1964 through the late 1970s, followed by relatively modest decreases in the 1980s. A second example is the apparent increase in smoking by teenage girls through the mid-1970s. (See Chapter 5.)

Warner and Murt (1982) argued that the female prevalence data have been misinterpreted. Conceptually, they suggested, the appropriate question was how prevalence in a given year compared with the rate that would have been experienced without the campaign, and not simply how prevalence had changed over time. In the case of women, smoking prevalence had been rising rapidly since World War II, paralleling the diffusion pattern of smoking by men two to three decades earlier. Without the antismoking campaign, Warner and Murt argued, smoking prevalence would have been expected to have continued to increase as it had with men. As such, the stability of female smoking prevalence in the mid-1960s, at a level far below that attained by men, should be interpreted as a significant response to the antismoking campaign.

Warner and Murt (1982) and Warner (1989) developed estimates of prevalence without the campaign, a process they described as necessarily involving the use of numerous assumptions whose quantitative precision or qualitative appropriateness can be challenged. The authors tested the overall validity of their estimates by converting the annual cohort projections into estimates of annual aggregate cigarette consumption and then comparing these with estimates derived by Warner (1981a, 1989) in a methodologically distinct analysis of aggregate cigarette demand. The pattern generated by aggregating the subjective data was highly similar to that estimated through use of regression analysis with objective data on cigarette production and sales. Nevertheless, the nature and number of assumptions recommend that the analysis be interpreted in qualitative terms, as a demonstration that smoking prevalence has been influenced, apparently substantially, by the smoking-and-health message.

Tables 1 and 2 illustrate the authors' comparative perspective for men and women, respectively. Each cell in each table records smoking prevalence for the relevant birth cohort and the relevant year, in 5-year increments from 1965 through 1985, based on survey respondents' self-reports. These entries are called "reported" prevalence (R in the tables). (See Harris 1983 for discussion of retrospective self-report biases.) Each cell also provides an estimate of the smoking rate that might have been expected in the absence of the antismoking campaign ("expected" prevalence, E in the tables). The difference between the two figures for the specific birth cohort in a given year represents an estimate of the percentage points of smoking prevalence avoided by the campaign. Avoided prevalence includes both campaign-related quitting and noninitiation of smoking. The data are from Warner's (1989) updating of the authors' original study (Warner and Murt 1982). Both references describe the method of determining "expected" prevalence. The updated study presents annual data for both "reported" and "expected" prevalence for 1964 through 1985.

Table 1 indicates, for example, that in 1975, 53 percent of men born between 1941 and 1950 reported themselves to be smokers. However, had their smoking patterns not been influenced by the antismoking campaign, an estimated 64 percent of them would have been smoking in 1975. Without a response to the campaign, their smoking prevalence would have been 11 percentage points, or 21 percent, higher than it actually was. By 1985, the cohort's smoking prevalence had fallen 15 points to 38 per-

TABLE 1.—Smoking prevalence for males (percent), 1965–85, reported and expected in the absence of the antismoking campaign

Year	Birth cohort											
	1901–10		1911–20		1921–30		1931–40		1941–50		1951–60	
	R	E	R	E	R	E	R	E	R	E	R	E
1965	45	46	60	61	62	66	59	63	46	48	2	3
1970	39	42	53	56	55	64	53	64	58	62	18	21
1975	30	37	46	54	47	62	46	62	53	64	38	50
1980	18	32	30	49	41	58	44	58	44	63	42	64
1985	16	25	22	45	32	53	35	54	38	60	38	66
E–R, 1985	9		23		21		19		22		28	

NOTE: R, reported; E, expected; E–R, expected minus reported.
SOURCE: Warner (1989).

TABLE 2.—Smoking prevalence for females (percent), 1965–85, reported and expected in the absence of the antismoking campaign

Year	Birth cohort											
	1901–10		1911–20		1921–30		1931–40		1941–50		1951–60	
	R	E	R	E	R	E	R	E	R	E	R	E
1965	21	21	36	37	43	45	44	46	30	32	1	2
1970	18	19	33	36	40	48	43	48	41	46	13	15
1975	15	18	28	35	38	48	42	50	40	50	35	40
1980	15	16	26	33	31	47	35	51	34	52	32	50
1985	8	14	18	31	27	44	32	49	32	52	32	54
E–R, 1985	6		13		17		17		20		22	

NOTE: R, reported; E, expected; E–R, expected minus reported.
SOURCE: Warner (1989).

cent. Prevalence expected in the absence of the campaign would have fallen too, but only by 4 points (to 60 percent). Consequently, the gap between reported prevalence and that which would have been anticipated without the campaign had increased to 22 percentage points. Thus, Warner (1989) estimated that for men born between 1941 and 1950, smoking prevalence would have been 58 percent higher than it was in 1985 (the 22 percentage-point gap divided by reported prevalence of 38 percent), had the men's smoking not been influenced by smoking-and-health knowledge and social change.

Table 2 shows that for women born between 1921 and 1930, expected prevalence exceeded reported prevalence by 10 percentage points in 1975. Both measures fell through the mid-1980s, although reported prevalence decreased more than expected prevalence without the campaign, so that the gap between the two widened to 17 percentage points by 1985. In that year, according to the estimates, in the absence of the antismoking campaign, smoking prevalence in this cohort of women would have been 63 percent higher than it actually was (the 17 percentage-point gap divided by reported prevalence of 27 percent).

Figures 1 and 2 illustrate this perspective on the impact of the campaign on smoking prevalence by plotting annual figures for reported and expected prevalence, as well as pre-1964 prevalence estimates, for two other cohorts, one male and one female. In each case, the solid line plots actual reported prevalence and the dashed line plots the anticipated prevalence in the absence of the antismoking campaign. The gap between the two lines constitutes a measure of the impact of the campaign on smoking prevalence for these two birth cohorts.

The analysis indicates that all 12 of the age–sex birth cohorts experienced substantial quitting or noninitiation of smoking as a result of the antismoking campaign. By 1985, the estimated gap between actual (reported) prevalence and that anticipated without the campaign ranged from a low of 6 percentage points for the eldest female cohort to a high of 28 percentage points for the youngest males.

The percentage-point gap is larger for each male cohort than for the same-age female cohort. This is consistent with the common observation that the campaign has encouraged more men to quit than women. However, because the actual smoking prevalence of each birth cohort is smaller for women than for men, this standard observation misses an essential consideration: the ratios of percentage points of campaign-related quitters and noninitiators to the percentages of actual smokers are quite comparable for men and women. Thus, when the 1985 percentage-point gap (the last row in Tables 1 and 2) is divided by actual prevalence in that year, this measure of relative quit-and-nonstart rate indicates little difference between males and females.

The percentage-point gap in 1985 generally increases from the older to the younger birth cohorts, especially for the females. Warner and Murt observed that this might be expected because decisions concerning the initiation of smoking occurred after 1964 for many members of the two youngest cohorts and well before 1964 for the older cohorts. Decisions not to start smoking may be easier than decisions to quit.

