The Long-Term Effects of a Cardiovascular Disease Prevention Trial: The Stanford Five-City Project

ABSTRACT

Objectives. This study examined long-term effects of a health-education intervention trial to reduce the risk of cardiovascular disease.

Methods. Surveys were conducted in California in two treatment and two control cities at baseline (1979/1980), after the 6-year intervention (1985/1986), and 3 years later at follow-up (1989/1990). Net treatment/control differences in risk-factor change were assessed for women and men 25 to 74 years of age.

Results. Blood pressure improvements observed in all cities from baseline to the end of the intervention were maintained during the follow-up in treatment but not control cities. Cholesterol levels continued to decline in all cities during follow-up. Smoking rates leveled out or increased slightly in treatment cities and continued to decline in control cities but did not yield significant net differences. Both coronary heart disease and all-cause mortality risk scores were maintained or continued to improve in treatment cities while leveling out or rebounding in control cities.

Conclusions. These findings suggest that community-based cardiovascular disease prevention trials can have sustained effects. However, the modest net differences in risk factors suggest the need for new designs and interventions that will accelerate positive risk-factor change. (*Am J Public Health.* 1996;86:1773–1779)

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Introduction

During the last 40 years, epidemiological studies have established that hypertension, elevated plasma cholesterol, cigarette use, overweight, and sedentary lifestyle are involved in the pathogenesis of cardiovascular diseases.[1] The link between these risk factors and personal health behaviors led to the design and implementation of intervention trials that approached cardiovascular disease risk reduction by promoting the adoption of healthy practices in entire communities.[2,3] The earliest community-based study in the United States was the Stanford Three-Community Study, initiated in 1972.[4] This study, which targeted cardiovascular disease risk factors through a broad health promotion program, showed significant net improvements in smoking, cholesterol, and blood pressure in the two treatment cities compared with the one control city.

The Three-Community Study generated the Stanford Five-City Project, a larger-scale community-based intervention trial designed to test whether a comprehensive program of community organization and health education produced favorable changes in cardiovascular disease risk factors, morbidity, and mortality in two treatment versus three control cities in northern California.[5] A 6-year intervention targeted all residents in the two treatment cities and involved a multiple risk factor strategy delivered through multiple educational channels.[6] To assess whether more favorable changes occurred in cardiovascular disease risk factors in treatment vs control cities, independent surveys of cross-sectional samples and repeated surveys of a cohort sample were conducted biennially in the two treatment cities and in two of the three control cities. In the third control city, only morbidity and mortality events were monitored.

Results of the Five-City Project, from baseline to the end of the 6-year intervention, showed that the treatment cities produced significantly greater improvements in cardiovascular disease knowledge, blood pressure, and smoking than the control cities in the cohort sample, and significantly greater improvements in cardiovascular disease knowledge, body mass index, and resting pulse in the cross-sectional samples.[7–11] The Five-City Project also documented strong, positive secular trends in cardiovascular disease knowledge, blood pressure, total cholesterol, and smoking in control cities,[12] making it difficult to demonstrate intervention effects.

The health promotion and disease prevention activities of the Five-City Project were designed to create a self-sustaining structure in the treatment cities at the end of the intervention on the assumption that the cities should both be responsible for and maintain the intervention activities.[13] Although the main study hypothesis did not predict that intervention effects would be maintained or would yield continued improvements, it is important to evaluate the potential long-term effects. Toward this end, a follow-up, population-based, cross-sectional survey

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was conducted in the two treatment and two control cities in 1989/1990, 3 years following the conclusion of the main intervention.

This paper reports the results of this final survey and tests net treatment/control differences in cardiovascular disease risk factor change from the conclusion of the main intervention in 1985/1986 to the final follow-up survey in 1989/1990. For comparative purposes, knowledge and risk factor data are also presented from the baseline survey, conducted in 1979/1980 before the start of the intervention.

