TABLE 1.—Summary of longitudinal studies of overall mortality ratios relative to never smokers among male current and former smokers according to duration of abstinence (when reported)

Study		Current smokers	Former smokers — Duration of abstinence (yr)				
			All	1–4	5–9	10–15	>15
British Physicians[a] (Doll and Peto 1976)		1.8		1.5	1.5	1.3	1.1
ACS CPS-I[b] (Hammond 1966)	1–19 cig/day	1.72		1.44	1.34	1.01	
	20–39 cig/day	1.92		1.96	1.48	1.31	
U.S. Veterans[c] (Kahn 1966)	10–20 cig/day	1.82			1.87	1.24	1.47
	21–39 cig/day	2.04			2.08	1.88	1.22
Swedish study (Carstensen, Pershagen, Eklund 1987)	1–7 g/day[d]	1.21	1.08				
	8–15 g/day[d]	1.35					
	>15 g/day[d]	1.70					
				<5	≥5		
Australian petrochemical workers[c] (Christie et al. 1987)	1–19 cig/day	1.45		1.60	0.93		
	20–29 cig/day	2.09		1.55	0.90		
	≥30 cig/day	2.10		1.58	0.92		
Framingham[a] (Gordon, Kannel, McGee 1974)		1.47	0.84				

TABLE 1.—Continued

Study	Current smokers	Former smokers, All durations: Temporary quitters	Former smokers, All durations: Persistent quitters
California HMO[f] (Friedman et al. 1981)	1.82	1.51	1.13

NOTE: All mortality ratios are relative to never smokers. ACS CPS-I=American Cancer Society Cancer Prevention Study I; HMO=Health Maintenance Organization.
[a]Age-adjusted.
[b]Aged 50–74.
[c]Aged 54–64.
[d]Tobacco consumption in g/day.
[e]Former smokers are those with sustained abstinence.
[f]Persistent quitters are those with sustained abstinence.

mortality risk was still higher than that of never smokers even after 10 years of abstinence.

The more recent ACS study, ACS CPS-II, is designed similarly to CPS-I. Researchers enlisted 77,000 volunteers, who then solicited their friends, neighbors, and relatives to participate in the study. Those enrolled completed a four-page confidential questionnaire on medical history, health behaviors, medication use, and occupational exposures (Stellman and Garfinkel 1986; Garfinkel and Stellman 1988). A total of 521,555 men and 658,748 women were enrolled; 4-year followup data (1982–86) on the cohort were included in the 1989 Surgeon General's Report (US DHHS 1989).

In this Report, mortality rates for all causes of death from the ACS CPS-II were calculated using updated data for the same 4-year followup period (Table 2). Rates were calculated by gender in 5-year age groups for current and former smokers according to level of cigarette consumption (1–20 cig/day, ≥21 cig/day for males; 1–19 cig/day, ≥20 cig/day for females). Rates for former smokers were further stratified by years since smoking cessation (<1, 1–2, 3–5, 6–10, 11–15, and ≥16). Slightly different strata were used for men and women with respect to daily cigarette consumption in order to provide suitable distributions of subjects across categories of smokers and ex-smokers.

TABLE 2.—Overall mortality ratios among current and former smokers, relative to never smokers, by sex and duration of abstinence at date of enrollment, ACS CPS-II

		Former smokers					
		Duration of abstinence at enrollment (yr)					
	Current smokers	<1	1–2	3–5	6–10	11–15	≥16
Males							
1–20 cig/day	2.22	2.49	2.38	2.03	1.63	1.38	1.06
≥21 cig/day	2.43	2.77	2.64	2.25	2.04	1.77	1.27
Females							
1–19 cig/day	1.60	1.58	1.96	1.41	1.14	1.10	1.01
≥20 cig/day	2.10	3.39	2.58	2.03	1.60	1.38	1.15

		Former smokers excluding those with cancer, heart disease, or stroke and those "sick" at interview					
		Duration of abstinence at enrollment (yr)					
	Current smokers	<1	1–2	3–5	6–10	11–15	≥16
Males							
1–20 cig/day	2.34	2.06	2.05	1.89	1.48	1.29	1.01
≥21 cig/day	2.73	1.85	2.15	1.90	1.77	1.65	1.19
Females							
1–19 cig/day	1.82	0.76	1.26	1.42	1.01	1.09	1.00
≥20 cig/day	2.46	3.33	2.15	1.44	1.46	1.18	0.95

NOTE: Mortality ratios are relative to those of never smokers. ACS CPS-II=American Cancer Society Cancer Prevention Study II.

SOURCE: Unpublished tabulations, American Cancer Society.

In this analysis, subjects who had quit smoking were assigned to the duration of abstinence category appropriate for when they enrolled in the study. This method of assignment tends to blunt the rate of decline of mortality risk according to duration of abstinence when compared with never smokers because former smokers do not change categories as duration of abstinence lengthens. No attempt was made in this study to determine smoking status after enrollment, and persons who had quit at enrollment but had resumed smoking were still considered former smokers. Likewise, persons who smoked at enrollment but subsequently quit remain assigned to the current smoker category. This probably leads to some degree of misclassification and affects relative risk estimates (Chapter 2).

Like ACS CPS-I and other cohort studies, mortality ratios were substantially lower among former smokers than continuing smokers for all durations of abstinence except that of 1 to 3 years. With the exclusion of those subjects who had a history of cancer, heart disease, or stroke and those who said they were "sick" at the time of recruitment, mortality ratios were lower among former than continuing smokers for all durations of abstinence, among males at all prior levels of cigarette consumption, and among females who smoked fewer than 20 cigarettes per day before they quit.

The difference in the pattern of decline in overall mortality between all subjects and the subset of subjects who were healthy at recruitment provides strong evidence that recent quitters disproportionately include those who have quit because they are ill. In contrast with ACS CPS-I, which was conducted in the early 1960s, mortality ratios among both heavy and light smokers in ACS CPS-II remained substantially elevated in comparison with those of never smokers 10 years after quitting. This increase was evident in all subjects and in the subset of subjects who did not have a history of cancer, heart disease, or stroke and who did not state that they were "sick" when recruited. Sixteen years after quitting, the mortality risk among male former smokers of fewer than 21 cigarettes reached that of never smokers but remained elevated among former smokers of 21 cigarettes or more. Among female former smokers in both categories, mortality was comparable with that of never smokers after 16 years of abstinence.