The expected prevalence figures indicate that a majority of each of the four youngest male cohorts would have been expected to be smokers in 1985 without the campaign, including two-thirds of men born from 1951 through 1960. In fact, fewer than 40 per-

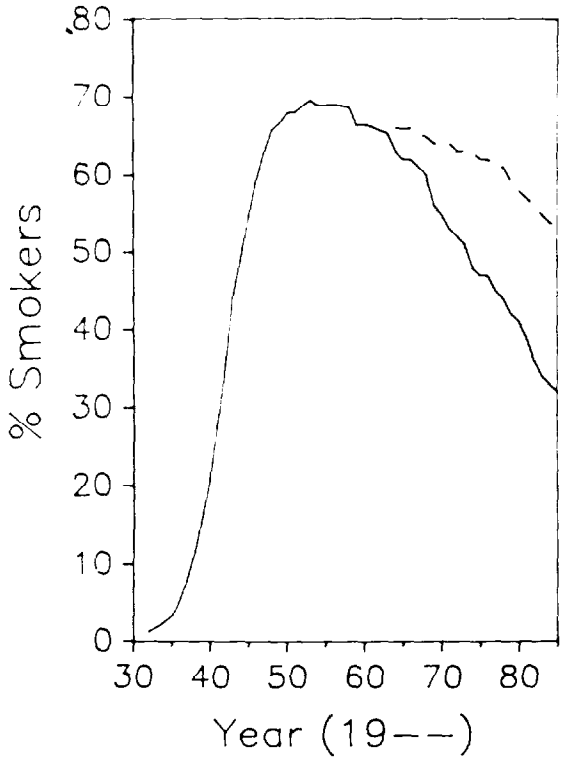

FIGURE 1.—Actual smoking prevalence history (solid line) and estimated prevalence for 1964–85 in the absence of the antismoking campaign (dashed line), 1921–30 male cohort

SOURCE: Warner (1989).

cent of each cohort reported themselves to be smokers that year. Similarly, without the campaign, smoking prevalence in the four youngest female cohorts would have been expected to include a majority or near majority of the women (44 percent for the 1921–30 birth cohort to 54 percent for the 1951–60 cohort). Yet each of these cohorts reported prevalence rates of either 27 percent (1921–30 cohort) or 32 percent (1931–60 cohorts).

Warner and Murt observed that the peak prevalence of the youngest cohort of males (born 1951–60), which fell short of 50 percent, made this cohort the first group of men born during the century never to have included a majority who were smokers. Supportive of the large gap found between this cohort's reported prevalence and the estimate of prevalence without the campaign are data on the peak prevalence of each of the older cohorts, reported by Harris (1983) and presented in Table 3. In the space of a single 10-year period, peak prevalence fell 16 percentage points, from 58 to 42 percent (for the 1941–50 and 1951–60 birth cohorts, respectively). In the span covered by three 10-year birth cohorts, the maximum percentage of men smoking fell by almost 30 percent-

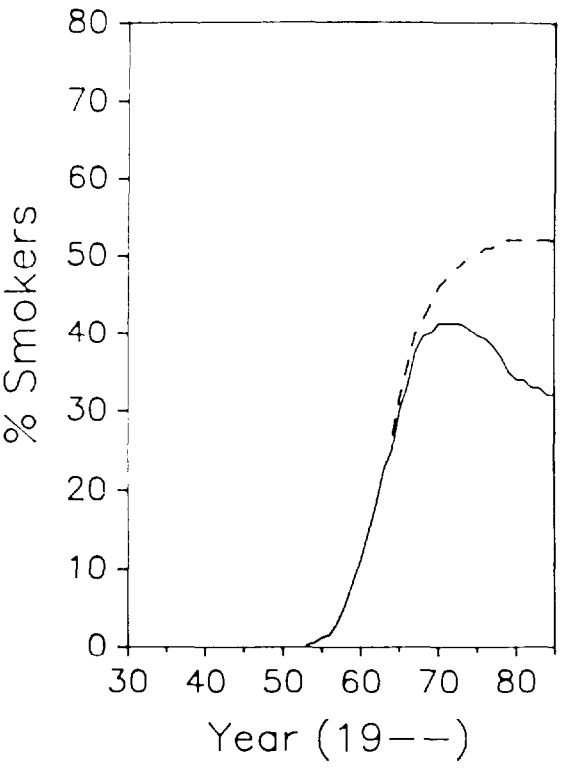

FIGURE 2.—Actual smoking prevalence history (solid line) and estimated prevalence for 1964–85 in the absence of the antismoking campaign (dashed line), 1941–50 female cohort

SOURCE: Warner (1989).

age points (from 70 percent for the 1921–30 cohort). Preliminary data from the 1987 National Health Interview Survey (NHIS), combined with other NHIS data from the 1980s, suggest that the peak prevalence for the cohort of males born between 1961 and 1970 may represent a further decrease of as much as 12 or 13 percentage points, to a rate of 29 to 30 percent.

The rates attained by the 1911–30 cohorts suggest that the expected peak prevalence figures for males in Table 1 may be conservative. This perception is reinforced by recognition that the 1921–30 cohort achieved its peak rate of smoking the year of the first major public concern about smoking and cancer, and that succeeding cohorts reached peak smoking age during other periods of concern about the health consequences of smoking.

In this context, had women's smoking patterns eventually mirrored those of men approximately three decades earlier, the expected prevalence figures in Table 2 would have to be considerably larger than they are. As such, the gaps between reported and

TABLE 3.—Peak smoking prevalence, males born 1901–60

Birth year	Year of peak prevalence	Prevalence (percentage)
1901–10	1938	62
1911–20	1947	71
1921–30	1953	70
1931–40	1962	61
1941–50	1969	58
1951–60	1980	42

SOURCE: Harris (1983); NHIS 1983.

expected prevalence for women may be conservative measures of the impact of the antismoking campaign on women's smoking prevalence.

Warner (1989) multiplied the reported and expected prevalence estimates for 1985 by cohort-specific population estimates to generate estimates of the 1985 population of smokers with and without the antismoking campaign. Including the cohort born 1961–70, and adjusting population estimates to reflect the differential mortality of smokers, Warner estimated that in 1985 there were 56 million American smokers born between 1901 and 1970. In the absence of the campaign, he estimated that there would have been 91 million smokers.

Not considered in Warner and Murt's analyses is change in the consumption of other tobacco products. Throughout much of the century, while the prevalence of cigarette smoking was first rising and then falling, the use of other smoking tobaccos and smokeless tobacco products was diminishing. From the mid-1970s into the present decade, decreases in the prevalence of smoking by boys occurred at the same time that the prevalence of smokeless tobacco use by boys was rising (Connolly et al. 1986). (See Chapter 5.) The significance of this most recent inverse correlation has not been established, but it implies that the prevalence of tobacco use by boys may not have decreased as much as data on cigarette smoking might suggest.