Methods

The two treatment cities were Salinas (1980 population 80 500) and Monterey (population 44 900), and the two control cities were Modesto (population 132 400) and San Luis Obispo (population 34 300). Santa Maria was the third control city, in which only morbidity and mortality events were monitored. Persons 12 through 74 years of age who resided in randomly selected households in the four surveyed cities were eligible to participate. Information was collected on site at survey centers located in each city. Each survey comprised approximately 1800 to 2500 participants. The data presented here focus on women and men aged 25 to 74, consistent with the age range included in the main results[7] and main risk factor change papers.[8–11] Data from the cross-sectional surveys are used here since the samples are not subject to the effects of aging, repeated-measures bias, or dropout bias; only 45% of the original baseline cohort sample participated in the final survey, primarily because of high rates of outmigration. Further details of the Five-City Project's study design, field methodology, and results have been published.[7–15]

Specification of Variables

Questionnaire and physical measurement data were collected by health professionals at the survey centers. Except for those for cholesterol (see below), measurement protocols and methods were similar at all time points. A summary index of 17 questions about cardiovascular disease risk factors was used to generate knowledge scores; the highest scores represent the highest levels of knowledge. Cigarette smoking, coded as "yes" if the respondent reported ever smoking on a daily basis and having smoked one or more cigarettes in the last week, was confirmed by expired air carbon monoxide and serum thiocyanate.[16] Height was measured without shoes to the nearest 0.6 cm by metal rule, and weight was measured to the nearest 0.1 kg without shoes on a beam balance scale. Body mass index is defined as weight in kilograms divided by height in meters, squared. Three blood pressure measurements were taken on the right arm with a semiautomatic recorder, which minimizes observer bias[17]; the mean of the second and third readings was used for analysis. Each semiautomatic recorder was calibrated daily, was serviced every 6 months, and produced a tracing on a graduated paper disk, which was read according to a set of standardized instructions. All disks were read by a team of certified coders who were unaware of the city from which the disk originated. A randomly selected 5% of all disks were reread by a second coder. Overall, the original and repeat readings agreed within 2 mm Hg for 97% of the systolic and 95% of the diastolic readings.

Total serum cholesterol, derived from nonfasting venous samples, was measured in milligrams per deciliter. Lipid levels were determined with an Auto-Analyzer II and Lipid Research Clinic methods during the first two surveys (1979/1980 and 1985/1986).[18] Because of changing technology, an Abbott 200 and enzymatic methods were used to determine lipid levels during the final survey (1989/1990). Comparison studies showed that the Abbott 200 generated mean cholesterol values that were 5.5% higher (10.98 mg/dL) than the Auto-Analyzer II. As a result, an adjustment for the cholesterol values from the final survey was developed and used.[19] This change in machines limits the interpretation of cholesterol trends over time but should not bias treatment vs control city comparisons.

As measures of change in overall cardiovascular disease risk factors, two composite risk factor functions based on the Framingham study were used. The first provides an estimate of coronary heart disease risk, morbidity, and mortality events per 1000 persons in 12 years; the second provides an estimate of all-cause mortality risk per 1000 persons in 10 years.[20] The all-cause mortality risk indicates the potential impact of risk factor changes on total mortality since several measured variables are associated with non–coronary heart disease mortality. Variables in the coronary heart disease risk function were age in years, systolic blood pressure, total cholesterol, cigarettes smoked, and relative weight. Variables in the all-cause mortality risk function were age in years, diastolic blood pressure, total cholesterol, cigarettes smoked, and—in men only—pulse.

Cardiovascular Education Intervention

The Five-City Project cardiovascular education program began in 1980 and lasted 6 years. Directed at all residents in the two treatment cities, the intervention used both mass media and direct, interpersonal education programs for both the public and health professionals.[6,21] In addition, community organization strategies were designed to create institutional and societal support for the educational goals. The education program was based on social learning and persuasion theories, social marketing theories,[6,22,23] and community change theories.[24] At the end of the sixth year of intervention, the goal of the Five-City Project was to create a self-sustaining health promotion structure, embedded within the organizations of the communities, that continued to function after the project ended.[13]

Statistical Methods

The independent, cross-sectional surveys were completed in 1979/1980, 1985/1986, and again in 1989/1990 (noted as I-1, I-4, and I-5, respectively). Long-term effects of the Five-City Project were tested by using analysis of covariance (ANCOVA) models to assess differences in knowledge and cardiovascular disease risk factors between the fourth cross-sectional survey (I-4), conducted at the conclusion of the main intervention, and the fifth cross-sectional survey (I-5), conducted at follow-up 3 years later.