The results of ACS CPS-II are broadly in agreement with those of the British Physicians Study (Doll and Peto 1976; Doll and Hill 1964a,b) and the U.S. Veterans Study (Kahn 1966; Rogot and Murray 1980). In both, the overall mortality risk among former smokers remained elevated in comparison with that of never smokers up to 15 years after quitting, although the risk was substantially less than among continuing smokers.

An Australian study of petrochemical workers (Christie et al. 1987) appears to differ from the other cohort studies in finding that overall mortality risk among former smokers reached that of never smokers 5 years after quitting. This study is unique in that subjects classified as former smokers were all persistent abstainers.

The differences among other studies in estimates of the duration of abstinence needed for a former smoker to have the same overall mortality risk as a never smoker are likely to be due to other smoking-related factors, such as age at smoking initiation, that differ among study populations and over time (Chapter 2). Irrespective of the duration of abstinence needed to reach the mortality risk of never smokers, former smokers have substantially lower mortality when compared with continuing smokers.

For three representative age groups (50–54, 60–64, and 70–74 yr), Figure 1 shows the relative risk of death among current and former smokers compared with never smokers based on recent ACS CPS-II data for the subjects who did not have cancer, heart disease, or stroke and were not "sick" at recruitment. Complete data from ACS CPS-II on mortality in current, former, and never smokers aged 50–74 years are presented in Table 7 of the Chapter Appendix. Data are not presented for those aged less than 45 years and greater than 80 years because there were fewer than 10 deaths in almost all of the categories of former smokers. In each of the age subgroups shown in Figure 1, among both sexes and among former light and heavy smokers, mortality risk relative to continuing smokers decreased with increasing duration of abstinence.

Using a method described by Kleinbaum, Kupper, and Morgenstern (1982), the data from ACS CPS-II were also used to estimate the effects of quitting at various ages on the cumulative risk of total mortality in a fixed interval after cessation. Several assumptions have been made in conjunction with CPS-II age-specific mortality data in order to estimate as many as 16.5 years' risk of death from all causes for individuals who continue to smoke and those who stop smoking. The first assumption is that age-specific mortality rates measured from 1982–86 CPS-II data remain constant for the next 16.5 years. The first category of smoking cessation is 1–2 years; that is, the individual gave up smoking 1 to 2 years ago. It is assumed that, on average, respondents in the 1–2-year category gave up smoking 1.5 years ago. Similarly, for the cessation categories 3–5, 6–10, and 11–15 years, the average durations of abstinence are 4, 8, and 13 years, respectively. It is further assumed that respondents are exposed to the age-specific mortality rates of the age interval in which quitting occurs for 1.5 years and to each of the next three age intervals for 5 years each, making a total of 16.5 years. For example, a quitter of the 40–44-year interval would be exposed to the age-specific mortality rates of the 40–44-year-olds for 1.5 years, to those of 45–49-year-olds for 5 years, to those of 50–54-year-olds for 5 years, and to 55–59-year-olds for 5 years.

The results of this analysis, presented in Table 3 and in greater detail in Table 8 of the Chapter Appendix, show that the benefits of cessation for total mortality extend to quitting at older ages. For example, a healthy man aged 60–64 years who smokes 21 cigarettes or more per day is estimated to have a chance of dying in the next 16.5 years of 56 percent if he continues to smoke and 51 percent if he quits. Quitting smoking at younger ages confers even greater proportionate increases in survival (see Figure 2 of the Chapter Appendix).

Framingham investigators recently analyzed data from their cohort (D'Agostino et al. 1989) and also found that the benefits of quitting apply to those who quit at more advanced ages. These researchers estimated that mean additional life expectancy for those who quit at ages 35 to 39 was 5.1 years for males and 3.2 years for females. For those who quit at ages 65 to 69, additional life expectancy was estimated to be 1.3 years for males and 1.0 year for females.

As discussed in detail in Chapter 2 and other chapters, smokers differ from nonsmokers in a variety of social, behavioral, and psychological characteristics, and successful quitters differ from those who continue to smoke (Rode, Ross, Shephard 1972; Blair et al. 1980; Haines, Imeson, Meade 1980; McManus and Weeks 1982; Billings and Moos 1983; Gottlieb 1983; Brod and Hall 1984; Seltzer and Oechsli 1985;