Per Capita Cigarette Consumption

While smoking prevalence is likely the best single measure of smoking behavior, a second measure has been employed frequently as an index of a society's smoking exposure: adult per capita cigarette consumption, typically defined as total cigarette consumption divided by the population over 17 years of age. One advantage of this measure is that it is derived from objective data. Aggregate consumption is calculated on the basis of cigarette production, tax, and sales data, adjusted for inventories (US DHEW 1979). (See Chapter 5.) Adult population estimates are from census data. Both sources are considered quite reliable. By contrast, self-reported cigarette consumption is subject to inaccuracies due to underreporting (Warner 1978) and "digit bias," the tendency to report daily consumption in terms of the number of cigarettes in the packs

selected by smokers or in other round numbers (e.g., 10 and 30; see Chapter 5) (Kozlowski 1986).

Per capita consumption has the additional advantage of being a conservative measure of downward trends in smoking behavior, one thus unlikely to exaggerate the extent of change, because it does not take account of other smoking behavior changes that might increase one's estimation of response to the antismoking campaign. For example, smokers' switching to low-yield cigarettes could increase per capita consumption, because of the tendency to compensate for reduced nicotine yield per cigarette (US DHHS 1981, 1988; Gerstein and Levison 1982). As such, by itself, the market shift toward low-tar and -nicotine cigarettes may have introduced a tendency toward increases in per capita consumption that does not necessarily reflect any greater societal exposure to tobacco (Walker and Brin 1988). Thus, estimation of campaign response based on the pattern of per capita consumption may understate the extent of true response.

This advantage of the measure also points out its chief limitation: it masks changes in the composition and individual behavior of the smoking population. Per capita consumption offers no insight into variations in the sex, age, income, or education distribution of smokers; it fails to distinguish a change in the number of smokers from a change in the number of cigarettes the average smoker consumes; and, as just discussed, it ignores several other potentially important changes in smoking behavior, such as smokers' switching to low-yield cigarettes or reducing the amount of each cigarette smoked.

The analytical perspective involved in the per capita consumption studies is identical to that employed in the preceding cohort analysis: the objective remains to estimate smoking patterns that would have been expected without the antismoking campaign and then to compare them with realized patterns. The methodological approach is quite different, however, as has been the focal point of most of the relevant studies. Specifically, several authors have estimated impacts of the campaign in econometric analyses in which data on adult per capita cigarette consumption (the dependent variable) were regressed on data on a series of independent variables, including dummy variables and other measures intended to reflect years of prominent antismoking activity. Regression coefficient estimates in these studies indicate whether the years of special antismoking activity were associated with statistically significant decreases in per capita cigarette consumption, and if so, to what extent.

Effects in Years of Major Smoking-and-Health Events

Interest in major developments affecting the demand for cigarettes has emphasized changes in per capita cigarette consumption in and after the years in which they occurred. The developments studied have included the first widespread public discussion about the link between smoking and cancer in the United States in 1953 and 1954; publication of the first report of the British Royal College of Physicians on smoking and health in 1962 (Royal College of Physicians 1962); publication of the first Surgeon General's Report in 1964 (US PHS 1964); airing of the Fairness Doctrine antismoking messages on U.S. television and radio from 1967 through 1970; broadcast ad bans in several countries; and the spread of nonsmokers' rights laws in the United States begin-

ning in the mid-1970s. Figure 3 indicates how decreases in adult per capita consumption in the United States corresponded to the timing of the major U.S. smoking-and-health events.

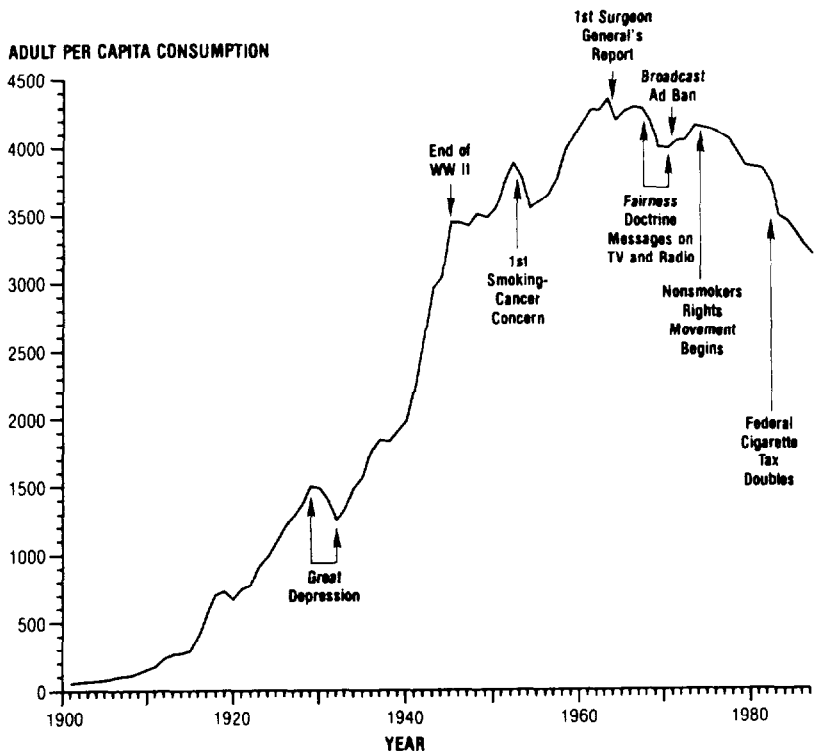

FIGURE 3.—Adult per capita cigarette consumption and major smoking-and-health events

SOURCE: Adapted from Warner (1985a).

Although there are exceptions (e.g., Fujii 1980), studies of individual "shocks to the system," such as publication of the first Surgeon General's Report, are quite consistent in their finding that cigarette consumption exhibited statistically significant decreases during these years, with the estimated magnitude ranging from about 3 to 8 percent of per capita consumption in the year of the event (Bishop and Yoo 1985; McGuinness and Cowling 1975; Radfar 1985; Witt and Pass 1983; Hamilton 1972; Atkinson and Skegg 1973, 1974; Atkinson and Townsend 1977; Peto 1974; Russell 1973; Ippolito, Murphy, Sant 1979; Doron 1979; Schneider, Klein, Murphy 1981; Warner 1977, 1981a, 1989). Many authors of these studies have concluded that these effects were transitory—that is, consumption rapidly returned to its previous baseline (e.g., Atkinson and Skegg 1973, 1974; Atkinson and Townsend 1977; Warner 1977, 1981a; Witt and Pass 1983)—but others believe that some of the shocks caused permanent shifts downward in the demand for cigarettes (e.g., Ippolito, Murphy, Sant 1979).

Considering antismoking activities after the 1964 Report and the Fairness Doctrine ads (discussed in Chapter 7), Doron (1979) concluded that antismoking publicity depressed per capita consumption by approximately 900 cigarettes in 1970. Schneider, Klein, and Murphy (1981) analyzed the effects of three antismoking events together and concluded that they had had a modest collective impact on cigarette consumption (decreasing it 8.3 percent), but a substantial impact on per capita tobacco consumption (a decrease of 39 percent from 1964 through 1978), because they encouraged smokers to switch to filter and low-tar and -nicotine cigarettes (discussed below). However, Schneider, Klein, and Murphy failed to account for changes in cigarette production technology that reduced tobacco consumption independent of changes in consumer demand. These included tobacco sheet reconstitution, increased use of stems and scraps, and addition of nontobacco filler materials. (See also Walker and Brin 1988.)

