TABLE 1.—Continued.

Clinical trial (duration)	Population	Randomization methods/ study groups	Baseline age and smoking data
Multiple Risk Factor Intervention Trial (MRFIT) (*19, 43*) (1974–1982)	12,866 healthy males Aged 35–37 Top 10–15% risk for CHD based on risk score	Randomized to intervention for smoking, cholesterol, and/or blood pressure; or to control group Special intervention (SI) = 6,428 males Usual care (UC) = 6,428 males	X age = 46 X cigs = 21 64% were smokers X cigs (smokers) = 34
Stanford Three Community Study (*36, 41, 44*) (1972–1975)	Residents of Watsonville, Gilroy, and Tracy, in California Random sample of 500 residents assessed in each community (ages 35–59) Upper quartile of CHD risk selected from random samples	Communities matched, not randomized Watsonville high risk sample randomized: media only (W-RC) = 56 ppts. media and intensive instruction (W-II) = 113 ppts. Gilroy: media only (GMO) = 136 ppts. Tracy: control (C) = 136 ppts.	X age (35–59 sample) = approx. 47 X cigs (high risk sample) = approx. 14

by personal consultations or to further contact by mailed personal responses from the physician (*58, 59*).

In the initial stage of the trial no contact was made with the control subjects, who were at no time made aware of their high risk status or participation in the trial (*58, 60*). Intervention and control groups were invited in for a physical examination at 1, 3, and 9 years. They were also sent a self-administered questionnaire on current smoking habits, symptoms, and recent illnesses at years 1, 3, and 9. When the control group smokers were invited for the 1-year examinations, they were told that their names were included in a "statistically chosen sample" (*58*). At 1-year followup, 19 percent of the smokers in both groups did not attend, and a similar loss to followup rate was true for the intervention group at 9 years (*59, 61*).

No objective measures were used in this trial to validate self-reported cigarette smoking behavior. On the basis of the self-reports, there was a cigarette smoking cessation rate of 51 percent for intervention group smokers at 1-year followup (nonattendee baseline smokers were included as smokers) (Table 2). Only 31 percent reported cessation of all tobacco, as many had switched to pipes and cigars (*58*). Of all of the men who stopped smoking cigarettes by the end of year 1, 80 percent reported doing so immediately after the first interview (*60*). At 3 years the reported cessation rate went down to 36 percent, perhaps partly owing to the drop in attendance at examinations and in return of questionnaires (i.e., only 64 percent returned for assessment and nonattendees are included at baseline levels).

A comparison of the intervention subgroups who were contacted by mail with those who had a personal consultation indicates that outcome was significantly poorer when the personal contact was omitted, with a 59 percent cessation rate at 10 weeks for the personal contact group and a 46 percent cessation rate for the postal contact group (*62*).

In the normal care group, 10 percent of the total smokers reported cessation at year 1 and 14 percent at year 3. Only 70 percent of the normal care group returned for the third-year examination. At 1 year and 3 years, respectively, there is a 41 and 22 percent net difference in intervention versus control group reported cigarette smoking cessation rates. At 9 years, the return rate for intervention men was 83 percent, with 55 percent reporting cessation, producing a 46 percent reported cessation rate for all baseline smokers (*62*). About one-third of the cigarette abstainers continued to smoke pipes and cigars. The final 9-year smoking cessation rates have not been reported for the normal care group, but cessation rates reported in a postal survey to which 60 percent of the survivors responded indicated that 41 percent of the normal care respondents reported that they were no longer smoking. As these figures have been

TABLE 2.—Intervention, followup, and cessation results for five major controlled clinical trials

Clinical trial	Intervention	Control group contact	Followup	Reported cessation rates/ (objective measures)
London Civil Servants Smoking Trial (*58, 59, 60*)	Letter inviting ppt. to meet with MD Initial 15 min session Three more 15 min visits (with MD) in 10 weeks 6 mo visit Additional help if needed	Not told of high risk status or trial participation	Physical exams & smoking & medical Hx questionnaire at 1, 3, & 9 yrs for both groups Missed visit rates IG NC Year 19% 19% 1 30% 30% 3 17% — 9	Treated Control Time 51%[1] (cigs) 10% (cigs) 1 yr 31% (all smoking) 36% (cigs) 14% (cigs) 3 yrs 46% (cigs) — 9 yrs (no objective measures used)
Göteborg (Sweden) Study (*78*)	Smokers ≥ 15 g tobacco/day invited to antismoking clinic Five biweekly small group sessions 2d session: ppts. given nicotine chewing gum Followup letters at 3, 5, 12 mo	Baseline smoking & medical Hx questionnaire sent to all ppts. in one CG 2% random sample of one CG screened	Physical exams & smoking & medical Hx questionnaire at 4 yrs for all IG males & all males in one CG No missed visit rates noted	31%[1] 26% 4 yrs (no objective measures used)

TABLE 2.—Continued.

Clinical trial	Intervention	Control group contact	Followup	Reported cessation rates/ (objective measures)	
Oslo (Norway) Study (16, 17)	Initial 15 to 20 min session with MD Group session for men with wives "5-day smoking cessation program" halfway through for those who cont. to smoke 6 mo exam & contact for smoking intervention	Yearly examination	IG: Physical exam & assessment every 6 mos CG: same as above each year Missed visit rate: 1% at 5 yrs for males still living	29% (cigs) 31% (cigs) 18% (all tobacco) (measured SCN at end, but rates not reported)	13% (cigs) 3 yrs 18% (cigs) 5 yrs 1% (all tobacco)
Multiple Risk Factor Intervention Trial (MRFIT) (48)	Session with MD at 3d screen Ten group intervention sessions for all risk factors Maintenance protocol if stopped smoking cigs Extended intervention protocol if still smoking Followup at least every 4 mos	Three screening visits Yearly exam & assessments Results sent to MD	SI: every 4 mos for at least 6 yrs UC: yearly exam & assessment for at least 6 yrs Missed visit rates SI UC Year 4.5% 5.2% 1 10% 10% 6	40%[a] (29% SCN adjusted) 40%[a] (35% SCN adjusted) 43%[a] (42% SCN adjusted)	13% (11% SCN adjusted) 1 yr 16% (15% SCN adjusted) 3 yrs 26% (24% SCN adjusted) 6 yrs

TABLE 2.—Continued.