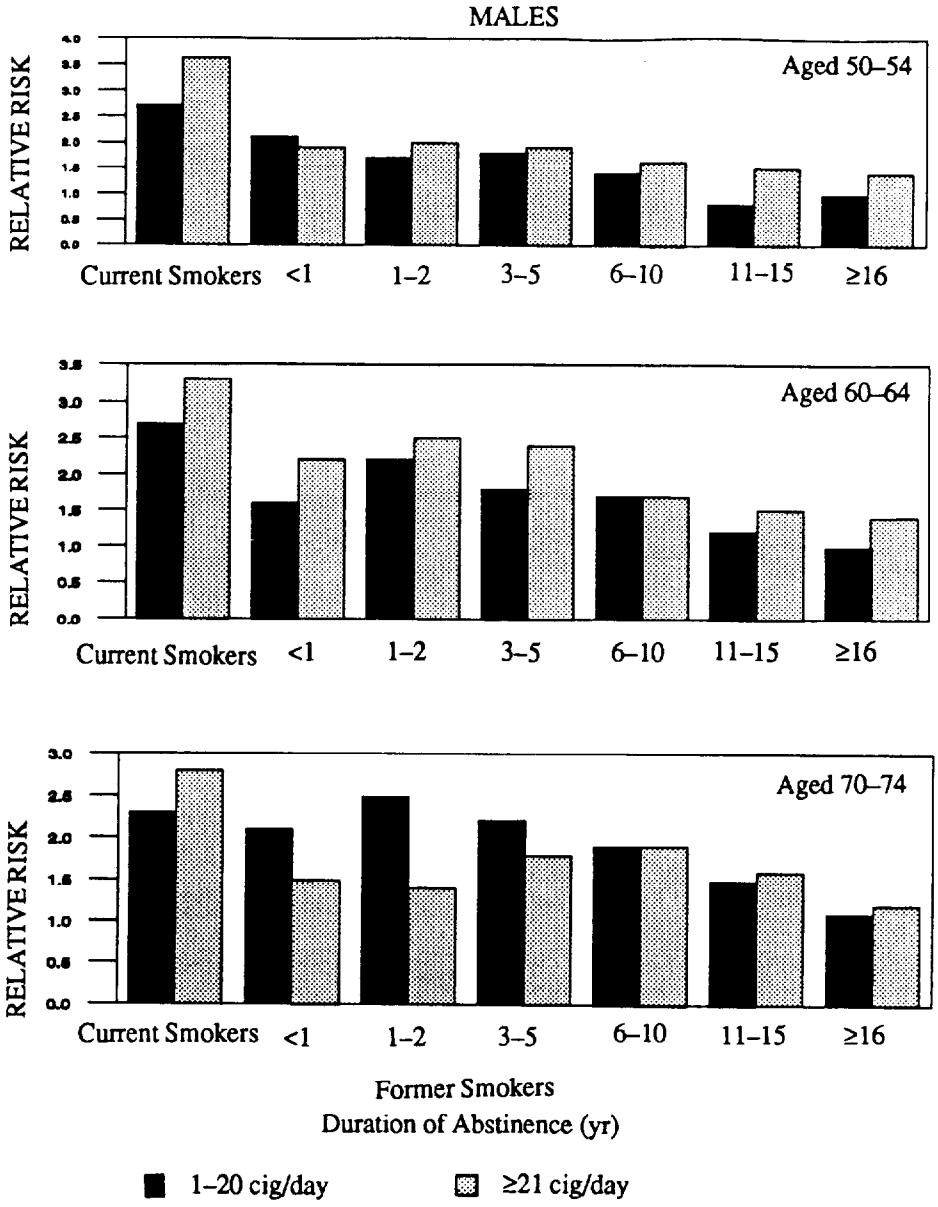

FIGURE 1.—Compared with never smokers, relative risk of mortality in current and former smokers aged 50–54, 60–64, and 70–74 at enrollment, by amount smoked and duration of abstinence

SOURCE: Unpublished tabulations, American Cancer Society.

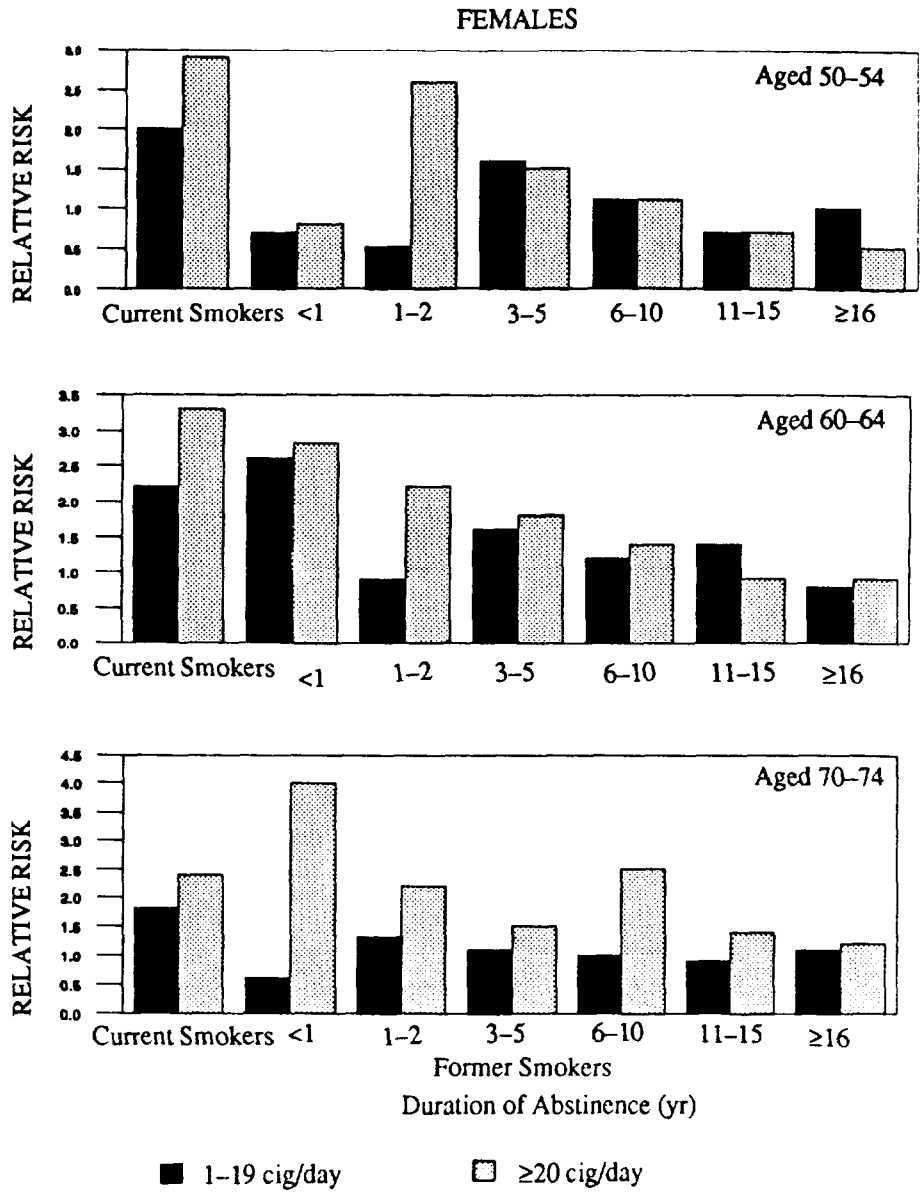

FIGURE 1. (Continued)—Compared with never smokers, relative risk of mortality in current and former smokers aged 50–54, 60–64, and 70–74 at enrollment, by amount smoked and duration of abstinence

SOURCE: Unpublished tabulations, American Cancer Society.

