 | 43,083,427 | 4,920 |
| 1994 | 17.0 | 1.07 | * | * | 2.4 | 0.44 | 21.1 | 1.16 | 40.2 | 1.37 | 18.4 | 1.06 | 45,441,782 | 4,766 |
| 1995 | 18.0 | 1.18 | * | * | 2.3 | 0.46 | 19.9 | 1.22 | 38.4 | 1.47 | 20.7 | 1.21 | 44,468,861 | 4,064 |
| 1997 | 17.2 | 0.81 | * | * | 2.7 | 0.36 | 21.4 | 0.88 | 39.0 | 1.02 | 19.2 | 0.81 | 45,541,495 | 8,538 |
| 1998 | 16.9 | 0.85 | * | * | 3.7 | 0.44 | 21.4 | 0.94 | 38.9 | 1.10 | 18.5 | 0.86 | 44,527,060 | 7,420 |

*Information not available.

NOTE: Percents are standardized to the age and race distribution of the nation as indicated by NHIS 1965.

definition used to classify current smokers was consistent through this series of NHIS.

In order to minimize the effect both of the change in definition of current smoking and of the trend toward a higher prevalence of occasional smoking on the distribution of number of cigarettes smoked per day, we examine the change in mean number of cigarettes smoked per day among only those who report smoking every day for the NHIS years in which that question was asked. Figure 7-3 presents data for male and female smokers. There is no clear decline over time in number of cigarettes smoked per day in this figure. Since it is difficult to characterize as hardened smokers those who do not smoke every day, the group for whom a change over time in number of cigarettes smoked per day is most relevant as a measure of hardening is daily smokers.

Table 7-2
Cross-Sectional Number of Cigarettes Smoked per Day for Male Smokers by Year

| NHIS | Cigarettes per Day | | | | | | | | | | | | Population | Sample |
|------|--------------------|------|-----|------|--------|------|---------|------|----------|------|------|------|------------|--------|
| | Occasional | | < 1 | | 1 to 4 | | 5 to 14 | | 15 to 24 | | 25+ | | | |
| | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | | |
| 1965 | * | * | 1.4 | 0.16 | 6.7 | 0.35 | 20.2 | 0.56 | 46.3 | 0.70 | 25.4 | 0.61 | 27,001,634 | 19,518 |
| 1966 | * | * | 1.8 | 0.18 | 6.3 | 0.34 | 19.5 | 0.55 | 46.6 | 0.70 | 25.9 | 0.61 | 27,538,859 | 19,661 |
| 1970 | * | * | 0.5 | 0.11 | 5.9 | 0.38 | 18.7 | 0.64 | 43.0 | 0.81 | 28.0 | 0.73 | 24,318,169 | 13,912 |
| 1974 | * | * | * | * | 6.0 | 0.72 | 17.8 | 1.17 | 42.9 | 1.49 | 32.7 | 1.40 | 24,453,968 | 4,225 |
| 1976 | * | * | * | * | 6.4 | 0.76 | 16.9 | 1.18 | 44.0 | 1.54 | 31.6 | 1.43 | 23,489,129 | 3,950 |
| 1977 | * | * | 0.2 | 0.14 | 5.4 | 0.74 | 17.8 | 1.26 | 41.7 | 1.60 | 33.7 | 1.52 | 22,516,926 | 3,617 |
| 1979 | 6.7 | 0.77 | 0.2 | 0.14 | 5.3 | 0.69 | 16.2 | 1.15 | 38.3 | 1.49 | 31.9 | 1.42 | 25,323,489 | 3,776 |
| 1980 | 6.8 | 1.16 | 0.3 | 0.26 | 4.6 | 0.97 | 15.2 | 1.70 | 38.8 | 2.26 | 32.5 | 2.16 | 26,077,192 | 1,650 |
| 1983 | 1.5 | 0.42 | 0.2 | 0.13 | 4.1 | 0.71 | 17.2 | 1.34 | 42.7 | 1.72 | 34.0 | 1.62 | 26,110,678 | 3,141 |
| 1985 | * | * | 1.3 | 0.34 | 5.0 | 0.65 | 18.1 | 1.15 | 40.7 | 1.44 | 34.1 | 1.37 | 24,792,850 | 4,451 |
| 1987 | * | * | 1.6 | 0.49 | 5.6 | 0.86 | 18.8 | 1.48 | 40.4 | 1.82 | 33.0 | 1.72 | 24,629,866 | 2,778 |
| 1988 | * | * | 1.4 | 0.32 | 4.0 | 0.53 | 19.0 | 1.04 | 41.8 | 1.29 | 31.8 | 1.20 | 24,446,987 | 5,552 |
| 1990 | * | * | 1.6 | 0.37 | 6.4 | 0.71 | 19.0 | 1.14 | 41.9 | 1.40 | 30.7 | 1.29 | 23,356,894 | 4,767 |
| 1991 | 12.8 | 0.94 | * | * | 3.0 | 0.48 | 15.0 | 1.01 | 40.3 | 1.35 | 28.4 | 1.22 | 22,977,773 | 4,987 |
| 1992 | 14.9 | 1.90 | * | * | 2.6 | 0.87 | 14.1 | 1.89 | 38.3 | 2.53 | 29.8 | 2.33 | 23,244,280 | 1,383 |
| 1993 | 18.9 | 1.58 | * | * | 2.0 | 0.60 | 15.2 | 1.49 | 37.8 | 1.94 | 25.4 | 1.70 | 22,668,556 | 2,294 |
| 1994 | 17.1 | 1.60 | * | * | 2.4 | 0.63 | 16.5 | 1.56 | 39.9 | 2.01 | 23.1 | 1.70 | 23,971,556 | 2,210 |
| 1995 | 17.2 | 1.70 | * | * | 2.2 | 0.66 | 15.1 | 1.60 | 37.6 | 2.13 | 27.0 | 1.92 | 23,198,580 | 1,937 |
| 1997 | 16.8 | 1.15 | * | * | 2.5 | 0.49 | 16.7 | 1.15 | 40.1 | 1.47 | 23.4 | 1.24 | 24,406,479 | 4,191 |
| 1998 | 17.2 | 1.24 | * | * | 3.2 | 0.59 | 16.5 | 1.23 | 38.2 | 1.56 | 24.2 | 1.35 | 23,388,276 | 3,629 |

*Information not available.