Clinical trial	Intervention	Control group contact	Followup	Reported cessation rates/ (objective measures)
Stanford Three Community Study (*36, 41*)	Media: TV, radio, posters, mail, phone, newspapers Face-to-face intervention: group sessions 10 wks, then biweekly, yr 1 Continued intervention for yrs 2 & 3	Baseline survey (physical + interview) 1st, 2d, & 3d yr surveys repeated: 40 min contact Medical results sent to MD	Surveys (physical + interviews) yrs 1, 2, & 3 High nonattendance rate each yr Highest rate for WII group	Year 3 WII: 32% cessation [3] W-RC: 0% cessation GMO: 11.3% cessation (nonattenders excluded) TC: 14.9% cessation (nonattenders excluded) (SCN measured, but not used to adjust cessation rates)

[1] $P \leq 0.05$.

[2] Not significant.

[3] $P \leq 0.01$.

IG: Intervention Group; CG: Control Group; SI: Special Intervention group; UC: Usual Care group; WII: Watsonville Intensive Intervention group; W-RC: Watsonville media-only group; GMO: Gilroy media-only group; TC: Tracy Control group.

obtained with different means at 9-year followup, they cannot be compared.

During the first year of the trial, the reported number of cigarettes smoked fell dramatically for the intervention group from 19 cigarettes per day to about 4 cigarettes per day, which was about one-quarter of the consumption of the control group. There was a steady decrease over the next 9 years in the number of cigarettes smoked by the control group, but there was a steady increase for the intervention group. The net apparent reduction in number of cigarettes smoked at 9 years was 7.6 cigarettes for the intervention group (*62*).

Multifactor Clinical Trials

The Göteborg (Sweden) Primary Prevention Trial

The Göteborg study (*78, 79, 80*), a 4-year multifactor clinical trial, began in 1970 and was designed to determine whether alteration of the risk factors of smoking, hypertension, hypercholesterolemia, and to some degree, low physical activity in men aged 47 to 54 would lower the incidence of CHD and stroke in a random sample (*78, 79, 80*). At the time that the study began, 30,000 men aged 47 to 54 were living in Göteborg. One-third of them, 10,000 men, were randomized into an intervention group, and the other 20,000 were placed into two control groups (Table 1). Screening took place between 1970 and 1973, and reexamination took place between 1974 and 1977. All men in the intervention group and in one control group were sent a questionnaire that included an assessment of smoking and symptoms of CHD and family history. All men in the intervention group were invited to a baseline health checkup; a 2 percent random sample of men in one control group was also screened to assure comparability to the intervention group. At the 4-year followup, all intervention men and men in one control group returned for a physical examination and questionnaire assessment (*78, 79, 80*). The whole population will be followed for 10 years.

Of the 10,000 men randomized to the intervention group, 7,455 (or 75 percent) took part in the entry examination; approximately 65 percent were smokers (*78*). There are no indications in the scientific reports that investigations were implemented to determine whether there were any differences in individuals who participated when compared with those who did not come for screening. All men who smoked 15 or more g of tobacco per day (equivalent to 15 cigarettes or 3 cigars) were invited to an antismoking clinic (*78, 79*). Only 2.7 percent of the men screened smoked 25 or more cigarettes per day (*79*). Hypertension and hypercholesterolemia were given intervention priority so that men with elevated blood pressure or cholesterol would be referred for treatment to the relevant clinic and the clinic physician would also provide antismoking advice. The smokers of

more than 15 cigarettes per day were eventually sent to the special smoking clinic. The smoking clinic included about five small group sessions run by a physician and a psychologist (*79*). Very occasionally, men had an individualized session. All smokers, regardless of number of cigarettes smoked, were sent information about smoking and cessation and followup letters at 3, 5, and 12 months.

Objective measures of smoking were not used in this trial. The immediate rate of smoking cessation among the smokers referred to the antismoking clinic was 35 percent. (There is no indication whether this is for all smokers or just for those who attended.) After 3 months this rate fell to 23 percent. At the 4-year rescreening visit, it was reported that there was no significant difference in reported smoking cessation between the intervention and the control groups (*78*) (Table 2). A table presented in a paper reporting the trial results shows cessation rates of 31 and 26 percent at 4 years for the intervention and control groups, respectively (*78*), but upon which smokers these results are based is not indicated; thus, interpretation is difficult.

The Oslo (Norway) Study

The Oslo study (*16, 17, 18*), a 5-year randomized clinical trial, was designed to determine whether the lowering of serum lipids and cessation of cigarette smoking in middle-aged men would lower the incidence of CHD. Of the 16,202 volunteers screened, 40 to 49 years old, 1,232 healthy men free of overt cardiac and other chronic diseases but at high risk for CHD were randomized to an intervention (I) group (n =604) or to a control (C) group (n =628) (Table 1). All of the men at entry were normotensive with systolic blood pressures less than 150 mm Hg; had serum cholesterol levels of 290 to 380 mg/dl; and were in the upper quartile of CHD risk based on smoking and elevated serum cholesterol. Eighty percent were smokers. The two groups were very comparable on all risk factors, with a mean age of approximately 45 and the mean number of cigarettes smoked daily at 12.5 and 13 for intervention group and control group men, respectively (*16, 17*).

The smoking intervention program for the intervention group started immediately after randomization when each of the smokers met with Hjermann for 10 to 15 minutes and were informed about the risk factors and strongly advised to stop smoking all forms of tobacco. Special emphasis was placed on the synergistic effect of smoking and hyperlipidemia. Participants and their wives then attended a group session of 30 to 40 persons, where intervention included motivating the wives to aid their husbands in changing their smoking and eating habits. Half way through the trial, those men who continued to smoke were invited to attend in one group a "5-day smoking cessation program" (*16*).

The intervention group had followup examinations at the center every 6 months. These examinations took 20 to 30 minutes and included a physical examination aimed at cardiovascular symptoms, a resting ECG, and questions about smoking and dietary habits (*16, 17*). The control group returned for a similar examination annually. At the 5-year examination, followup was excellent, with only 1 percent of the men who were alive refusing to attend.