TABLE 3.—Estimated probability of dying in the next 16.5-year interval for quitting at various ages compared with never smoking and continuing to smoke, by amount smoked and sex

Age at quitting or at start of interval	Males				
		1–20 cig/day		≥21 cig/day	
	Never smokers	Continuing smokers	Former smokers	Continuing smokers	Former smokers
40–44	0.05	0.11	0.05	0.14	0.07
45–49	0.07	0.18	0.10	0.22	0.11
50–54	0.11	0.27	0.17	0.31	0.21
55–59	0.18	0.39	0.28	0.46	0.33
60–64	0.30	0.54	0.46	0.56	0.51
65–69	0.46	0.68	0.59	0.67	0.64
70–74[a]	0.40	0.61	0.55	0.58	0.52
	Females				
Age at quitting or at start of interval		1–19 cig/day		≥20 cig/day	
	Never smokers	Continuing smokers	Former smokers	Continuing smokers	Former smokers
40–44	0.03	0.06	0.03	0.08	0.04
45–49	0.04	0.09	0.06	0.13	0.05
50–54	0.07	0.14	0.07	0.19	0.09
55–59	0.11	0.21	0.12	0.27	0.15
60–64	0.18	0.30	0.19	0.38	0.32
65–69	0.30	0.46	0.39	0.52	0.32
70–74[a]	0.26	0.41	0.27	0.45	0.31

NOTE: Based on American Cancer Society Cancer Prevention Study II data for persons without a history of cancer, heart disease, or stroke who were not "sick" at enrollment.

[a]Estimates for quitting at this age are estimates of the probability of dying in the next 12.5-yr interval.

SOURCE: Unpublished tabulations, American Cancer Society.

Kaprio and Koskenvuo 1988). These differences may exist among adolescents prior to initiation of smoking (Seltzer and Oechsli 1985). For these reasons, interpretations of studies comparing these self-selected groups (never smokers, smokers, and quitters) must consider the problem of confounding (Chapter 2). Misclassification, which is discussed in detail in Chapter 2, also must be considered. However, studies of smoking cessation predominantly misclassify persons who are still smoking cigarettes as former smokers, and this would tend to obscure the benefits of cessation in comparison with continued smoking. Further, although the possibility of uncontrolled confounding needs to be considered in epidemiologic studies of smoking cessation and mortality, the totality of data must be interpreted with consideration of its consistency. To account for the evidence of a benefit of quitting that derives from nonexperimental cohort studies, confounders would need to be distributed quite differently among current and

former smokers and would need to be strong predictors of mortality. There is no substantial evidence that this is the case.

SMOKING CESSATION AND OVERALL MORTALITY IN INTERVENTION STUDIES

Five studies, four of which were randomized trials, evaluated overall mortality in relation to interventions that included smoking cessation as a component. The results of these studies are summarized in Table 4.

TABLE 4.—Summary of overall mortality ratios in intervention studies in which smoking cessation was a component

Study	Intervention	Subjects (age)	Difference in smoking	Mortality ratio
Whitehall Civil Servants[a] (Rose et al. 1982)	Smoking	Males (40–59)	−14%[b]	0.98
North Karelia (Tuomilehto et al. 1986)	Smoking, BP, diet	Both sexes (35–64)	Males −4%[b] Females −3%[b]	1.00[c] (males) 0.94[c] (females)
Oslo[a] (Hjermann et al. 1981)	Smoking, BP, diet	Males (40–59)	−4 cig/day[b]	0.68[d]
WHO[a] (WHO European Collaborative Group 1983)	Smoking, BP, diet	Males (40–59)	−8.9%	0.97[d]
MRFIT[a] (MRFIT Research Group 1982, 1990)	Smoking, BP, diet	Males (35–57)	−13%[b]	1.02[d] (7 yr) 0.92 (10.5 yr)

NOTE: BP=blood pressure; WHO=World Health Organization; MRFIT=Multiple Risk Factor Intervention Trial.
[a]Randomized trial.
[b]Intervention minus control.
[c]Change in mortality in rest of Finland/change in mortality in North Karelia.
[d]Mortality in intervention/mortality in control.

Only one study examined smoking intervention alone (Rose and Hamilton 1978; Rose et al. 1982). Of 1,445 male smokers, aged 40 to 59 and at high risk of coronary heart disease (CHD) or chronic bronchitis, 714 were randomly assigned to an intervention group and 731 to a normal care group. Men in the intervention group were given individual advice to quit smoking, and if interested in quitting, up to four additional visits over 12 months. At the 9-year followup, 55 percent of responders in the intervention reported abstinence compared with 41 percent in the normal care group. After 10 years of follow up, there were 123 deaths in the intervention group and 128 in the normal care group. The proportionate difference in total mortality between the intervention group and normal care group (−2 percent) was not statistically significant, but the confidence interval was wide (−22 percent to +23 percent). There were 81

smoking-related deaths in the intervention group and 92 in the normal care group. The proportionate difference in smoking-related deaths was –9 percent. Again the confidence interval was wide (–31 percent to +20 percent). Twenty percent of the men in the intervention group who quit smoking cigarettes took up pipe or cigar smoking compared with 3 percent of the men in the normal care group, and to the extent that pipe and cigar smoking are mortality risk factors, any benefit of cessation of cigarette smoking is obscured.

This trial is largely uninformative as to the benefit or lack of benefit of smoking cessation for total mortality because of the small number of subjects. The trial was further compromised by the relatively poor compliance of the subjects with the intervention; the net reduction in mean cigarette consumption over the 10 years of the followup among the intervention group compared with the normal care group was only 7.6 cigarettes per day.

Other intervention studies that allow assessment of the relation of smoking cessation to overall mortality have involved multiple interventions aimed at reducing several different factors for CHD. The ability to draw conclusions about the effect of smoking cessation on overall mortality from these studies is quite limited for this reason.

The North Karelia study targeted a region of Finland that had the world's highest CHD death rate at the time of the study's initiation (Tuomilehto et al. 1986) and was aimed at modifying smoking, cholesterol levels, and blood pressure. The rest of Finland was used for comparison. In the 10 years after initiation of an aggressive risk reduction program, there was a 35-percent decrease in smoking in North Karelia compared with a 2-percent reduction in the rest of Finland (Salonen et al. 1989). Blood pressure and cholesterol levels did not change significantly in the intervention area compared with the rest of Finland. Total mortality in the intervention area in the 10 years after the start of the study declined more rapidly than in the rest of Finland, although the difference in the rate of decline in overall mortality was not statistically significant.