NOTE: Percents are standardized to the age and race distribution of the nation as indicated by NHIS 1965.

Distribution of Number of Cigarettes Smoked per Day in the Population 1965 to 1998

The percentage of current smokers who reported smoking different numbers of cigarettes per day is presented in Tables 7-1 through 7-3 for each of the NHIS where the data were available, and the data are presented in the format in which the data was collected; that is, some of the surveys in which current smoking was defined by the question "Do you smoke now?" also asked a question of those who responded "yes" as to whether they smoke daily or occasionally. The percentage of smokers who reported smoking 25 or more cigarettes per day increased from the first survey in 1965 and peaked in 1980. Between 1980 and 1990, there was a decline in the prevalence of heavy smoking, which accelerated with the change in definition in 1991.

In order to minimize the effects of the change in definition and the trend toward an increased prevalence of occasional smoking, Tables 7-4 through 7-6 present the data as percentages of the entire population rather than as percentages of current smokers. The percentage of the entire

Table 7-3
Cross-Sectional Number of Cigarettes Smoked per Day for Female Smokers by Year

| NHIS | Cigarettes per Day | | | | | | | | | | | | Population | Sample |
|------|--------------------|------|-----|------|--------|------|---------|------|----------|------|------|------|------------|--------|
| | Occasional | | < 1 | | 1 to 4 | | 5 to 14 | | 15 to 24 | | 25+ | | | |
| | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | | |
| 1965 | * | * | 2.1 | 0.23 | 10.8 | 0.50 | 30.8 | 0.74 | 42.2 | 0.80 | 14.2 | 0.56 | 20,019,333 | 14,780 |
| 1966 | * | * | 2.5 | 0.25 | 9.8 | 0.48 | 29.0 | 0.73 | 43.1 | 0.80 | 15.5 | 0.58 | 20,464,624 | 14,794 |
| 1970 | * | * | 0.8 | 0.16 | 8.5 | 0.50 | 27.5 | 0.80 | 42.5 | 0.88 | 18.5 | 0.69 | 20,249,098 | 11,794 |
| 1974 | * | * | * | * | 8.3 | 0.87 | 27.7 | 1.40 | 43.6 | 1.53 | 19.8 | 1.22 | 21,841,134 | 3,973 |
| 1976 | * | * | * | * | 8.7 | 0.91 | 26.2 | 1.41 | 43.6 | 1.58 | 20.0 | 1.26 | 21,967,310 | 3,728 |
| 1977 | * | * | 0.5 | 0.23 | 7.9 | 0.89 | 26.2 | 1.44 | 44.4 | 1.60 | 20.3 | 1.28 | 22,099,129 | 3,655 |
| 1979 | 6.7 | 0.77 | 0.4 | 0.18 | 5.5 | 0.73 | 22.9 | 1.33 | 41.4 | 1.53 | 22.0 | 1.27 | 22,339,372 | 3,681 |
| 1980 | 6.8 | 1.16 | 0.3 | 0.26 | 6.3 | 1.20 | 22.4 | 2.04 | 40.3 | 2.34 | 23.8 | 2.00 | 22,770,121 | 1,587 |
| 1983 | 1.5 | 0.42 | 0.1 | 0.10 | 6.0 | 0.80 | 25.6 | 1.45 | 45.5 | 1.63 | 20.8 | 1.30 | 24,208,586 | 3,511 |
| 1985 | * | * | 1.9 | 0.37 | 6.4 | 0.67 | 26.2 | 1.20 | 42.8 | 1.33 | 22.0 | 1.09 | 23,577,624 | 5,274 |
| 1987 | * | * | 1.6 | 0.43 | 6.1 | 0.83 | 26.8 | 1.51 | 43.4 | 1.67 | 21.4 | 1.36 | 23,094,774 | 3,356 |
| 1988 | * | * | 1.7 | 0.31 | 5.8 | 0.59 | 25.0 | 1.07 | 44.7 | 1.21 | 21.2 | 0.98 | 22,497,933 | 6,384 |
| 1990 | * | * | 1.8 | 0.35 | 7.4 | 0.71 | 29.5 | 1.21 | 43.8 | 1.31 | 17.3 | 0.99 | 20,845,919 | 5,476 |
| 1991 | 12.8 | 0.94 | * | * | 2.8 | 0.44 | 22.7 | 1.08 | 43.3 | 1.26 | 16.8 | 0.94 | 21,178,005 | 5,813 |
| 1992 | 14.9 | 1.90 | * | * | 3.5 | 0.89 | 25.2 | 2.11 | 40.1 | 2.36 | 16.6 | 1.78 | 22,725,565 | 1,611 |
| 1993 | 18.9 | 1.58 | * | * | 3.3 | 0.68 | 24.2 | 1.61 | 41.5 | 1.84 | 13.6 | 1.26 | 20,414,871 | 2,626 |
| 1994 | 17.1 | 1.60 | * | * | 2.4 | 0.61 | 26.3 | 1.70 | 40.8 | 1.87 | 13.2 | 1.27 | 21,470,226 | 2,556 |
| 1995 | 17.2 | 1.70 | * | * | 2.4 | 0.65 | 25.5 | 1.83 | 39.1 | 2.04 | 14.2 | 1.45 | 21,270,281 | 2,127 |
| 1997 | 16.8 | 1.15 | * | * | 3.0 | 0.53 | 26.8 | 1.32 | 37.8 | 1.42 | 14.5 | 1.01 | 21,135,016 | 4,347 |
| 1998 | 17.2 | 1.24 | * | * | 4.1 | 0.65 | 26.6 | 1.41 | 39.9 | 1.54 | 12.6 | 1.03 | 21,138,784 | 3,791 |

*Information not available.

NOTE: Percents are standardized to the age and race distribution of the nation as indicated by NHIS 1965.