To assess possible delayed treatment effects, the analysis evaluates differences in all risk factors targeted by the intervention, regardless of whether those risk factors showed significant changes at the conclusion of the main intervention (I-4). The analysis was conducted separately by gender. The classification variables included in the three-way ANCOVA were condition (treatment vs control), city within condition (city as a fixed effect), survey time period, and the first-order interaction terms of condition × survey and city within condition × survey. The covariates were age and years of education, both measured on a continuum. Significant values reported are those for the condition × survey interaction term, which evaluates the main study question of whether the treatment cities experi-

TABLE 1—Mean Cardiovascular Disease Knowledge and Risk Factors for Three Time Periods, and Net Treatment/Control Differences from End of Intervention to Follow-Up: Women Ages 25 to 74 in the Stanford Five-City Project Cross-Sectional Surveys

	Baseline (I-1, 1979/1980), Mean ± SD	End of Intervention (I-4, 1985/1986), Mean ± SD	Follow-Up (I-5, 1989/1990), Mean ± SD	Difference (I-5 − I-4)	Net Differences (Treatment − Control)	P^a
Sample size	916	961	988			
Knowledge of cardiovascular disease, 17-point score						
Treatment cities	6.6 ± 2.9	8.4 ± 3.0	8.7 ± 3.0	+0.3	−1.0	<.001
Control cities	6.9 ± 3.0	8.0 ± 3.0	9.3 ± 3.0	+1.3		
Mean systolic blood pressure, mm Hg						
Treatment cities	123.7 ± 14.6	118.0 ± 14.5	118.2 ± 14.5	+0.2	−2.2	.115
Control cities	119.7 ± 14.7	116.6 ± 14.6	119.0 ± 14.8	+2.4		
Mean diastolic blood pressure, mm Hg						
Treatment cities	77.0 ± 10.4	73.6 ± 10.4	74.2 ± 10.4	+0.6	−1.9	.061
Control cities	73.0 ± 10.5	71.8 ± 10.5	74.3 ± 10.6	+2.5		
Total cholesterol level, mg/dL[b]						
Treatment cities	202.1 ± 37.4	199.1 ± 37.5	187.4 ± 37.5	−11.7	−2.4	.495
Control cities	199.8 ± 37.6	197.9 ± 38.0	188.6 ± 38.0	−9.3		
Smokers, %						
Treatment cities	31.2 ± 42.0	22.6 ± 39.9	22.4 ± 39.9	−0.2	+3.8	.302
Control cities	30.3 ± 42.3	19.2 ± 40.4	15.2 ± 40.7	−4.0		
Body mass index, kg/m^2						
Treatment cities	24.7 ± 5.3	25.1 ± 5.6	25.9 ± 5.6	+0.8	−0.3	.506
Control cities	24.0 ± 5.3	25.3 ± 5.6	26.4 ± 5.7	+1.1		
Coronary heart disease risk, morbidity, and mortality events per 1000 persons in 12 years						
Treatment cities	49.1 ± 41.6	42.0 ± 39.9	39.4 ± 39.9	−2.6	−8.0	.034
Control cities	43.6 ± 41.8	37.3 ± 40.3	42.7 ± 40.4	+5.4		
All-cause mortality risk, deaths per 1000 persons in 10 years						
Treatment cities	43.1 ± 21.4	37.7 ± 19.7	38.1 ± 19.7	+0.4	−0.5	.795
Control cities	40.9 ± 21.5	36.9 ± 19.9	37.8 ± 20.0	+0.9		

[a]Based on analysis of covariance models, which adjusted for age and education. Two-tailed P values from the condition × survey interaction term, indicating that the treatment cities experienced significantly different changes than control cities from I-4 to I-5.
[b]The large decreases in mean cholesterol levels between I-4 and I-5 in both treatment and control cities may be partially or fully explained by a necessary change in assessment methods; however, treatment vs control comparisons should be unbiased.

enced significantly different changes between I-4 and I-5 than the control cities. The error mean square is used as the denominator effect for the F test (with df ranging from 1525 to 1592 for men and from 1817 to 1939 for women). The cutpoint of $P < .05$ is used for significance; all reported P values are two-tailed.

The adjustment procedure used in this paper builds on the knowledge gained from Five-City Project analyses following the main results paper.[8-12,14,15] In this paper, separate models are run for women and men since there is increasing evidence that women and men respond differently to interventions.[14,15] Furthermore, because of strong secular trends as well as some significant treatment effects, this paper, rather than pooling all time points, uses the data at each time point as a reference for the observations at that time point. Finally, rather than forming strata, this paper adjusts for age and education as continuous variables in order to have greater sensitivity to differences and greater power to detect effects. This adjustment procedure results in some differences in absolute values for risk factors at baseline and at the end of the intervention in this and the main results paper, but it does not alter the overall findings.