For at least two reasons, interpretation of the North Karelia study is problematic with respect to the effect of smoking cessation on overall mortality. First, the study was nonexperimental, with conclusions based on a comparison of total mortality in the study area with that of Finland. During the study period, overall mortality also declined in the rest of Finland, perhaps because of secular changes in other factors related to mortality and to changes in medical care (Salonen et al. 1989). Second, the study was not designed to investigate smoking cessation alone. Because of the mixing of interventions for three CHD risk factors, it was difficult to isolate the impact of the smoking cessation component.

The Oslo study (Hjermann 1980; Hjermann et al. 1981; Holme 1982) involved 1,232 normotensive men at high risk for CHD because of their smoking behavior and cholesterol levels. The men were randomly assigned either to receive interventions aimed at reducing both CHD risk factors or to a control group. Tobacco consumption, including pipe and cigar smoking, fell 45 percent more in the intervention group than in the control group.

There was also a mean difference of 13 percent in serum cholesterol between the intervention and control groups over 5 years (Hjermann et al. 1981). The study was small, and it was not designed to examine total mortality endpoints; only 42 deaths were

observed. Nevertheless, the mortality rate in the intervention group was one-third lower than in the control group (one-sided p value=0.12). Because there were changes in both smoking and cholesterol levels, the difference in mortality cannot be attributed entirely to smoking cessation.

The World Health Organization (WHO) European Collaborative Group conducted an intervention study in factories in four European countries (WHO European Collaborative Group 1983). The study involved random allocation of 66 factories that employed 49,781 men aged 40 to 59 to an intervention program targeting smoking, cholesterol level, and blood pressure or to a control group. After 4 years, the net reduction in mean cigarettes per day in the intervention factories was 8.9 percent (WHO European Collaborative Group 1983). At 6 years, overall mortality in the intervention factories was 4.04 percent; in the control factories, it was 4.15. The difference was not statistically significant.

The Multiple Risk Factor Intervention Trial (MRFIT) was a randomized study of more than 12,000 American men, aged 35 to 57 at entry, who were at high risk for CHD on the basis of their smoking behavior, blood pressure, and cholesterol levels (MRFIT Research Group 1982). Men in the special intervention group received an intensive intervention aimed at reducing blood pressure and cholesterol and encouraging smoking cessation. Men in the usual care group were referred to their physicians and examined annually. The interventions continued over the entire course of the study. At 6 years, 44.4 percent of special intervention smokers and 25.8 percent of the usual care smokers reported cessation. In the 7-year followup data reported in 1982, there was no difference in total mortality between the special intervention and usual care groups (MRFIT Research Group 1982). However, in the 10.5-year followup data of MRFIT participants, overall mortality for the special intervention participants was 7.7 percent lower than for the usual care group (one-sided p value=0.10; 90-percent confidence interval (CI), −16.6 to +2.3) (MRFIT Research Group 1990).

A subgroup of MRFIT special intervention participants, who were hypertensive, had resting electrocardiogram abnormalities, and comprised 31 percent of the special intervention group, may have suffered excess mortality as a result of an unanticipated adverse effect of one of the antihypertensive drugs (Cutler, MacMahon, Furberg 1989). This has recently been suggested as an explanation for the absence of an overall difference in mortality between the special intervention and usual care groups at the 7-year followup (MRFIT Research Group, submitted for publication). Furthermore, Ockene and coworkers (1990) recently reported that at 10.5 years, MRFIT participants who quit smoking had significantly lower death rates than those who continued to smoke in both special intervention and usual care groups. Most important, like the other multifactor intervention trials, it is difficult to infer a benefit or a lack of benefit of smoking cessation for total mortality from this study.

In summary, studies involving smoking cessation interventions include a randomized trial in which smoking cessation was the sole intervention and three intervention studies in which it was a component. The small size of the former and the mixing of a smoking intervention with other interventions in the latter make it impossible to reach conclusions about the benefits of smoking cessation from these studies alone; however,

nonintervention (i.e., cohort) studies described in the previous Section clearly indicate a benefit of smoking cessation on overall mortality.

SMOKING CESSATION AND MEDICAL CARE UTILIZATION

Population Projections

The relationship between smoking cessation and medical care utilization is a complex issue. Data on differential disease and mortality rates comparing smokers and abstainers are abundant, and many investigators have used these data to project the savings in dollars attributable to smoking cessation (Weinkam, Rosenbaum, Sterling 1987; Leu and Schaub 1983; Luce and Schweitzer 1978; Oster, Colditz, Kelly 1984). Generally, these projections produce results that depend on the many assumptions of the models that create them. For example, Luce and Schweitzer (1978) projected that the total 1976 dollar cost of smoking in the United States was about $27.5 billion and that excess medical care costs accounted for about $8.2 billion of those costs. Weinkam, Rosenbaum, and Sterling (1987) and Leu and Schaub (1983), both using population simulation approaches, concluded that smoking does not, over a lifetime, lead to increased medical care utilization. This is because the short-term higher levels of utilization of smokers are approximately balanced by shorter longevity and the resulting reduced need for medical care.

Oster, Colditz, and Kelly (1984) used population projections to estimate the medical care costs of smoking and the proportion of those costs that are potentially recoverable depending on the age at which smoking is given up and the level of smoking prior to quitting. Male light smokers (<1 pack/day) who quit between ages 35 and 39 were estimated to recover about 59 percent of their lifetime excess medical care costs. Even if quitting was delayed until ages 75 to 79, light smokers were estimated to recover one-third of the costs. For heavy smokers, quitting earlier was estimated to have somewhat more benefit. For both sexes and all levels of smoking, medical care cost savings from smoking cessation were estimated to be substantial.

Observational Studies

Table 5 summarizes studies that directly measured utilization of medical services by current smokers, former smokers, and never smokers. These studies suggest that smoking is associated with higher utilization of hospital services and that former smokers experienced a brief period of increased utilization of hospital services just after quitting followed by declines in utilization to levels of never smokers. Modest increases in outpatient utilization by smokers are to some degree offset by a decreased propensity to use preventive care services (Marsden, Bray, Herbold 1988; Vogt and Schweitzer 1985; Oakes et al. 1974).