Self-reported smoking behavior at 3 years produced a cessation rate of 29 percent in the intervention group and 13 percent in the control group (*16*), a difference of 16 percent. Objective measures were not made at this point. Pipe smokers were included as smokers, one pack of pipe tobacco per week equaling seven cigarettes per day. Self-reported smoking behavior at 5 years indicated a 31 percent cessation rate in the intervention group and 18 percent cessation in the control group, producing a difference of 13 percent. Cessation of all tobacco smoking was 25 percent by self-report at year 5 in the intervention group and 1 percent in the control group (*16*). Although serum thiocyanate (SCN) was determined at the end of the trial as a validation of self-reported smoking, the corrected rates have not been reported. The investigators have noted that when serum SCN is used, the difference in cessation between the intervention group and the control group becomes smaller and there is a greater discrepancy between reported and corrected rates in the intervention group (*16*).

When smoking behavior is stratified, it can be noted that about 10 percent of the men at baseline both in the intervention group and in the control group were light smokers (one to nine cigarettes per day). This increased to about 30 percent in the intervention group by the end of trial. An increase in this group of light smokers was accompanied by a decrease in the group with heavier levels of smoking. This reported reduction in smoking did not occur in the control group. Most of the cessation in the control group occurred in the 10 to 19 cigarettes per day group and not in the lighter or heavier smokers (*16, 17*).

The percentage of nonsmokers continued to increase steadily in the control group over the duration of the trial, but the greatest increase in the intervention group occurred in the first year, with slight increases through year 4 and a slight decline in year 5; thus, a decrease occurred in the differences between the intervention and control groups during the fifth year (*16*). The number of cigarettes smoked per day decreased from 13 in both groups to about 7 in the intervention group and 11 in the control group, resulting in an almost 50 percent reported decrease in smoking in the intervention group (*17*).

The Multiple Risk Factor Intervention Trial (MRFIT)

The Multiple Risk Factor Intervention Trial was a randomized clinical prevention trial followed for an average of 7 years, designed to test the effect of a multifactor intervention program on coronary heart disease (CHD) mortality and morbidity (*19, 43*). There were 12,866 high-risk men, 35 to 57 years of age distributed among 22 clinical centers. They were randomly assigned either to a special intervention (SI) group that received treatment for hypertension, cigarette smoking, and elevated blood cholesterol levels or to a usual care (UC) group that received their usual health care in the community (Table 1). Persons were designated "at increased risk" if their levels of the three risk factors were sufficiently high at a first screening visit to place them in the upper 10 to 15 percent[1] of a risk score distribution based on data from the Framingham heart study.

Eligibility was determined at three successive screening visits. Men were excluded from the trial on the basis of low risk, history of certain diseases, among which were CHD and diabetes mellitus requiring medication, expected geographic mobility, a serum cholesterol level of 350 mg/dl or higher, or a diastolic blood pressure of 115 mm Hg or higher. Randomization resulted in an SI group with 6,428 participants and a UC group with 6,438 participants. There was excellent agreement in prerandomization levels of numerous risk factors and risk-factor-related variables (*19, 43, 49*), with a mean age of approximately 46 years and a mean number of 21 cigarettes smoked per day. The 64 percent of the participants who were smokers smoked an average of 34 cigarettes per day (*19, 49*). The proportion of men who were smokers decreased markedly as the age of the participants increased (*19*).

Since smokers were defined by their cigarette smoking habits, an individual who smoked only pipes and/or cigars or cigarillos at baseline but not cigarettes was not included in this group. Approximately 9 percent of the MRFIT participants smoked only pipes and/or cigars or cigarillos at baseline. Classification of this group as nonsmokers was in accord with the lack of substantial evidence linking this type of smoking with coronary artery disease.

Intervention for smoking cessation began after randomization at the third screening visit, when the smoker met with a physician who noted the effects of smoking on the cardiovascular and respiratory systems and strongly advised him to stop smoking. At this time the smoker also met with a "smoking specialist" who discussed the smoking intervention program with him and invited him to attend the intensive intervention group (*19*). Ninety-four percent agreed to join the group program, and 6 percent of the men elected to be seen individually. Each group included about 10 men and met for 10

[1]The percentage of risk was changed from the upper 15 percent to the upper 10 percent almost midway through screening. This change occurred in order to increase the power of the trial (*19*).

sessions. The men were encouraged to bring their spouses or friends to the series of weekly group discussions, which were intensive efforts to intervene in the three risk factors (*19, 48*). The smoking intervention program included a broad spectrum of educational, cognitive, and behavioral approaches for cigarette smoking cessation; no special effort was made to alter the smoking habits of persons smoking only pipes or cigars. Uniformity of content and structure was sought by the use of common protocols and educational material (*19, 48, 49*).

After the initial intensive intervention phase, individual counseling planned and executed by an intervention team became the general approach. Behavioral scientists often headed the intervention team, which also included nutritionists, nurses, physicians, and health counselors (*19, 49*). The smoking cessation program following the termination of the integrated intervention group was either a "maintenance program," directed at participants who had successfully quit cigarette smoking, or an "extended intervention program," directed at those who continued to smoke cigarettes or had stopped and recidivated. The key item in both the maintenance and the extended intervention components was a specified minimum contacts schedule. The maintenance program was based on a series of scheduled contacts between staff and participant, with the frequency of contacts decreasing over time as the participant continued to remain a nonsmoker. Participants who maintained their non-cigarette-smoking status were eventually seen by the smoking specialist at regular 4-month followup visits only.

Although similar methods, materials and protocols for schedules of contact and suggested sequencing of methods were used for smokers in the extended intervention phase, an individualized approach took into account individual needs and differences. Thus, although uniformity of content and structure was sought by the use of common protocols, methods, and educational materials, a single step-by-step procedure could not be used for smokers in this phase of intervention. It was not the goal of this study to treat all smokers alike; rather it was intended to produce the optimal treatment effect.