Considerable interest has focused on government policies with respect to broadcast advertising of cigarettes, encompassing both the Fairness Doctrine antismoking messages in the United States and the banning of television and radio advertising of cigarettes in several Western countries. Research on the impacts of these policies emerged soon after they were adopted. Analysis has reemerged in recent years in part because of the relevance of these experiences to the contemporary debate on banning advertising and promotion of tobacco products (Chapter 7).

Most analysts have concluded that the Fairness Doctrine ads were effective in discouraging cigarette consumption, although estimates of their deterrence effect range from relatively small impacts (Baltagi and Levin 1986; Schneider, Klein, Murphy 1981; Fujii 1980) to effects on the order of other major shocks, such as the Surgeon General's Report (Doron 1979), to as much as 14 percent of per capita consumption (Hamilton 1972; Warner 1977, 1981a, 1989). At least one study has concluded that the antismoking ads did not have an independent deterrence effect (Ippolito, Murphy, Sant 1979). Per capita consumption fell each of the years of the ads. (See Chapter 7.)

Because objective consumption data are not specific to groups of consumers, no analysis based on these data has investigated campaign effects on children and teenagers. The only econometric analysis to examine teenagers' consumption response to the Fairness Doctrine ads relied on survey-based prevalence data (Lewit, Coate, Grossman 1981). That study concluded that the messages produced a 5.2-percent decrease in teen smoking during their first year, but their novelty, and hence effectiveness, diminished by the second year.

With broadcast ad bans having been adopted in several Western countries, analysts have studied the effect of this major antismoking event in a variety of countries. While assessments of the impact of the U.S. broadcast ad ban effective in 1971 were reviewed briefly in Chapter 7, it is useful to reiterate those findings and supplement them with the conclusions of authors who have studied bans in other countries.

The U.S. broadcast ban on cigarette ads is the event for which there is least agreement in the literature about consumption implications. As discussed in Chapter 7, some analysts have concluded that the U.S. ban was counterproductive, actually contributing to increased cigarette consumption. Hamilton (1972) predicated this judgment on his evaluation of the relative effectiveness of pro- and antismoking advertisements. He estimated that prosmoking advertising increased per capita consumption by 95 ciga-

rettes per year, while the Fairness Doctrine ads decreased it by 531. Consequently, prohibiting cigarette advertising, which also eliminated the need for broadcasters to donate time to the smoking-and-health cause, resulted in a net gain in cigarette sales. Schneider, Klein, and Murphy (1981) also concluded that the ban increased consumption, but primarily because it reduced a major cost of business for the tobacco companies—broadcast advertising—which, according to these authors, did not affect the aggregate level of consumption. They argued that decreased cost permitted price reductions, which, other things being equal, would increase consumption.

Other analysts have found no support for this position (Baltagi and Levin 1986). One of its premises was disproven soon after the ban, namely that cigarette advertising expenditures would fall sharply and remain, if not permanently lower, at least substantially lower for a long time, thus permitting the price of cigarettes to fall. Advertising expenditures did decrease in 1971, immediately following the broadcast ad ban, but they increased in succeeding years such that real expenditures (i.e., controlling for inflation) exceeded pre-ban levels by the mid-1970s (Federal Trade Commission 1988). Real cigarette price actually increased in the first 2 years of the ban period, although real manufacturers' wholesale prices declined during those years (excise taxes accounting for the increase).

Several analysts have concluded that broadcast bans have decreased consumption, albeit typically quite modestly (Bishop and Yoo 1985; Peto 1974). A common assessment, particularly in studies of the British broadcast ad ban, has been that the consumption impact of the ban trailed off, with consumption returning to baseline within 2 to 5 years (McLeod 1986; Witt and Pass 1983; Atkinson and Skegg 1974). As noted in Chapter 7, however, none of these analyses was designed to assess the long-run social influence of entire generations not being exposed to broadcast advertising of cigarettes (Warner 1979).

Many observers believe that the seminal smoking-and-health event in the United States in the past 15 years has been the growth of the nonsmokers' rights movement, reflected in passage of State and local laws and private business policies restricting smoking in public places and workplaces. Laws and policies and their effects were reviewed in the preceding chapter and, in greater depth, in the 1986 Surgeon General's Report (US DHHS 1986) and other recent publications (Bureau of National Affairs 1986, 1987).

As noted in the last chapter, to date few statistical studies using objective consumption data have examined the relationship between smoking restriction policies and per capita consumption. Three econometric analyses found a significant inverse relationship between restrictions and consumption, but none concluded that the relationship was causal. In one study, an index of the growth of State-level smoking restriction laws correlated strongly with the decline in adult per capita consumption after 1973 (Figure 3), but the author concluded that "This correlation seems unlikely to reflect causation. Rather, both declining consumption and growth in legislation probably reflect a prevailing nonsmoking ethos and the conversion of modified knowledge and attitudes into behavioral change" (Warner 1981a).

In the second econometric study, the author found a significant reduction in smoking associated with laws categorized as restrictive, but no significant reduction as-

sociated with less restrictive laws. The study could not determine, however, whether passage of restrictive laws preceded or followed decreases in consumption (Lewit 1988). In the third study, the authors concluded that the significant correlation between passage of laws and reduced cigarette demand likely reflected reverse causality; that is, that cigarette demand has a significant negative effect on the probability of passing a clean indoor air law (Chaloupka and Saffer 1988).

Aggregate Effects

While numerous econometric studies have contributed to understanding the impact of major individual smoking-and-health events, regression analysis has also been used by Warner (1977, 1981a, 1989) to estimate changes in per capita consumption associated with changes in the smoking-and-health environment over the entire period since 1964. In the two more recent studies, to estimate what consumption would have been in any given year without the antismoking campaign, Warner added the values of the relevant antismoking variables in the regression, multiplied by their corresponding coefficients, to the year's actual per capita consumption. (With the previous year's consumption included among the independent variables as a measure of the addiction effect, an antismoking effect was also carried forward into future years and was included in the analysis.) The resulting estimates of per capita consumption in the absence of the campaign were then compared with the realized levels of consumption to measure the aggregate impact of the campaign in the year in question.

Figure 4 presents the results of the most recent analysis (Warner 1989). The solid line in the Figure tracks actual adult per capita cigarette consumption from 1932 through 1987. (The regression covered the post-World War II period, 1947 through 1987.) The dashed and dotted lines are two estimated patterns that consumption would have followed from 1964 through 1987 had the demand for cigarettes never been influenced by the development and dissemination of scientific knowledge on the hazards of smoking and the associated social and policy developments.