SMOKING CESSATION AND HEALTH STATUS

Table 6 summarizes studies of smoking cessation and health status. The variety of measures used makes direct comparison across studies problematic. Furthermore, in most cases, only a comparison of measures for never, current, and former smokers is available. Because some smokers quit due to illness and because most studies fail to

TABLE 5.—Summary of studies of medical care utilization among smokers and former smokers

Reference	Population	Measure of medical care utilization	Results		
Ashford (1973)	75,500 residents of Exeter	Physician visits, home visits, hospitalization	No consistent differences in any measure of utilization between former smokers and current smokers.		
Oakes et al. (1974)	2,557 HMO members in California	Physician visits, hospitalization	Male former smokers have more physician visits than current smokers; female former smokers have more physician visits than current smokers. Male former smokers are less likely than current smokers to be hospitalized; hospitalization among female former smokers compared with current smokers varies with age.		
				Physician visits[a]	Days hospitalized[a]
Marsden, Bray, Herbold (1988)	1985 worldwide survey of alcohol and drug use by military personnel	Physician visits, days hospitalized	Nonsmokers	2.41	0.64
			Smokers		
			≤0.5 ppd	2.37	0.82
			1 ppd	2.56	0.68
			≥1.5 ppd	3.16	0.99
Vogt and Schweitzer (1985)	2,582 HMO members in Oregon	Days hospitalized, physician visits	Former smokers have lower mean number of hospital days than current smokers after adjustment for age, sex, duration of membership, and alcohol use. Total physician visits are higher among former smokers than current smokers after adjustment for age, sex, duration of membership, and alcohol use.		
Newcomb and Bentler (1987)	654 adults aged 21–24, in Los Angeles	Nights hospitalized, physician visits	Adolescent smoking is related to spending more nights in the hospital and having more physician visits for illness during early adulthood.		
Freeborn et al. (1990)	312 adults aged ≥65 in an HMO in Oregon	Ambulatory care use	Smokers consistently are more often in upper tertile of care utilization.		

NOTE: ppd=packs/day; HMO=Health Maintenance Organization.
[a]Mean.

identify the reasons for quitting, the relation between quitting and health status may be obscured in studies that classify persons as former and current smokers (Chapter 2). A few studies differentiate between short-term abstainers (<1 yr) and long-term abstainers (>1 yr), and these studies are highlighted.

Data from the National Center for Health Statistics (US DHHS 1980) suggest that former smokers have fewer illness days than continuing smokers, particularly among younger women. Gallop (1989) found that former smokers have absentee rates between those of current smokers and never smokers.

Segovia, Bartlett, and Edwards (1989) conducted a telephone survey of 3,300 adults and found a strong relation between smoking status and the reporting of good health. Persons who had quit smoking for more than 1 year reported good health with about the same frequency as persons who smoked only 1 to 5 cigarettes per day, whereas those who had quit for less than 1 year reported good health at a frequency comparable with smokers of 16 to 20 cigarettes per day. Balarajan, Yuen, and Bewley (1985) examined the associations among various levels of smoking, recent and former cessation, and presence of acute and chronic illness, medical office visits, and doctor consultations. Current smokers had a higher prevalence of acute and chronic illness, and rates varied in relation to the amount smoked. Former smokers who had quit in the year prior to the survey had higher rates of illness compared with continuing smokers, and former smokers who quit more than 1 year prior to the survey had rates between those of never smokers and smokers of 20 cigarettes or more per day.

Reed (1983) found no difference in general physical health status between current, former, and never smokers, not otherwise defined. Seidell and colleagues (1986) examined the number of reported health complaints, out of an inventory of 51 possible complaints, by smoking status and found that male, but not female, former smokers reported fewer health complaints than smokers.

Astrand and Isacsson (1988) found that male employees of a pulp and paper plant who smoked retired at an earlier age than nonsmokers. Data from the 1979 National Health Interview Survey indicate that smokers have more restricted activity days, more bed disability days, more hospital days, more physician visits, and an increased probability of being unable to work or keep house, than nonsmokers (Rice, Hodgson, Sinsheimer 1986). Analyses of data for the 1976–80 Health Interview Surveys showed that smokers have a 55 to 75 percent excess in days with respiratory conditions associated with reduced activity (Ostro 1989). Smokers experience more school absences (Charlton and Blair 1989; Alexander and Klassen 1988) and work absenteeism (Andersson and Malmgren 1986; Coughlin 1987; Hendrix and Taylor 1987; Gallop 1989) than do never smokers. None of these studies reported information on former smokers.

These studies are extremely heterogeneous, with some methodologic shortcomings (Chapter 2). Furthermore, smoking is associated with other behaviors that may affect health (Pearson et al. 1987; Stephens 1986), and the studies do not adjust for changes in other risk variables, such as increased exercise, that might be associated with smoking cessation. Taken together, however, the studies are consistent with the hypothesis that smoking cessation produces improvements in health status. This conclusion is evident particularly when considering that smoking-related morbidity is a powerful motivation to quit smoking and that recent quitters are likely to be sicker than continuing smokers.

TABLE 6.—Relation of smoking cessation to various measures of general health status

Reference	Population	Health status measure		Results					
				Current smokers			Former smokers		Never smokers
US DHHS (1985)	Representative sample of US population	Days of work lost due to illness	Females						
			≥20 yr	1.00[a]			0.82[b]		0.86[b]
			20–44 yr	1.00[a]			0.79		0.79
			45–64 yr	1.00[a]			0.91		1.00
			Males						
			≥20 yr	1.00[a]			1.03[b]		0.79[b]
			20–44 yr	1.00[a]			0.92		0.86
			45–64 yr	1.00[a]			1.05		0.66
Reed (1983)	450 employees offered subscription to an HMO	General physical health status		0.50[c]			0.52[c]		0.49[c]
				Cig/day			Quit	Quit	
				1–9	10–19	≥20	≥1 yr	<1 yr	
Balarajan, Yuen, Bewley (1985)	Household survey of residents of Great Britain	Self-report of illness and physician visits	Chronic illness	1.07[d]	1.31[d]	1.76[d]	1.43[d]	1.26[d]	1.0[a]
			Acute illness	1.03	1.09	1.29	1.11	1.48	1.0[a]
			Outpatient visit	1.46	1.46	1.43	1.40	1.25	1.0[a]
			Physician consultation	1.12	1.08	1.09	1.19	1.47	1.0[a]
				Cig/day					
				<10	≥10				
Seidell et al. (1986)	1,245 persons in a morbidity registry	Number of health complaints	Females	9.6	11.6		10.2		9.0
			Males	9.0	9.6		6.8		7.3