On or about each anniversary of randomization, participants in both the SI and the UC groups returned for assessment of risk factor levels, status on physical examination, laboratory studies, and morbidity status (*19, 43, 48, 49*). UC participants visited the clinical center once a year, and the results of the examinations were sent to their usual source of medical care. The missed-visit rates (the number of men alive at the time of the specified annual visit who did not attend, divided by the number of men randomized) were 4.5 percent for SI and 5.2 percent for UC men at 12 months; these increased only slightly each year and, although somewhat higher for

the UC group at each visit, remained below 10 percent through 6 years for both groups (*43*).

Serum thiocyanate (SCN) and carbon monoxide (CO) levels provided objective measures and a check on the validity of self-reported smoking. MRFIT used a multiple regression model, which takes factors affecting SCN (e.g., use of diuretics, pipes, or cigars) into account in order to "adjust" the reported data on cessation (*46*). Cessation rates that have been reported from MRFIT (*19, 48, 49*) therefore include both self-report and SCN-adjusted rates. At year 6, 43 percent of the SI smokers were reporting cessation, and 25 percent of the UC noted that they were not smoking (Table 2) (*48*). These rates include all baseline cigarette smokers so that individuals who did not attend the sixth annual visit were included at their baseline levels of smoking. When these rates are adjusted for SCN levels, they are 42 percent and 24 percent for SI and UC smokers, respectively, producing a statistically significant difference ($p < 0.01$) between SI and UC of 17 percent. Significantly more cessation occurred among lighter smokers in both treatment groups than among heavier smokers.

The reported cessation rate for SI smokers was relatively stable from year 1 to year 4—about 40 percent—and then increased in years 5 and 6 to 41 percent and 43 percent, respectively; cessation rates for UC smokers increased in a linear fashion from year 1 (about 13 percent) to year 6 (25 percent). Thus the SI–UC difference in reported and adjusted rates decreased each year, although always remaining significant. Similar to the Oslo study findings (*16*), there were greater discrepancies between reported and adjusted rates for SI smokers than for UC smokers early in the trial, although by the sixth year there was little discrepancy in either group. In year 3, the reported cessation rates were 40 and 16 percent for SI and UC smokers, respectively, and the adjusted rates were 35 and 15 percent (*48*).

Cohort analyses revealed that 26 percent of *all* SI smokers and 6 percent of *all* UC smokers stopped at year 1 and continued to report cessation through year 6 (*48*). That is, the 43 percent of the baseline SI smokers who reported cessation at year 6 included the 26 percent of the baseline smokers (or 60 percent of those smokers who initially stopped) who continued to report cessation each year and the 17 percent who had stopped later in the trial at years 2 through 5 or had recidivated and then stopped again. At year 2, 6.9 percent of baseline smokers were new stoppers. The rate of new reported cessation ranged from 3.3 to 4.7 percent at years 3 through 6. Similarly, the 25 percent reported cessation rate at 6 years for the baseline UC smokers include the almost 7 percent of the baseline smokers who continued to report cessation each year to year 6 and the 19 percent of the baseline UC smokers who had stopped later in

the trial at years 2 to 6 or had stopped earlier, then recidivated and stopped again. At year 2, 7.5 percent of baseline UC smokers reported new cessation. The rate of new cessation reported at years 3 through 6 was 4.2 to 4.8 percent.

Among smokers who stopped early in the trial (i.e., the early abstainers), the SI smokers had significantly less recidivism than did the UC, but among the late abstainers, the UC participants maintained their nonsmoking status somewhat better than did the SI cohort. The latter finding may reflect the differences in the remaining pool of smokers at the end of the first year of the program, with the smaller group of remaining SI smokers being those who were more recalcitrant and who would recidivate more readily. The data indicate that regardless of the conditions surrounding cessation (i.e., amount smoked, time from entry into the study at which cessation occurred, assignment to either the SI or UC group), the recidivism rates for the second and third year after cessation are much lower than for the first year (*49*).

Although the primary objective of the MRFIT smoking intervention program was total cessation, a program for dosage reduction was extended to smokers who had not been successful in their cessation attempts (*19*). It provided the trial an opportunity to continue working with participants who stated that they did not want to stop smoking completely. Reduction data that were reported through 4 years of the trial indicate that participants in the SI group who did not quit smoking reported reducing their cigarette smoking by approximately 10 cigarettes per day at year 1, smoking about three-quarters of their baseline rate (*19, 49*). This reduction continued to be reported through 4 years, but was not accompanied by a marked decrease in SCN levels. Since SCN levels can be utilized as a correlate of cigarette smoke exposure, there are at least two possible explanations of this finding. First, underreporting of cigarette consumption was occurring among continuing smokers. Second, smokers compensated for reductions in the number of cigarettes smoked, increasing the intensity of smoking by modifying the topography of puffing (*15*).

The Stanford Three-Community Study

From 1972 to 1975, the Stanford Heart Disease Prevention Program (SHDPP) conducted the Stanford Three-Community study, a field study in three comparable Northern California communities (*13, 14, 36, 41*). The noted objective of this communitywide health education project was to develop successful methods for reducing cardiovascular risk for the adult population at large that would be generally applicable within communities, hoping to demonstrate that it was indeed possible to reduce risk in this way (*36, 41*). In order to demonstrate that a community-based health education program

can decrease the risk of CHD, the program compared changes in risk behaviors and in risk factors (smoking, increased serum cholesterol, and hypertension) for subjects in two communities, using two different approaches to intervention, and in a third community, used as a no-intervention control.

To assess the effects of interventions on risk factor knowledge and behavior change, baseline and three annual followup surveys (medical examination and interview) were conducted for a random sample of approximately 500 men and women, aged 35 to 59, in each of three intervention groups (one community had two intervention groups) and in the control group (*36, 41, 44*). These exams took about 40 minutes each. High risk samples of individuals who were in the top quartile of risk at baseline were selected from these groups for further study (*41*). The male to female ratios in these high risk samples of individuals ranged from 0.97 to 1.36 (*41*).

One community, Gilroy, received a mass media program only; in a second community, Watsonville, a media approach was used, and in addition, intensive face-to-face intervention was provided for a randomized two-thirds of the participants who were in the top quartile of risk for CHD. A third community, Tracy, was selected as a no-treatment control community because it is geographically remote from the other two and does not have the media systems they share (*36, 41*) (Table 1). Followup at all three annual examinations was between 58 and 68 percent for each of the four groups, with the highest nonattendance occurring in the media plus face-to-face intervention groups (*14, 36, 41*). Of the high risk subjects, 59 to 66 percent of those subjects seen at baseline in three communities attended all three annual surveys, with the greatest nonattendance again in the face-to-face intervention group (*41*).