The distinction between the two estimated lines lies in how price changes are treated. The dotted line results from the assumption that the pattern of price changes was itself a function of legislators' reactions to the emerging evidence on smoking and health (Warner 1981a,b). In particular, the real price of cigarettes rose every year from 1964 through 1972 and again from 1981 through 1987. The intervening period of real price decreases has been attributed to reduction in new State excise tax increases due to concern about interstate cigarette smuggling, the result of tax-based price differentials between low- and high-tax States (Advisory Council on Intergovernmental Relations 1985; Warner 1982). The resumption of real tax increases in 1981 may reflect reduced concern about smuggling, as a consequence of the diminishing real value of interstate tax differences during the preceding decade. (See Chapter 7.) To reflect the assumption that this pattern of price changes was a function of the antismoking campaign, the dotted line in Figure 4 treats price as if it had been constant (in real terms) in the years after 1963. This permits an assessment of the effects on consumption of price fluctuations possibly resulting from the campaign.

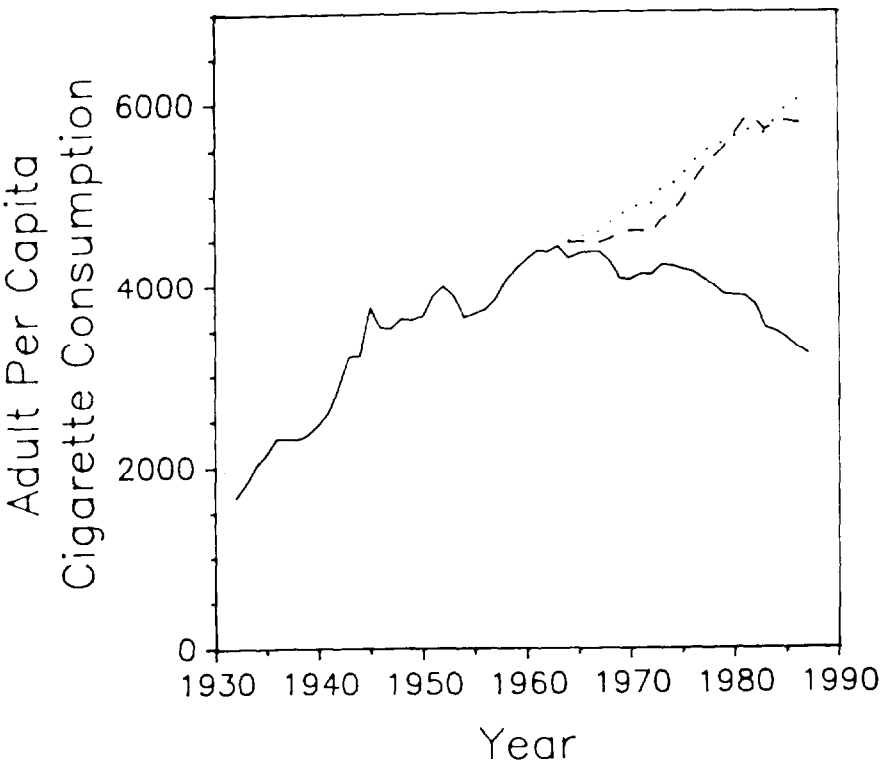

FIGURE 4.—Comparison of actual per capita cigarette consumption (solid line) with estimated consumption in the absence of the antismoking campaign (dashed line = actual cigarette prices; dotted line = real price held constant)

SOURCE: Warner (1989).

The dashed line treats the pattern of realized prices as independent of the antismoking campaign; actual experienced prices are reflected in the dashed line. Warner interpreted the gap between the solid line (actual consumption) and dashed line (estimated consumption, actual prices) as a measure of the " 'pure' publicity effect" of the campaign, whereas the gap between the dashed line and dotted line (estimated consumption, constant prices) measured the impact on consumption of changing prices. To the extent that the latter was attributable to smoking-and-health concerns of legislators, Warner considered it a measure of price-related campaign-induced changes in consumption.

While the precise pattern of estimated per capita consumption without the antismoking campaign depends on the treatment of price change, each of the estimated lines indicates a generally increasing pattern of consumption over time, in contrast to the pattern actually experienced. According to the analysis, in 1987, without the antismoking campaign, and treating price changes as independent of the campaign (i.e., the dashed

line in Figure 4), per capita consumption would have been 79 percent greater than the level actually experienced. When the pattern of price changes is removed (the dotted line in Figure 4), the estimate rises to 89 percent, indicating that price fluctuations contributed to decreased consumption, but to a much smaller degree than did the publicity effect. An alternative way to interpret the 1987 figures is to observe that actual consumption was from 53 to 56 percent of the expected level in the absence of the antismoking campaign.

Two observations support the magnitude of the campaign impact estimated in this per capita consumption analysis. First, the finding of a substantial impact of the antismoking campaign is consistent with the cohort analysis of prevalence reviewed above. Second, continued diffusion of smoking among women to levels comparable to those attained by men prior to the mid-1960s, combined with the maintenance of men's smoking rates, would have produced rates of per capita consumption higher than those estimated here (Warner 1977).

Filter-Tipped and Low-Tar and -Nicotine Cigarettes

Whereas quitting smoking or avoiding initiation constitutes the most obvious reaction to campaign-related health or social concerns, switching to cigarettes perceived as less hazardous better reflects some smokers' responses, in part because actions short of quitting allow smokers to respond to their concerns without having to take the more drastic step of ceasing an addictive behavior. In this regard, two of the best markers of smokers' reactions to antismoking publicity have been the rapid spread of filtered cigarettes in the 1950s and low-tar and -nicotine cigarettes in the 1970s (Schneider, Klein, Murphy 1981).

While evidence linking cigarette smoking with cancer dates back at least to the 1930s, the period of sustained, intensive scientific investigation began in the late 1940s and early 1950s. (See Chapters 1 and 2.) A few popular publications transmitted the new scientific findings to the lay public soon thereafter, including *Reader's Digest* (Riis 1950; Norr 1952; Lieb 1953; Miller and Monahan 1954) and *Consumer Reports* (1953, 1954, 1955). At the same time, cigarette manufacturers were developing and marketing new filtered cigarettes. Cigarette filters were advertised as a technology to remove the harmful elements of smoke (Calfee 1986; Davis 1987; Tye 1986; Warner 1985b; Whelan 1984).

As the data in Chapter 5 indicate, the shift to filtered cigarettes at this time was swift. While filtered cigarettes had been available since the 1930s, they composed only 1 percent of the market in 1952. By 1954 the proportion of filtered cigarettes had increased to 9 percent. The filter-tip market share rose by at least 9 percentage points each of the next 3 years, reaching 38 percent in 1957. Three years later, the filtered cigarette became the dominant product on the market. This first widespread public concern about smoking and health was also associated with a 2-year decline in adult per capita cigarette consumption in 1953 and 1954 (Figure 3).