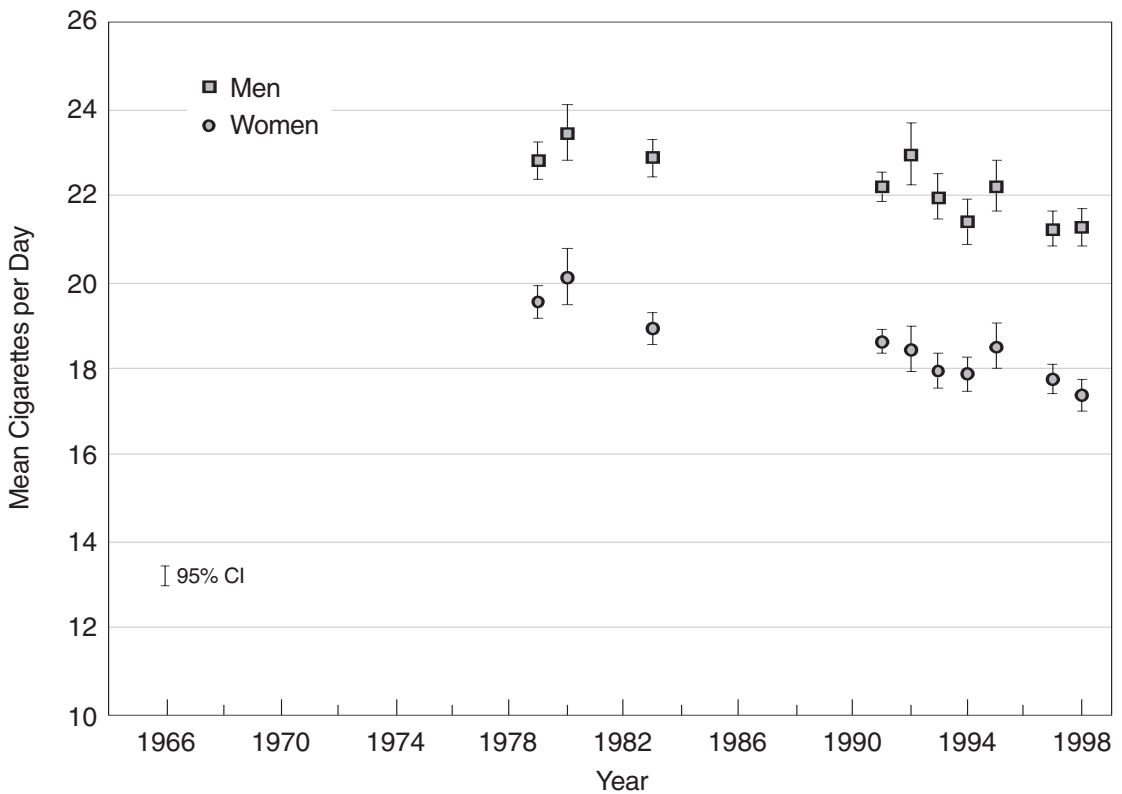
population who reported smoking 25 or more cigarettes per day also peaked in 1980 and then declined. There is also a statistically significant decline in the prevalence of heavy smoking from 1991 through 1998, a period during which the new definition of current smoking was consistently used. This trend toward fewer heavy smokers is accompanied by an increase in the prevalence of smoking 5 to 14 cigarettes per day.

There is no dramatic shift in the percentage of the population reporting smoking 25 or more cigarettes per day between the pre-1990 period during which the old definition was in use and the post-1991 period during which the new definition was in use. This suggests that the trends in prevalence of heavy smoking were not influenced by the definition of current smoking used in the individual NHIS.

In summary, the cross-sectional evaluation of the NHIS data suggests that between 1965 and 1980, there was a trend toward an increasing number of cigarettes smoked per day and a higher prevalence of heavy smoking. Since that time, however, the prevalence of heavy smoking has

Figure 7-3

Mean Number of Cigarettes Smoked per Day* Reported by Daily Cigarette Smokers in Each NHIS Survey Year



*Average number of cigarettes per day standardized to the age and race distribution of NHIS 1965.

NOTE: Includes only those surveys that distinguished daily from occasional smokers. Brackets indicate 95% confidence intervals on the estimates.

fallen substantially and has continued to fall through the decade of the 1990s. This fall in heavy smokers is similar in proportion to the fall in prevalence of daily smoking over this same period, but the accompanying trend of an increasing prevalence of smoking 5 to 14 cigarettes per day suggests a general shift toward lighter smoking among daily smokers during the 1990s. These data do not suggest that the remaining current smokers are a heavier-smoking population. There is no suggestion that the residual population of smokers has become hardened over the last 15 years, at least for number of cigarettes smoked per day as a measure of hardening.

Table 7-4
Cross-Sectional Number of Cigarettes Smoked per Day for the Total U.S. Population by Year