The media campaign consisted of spots on radio and television, newspaper columns, and mailings of different materials (*44*). The intensive instruction, or face-to-face counseling, took the form of group meetings or at-home instruction, whichever the participant preferred. The group, usually 12 to 15 participants, met in local church rooms for 10 weekly sessions and then twice a month for the first year. In many respects the intensive face-to-face intervention for the Stanford study is very similar to the MRFIT intensive intervention. Of the 169 subjects identified as being at high risk in Watsonville, 113 were randomized to treatment. Of these, 107 started treatment, and a cohort of 77 continued until the second annual examination. During the third year, little intervention took place.

Plasma thiocyanate (SCN) concentrations were determined at each annual survey to help distinguish smokers from nonsmokers. A concentration of greater than 100 μmol/liter was chosen to indicate possible inaccurate reporting (*41*). The investigators reported that

SCN measurement indicated that about 4 percent of those reporting abstinence "may have given false reports" (*14*), but SCN data were not integrated with the reported cessation rates (*24*). Therefore, the reported smoking behavior change results that follow have not been adjusted with SCN findings. The reported findings (*36, 41*) are also based only on those individuals attending followup surveys; dropouts and refusals are not an integral part of the analyses. Cessation results have been reported for high risk participants only.

For those individuals who attended all followup visits in the Watsonville intensive instruction group, a 50 percent cessation rate was reported (*41*) (Table 2). This rate becomes 32 percent when the 13 dropouts are included. Significantly fewer subjects stopped smoking in the Watsonville media-only group than did in the Tracy control community. In fact, no smokers who attended the 3-year followup visit in the Watsonville media-only group reported cessation, while 14.9 percent of the control group who attended the visit reported cessation. In the Gilroy media-only group, 11.3 percent reported cessation (*41*). For the cohort of individuals who attended all survey visits there was a steady increase in the number of smokers reporting cessation each year in the Watsonville face-to-face intervention group. This appeared to be true also for the control group. *No* cessation in the Watsonville media-only group was noted during any survey.

With regard to reduction in number of cigarettes smoked, there was a reported reduction of 51.6 percent for the smokers in the intensive instruction group who attended all three surveys (*41*). Data are not provided for the group of nonattendees. More reduction was reported in the control group (21 percent) than in the two media-only groups (10 and 11.8 percent, respectively).

Deficiencies in the Clinical Trials

In this review, the objectives, smoking control methods, and smoking behavior change findings of the major large-scale preventive trials have been presented. As noted in the beginning of this section, because of their emphasis on experimental design, preventive trials provide a valuable opportunity for scientifically assessing the efficacy and outcomes of smoking intervention techniques with special populations. Although they have greatly added to the quality of the available smoking-behavior-change data and the methodology used to assess intervention techniques and outcomes, they too are beset with deficiencies in some important areas. The major deficiencies noted in the reviewed trials are the lack of objective data to verify self-reported outcomes, the use of cross-sectional analyses to the almost complete exclusion of cohort analyses, failure to provide sufficient information in scientific reports to allow adequate inter-

pretation of outcomes, and lack of evaluation of components of the intervention packages.

The use of objective data to verify self-reported data was missing in two of the trials: the London Civil Servants smoking trial and the Göteborg study. Although SCN was reported to have been measured in the Stanford study and in the Oslo study, the findings were not used to correct the reported data. Only one trial—MRFIT—measured and used objective data to adjust reported cessation rates. As observed in the discrepancies between reported and objectively measured cessation data for intervention group smokers in studies that have used objective data for verification (e.g., MRFIT and the Oslo study), self-reports that have not been verified need to be interpreted with caution: often pressures to stop smoking, perceived and real, are felt by participants in an intervention program, which may cause misreporting and inflated cessation rates. The same pressures may lead to underreporting of consumption levels among continuing smokers, a possible interpretation of the MRFIT data showing reduced reported smoking among nonstoppers but maintained high SCN levels. Because of differences in the samples studied and in the intervention methods used, it is difficult to extrapolate from a study that has used objective data to a study that has not used these data. The very use of biochemical verification techniques of which subjects are aware has been shown to lower deception rates (*11, 35*). Thus, although MRFIT found a discrepancy of about 6 to 9 percent between reported and SCN-adjustment cessation rates, depending at which point of followup the measurements were made (*46*), the possibility of a similar discrepancy in another study using a different intervention approach and making different demands on different populations of smokers cannot safely be suggested.

None of the trials, with the exception of MRFIT, reported cessation outcomes for cohorts of smokers; they used cross-sectional data almost exclusively. Therefore there is very little understanding of the actual degree of recidivism occurring each year in either the intervention groups or the control groups in these trials or of the rate of new cessation taking place in either of the groups. A program that obtains an outcome of 30 percent cessation at year 2 and includes a large proportion of individuals who have been cigarette free for the 2 years is perhaps fulfilling the needs of smoking control programs more successfully than a program that yields a 40 percent cessation rate at 3 years and includes a large group of smokers who have gone back and forth with regard to smoking cessation. As has been consistently noted in the smoking literature, stopping is not the major problem, it is stopping and staying stopped (*5, 20, 34*). Even the commonly cited relapse curves (*20*) use cross-sectional data and do not give the true picture of relapse. In order to judge the effectiveness of a program, in addition to knowing cessation rates it is

important to know whether any new cessation occurs as the program progresses or whether all of the smokers available for cessation made changes early in the program. Is there a group of recalcitrant smokers whom the program never reaches? For example, Ockene et al. (*48*) noted with their use of cohort data that although there were new stoppers in the SI group each year, approximately 27 percent of baseline cigarette smokers never reported cessation during the next 6 years of the trial. Thus the program never reached slightly more than one quarter of the smokers, a fact that would not be brought out by cross-sectional data. None of this information can be provided with cross-sectional data.