Two decades later, in the mid-1970s, the rapid shift toward low-tar and -nicotine cigarettes represented a second major change in consumers' choice of cigarette product. In the late 1960s, low-tar and -nicotine cigarettes (defined as cigarettes yield-

ing 15 mg tar or less, as measured by the Federal Trade Commission) constituted from 2 to 3 percent of the cigarette market. In the early 1970s, cigarette manufacturers initiated an advertising campaign for low-tar and -nicotine cigarettes, which resulted in 50 percent of advertising dollars being dedicated to these products by 1977 (Schneider, Klein, Murphy 1981; Federal Trade Commission 1988). Many of the ads made health claims for the products, most implicitly (Altman et al., in press; Davis 1987; Tye 1986; Warner 1985b).

From 1970 through 1974, the market share of low-yield cigarettes increased from 4 to 9 percent. Three years later, with 50 percent of all cigarette ads devoted to the low-yield products, market share had increased to 23 percent. By the end of the decade, the market share exceeded 40 percent, and it hit 56 percent in 1981. Thereafter, the percentage backed off a few points, but the low-tar and -nicotine cigarette remained the principal product on the market (Federal Trade Commission 1988).

Surveys in the 1970s found that large proportions of the smoking public believed that some cigarettes posed little or no health risk (Federal Trade Commission 1981). (See Chapter 4.) As such, many smokers may have perceived low-tar and -nicotine cigarettes as an alternative to quitting smoking that would not compromise health. Some analysts have concluded that the shift to low-tar and -nicotine cigarettes, and before it to filter-tipped cigarettes, was the smoking public's principal behavioral response to concerns about the health hazards of smoking (Schneider, Klein, Murphy 1981).

Health Consequences of the Campaign

Given the health consequences of smoking, described in Chapters 2 and 3, the behavioral impact of the antismoking campaign implies that the campaign has had significant effects on the health of the American public. These health effects may be quite varied, reflecting the number and variety of behavioral changes, ranging from outright smoking cessation to shifts to low-tar and -nicotine cigarettes. In addition to reductions in the amount of smoking-related mortality, the mix of smoking-related deaths may have been altered by campaign responses, as a result of changes in the nature of the product and its disease-producing properties. (See Chapters 2 and 3 and US DHHS 1981.) Similarly, patterns of morbidity and disability may have been affected.

While smoking-related deaths have been averted as a result of people's responses to the antismoking campaign (as discussed below), it is also possible that some additional deaths have occurred because of campaign response. The latter could result, for example, if industry advertising, responding to smokers' health concerns, prompted smokers who otherwise would have quit smoking to switch to low-yield cigarettes. There is a clear consensus that among the principal factors motivating the growth of filtered cigarettes and the shift toward brands lower in tar and nicotine yield were concerns about the health effects of smoking—on the part of consumers, the Federal Trade Commission (which decided in 1967 to publish standardized tar and nicotine measurements), and the cigarette manufacturers in response (US DHHS 1981, 1988; Gerstein and Levison 1982; Schneider, Klein, Murphy 1981; Miles 1982). As noted above, analysts have concluded that, at the time of the shifts to filtered and low-yield cigarettes, cigarette advertising stressed the new products' health "advantages," with the

apparent intent of allaying consumer fears and thereby discouraging quitting of smoking (Calfee 1986; Davis 1987; Tye 1986; Warner 1985b; Whelan 1984; Altman et al., in press).

A number of factors complicate assessment of the net health consequences of reduced-yield cigarettes. These include the unknown health effects of additives in low-yield cigarettes and the tendency toward nicotine regulation, both discussed in detail in previous reports of the Surgeon General (US DHHS 1981, 1988); the possibility that many low-yield-cigarette smokers would have quit smoking in the absence of the availability of lower yield products; and the possibility that the availability of low-tar and -nicotine brands may account in part for the increase in smoking by teenage girls and young women in the 1970s (Harris 1980). To date, the net health effects of the introduction and consumer acceptance of filtered and low-yield cigarettes have not been determined. Furthermore, no formal analysis has attempted to assess how much of the switch to lower yield products constitutes response to the antismoking campaign.

Only one measure of health impact of the campaign has been evaluated quantitatively: aggregate mortality associated with changes in smoking prevalence. The concluding section of this Chapter reviews the relevant findings.

Mortality Postponed by Campaign-Related Decreases in Smoking Prevalence

While the net health effects of filter and low-tar and -nicotine cigarettes have not been determined, Warner (1989) has estimated the mortality postponed as a result of campaign-induced decisions of smokers to quit and of nonsmokers not to start smoking. Updating an earlier analysis (Warner and Murt 1983), Warner applied epidemiologic data on age–sex-specific mortality rates of smokers, former smokers, and never smokers to the cohort-specific changes in smoking prevalence summarized above in Tables 1 and 2. The reduced mortality rates of former smokers (compared with continuing smokers) were multiplied by the estimated number of campaign-induced quitters and noninitiators (i.e., people influenced by the campaign not to start smoking) in each cohort and in each year from 1964 through 1985. This procedure generated estimates of the number of additional smoking-related deaths that would have occurred had the antismoking campaign not encouraged quitting and noninitiation. (See Chapter 3 for discussion of smoking-related deaths.) The analysis also produced estimates of life–years saved. These represent the life expectancy gained by campaign-induced quitters and noninitiators who avoided or postponed premature smoking-related deaths.

Given the need to make several assumptions to perform the study, Warner subjected his findings to four sensitivity analyses. He altered each of four variables' assumed values in a conservative direction to determine whether the specific values selected for the base case fundamentally affected the qualitative findings of the study. While the sensitivity analyses reduced the estimates of deaths postponed by the campaign, the author concluded that none reduced them sufficiently to alter the essential qualitative finding: from 1964 through 1985, hundreds of thousands of smoking-related premature deaths were delayed or avoided as a result of campaign-induced decisions to quit smoking or not to start.

Table 4 presents estimates of deaths postponed for each of the 12 age–sex cohorts identified in Tables 1 and 2, from 1964 through 1985. For Americans born after 1900, the total number of deaths postponed as a result of campaign response was estimated as 789,200. The distribution between men and women and across birth cohorts is seen in the individual cells of Table 4.

TABLE 4.—Deaths postponed by campaign-related smoking cessation and noninitiation, 1964–85 (in thousands)

Birth year	Males	Females	Total
1901–10	103.6	16.7	120.3
1911–20	182.0	46.0	228.0
1921–30	182.7	59.6	242.3
1931–40	83.2	22.7	105.9
1941–50	44.0	15.5	59.5
1951–60	29.0	4.2	33.2
Total	624.5	164.7	789.2

SOURCE: Warner (1989).

According to the estimates in Table 4, nearly four times as many men as women realized additional years. In part this reflects the greater consumption impact of the campaign on men, as well as their higher mortality rates. However, Warner's analysis utilized male smoker mortality ratios from an insurance study (Cowell and Hirst 1980) and adopted as a conservative assumption an estimate that women's excess smoker mortality ratios were half those of men. New data from the American Cancer Society's survey, analyzed in Chapter 3, demonstrate that women's excess smoker mortality ratios are closer to two-thirds those of men. Consequently, the data in Table 4 likely underestimate the number of women's deaths postponed relative to those of men.