Results

Fifty-four percent of those who participated in the two final cross-sectional surveys (I-4 and I-5) were women, 84% were non-Hispanic White, 81% were high school graduates, and 71% were married. Survey response rates were similar in the treatment and control cities (59% vs 63% at I-4; 65% vs 64% at I-5). A telephone survey completed by 75% of nonrespondents showed that respondents at both I-4 and I-5 tended to be slightly older, slightly more educated, and less likely to smoke cigarettes than nonrespondents for the same surveys. These differences between respondents and nonrespondents were similar in both the treatment and control cities.

Tables 1 and 2 present the cardiovascular disease knowledge and risk factor means from the three cross-sectional surveys conducted at I-1 (baseline), I-4 (end of the main intervention), and I-5 (3 years later). The net treatment/control differences from I-4 to I-5 and the P

TABLE 2—Mean Cardiovascular Disease Knowledge and Risk Factors for Three Time Periods, and Net Treatment/Control Differences from End of Intervention to Follow-Up: Men Ages 25 to 74 in the Stanford Five-City Project Cross-Sectional Surveys

	Baseline (I-1, 1979/1980), Mean ± SD	End of Intervention (I-4, 1985/1986), Mean ± SD	Follow-Up (I-5, 1989/1990), Mean ± SD	Difference (I-5 − I-4)	Net Differences (Treatment − Control)	P[a]
Sample size	785	789	813			
Knowledge of cardiovascular disease, 17-point score						
Treatment cities	6.5 ± 3.0	8.0 ± 3.1	8.3 ± 3.1	+0.3	−1.0	.002
Control cities	6.7 ± 3.0	7.5 ± 3.1	8.8 ± 3.1	+1.3		
Mean systolic blood pressure, mm Hg						
Treatment cities	130.8 ± 14.4	126.8 ± 14.0	126.0 ± 14.0	−0.8	−3.6	.011
Control cities	129.3 ± 14.4	125.2 ± 13.9	128.0 ± 14.0	+2.8		
Mean diastolic blood pressure, mm Hg						
Treatment cities	81.6 ± 10.4	78.5 ± 10.6	79.4 ± 10.6	+0.9	−3.0	.006
Control cities	78.3 ± 10.4	74.7 ± 10.5	78.6 ± 10.5	+3.9		
Total cholesterol level, mg/dL[b]						
Treatment cities	208.5 ± 40.7	201.0 ± 40.8	192.0 ± 41.0	−9.0	−0.1	.983
Control cities	200.1 ± 40.7	196.9 ± 40.8	188.0 ± 40.7	−8.9		
Smokers, %						
Treatment cities	35.9 ± 44.0	24.3 ± 42.5	27.3 ± 42.6	+3.0	+5.8	.167
Control cities	34.3 ± 44.0	24.4 ± 42.5	21.6 ± 42.5	−2.8		
Body mass index, kg/m^2						
Treatment cities	25.9 ± 3.8	26.5 ± 4.0	26.9 ± 4.0	+0.4	+0.7	.041
Control cities	25.6 ± 3.8	26.6 ± 4.0	26.3 ± 4.0	−0.3		
Coronary heart disease risk, morbidity, and mortality events per 1000 persons in 12 years						
Treatment cities	105.2 ± 75.1	89.7 ± 70.6	82.6 ± 70.9	−7.1	−5.6	.431
Control cities	99.0 ± 75.0	81.4 ± 70.4	79.9 ± 70.5	−1.5		
All-cause mortality risk, deaths per 1000 persons in 10 years						
Treatment cities	53.7 ± 41.4	44.7 ± 40.3	43.6 ± 40.5	−1.1	−3.1	.447
Control cities	49.4 ± 41.3	41.6 ± 40.2	43.6 ± 40.2	+2.0		

[a]Based on analysis of covariance models, which adjusted for age and education. Two-tailed P values from the condition × survey interaction term, indicating that the treatment cities experienced significantly different changes than control cities from I-4 to I-5.
[b]The large decreases in mean cholesterol levels between I-4 and I-5 in both treatment and control cities may be partially or fully explained by a necessary change in assessment methods; however, treatment vs control comparisons should be unbiased.

values from the ANCOVA models, testing whether the treatment cities experienced significantly different changes than the control cities during the follow-up period, are also presented.