The 51 percent reported cessation in the London Civil Servants trial (*58*) is impressive on first look, especially given the seemingly less expensive intervention approach, when compared with studies such as the Stanford study and the MRFIT. A major difference for this trial when compared with the other trials in this section is that the London Civil Servants trial was a one-factor trial, that is, smoking, and the others were multifactorial trials. This difference is an important one when considering intervention outcomes. In year 3, the rate fell considerably, to 36 percent. How many of the 36 percent of the smokers who reported cessation at year 3 in the Civil Servants trial also reported not smoking cigarettes at year 1? It is possible for this rate to be made up of individuals who were, in fact, not part of the original 51 percent at year 1. This lack of cohort data coupled with a lack of objective data makes it difficult to adequately interpret the outcomes. The Göteborg study investigators noted that there was no significant difference at 4 years for the intervention group relative to the control group. Although the cessation rates may not be significantly different, there may be significant differences in the percentage of smokers who met with long-term success in each group; thus, there is a possibility that the program had an effect on long-term outcome without differentially affecting the prevalence of smokers.

The nonuse of cohort data is also part of a third deficiency in the preventive trial literature: a lack of adequate information in the scientific reports to permit proper interpretation of outcomes. Also included here is a lack of adequate definitions of terms or criteria. Investigators in the London Civil Servants study (*55, 60, 61*) noted that additional smoking intervention help was provided "if needed." Likewise, the Oslo study provided a "5-day smoking cessation program" halfway through the trial for those who "continued to smoke" (*16*). There are no indications in either case of specifically how smokers who received additional help were defined, what percentage in fact needed it, what types of intervention were included in these programs, or what the outcomes of these specific programs were.

The lack of important data in the reports of some of the trials is yet another concern. In the Stanford study, 3-year cessation rates for each study group are provided for individuals who attended the visit, but rates that include nonattendees are not given for each community. A rate of 11.8 percent for the control community of Tracy does not give the full story. Likewise, the investigators in the Göteborg study provided a control group in which only 2 percent were initially screened, but all were assessed at 4 years (*78, 79, 80*). Comparison of 4-year data for the control group participants who were screened at baseline with those not screened would also have been useful, as a major problem noted for some of the trials is the possible intervention effect of screening. The Göteborg study could provide a valuable opportunity to investigate this possible intervention effect.

Another deficiency noted in the trials is the lack of evaluation of parts of the intervention packages. Most of the trials used approaches that combined many different behavioral, educational, and medical interventions, but were not able to note which components were most effective among all of the approaches. The data available at present tell us only the effects of the total intervention. The total package may have many components that can be delivered in different intensities or sequences to different subgroups of the target population (*24*). It is not possible to estimate the outcome of some changes in the total package, as there are too many confounding variables that prevent procurement of secure inferences with regard to the additive or interactive effectiveness of the individual components (*24*). Sorting out the effectiveness of single stages or elements in treatment packages has been a particularly complex area of research, with results indicating that simpler models can be superior (*30*). Also lacking are adequate studies designed to determine which subgroups of smokers benefit from certain interventions and which smokers respond poorly to these interventions (*47, 50*). Some persons may not need as intensive and expensive an intervention as used in the Stanford study and MRFIT and may do well with approaches similar to the less expensive and intensive approaches of the London Civil Servants study or the Oslo study or with less intervention. Trials testing differential intervention effects for subgroups of smokers would be able to provide valuable information.

Comparison of Clinical Trial Outcomes

Although deficiencies are present in the clinical trials, there are also many advances that these trials have made in smoking intervention studies. Each trial provided randomized control and intervention groups, long-term followup of at least 3 years, and standardized points of followup. The long-term followup of control and intervention groups provides some valuable data with regard to the process of smoking behavior change, although interpretation of

these data remains difficult because of the deficiencies as well as some of the differences inherent in the trials. In spite of these deficiencies and differences there remains much that we can learn from the trials reviewed above. The major points will be summarized in this section.

As noted in Table 2, the 3-year reported outcomes for all of these trials (except for the Göteborg study) showed a significant difference between the intervention groups and the control groups. The Göteborg study did not have 3-year data available, and the 4-year data showed no significant difference in cessation between the control and the intervention groups. The control groups in the trials where sufficient data are available (i.e., London Civil Servants study, the MRFIT, and the Oslo study) generally showed a steady increase in cessation as the trial progressed. In each of these studies there was a yearly examination for the control group smokers, raising the possibility of an intervention effect. In spite of the steady yearly increase of control group cessation rates in the trials, the MRFIT cohort data demonstrated that a significantly smaller percent of the control group smokers reporting cessation each year were long-term stoppers compared with the intervention group participants (*48*). Although cessation occurred among nonintervention smokers, it was probably not as well maintained as among the intervention group smokers. Because of the lack of cohort data, this issue cannot be reasonably addressed for the trials presented.

The range of cessation rates among the control groups at 3 years is 13 to 16 percent (except for the Göteborg study, which will be discussed below), with the highest rate recorded for the MRFIT. The London Civil Servants study provided an annual examination for the control group, but did not inform the participants of their high risk status. This latter point does not seem to have lessened the effect on cessation in the comparison group. On the contrary, the nonattendance rate for the control group in the London study was high—19 percent at year 3—which may in fact have decreased the cessation rate, since nonattendees were included as smokers.

The Göteborg study control group is unusual, with a possible cessation rate of 26 percent at 4 years. As noted, it is difficult to discern the rate from the investigators' scientific report. (Three-year rates were not reported.) Although the rate is slightly higher than what might possibly be expected at 4 years from the other control groups, it might be anticipated that with the steady yearly increases observed in the other trials, they would also have higher 4-year rates. A cessation rate of 21 percent was reported for the MRFIT UC group at 4 years, and at the 6-year visit this rate was 26 percent (*48*).

Where yearly data are available (i.e., London Civil Servants, MRFIT, Stanford study), control groups increased their cessation rates about 2 or 3 percent each year, and during the first year,

reported rates were about 10 percent. The 2 or 3 percent cessation rate each year is not unlike what might be expected from smoking cessation in the general population of smokers who stop smoking on their own each year without intervention (*75*). The greater cessation rate for the control group relative to the general population of middle-aged men at year 1 suggests that factors related to the trials—identification as being at high risk, the screening process, and the yearly examinations that include questions about smoking and cardiovascular fitness–may have had an intervention effect (*49*). Also, illness in this high risk group may have led to cessation.