| NHIS | Cigarettes per Day | | | | | | | | | | | | Population | Sample |
|------|--------------------|------|-----|------|--------|------|---------|------|----------|------|------|------|-------------|--------|
| | Occasional | | < 1 | | 1 to 4 | | 5 to 14 | | 15 to 24 | | 25+ | | | |
| | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | | |
| 1965 | * | * | 0.7 | 0.06 | 3.6 | 0.13 | 10.4 | 0.21 | 18.8 | 0.27 | 8.7 | 0.19 | 111,604,002 | 81,436 |
| 1966 | * | * | 0.9 | 0.06 | 3.3 | 0.12 | 10.1 | 0.21 | 19.3 | 0.27 | 9.2 | 0.20 | 112,594,597 | 81,081 |
| 1970 | * | * | 0.2 | 0.04 | 2.7 | 0.12 | 8.6 | 0.21 | 16.2 | 0.27 | 9.0 | 0.21 | 121,729,938 | 70,136 |
| 1974 | * | * | * | * | 2.7 | 0.21 | 8.5 | 0.37 | 16.1 | 0.48 | 9.9 | 0.39 | 125,080,937 | 22,280 |
| 1976 | * | * | * | * | 2.8 | 0.22 | 7.9 | 0.37 | 16.1 | 0.49 | 9.5 | 0.39 | 126,397,470 | 21,250 |
| 1977 | * | * | 0.1 | 0.05 | 2.4 | 0.21 | 8.0 | 0.38 | 15.5 | 0.50 | 9.8 | 0.40 | 124,968,643 | 20,440 |
| 1979 | 2.4 | 0.20 | 0.1 | 0.04 | 1.9 | 0.18 | 6.9 | 0.33 | 14.1 | 0.45 | 9.7 | 0.38 | 144,538,295 | 22,750 |
| 1980 | 2.3 | 0.29 | 0.1 | 0.07 | 1.9 | 0.27 | 6.7 | 0.50 | 14.0 | 0.68 | 10.1 | 0.58 | 147,895,036 | 9,912 |
| 1983 | 0.5 | 0.10 | 0.0 | 0.03 | 1.7 | 0.17 | 7.0 | 0.35 | 14.2 | 0.47 | 8.9 | 0.37 | 158,654,252 | 21,420 |
| 1985 | * | * | 0.5 | 0.08 | 1.8 | 0.15 | 6.8 | 0.28 | 12.7 | 0.36 | 8.5 | 0.30 | 160,299,371 | 31,858 |
| 1987 | * | * | 0.5 | 0.10 | 1.7 | 0.18 | 6.7 | 0.35 | 12.4 | 0.45 | 8.1 | 0.36 | 163,376,109 | 20,778 |
| 1988 | * | * | 0.4 | 0.06 | 1.4 | 0.12 | 6.3 | 0.23 | 12.2 | 0.31 | 7.6 | 0.25 | 168,456,196 | 42,439 |
| 1990 | * | * | 0.4 | 0.07 | 1.8 | 0.13 | 6.2 | 0.24 | 11.1 | 0.31 | 6.3 | 0.23 | 172,274,935 | 39,464 |
| 1991 | 3.4 | 0.18 | * | * | 0.8 | 0.08 | 4.8 | 0.21 | 10.8 | 0.29 | 5.9 | 0.22 | 173,611,554 | 41,961 |
| 1992 | 3.8 | 0.36 | * | * | 0.8 | 0.17 | 5.3 | 0.41 | 10.6 | 0.55 | 6.2 | 0.43 | 176,871,804 | 11,564 |
| 1993 | 4.5 | 0.29 | * | * | 0.6 | 0.11 | 4.9 | 0.30 | 10.1 | 0.41 | 5.0 | 0.29 | 179,189,372 | 20,274 |
| 1994 | 4.4 | 0.30 | * | * | 0.6 | 0.11 | 5.5 | 0.33 | 10.5 | 0.43 | 4.7 | 0.29 | 180,952,643 | 19,057 |
| 1995 | 4.4 | 0.32 | * | * | 0.6 | 0.12 | 5.0 | 0.33 | 9.7 | 0.44 | 5.3 | 0.33 | 182,986,412 | 16,736 |
| 1997 | 4.3 | 0.22 | * | * | 0.7 | 0.09 | 5.4 | 0.24 | 9.9 | 0.31 | 4.8 | 0.22 | 186,456,771 | 34,889 |
| 1998 | 4.2 | 0.22 | * | * | 0.9 | 0.11 | 5.3 | 0.25 | 9.6 | 0.32 | 4.6 | 0.22 | 187,965,272 | 31,360 |

*Information not available.

NOTE: Percents are standardized to the age and race distribution of the nation as indicated by NHIS 1965.

Birth Cohort Analyses of the Prevalence of Smoking 25 Or More Cigarettes Per Day

Since the NHIS records date of birth in all survey years, it is possible to assemble the smoking prevalence data by the year in which individuals were born as opposed to their age at the time of the survey. It is then possible to examine the changes in smoking behavior for repetitive cross-sectional samples of 10-year birth cohorts of individuals as they advance in age through the sequential series of the NHIS from 1965 to 1998. Since ever-smoking prevalence has varied from 70% to 80% among men born between the years 1910 and 1929 to 45% or less among those born after 1960 (Burns et al. 1997), examining changes in smoking behavior by birth cohort gives a more valid description of the changes in smoking prevalence occurring with age, and over time, than does cross-sectional data presented as age-specific analyses.

Table 7-5
Cross-Sectional Number of Cigarettes Smoked per Day for Male Population by Year

| NHIS | Cigarettes per Day | | | | | | | | | | | | Population | Sample |
|------|--------------------|------|-----|------|--------|------|---------|------|----------|------|------|------|------------|--------|
| | Occasional | | < 1 | | 1 to 4 | | 5 to 14 | | 15 to 24 | | 25+ | | | |
| | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | | |
| 1965 | * | * | 0.7 | 0.08 | 3.5 | 0.18 | 10.4 | 0.31 | 23.9 | 0.43 | 13.1 | 0.34 | 52,341,553 | 37,819 |
| 1966 | * | * | 0.9 | 0.10 | 3.3 | 0.18 | 10.2 | 0.31 | 24.5 | 0.43 | 13.6 | 0.35 | 52,524,255 | 37,560 |
| 1970 | * | * | 0.2 | 0.05 | 2.6 | 0.17 | 8.3 | 0.30 | 19.2 | 0.43 | 12.5 | 0.36 | 56,742,829 | 32,440 |
| 1974 | * | * | * | * | 2.6 | 0.32 | 7.8 | 0.54 | 18.6 | 0.77 | 14.2 | 0.68 | 56,695,042 | 9,828 |
| 1976 | * | * | * | * | 2.7 | 0.33 | 7.1 | 0.52 | 18.5 | 0.78 | 13.2 | 0.67 | 56,683,201 | 9,499 |
| 1977 | * | * | 0.1 | 0.06 | 2.2 | 0.31 | 7.3 | 0.54 | 17.1 | 0.78 | 13.8 | 0.70 | 55,695,105 | 9,017 |
| 1979 | 2.7 | 0.31 | 0.1 | 0.05 | 2.1 | 0.28 | 6.5 | 0.49 | 15.3 | 0.70 | 12.9 | 0.64 | 67,932,678 | 10,214 |
| 1980 | 2.7 | 0.48 | 0.1 | 0.11 | 1.9 | 0.40 | 6.1 | 0.72 | 15.6 | 1.07 | 13.3 | 0.98 | 69,634,859 | 4,455 |
| 1983 | 0.5 | 0.15 | 0.1 | 0.05 | 1.5 | 0.25 | 6.1 | 0.51 | 15.1 | 0.74 | 12.1 | 0.66 | 74,458,847 | 9,127 |
| 1985 | * | * | 0.4 | 0.11 | 1.6 | 0.22 | 6.0 | 0.41 | 13.4 | 0.58 | 11.2 | 0.53 | 75,399,614 | 13,373 |
| 1987 | * | * | 0.5 | 0.16 | 1.8 | 0.28 | 6.1 | 0.52 | 13.0 | 0.71 | 10.7 | 0.64 | 77,044,177 | 8,580 |
| 1988 | * | * | 0.4 | 0.10 | 1.2 | 0.17 | 5.9 | 0.36 | 12.9 | 0.50 | 9.9 | 0.43 | 79,676,062 | 17,751 |
| 1990 | * | * | 0.5 | 0.11 | 1.8 | 0.21 | 5.4 | 0.36 | 12.0 | 0.50 | 8.8 | 0.42 | 81,544,750 | 16,373 |
| 1991 | 3.6 | 0.28 | * | * | 0.8 | 0.14 | 4.2 | 0.31 | 11.3 | 0.47 | 8.0 | 0.39 | 82,230,069 | 17,510 |
| 1992 | 4.1 | 0.58 | * | * | 0.7 | 0.25 | 4.0 | 0.57 | 10.9 | 0.87 | 8.3 | 0.75 | 83,848,847 | 4,914 |
| 1993 | 5.3 | 0.48 | * | * | 0.6 | 0.17 | 4.2 | 0.44 | 10.4 | 0.65 | 7.0 | 0.53 | 85,254,203 | 8,514 |
| 1994 | 4.9 | 0.49 | * | * | 0.7 | 0.18 | 4.7 | 0.47 | 11.3 | 0.69 | 6.5 | 0.53 | 86,223,037 | 7,992 |
| 1995 | 4.6 | 0.50 | * | * | 0.6 | 0.18 | 4.1 | 0.47 | 10.2 | 0.70 | 7.3 | 0.59 | 87,274,556 | 7,214 |
| 1997 | 4.7 | 0.35 | * | * | 0.7 | 0.14 | 4.8 | 0.35 | 11.2 | 0.50 | 6.4 | 0.38 | 89,074,914 | 14,936 |
| 1998 | 4.6 | 0.36 | * | * | 0.9 | 0.16 | 4.5 | 0.35 | 10.2 | 0.50 | 6.4 | 0.40 | 89,850,921 | 13,682 |