Warner also estimated the number of life–years saved as a result of campaign-related smoking cessation and noninitiation. In total, the 12 cohorts gained 16.3 million additional life–years. The average number of life–years saved per death postponed was 20.6.

Figure 5 plots the cumulative number of smoking-related deaths estimated to have occurred within the 12 cohorts between 1964 and 1985 and the study's estimate of the number that would have occurred without the antismoking campaign. By 1985, when the cumulative number of postponed deaths was approaching 800,000, the number of smoking-related deaths during the period had totaled 5.7 million. Thus, life-savings attributable to the campaign equaled 12 percent of actual plus avoided smoking-related mortality. In Warner and Murt's earlier study, campaign-related life-savings through 1978 equaled 5 percent of actual plus avoided smoking-related mortality (Warner and Murt 1983). The increase reflects greater numbers of quitters and the health benefits of the passage of time, as former smokers' excess (smoking-related) mortality risks fall as years of smoking increase. Comparing the two analyses, one sees that almost three-

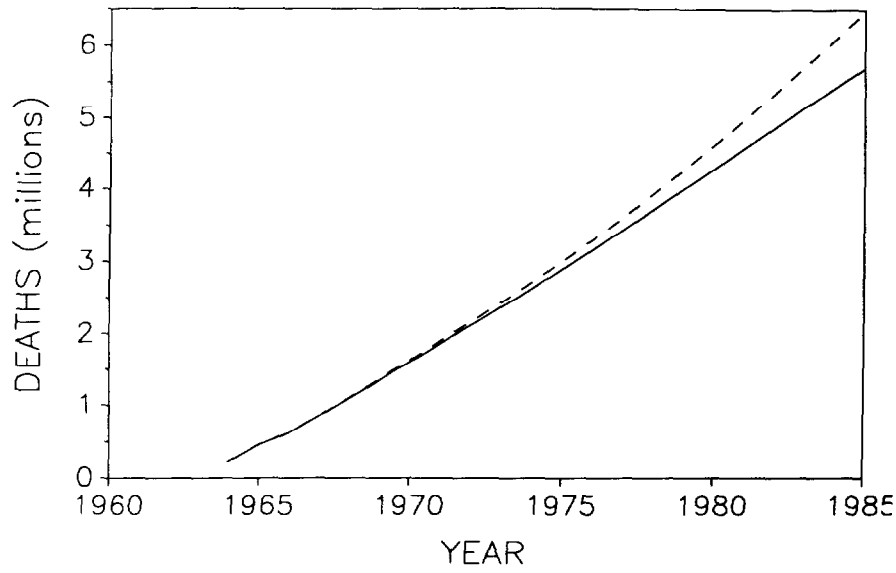

FIGURE 5.—Comparison of estimated cumulative smoking-related deaths (solid line) with estimate of the number that would have occurred without the antismoking campaign (dashed line), 1964–85

SOURCE: Unpublished data from study reported by Warner (1989).

quarters of the postponement of deaths occurred in the most recent 7 years of the 22 years studied. In particular, 112,400 deaths—14 percent of the total—were postponed in 1985 alone (Warner 1989).

For the youngest cohorts in the study, low overall death rates translated into relatively few deaths postponed through 1985. Given the substantial impact of the campaign on the smoking patterns of these cohorts, however, major life-saving accomplishments of antismoking efforts mounted to date will be realized two to three decades hence, when these cohorts reach the age at which smoking-related illnesses begin to take their greatest toll. Similarly, recent campaign-related quitting in the middle-aged cohorts will translate into large numbers of smoking-related deaths postponed or avoided in future years, as these recent quitters experience reduced smoking-related mortality rates. Thus, the health benefits of the antismoking campaign will continue to expand, both in absolute terms and as a percentage of the total potential burden of smoking-related mortality. This is illustrated by Warner's (1989) estimate that campaign-induced quitting and noninitiation through 1985 will result in the postponement or avoidance of an additional 2.1 million smoking-related deaths between 1986 and the year 2000.

The finding that men have realized a much greater collective health benefit from their responses to the antismoking campaign than have women reflects the fact that more men than women quit or did not initiate smoking as a result of the campaign, as well as the assumed lower smoker mortality ratios and death rates of women. As women's

smoking patterns have approached those of men in recent years (see Chapter 5), the disparity between male and female smoker mortality ratios has diminished. (See Chapter 3.) Particularly in the younger cohorts, if women respond to the relatively new emphasis on the health consequences of their smoking (US DHHS 1980), the male–female differential for postponed deaths would be expected to decrease in the future (Warner and Murt 1983; Warner 1989).

The authors of these studies acknowledged that their estimate of deaths postponed as a result of the antismoking campaign was an incomplete measure of the health consequences of the campaign (Warner and Murt 1983; Warner 1989). As noted above, the net health effects of the switch to filtered and low-yield cigarettes have not been established, and no formal analysis has assessed the impact of campaign-related reductions in smoking prevalence on smoking-related morbidity and disability. Nevertheless, Warner and Murt concluded that the estimated life-savings associated with responses to the campaign constitute a major public health accomplishment. They cautioned, however, that the magnitude of the remaining burden of smoking "places the impressive successes of the antismoking campaign in context" (Warner 1989).

Conclusions

1. All birth cohorts born between 1901 and 1960 experienced reductions in the prevalence of smoking relative to the rates that would have been expected in the absence of the antismoking campaign. By 1985, the gap between actual (reported) prevalence and that which would have been expected ranged from 6 percentage points for the eldest female cohort to 28 percentage points for the youngest male cohort.
2. In 1985, an estimated 56 million Americans 15 to 84 years of age were smokers. In the absence of the antismoking campaign, an estimated 91 million would have been smokers.
3. Adult per capita cigarette consumption has fallen 3 to 8 percent in years of major smoking-and-health events, such as publication of the first Surgeon General's Report on smoking and health in 1964. Per capita consumption fell each of the years the Fairness Doctrine antismoking messages were presented on television and radio (1967–70).
4. By 1987, adult per capita cigarette consumption would have exceeded its actual level by an estimated 79 to 89 percent had the antismoking campaign never occurred.
5. One of the most substantial behavioral responses to concerns about smoking and health has been the shift toward filtered cigarettes in the 1950s and low-tar and low-nicotine cigarettes in the 1970s. The net health impact of these product changes is unknown.
6. As a result of the antismoking campaign, an estimated 789,000 deaths were postponed during the period 1964 through 1985, 112,000 in 1985 alone. The average life expectancy gained per postponed death was 21 years.
7. The avoidance of smoking-related mortality associated with the antismoking campaign will represent a growing percentage of smoking-related mortality over time,

as the principal beneficiaries of the campaign, younger men and women, reach the ages at which smoking-related disease is most common. Campaign-induced quitting and noninitiation through 1985 will result in the postponement or avoidance of an estimated 2.1 million smoking-related deaths between 1986 and the year 2000.