TABLE 6.—Continued

Reference	Population	Health status measure	Results					
			Current smokers			Former smokers		Never smokers
			Cig/day			Quit	Quit	
			11–15	21–25	>31	≤1 yr	>1 yr	
Segovia, Bartlett, Edwards (1989)	Telephone survey of representative sample US adults	Self-report of "good health"	4.18[c]	2.00[c]	1.46[c]	3.42[c]	5.13[c]	6.14[c]
Gallop (1989)	Workers in the pulp/paper industry	Work absences	1.25[f]			1.09[f]		1.00[e]

[a]Referrent.
[b]Ratio compared with current smokers.
[c]Mean ridit score adjusted for age and sex.
[d]Odds ratio compared with never smokers and adjusted for age, sex, and socioeconomic status.
[e]Log odds of self-report of good health.
[f]Ratio of absences compared with never smokers.

CONCLUSIONS

1. Former smokers live longer than continuing smokers, and the benefits of quitting extend to those who quit at older ages. For example, persons who quit smoking before age 50 have one-half the risk of dying in the next 15 years compared with continuing smokers.

2. Smoking cessation at all ages reduces the risk of premature death.

3. Among former smokers, the decline in risk of death compared with continuing smokers begins shortly after quitting and continues for at least 10 to 15 years. After 10 to 15 years of abstinence, risk of all-cause mortality returns nearly to that of persons who never smoked.

4. Former smokers have better health status than current smokers as measured in a variety of ways, including days of illness, number of health complaints, and self-reported health status.

CHAPTER 3 APPENDIX

TABLE 7.—Age- and sex-specific mortality rates among never smokers, continuing smokers, and former smokers by amount smoked and duration of abstinence at time of enrollment for subjects in ACS CPS–II study who did not have a history of cancer, heart disease, or stroke and were not sick at enrollment

Males			Former smokers (1–20 cig/day)					
			Duration of abstinence (yr)					
Age	Never smokers	Current smokers	<1	1–2	3–5	6–10	11–15	≥16
45–49	186.0	439.2	234.4	365.8	159.6	216.9	167.4	159.5
50–54	255.6	702.7	544.7	431.0	454.8	349.7	214.0	250.4
55–59	448.9	1,132.4	945.2	728.8	729.4	590.2	447.3	436.6
60–64	733.7	1,981.1	1,177.7	1,589.2	1,316.5	1,266.9	875.6	703.0
65–69	1,119.4	3,003.0	2,244.9	3,380.3	2,374.9	1,820.2	1,669.1	1,159.2
70–74	2,070.5	4,697.5	4,255.3	5,083.0	4,485.0	3,888.7	3,184.3	2,194.9
75–79	3,675.3	7,340.6	5,882.4	6,597.2	7,707.5	4,945.1	5,618.0	4,128.9

Males		Former smokers (≥21 cig/day)					
		Duration of abstinence (yr)					
Age	Current smokers	<1	1–2	3–5	6–10	11–15	≥16
45–49	610.0	497.5	251.7	417.5	122.6	198.3	193.4
50–54	915.6	482.8	500.7	488.9	402.9	393.9	354.3
55–59	1,391.0	1,757.1	953.5	1,025.8	744.0	668.5	537.8
60–64	2,393.4	1,578.4	1,847.2	1,790.1	1,220.7	1,100.0	993.3
65–69	3,497.9	2,301.8	3,776.6	2,081.0	2,766.4	2,268.1	1,230.7
70–74	5,861.3	3,174.6	2,974.0	3,712.9	3,988.8	3,268.6	2,468.9
75–79	6,250.0	4,000.0	4,424.8	7,329.8	6,383.0	7,666.1	5,048.1

TABLE 7.—Continued

Females			Former smokers (1–19 cig/day)					
			Duration of abstinence (yr)					
Age	Never smokers	Current smokers	<1	1–2	3–5	6–10	11–15	≥16
45–49	125.7	225.6	0	433.9	212.0	107.2	135.9	91.0
50–54	177.3	353.8	116.8	92.1	289.5	200.9	121.3	172.1
55–59	244.8	542.8	287.4	259.5	375.9	165.8	202.2	247.2
60–64	397.7	858.0	1,016.3	365.0	650.9	470.8	570.6	319.7
65–69	692.1	1,496.2	1,108.0	1,348.5	1,263.2	864.8	586.6	618.0
70–74	1,160.0	2,084.8	645.2	1,483.1	1,250.0	1,126.3	1,070.5	1,272.1
75–79	2,070.8	3,319.5	0	2,580.6	2,590.7	3,960.4	1,666.7	1,861.5

Females		Former smokers (≥20 cig/day)					
		Duration of abstinence (yr)					
Age	Current smokers	<1	1–2	3–5	6–10	11–15	≥16
45–49	277.9	266.7	102.7	178.6	224.7	142.1	138.8
50–54	517.9	138.7	466.8	270.1	190.2	116.8	83.0
55–59	823.5	473.6	602.0	361.0	454.5	412.2	182.1
60–64	1,302.9	1,114.8	862.1	699.6	541.7	373.1	356.4
65–69	1,934.9	2,319.6	1,250.0	1,688.0	828.7	797.9	581.5
70–74	2,827.0	4,635.8	2,517.2	1,687.3	2,848.7	1,621.2	1,363.4
75–79	4,273.1	2,409.6	5,769.2	3,125.0	2,978.7	2,803.7	2,195.4

NOTE: Mortality rates are per 100,000 persons. ACS CPS-II=American Cancer Society Cancer Prevention Study II.

SOURCE: Unpublished tabulations, American Cancer Society.