*Information not available.

NOTE: Percents are standardized to the age and race distribution of the nation as indicated by NHIS 1965.

Figure 7-4 demonstrates the relationship between number of cigarettes smoked per day and age. This 10-year birth cohort (born between 1930 and 1939) has been adjusted for race and shows that the number of cigarettes smoked per day increases with age to midlife and then declines with advancing age. This pattern is consistent across multiple cohorts and is therefore not simply a function of calendar-year effects influencing the 1930 to 1939 cohort.

The percentage of current smokers in the birth cohort smoking 25-plus cigarettes per day is presented by survey year for males and females in Figures 7-5/7-6 and 7-6/7-7, respectively. The oldest male cohorts (Figure 7-5) show a steady decline in percentage of heavy smokers, as expected given their advanced age at the time of the first survey. The more recent cohorts show a percentage of heavy smoking that increases at younger ages and then either declines or levels off at a constant percentage. None of the cohorts shows an increase in the fraction of current male smokers who smoked 25-plus CPD during the 1990s.

Table 7-6
Cross-Sectional Number of Cigarettes Smoked per Day for Female Population by Year

| NHIS | Cigarettes per Day | | | | | | | | | | | | Population | Sample |
|------|--------------------|------|-----|------|--------|------|---------|------|----------|------|-----|------|------------|--------|
| | Occasional | | < 1 | | 1 to 4 | | 5 to 14 | | 15 to 24 | | 25+ | | | |
| | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | (%) | CI | | |
| 1965 | * | * | 0.7 | 0.08 | 3.6 | 0.18 | 10.4 | 0.29 | 14.3 | 0.33 | 4.8 | 0.20 | 59,262,449 | 43,617 |
| 1966 | * | * | 0.9 | 0.09 | 3.4 | 0.17 | 9.9 | 0.28 | 14.7 | 0.33 | 5.3 | 0.21 | 60,070,342 | 43,521 |
| 1970 | * | * | 0.3 | 0.05 | 2.7 | 0.17 | 8.9 | 0.29 | 13.6 | 0.35 | 5.9 | 0.24 | 64,987,109 | 37,696 |
| 1974 | * | * | * | * | 2.7 | 0.29 | 9.2 | 0.51 | 14.1 | 0.61 | 6.3 | 0.42 | 68,385,895 | 12,452 |
| 1976 | * | * | * | * | 2.9 | 0.30 | 8.6 | 0.51 | 14.1 | 0.62 | 6.4 | 0.44 | 69,714,270 | 11,751 |
| 1977 | * | * | 0.2 | 0.07 | 2.6 | 0.29 | 8.6 | 0.52 | 14.3 | 0.64 | 6.5 | 0.44 | 69,273,538 | 11,423 |
| 1979 | 2.1 | 0.25 | 0.1 | 0.06 | 1.8 | 0.23 | 7.3 | 0.46 | 13.0 | 0.58 | 6.9 | 0.43 | 76,605,617 | 12,536 |
| 1980 | 1.8 | 0.35 | 0.1 | 0.08 | 2.0 | 0.38 | 7.2 | 0.69 | 12.5 | 0.87 | 7.2 | 0.67 | 78,260,177 | 5,457 |
| 1983 | 0.5 | 0.13 | 0.0 | 0.03 | 1.8 | 0.24 | 7.8 | 0.48 | 13.5 | 0.60 | 6.0 | 0.41 | 84,195,405 | 12,293 |
| 1985 | * | * | 0.5 | 0.11 | 1.9 | 0.20 | 7.5 | 0.38 | 12.2 | 0.47 | 6.1 | 0.34 | 84,899,757 | 18,485 |
| 1987 | * | * | 0.5 | 0.12 | 1.7 | 0.23 | 7.4 | 0.47 | 11.9 | 0.57 | 5.9 | 0.41 | 86,331,932 | 12,198 |
| 1988 | * | * | 0.4 | 0.08 | 1.5 | 0.16 | 6.6 | 0.31 | 11.7 | 0.39 | 5.5 | 0.28 | 88,780,134 | 24,688 |
| 1990 | * | * | 0.4 | 0.08 | 1.8 | 0.17 | 6.9 | 0.33 | 10.4 | 0.39 | 4.1 | 0.25 | 90,730,185 | 23,091 |
| 1991 | 3.2 | 0.22 | * | * | 0.7 | 0.11 | 5.4 | 0.29 | 10.4 | 0.38 | 4.1 | 0.24 | 91,381,485 | 24,451 |
| 1992 | 3.6 | 0.45 | * | * | 0.9 | 0.23 | 6.4 | 0.59 | 10.4 | 0.71 | 4.3 | 0.47 | 93,022,957 | 6,650 |
| 1993 | 3.8 | 0.35 | * | * | 0.7 | 0.16 | 5.6 | 0.41 | 9.8 | 0.53 | 3.2 | 0.31 | 93,935,169 | 11,760 |
| 1994 | 4.0 | 0.37 | * | * | 0.6 | 0.15 | 6.3 | 0.45 | 9.8 | 0.54 | 3.1 | 0.32 | 94,729,606 | 11,065 |
| 1995 | 4.3 | 0.41 | * | * | 0.6 | 0.15 | 5.8 | 0.47 | 9.2 | 0.57 | 3.4 | 0.35 | 95,711,856 | 9,522 |
| 1997 | 4.0 | 0.27 | * | * | 0.7 | 0.12 | 6.11 | 0.33 | 8.6 | 0.38 | 3.2 | 0.24 | 97,381,857 | 19,953 |
| 1998 | 3.7 | 0.28 | * | * | 0.9 | 0.14 | 6.04 | 0.35 | 9.0 | 0.41 | 2.9 | 0.24 | 98,114,351 | 17,678 |