Appendix

Selected Developments Related to Smoking and Health, 1964–88

1964

- *Smoking and Health: Report of the Advisory Committee to the Surgeon General*, the first major U.S. report on smoking and health, is published. Concludes that cigarette smoking is a cause of lung cancer in men and a suspected cause in women. Identifies many other causal relationships and smoking–disease associations. Calls for "appropriate remedial action."
- National Interagency Council on Smoking and Health, the first national anti-smoking coalition, is formed.
- National Association of Broadcasters (NAB) amends its television advertising code to discourage portrayal of cigarette smoking as a behavior worthy of imitation by youngsters.
- Cigarette manufacturers establish voluntary Cigarette Advertising Code for television and radio.
- Federal Trade Commission (FTC) announces proposed Trade Regulation Rule on Cigarette Labeling and Advertising.
- National Center for Health Statistics begins collecting information on smoking as part of the National Health Interview Survey. Collected periodically thereafter.
- American Medical Association (AMA) officially calls smoking "a serious health hazard."
- Public Health Service (PHS) and Indian Hospitals discontinue distributing free cigarettes. The Department of Defense and the Veterans Administration soon do the same in their medical installations.
- State Mutual Life Assurance Company becomes the first company to offer life insurance to nonsmokers at discounted rates.

1965

- Congress passes the Federal Cigarette Labeling and Advertising Act, requiring health warning on all cigarette packages: "Caution: Cigarette Smoking May be Hazardous to Your Health."
- PHS establishes the National Clearinghouse for Smoking and Health.

1966

- Health warning label appears on all cigarette packages.
- Congress enacts the Fair Packaging and Labeling Act to require fair, nondeceptive packaging and labeling. Tobacco and tobacco products are excluded.

1967

- Report of the Surgeon General concludes smoking is the principal cause of lung cancer.
- Federal Communications Commission (FCC) rules that the Fairness Doctrine applies to cigarette advertising. Stations broadcasting cigarette commercials must donate air time to antismoking messages.
- PHS, American Cancer Society (ACS), American Lung Association (ALA) (then known as the National Tuberculosis Association), and American Heart Association (AHA) launch public service advertising campaigns against smoking.
- FTC releases the first report on tar and nicotine yield in cigarette brands.
- National Institutes of Health initiates research planning for developing "less hazardous" cigarettes.
- First World Conference on Smoking and Health is held in New York City.

1968

- Action on Smoking and Health is formed to serve as a legal action arm for the antismoking community.
- National Clearinghouse for Smoking and Health produces the first Government antismoking poster.
- CBS airs "National Smoking Test" during prime time.

1969

- NAB endorses phasing out of cigarette ads on television and radio.
- ACS sponsors a quit-smoking series on PBS.
- ALA introduces its first smoking cessation materials.

1970

- Congress enacts the Public Health Cigarette Smoking Act of 1969 (passed in 1970), banning cigarette advertising on television and radio and requiring a stronger health warning on cigarette packages: "Warning: The Surgeon General Has Determined that Cigarette Smoking is Dangerous to Your Health."
- Due to the new statutory prohibition on broadcast advertising, the voluntary Cigarette Advertising Code is disbanded.
- Due to the broadcast ban, the FCC rules that the Fairness Doctrine no longer will apply to cigarette advertising (effective 1971).
- First National Conference on Smoking and Health is held in San Diego.
- World Health Organization takes a public position against cigarette smoking.
- Congress enacts the Controlled Substances Act. Tobacco is excluded from jurisdiction.

1971

- Surgeon General proposes a Government ban on smoking in public places.
- Cigarette advertising ends on radio and television. Fairness Doctrine antismoking messages also end.
- Cigarette manufacturers' voluntary agreement to list tar and nicotine yield in all advertising becomes effective.
- Six major cigarette companies agree voluntarily to include health warnings in all printed advertising.
- The FTC announces intent to proceed against cigarette companies for false and deceptive advertising.
- Second World Conference on Smoking and Health is held in London.
- Interstate Commerce Commission implements rules to restrict smoking to rear seats (not to exceed 20 percent of capacity) on interstate buses.

1972

- First Report of the Surgeon General to identify involuntary smoking as a health risk.
- Under a consent order with the FTC, six major cigarette companies agree to include a "clear and conspicuous" health warning in all cigarette advertisements.

- Congress enacts the Consumer Product Safety Act. Tobacco and tobacco products are excluded from jurisdiction.
- Supreme Court upholds congressional action banning cigarette commercials from television and radio.
- Department of Health, Education, and Welfare issues policy directive to establish no-smoking rules in departmental conference rooms, cafeterias, and certain work areas.
- ALA sponsors first State-level "no-smoking day" in Oklahoma.

1973

- Congress enacts Little Cigar Act of 1973, banning little cigar ads from television and radio.
- Civil Aeronautics Board requires no-smoking sections on all commercial airline flights.
- General Services Administration issues guidelines on smoking in Federal buildings.
- Arizona becomes the first State to restrict smoking in a number of public places and the first to do so explicitly because environmental tobacco smoke exposure is a public health hazard.

1974

- Connecticut passes the first State law to apply smoking restrictions to restaurants.
- ACS, ALA, and AHA cosponsor no-smoking day in Minnesota.

1975

- Cigarettes are discontinued in K-rations and C-rations provided to soldiers and sailors.
- Third World Conference on Smoking and Health is held in New York City. Conferees call for a unified worldwide campaign against smoking.
- Minnesota passes landmark comprehensive statewide clean indoor air law.

1976

- Interstate Commerce Commission modifies interstate bus rules to permit smoking in 30 percent of seats.

- Interstate Commerce Commission prohibits smoking in railroad dining cars and requires separate smoking and nonsmoking passenger cars.
- Congress amends the Federal Hazardous Substances Act to exclude tobacco and tobacco products from jurisdiction.
- Congress enacts the Toxic Substances Control Act. Tobacco and tobacco products are excluded from jurisdiction.
- ACS appoints National Commission on Smoking and Public Policy to hold hearings on major policy. Report issued in 1978.

1977

- Secretary of Health, Education, and Welfare establishes Task Force on Smoking and Health.
- ACS sponsors the first national "Great American Smokeout."
- Doctors Ought to Care is formed to provide a focal point for physicians' antismoking advocacy, especially through counteradvertising.

1978

- Secretary of Health, Education, and Welfare announces major Government initiative against smoking. Calls smoking "Public Health Enemy Number One."
- National Clearinghouse for Smoking and Health is renamed Office on Smoking and Health and transferred from Atlanta to Washington, DC. Given expanded function to coordinate Federal smoking and health activities.
- AMA releases "Tobacco and Health," summarizing findings of a tobacco research program that included 15 million dollars in financial support from the tobacco industry. Concluded that smoking is harmful to health.
- Utah enacts the first State law banning tobacco advertisements on any billboard, streetcar sign, streetcar, or bus.

1979

- Fifteenth Anniversary Report of the Surgeon General is issued. Most comprehensive review of smoking and health ever published.
- National Institute of Education survey shows that girls are smoking more than boys.
- Fourth World Conference on Smoking and Health is held in Stockholm.