TABLE 8.—Estimated probability of dying in the next 16.5-year interval (95% CI) for quitting at various ages compared with never smoking and continuing to smoke, by amount smoked and sex

Males

Age at quitting or at start of interval	Never smokers	1–20 cig/day		≥21 cig/day	
		Continuing smokers	Former smokers	Continuing smokers	Former smokers
40–44	0.05	0.11	0.05	0.14	0.07
	(0.04–0.05)	(0.10–0.12)	(0.04–0.06)	(0.13–0.15)	(0.06–0.09)
45–49	0.07	0.18	0.10	0.22	0.11
	(0.07–0.08)	(0.17–0.19)	(0.08–0.11)	(0.21–0.23)	(0.10–0.13)
50–54	0.11	0.27	0.17	0.31	0.21
	(0.11–0.12)	(0.26–0.28)	(0.15–0.19)	(0.30–0.33)	(0.18–0.23)
55–59	0.18	0.39	0.28	0.46	0.33
	(0.17–0.19)	(0.38–0.41)	(0.25–0.31)	(0.43–0.48)	(0.30–0.37)
60–64	0.30	0.54	0.46	0.56	0.51
	(0.28–0.31)	(0.52–0.57)	(0.42–0.50)	(0.51–0.61)	(0.48–0.57)
65–69	0.46	0.68	0.59	0.67	0.64
	(0.43–0.48)	(0.64–0.72)	(0.51–0.67)	(0.57–0.78)	(0.51–0.77)
70–74[a]	0.40	0.61	0.55	0.58	0.51
	(0.38–0.43)	(0.56–0.65)	(0.45–0.64)	(0.44–0.71)	(0.32–0.72)

Females

Age at quitting or at start of interval	Never smokers	1–19 cig/day		≥20 cig/day	
		Continuing smokers	Former smokers	Continuing smokers	Former smokers
40–44	0.03	0.06	0.03	0.08	0.04
	(0.03–0.03)	(0.05–0.06)	(0.02–0.04)	(0.08–0.09)	(0.03–0.05)
45–49	0.04	0.09	0.06	0.13	0.05
	(0.04–0.04)	(0.08–0.09)	(0.04–0.07)	(0.12–0.13)	(0.04–0.07)
50–54	0.07	0.14	0.07	0.19	0.09
	(0.06–0.07)	(0.13–0.15)	(0.05–0.09)	(0.18–0.20)	(0.07–0.11)
55–59	0.11	0.21	0.13	0.27	0.15
	(0.11–0.11)	(0.19–0.22)	(0.09–0.16)	(0.25–0.29)	(0.12–0.19)
60–64	0.18	0.30	0.19	0.38	0.32
	(0.18–0.19)	(0.27–0.33)	(0.13–0.25)	(0.34–0.41)	(0.24–0.39)
65–69	0.30	0.46	0.39	0.52	0.32
	(0.29–0.31)	(0.41–0.52)	(0.26–0.52)	(0.45–0.59)	(0.17–0.47)
70–74[a]	0.26	0.41	0.27	0.45	0.31
	(0.25–0.27)	(0.35–0.47)	(0.09–0.46)	(0.37–0.53)	(0.13–0.50)

NOTE: Based on American Cancer Society Cancer Prevention Study II data for persons without a history of cancer, heart disease, or stroke who were not "sick" at enrollment. CI=confidence interval.

[a]Estimates for quitting at this age are estimates of the probability of dying in the next 12.5-yr interval.

SOURCE: Unpublished tabulations, American Cancer Society.

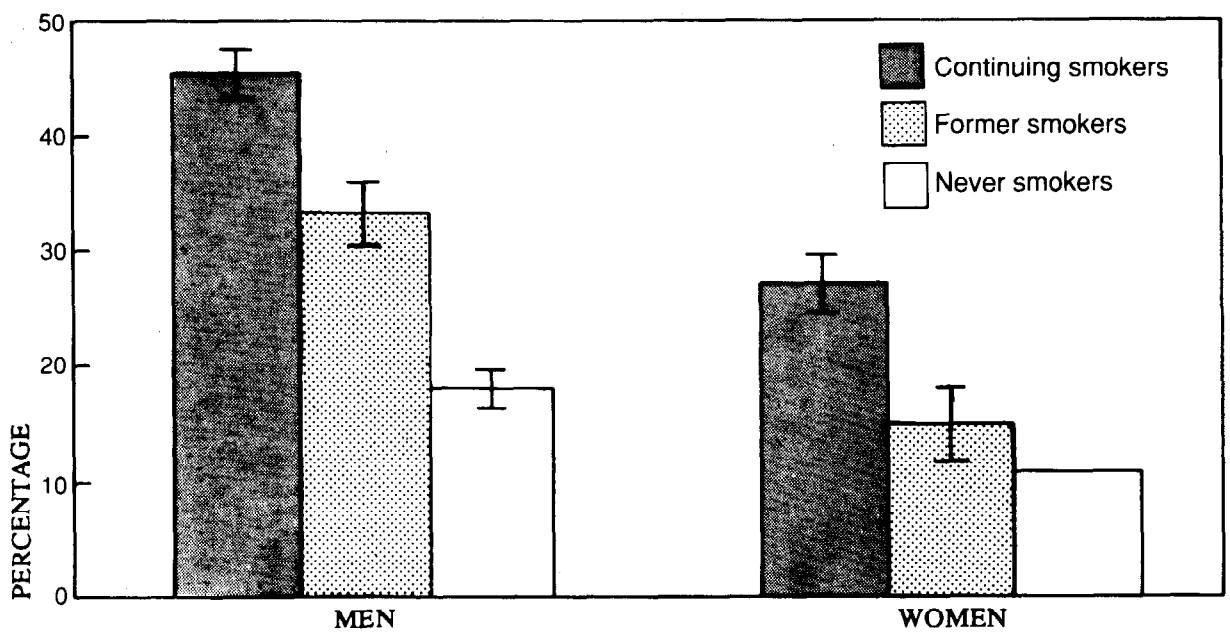

FIGURE 2.—Estimated probability of dying in the next 16.5-yr interval for quitting at ages 55–59 compared with never smoking and continuing to smoke, by sex

NOTE: Continuing and former smokers include only those smoking ≥21 (men) or ≥20 (women) cig/day. Vertical bars represent 95% CI; the interval for female never smokers is not shown because it is extremely narrow (11–11%). Based on American Cancer Society Cancer Prevention Study II data for persons without a history of cancer, heart disease, or stroke who were not "sick" at enrollment.

SOURCE: Unpublished tabulations, American Cancer Society, (see Table 8).

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