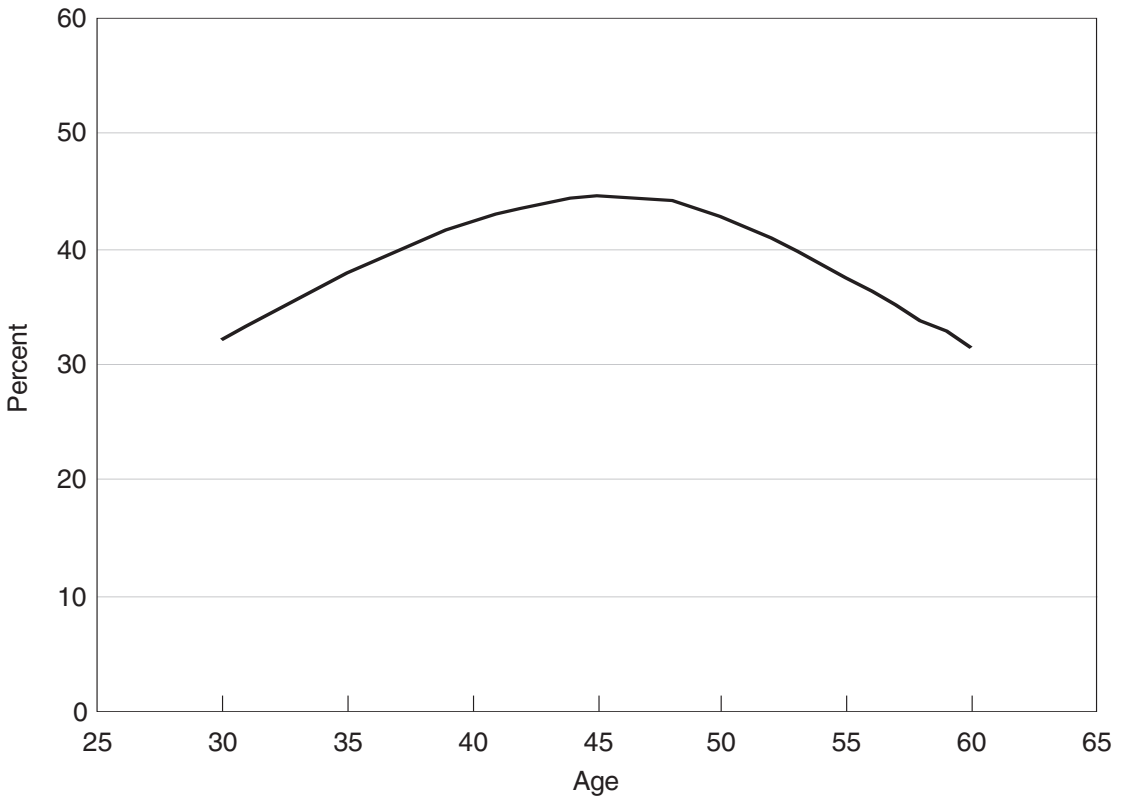
*Information not available.

NOTE: Percents are standardized to the age and race distribution of the nation as indicated by NHIS 1965.

Data for females (Figures 7-7/7-8) show lower percentages of female smokers reporting smoking 25-plus cigarettes per day, particularly for the older cohorts. In more recent cohorts, the percentages are similar to those for males. There is no suggestion of an increase in the fraction of females smoking 25-plus CPD during the 1990s.

Birth cohort analyses of those smoking 25-plus cigarettes per day as a percentage of the entire population, as distinct from the analyses as a percentage of all current smokers, were also conducted. These results are not shown, as they depict progressive declines in the prevalence of heavy smoking with advancing survey years. These declines sum up the effects of smoking cessation, excess mortality, and shifts to lower intensity of smoking with advancing age, and they offer little insight into whether the residual population of smokers is hardening.