With regard to the possibility of the effect of being at high risk, the Göteborg population is the only non-high-risk population in the noted trials, and they exhibited a high control group cessation rate. Likewise, although the London Civil Servant smokers were at high risk, the control group smokers were not informed of this status. Therefore, the increased awareness of one's smoking behavior through examination and questionnaires may be enough to motivate some persons to stop smoking. The onset of disease is certainly another possible factor. More analyses of the data for the control group smokers, including their reasons for cessation, must be accomplished before the variables affecting cessation in these groups can be better understood.

The reported cessation rates for the intervention groups (Table 2) in the trials at 3 years range from 29 percent for the Oslo study to 40 percent for the MRFIT. (For the Stanford study, only the results for the WII group are used here for comparison, i.e., 32 percent reported cessation.) In many respects, the five trials reviewed are remarkably similar with regard to the samples studied. The smoking cessation results reported were for healthy middle-aged men at high risk for CHD, except for the Göteborg study, which involved all middle-aged men, and for the Stanford study, which included an almost equal number of men and women in the intensive intervention group. The mean ages were similar in three studies (45 to 47), and in the Göteborg study and the London Civil Servants study the mean ages were 51 and 53, respectively. The greatest number of cigarettes smoked was by the men in the MRFIT study who smoked an average of 21 cigarettes per day. (The data for the Göteborg study are not clear with regard to the average number of cigarettes smoked per day by the smokers.) The least intensive intervention for smoking and the least expensive approach seemed to occur in the London Civil Servants smoking trial and the Oslo study, both of which used short initial visits with physicians and then one to three followup visits either individually (London study) or in a group (Oslo study). The fewest intervention visits were noted for the Oslo group. Both of these studies noted the use of additional intervention when necessary, but what this means or how much additional intervention was

provided is not specified. The Stanford study and the MRFIT seemed to provide the most intensive intervention, with at least 10 weekly group sessions and more if necessary. The smoking intervention program in the Göteborg study—small group sessions—falls between the two levels of intervention. In addition to the group sessions, the Göteborg study provided nicotine chewing gum at session two.

Each of the trials provided some continued contact, at least every 6 months and generally more often, for the intervention group smokers during the first 2 years of the trials. It appears as though the least maintenance contact may have been provided in the London Civil Servants study, although this is not entirely clear from the reports. Hypothetically, the more continued maintenance and intervention contacts provided, the greater the likelihood of new cessation and maintenance of cessation occurring. This possibility has been tested only for the MRFIT, since as noted previously, only cross-sectional data were available for the other studies. New cessation continued to occur in MRFIT each year at the rate of about 3 to 6 percent, and by the sixth year about two-thirds of the smokers who stopped initially continued to maintain cessation. Relative to past reports, this maintenance rate is indeed very promising, and it would be useful to know the maintenance rates of trials that used a lesser frequency of contact. Because of the continued contact, it is difficult to assess whether the followup data are good indicators of the level at which intervention effects stabilize (*24*).

The outcomes in the Stanford study are puzzling. At the third annual examination, the control community of Tracy showed the same rate of smoking cessation as the media-only town of Gilroy and significantly more cessation than the media-only intervention group in Watsonville. Zero percent of the Watsonville media-only group reported cessation, but there was a steady increase in the control group each year to about 15 percent. These data provide no support for the possibility that an intensive media blitz has an impact on smoking cessation that is greater than the impact of "usual" community intervention. Perhaps there is a "saturation point" with regard to the effectiveness of increased awareness, which when reached requires intervention to be at an intensive individual level before the next level of smokers can be affected. Albeit, a demonstrated intervention effect that is less than what is observed spontaneously in the general population merits investigation.

The Oslo study has the lowest 3-year reported cessation rate for the intervention groups, 24 percent, and seemed to deliver the least intensive intervention among the trials; the MRFIT had the highest cessation rate at 3 years, 40 percent, and perhaps provided the most intensive intervention among the trials. The best outcome was attained with the most intensive and perhaps the most expensive approach of the MRFIT, which demonstrated the possibility of long-

term cigarette smoking cessation with large numbers of people. Whether the intensive approach is cost effective must be evaluated. Similarly, as noted previously, it is important to determine whether there are certain groups of smokers who may not need intensive intervention and others who may require even more intensive work.

Even with the use of intensive intervention (Stanford study and MRFIT), a cross-sectional cessation rate of less than 50 percent was obtained. Is even more intensive intervention (or a different treatment package) desirable, or is this rate all that can be hoped for? Perhaps such intense interventions are not cost effective in terms of the outcome achieved, and much more attention should be devoted to self-help approaches.

Community Prevention Trials

The Heart Disease Prevention Project: World Health Organization European Collaborative Trials

The World Health Organization (WHO) European Collaborative Trials (*81*) were set up to evaluate the ability of a multifactoral intervention program to alter risk factors for CHD in industrial workers, aged 40 to 59, and the effect of such changes on CHD incidence and mortality. The allocation units were factories or other large occupational sites, thus permitting community health education as well as an individual approach. In most cases the program operated at the participants' workplace. The Collaborative Group included four centers: the United Kingdom, Belgium, Italy, and Poland. Although there was organizational diversity and each trial was essentially autonomous and self-sufficient, the experimental design was the same in each center with standardization of screening methods, intervention objectives, and end-point criteria (*81*). It was planned that each trial would run for about 5 years.

In each trial, factories or other occupational facilities were arranged in pairs and matched according to size, location, and type of industry, and then randomly allocated to an intervention or a control group. A central team visited each factory for screening. All men in the intervention factories between the ages of 40 and 59 and a random 10 percent of the men in the control factories were invited for a screening examination. The rest of the control men were not told of their participation in the trial, thus preventing a possible influence on risk factor change. The 10 percent of the controls who were initially screened were reexamined after 2 years. Random 5 percent samples of men in the intervention factories were reexamined annually in order to monitor risk factor changes. All survivors were examined at the termination of the trials (*81*).