Figure 7-4
Effect of Age on Number of Cigarettes Smoked per Day*



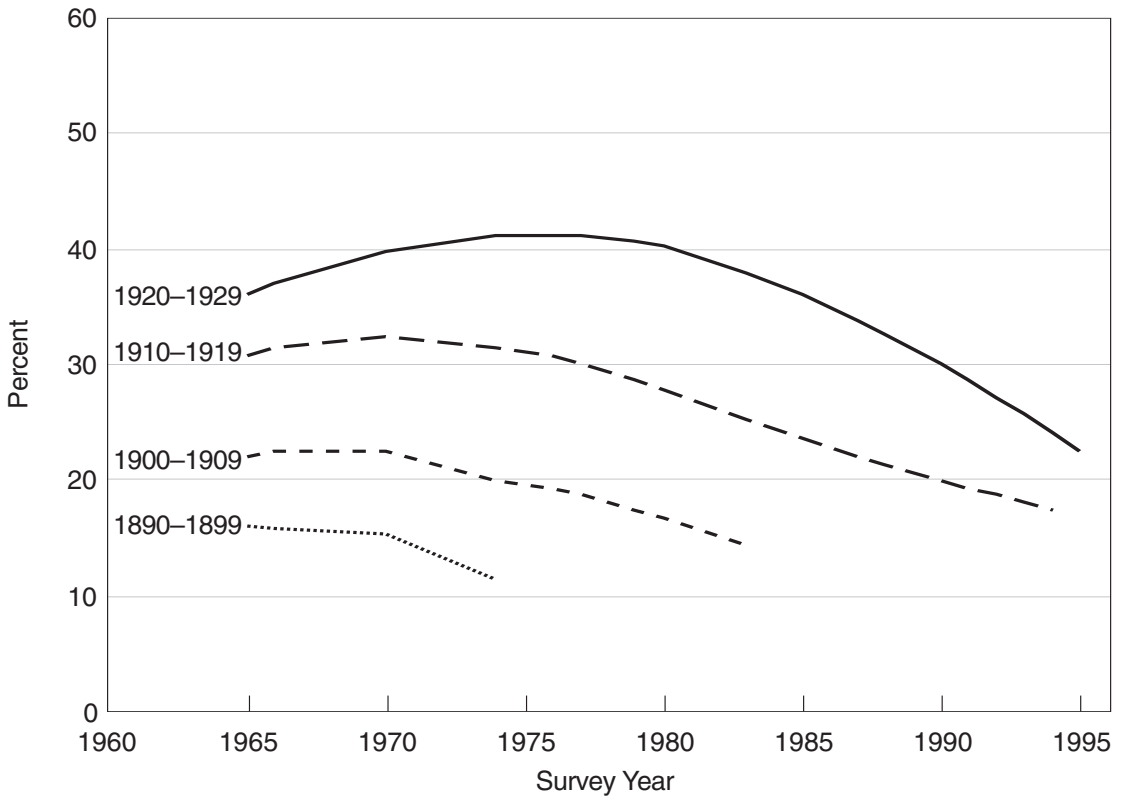
*NHIS percentage of male smokers reporting 25+ cigarettes per day (cohort born 1930–39).

DISCUSSION This chapter provides analyses of changes in number of cigarettes smoked per day from the NHIS conducted between 1965 and 1998. There has been a substantial fall in smoking prevalence over the last 25 years, but there is no evidence for a rise in the number of cigarettes smoked per day over the last 15 years in either cross-sectional analyses or in birth cohort analyses. The mean number of cigarettes smoked per day and the fraction of smokers who reported smoking 25-plus cigarettes per day appear to have declined over the last decade, although at least part of this decline is due to the increasing percentage of occasional smokers recorded in the surveys conducted since 1991, when the definition of current smoker was changed to ask specifically about occasional smoking.

These data are based on the reported number of cigarettes smoked per day in surveys, and it is possible that changes in the social acceptability of smoking over the last several decades have led to an increased underreporting of the number of cigarettes smoked over the last decade

Figure 7-5

Birth Cohort-Specific Percentage* of Male Smokers Reporting Smoking 25+ Cigarettes per Day 1965–1995



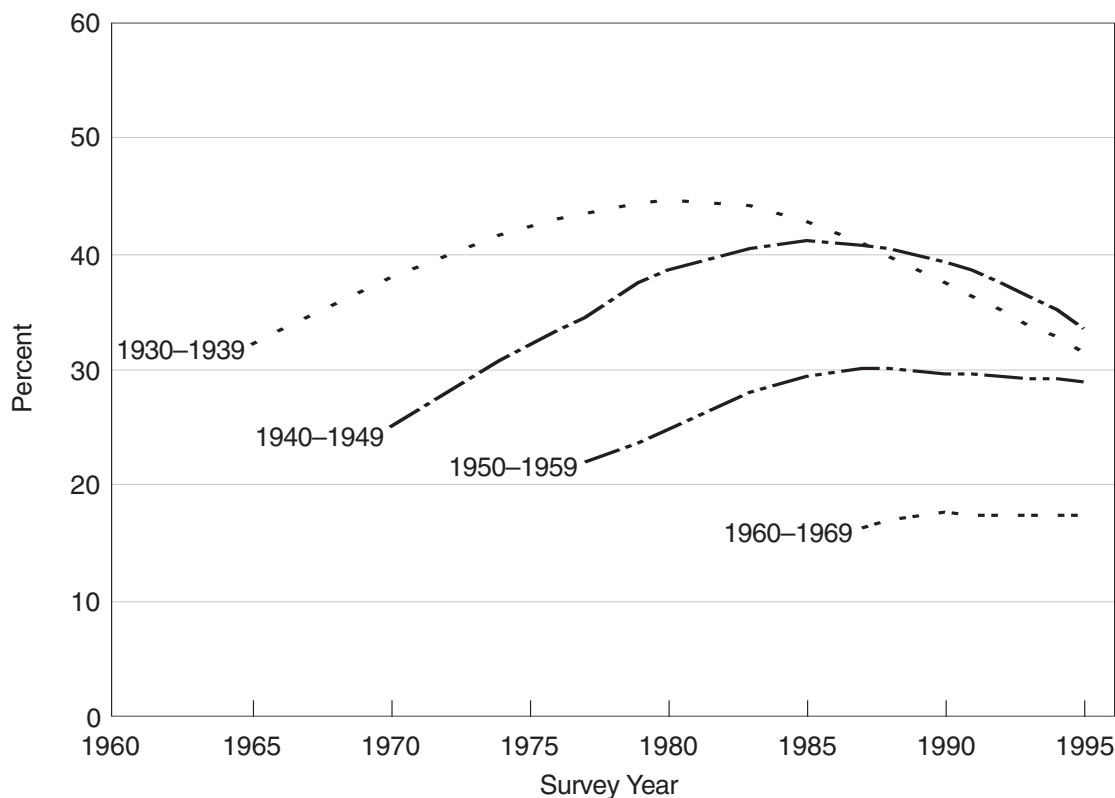
*Adjusted by race

(Warner 1978). If this underreporting is becoming more extensive, then the results of the NHIS would underestimate the actual trends in heavy smoking in the population. These underestimations could artifactually produce the declines in heavy smoking observed in the NHIS and could even mask an increase in the prevalence of heavy smoking if they are severe enough. However, concordance of the trends in per capita consumption with the trends observed in the NHIS, the increased prevalence of occasional smoking, and the decline in per capita consumption in California that is well in excess of the decline in smoking prevalence all suggest that the observations described in this chapter reflect real changes in smoking behavior of the U.S. population.

In summary, analyses of the National Health Interview Surveys neither demonstrate a rise in the fraction of the population who are heavy smokers (i.e., smoking 25-plus CPD) nor suggest that cessation among those who smoke has increased the mean of number of cigarettes smoked per day in the national adult smoker population.