Intervention was provided for hypercholesterolemia, cigarette smoking, sedentary activity, weight control, and hypertension. All of

the men in the intervention factories were exposed to mass intervention approaches such as posters, groups, films, and demonstrations and received a report of their results along with printed advice for change. Their personal physicians also received copies of the reports. Individualized intervention consultations were provided for the 10 to 20 percent of the men who, as a result of screening, were assessed to be at the "highest risk for CHD." The intervention approach used in this trial was similar in some respects to that of the Stanford study insofar as both used a combination of face-to-face and mass media techniques.

Information specific for the United Kingdom and Belgium trials and their results is presented below. The Rome and Warsaw trials have not yet reported their results.

United Kingdom Heart Disease Prevention Project

Recruitment for the heart disease prevention project in the United Kingdom occurred between 1971 and 1973. Twenty-four large industrial groups, generally factories, employing a total of 18,210 men, were recruited and paired (*62*). One of each pair was allocated to the intervention group (9,734 subjects) and to the control group (8,476 subjects). Intervention began with the acceptance of screening by 86 percent of the men aged 40 to 59. A cutoff risk factor score was determined within each intervention factory, such that it was exceeded by 12 to 15 percent of the examined men who were at "high risk" for CHD. Differences between factories in the mean levels of risk factors were slight (*62, 81*), with a mean age of approximately 50 for both groups and a mean number of cigarettes smoked of approximately 8 cigarettes per day for all men and 14.3 cigarettes per day for the high risk men (*62, 81*) (Table 3).

Intervention for all of the smokers in the intervention factories was initiated at the screening examination, when they were asked if they would like to stop smoking (*62*). The 40 percent who were interested were sent a letter of encouragement, smoking record cards that they were asked to return after 3 weeks, and a booklet with smoking cessation advice. All screened participants were sent general information on risk factors, and the mass health education intervention included posters, evening meetings to which spouses were invited, films, talks, and question and answer sessions. Because of the generally poor response to the community intervention in the first 2 years, more personal contact was added for men whose risk scores came close to the high risk scores. Annual examinations were also used to give personal advice on smoking and diet. In the third year, antismoking clinics for all smokers were held by a nurse. The high risk men were recalled after screening by the company physician, who advised and treated them individually. There was an

TABLE 3.—Population, randomization, and baseline smoking data for three major community prevention trials

Community trial (duration)	Population	Randomization methods/ study groups	Baseline smoking data
WHO European Collaborative Trial: United Kingdom (*62, 81*) (5 years) (screening 1971–1972)	18,210 factory workers Aged 40–59 24 large industrial groups (paired)	Factories paired for similarities Random allocation of one in each pair to intervention or to no intervention Intervention group (IG) = 9,734 males Control group (CG) = 8,476 males	$\bar{X}$ cigs for all participants = 8 $\bar{X}$ cigs for high risk males = 14.3
WHO European Collaborative Trial: Belgium (*8, 26, 27*) (5 years) (screening 1972–1974)	16,222 factory workers Aged 40–59 30 industrial groups (paired)	Same randomization as above Intervention group (IG) = 7,398 males Control group (CG) = 8,240 males	$\bar{X}$ cigs not noted

TABLE 3.—Continued.

Community trial (duration)	Population	Randomization methods/ study groups	Baseline smoking data
North Karelia (Finland) Project (*53, 54, 63, 64, 65*) (5 years) (screening 1972–1977)	Residents of North Karelia (Intervention community = IC) Residents of Kuopio (Control community = CC) Surveyed residents aged 25–59 at start of study	No randomization North Karelia had a high CVD rate and intervention was indicated Community similar to North Karelia was matched as a control Random 6.6% sample of population aged 25–59 in each community surveyed in 1972 Random 6.6% sample (independent of 1st sample) surveyed at study end in 1977 Over 10,000 subjects studied each time	IC: 50.2% males smoked 11.7% females smoked CC: 50.9% males smoked 13.1% females smoked X cigs (CC) = 8.9 for all males X cigs (IC) = 9.9 for all males X cigs (IC) = 19 for all smokers

average of about four 15-minute visits per high risk smoker during the first year (*62*).

Changes in risk factors for intervention were assessed each year for a new 5 percent random sample of all entrants. At year 5, half of all the men who had not been previously assessed were called, and at year 6, assessment was accomplished for the other half still employed. Followup of high risk men occurred at either the second or fourth year. A random 10 percent of the men in the control group were invited to an examination at entry and again at 2 years and at 4 years. The results for the intervention group were corrected for corresponding changes in the control group (*62*). Followup visits in all groups ranged from 86 to 94 percent of those invited.

Objective measures were not used to validate self-reported smoking behavior. High risk men reported the best changes in smoking levels, with a decrease in number of cigarettes per day from approximately 13 at entry to about 9 at the final examination, a 29 percent decrease. No decrease was noted for the control group; thus, the corrected estimate for the effect of intervention at the final examination was also minus 29 percent (*62*). There was a net reduction in number of cigarettes smoked of 19 percent for all smokers and of 16 percent when high risk smokers were removed.

At the end of the trial, a 12 percent cessation rate for the high risk men in the intervention group was reported, but no change was reported in the control group (Table 4). About 9 percent of all of the intervention smokers reported cessation by the end of the trial, which is about 7 percent if high risk smokers are excluded (*62*). These differences are statistically significant ($p \leq 0.001$). A comparison of risk factor levels at the final examination between the 90 percent of the control group men who had no contact with the trial before the examination and the remaining 10 percent who had been examined showed almost identical results for smoking (*62*).

The Belgium Heart Disease Prevention Project

After a preliminary feasibility study in 1971–1972 for the Belgium trial, initial examination for the main trial began in 1972 and terminated in April 1974 (*81*). The trial paired 30 Belgian industries, with 1 member of each pair randomized to the intervention and 1 to the control group (*8, 26, 27*). Out of 19,390 male workers in the age group of 40 to 59, 83.7 percent agreed to be screened, yielding 7,398 men in the intervention group and 8,821 men in the control group. There are no indications that investigations were implemented to determine whether there were differences between persons who were screened and a random sample of those who were not screened. Ten percent of the subjects in each occupational unit were randomly selected for an examination similar to that of the intervention group; the other 90 percent had a resting electrocardiogram (*8, 26, 27*). The