Figure 7-6

Birth Cohort-Specific Percentage* of Male Smokers Reporting Smoking 25+ Cigarettes per Day 1965–1995



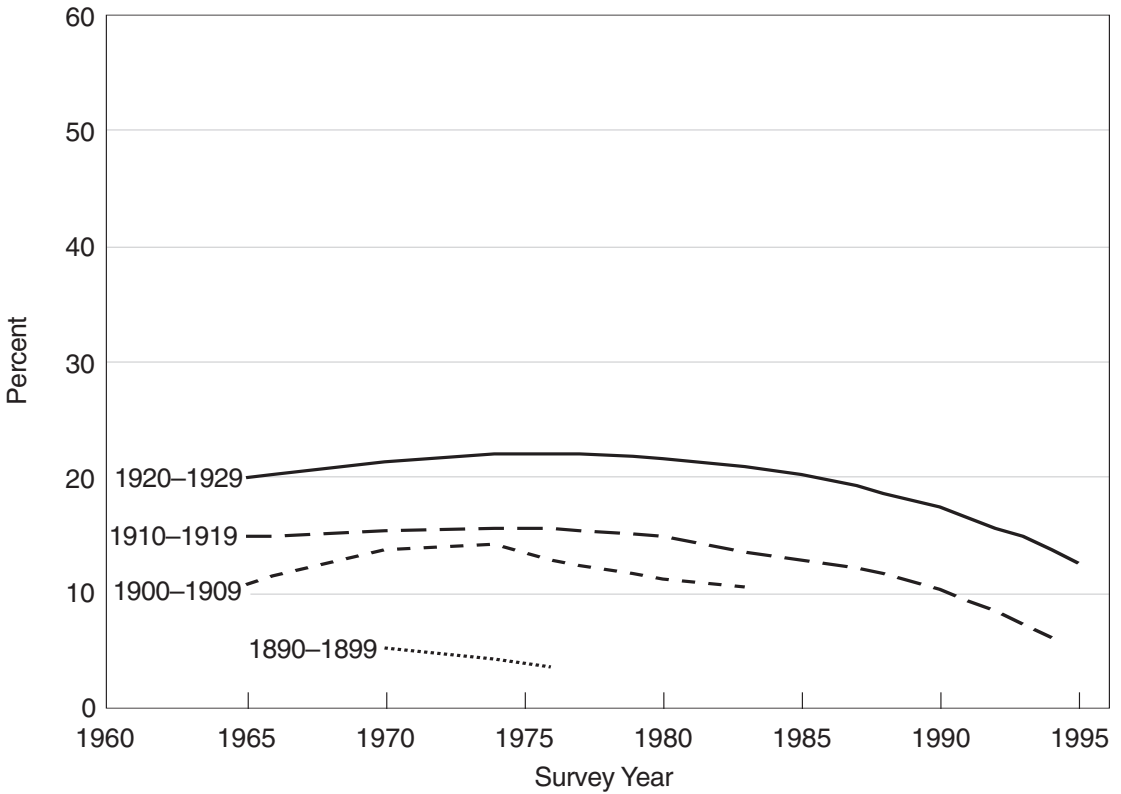
*Adjusted by race

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Figure 7-7

Birth Cohort-Specific Percentage* of Female Smokers Reporting Smoking 25+ Cigarettes per Day 1965–1995



*Adjusted by race

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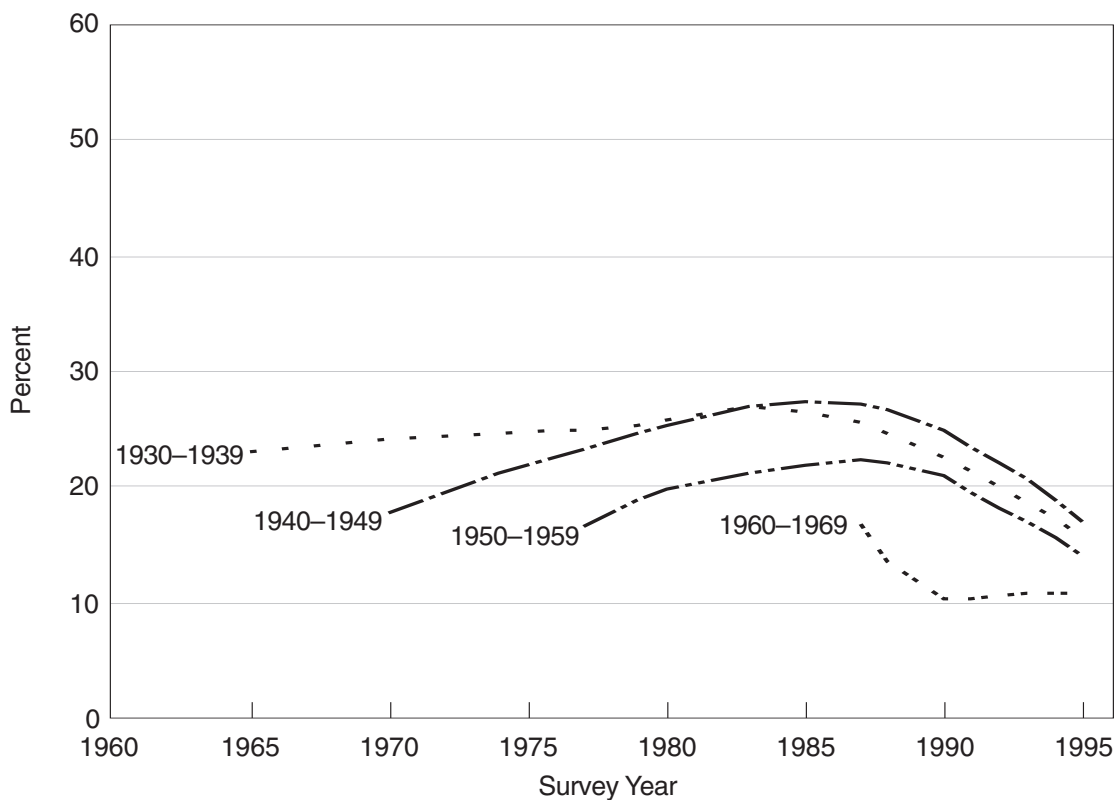
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Figure 7-8
Birth Cohort-Specific Percentage* of Female Smokers Reporting Smoking 25+ Cigarettes per Day 1965–1995



*Adjusted by race

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