As reported in the main results paper,[7] the treatment cities showed significantly greater net improvements in cardiovascular disease knowledge than control cities from baseline (I-1) to the end of the intervention (I-4). During the follow-up period (I-4 to I-5), cardiovascular disease knowledge continued to improve for both women and men in both treatment and control cities. The improvements were significantly larger in the control cities (significant condition × survey interaction term from the ANCOVA model; $P < .001$ for women and $P = .002$ for men).

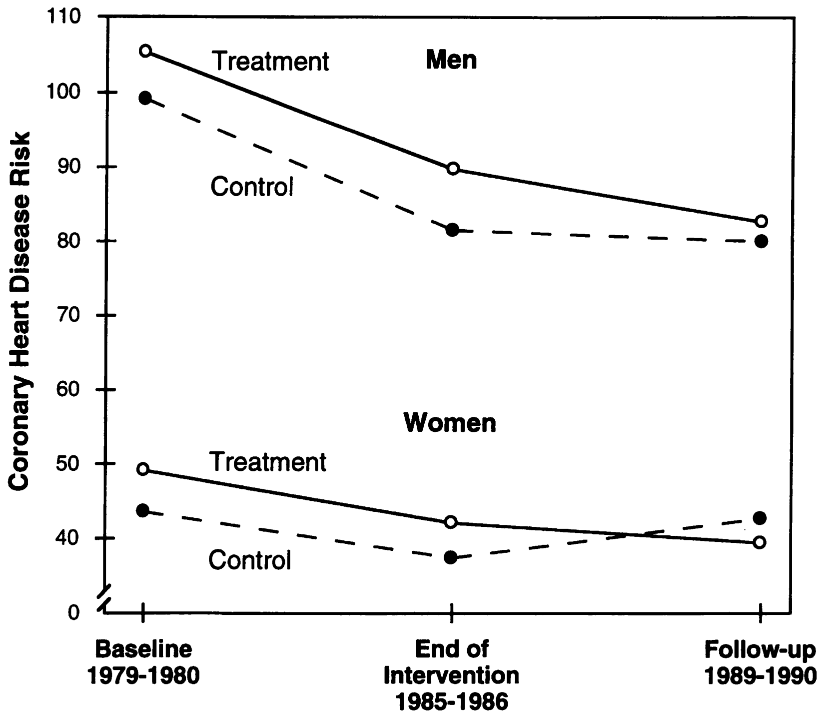
The improvements seen in systolic and diastolic blood pressures in treatment cities from I-1 to I-4 (decrease of 5.0 mm Hg for systolic and 3.2 mm Hg for diastolic) were maintained by both women and men during the follow-up period. In contrast, the improvements in blood pressure in control cities from I-1 to I-4 were not maintained, and follow-up means approximated the baseline levels. The rebound of blood pressures was especially strong for men in the control cities (increase of 2.8 mm Hg for systolic and 3.9 mm Hg for diastolic blood pressure). The treatment/control differences in blood pressure between men in the treatment and control cities were significant ($P = .011$ for systolic and $P = .006$ for diastolic blood pressures) during the follow-up period.

Cholesterol levels declined for women and men in both the treatment and control cities from I-1 to I-4 (no significant net treatment effects), and these declines continued during the follow-up period. The decreases in cholesterol levels were large during the follow-up, but this may be partially or fully explained by changes in cholesterol assessment methods (see Methods section). Net cholesterol differences between the treatment and control cities were not significant for women or men during the follow-up.

Smoking rates declined considerably in both women and men in the treatment as well as in the control cities from I-1 to I-4 (no significant net treatment effects). During the follow-up period, however, smoking rates leveled out or increased slightly in treatment cities, while declines in the control cities continued but were not large enough to yield significant treatment vs control differences.

In contrast to the declines seen for the other cardiovascular disease risk factors from I-1 to I-4, body mass index increased in women and men in both treatment and control cities, although slightly less in treatment cities. For women, the increases in body mass index continued during the follow-up in both treatment and control cities; however, there were no significant net treatment effects. For men, body mass index levels increased slightly in treatment cities and decreased slightly in control cities during the follow-up, resulting in a significant net effect favoring control cities ($P = .041$).

Changes in coronary heart disease risk and all-cause mortality risk were not significantly different in treatment and control cities from I-1 to I-4, although both women and men in treatment and control cities showed positive improvements in these two composite measures of health status, as measured by declining scores during that period (Figure 1). The positive changes in coronary heart disease and all-cause mortality risk were maintained or continued to improve for both women and men in the treatment cities during follow-up, especially for coronary heart disease risk. In contrast, the improvements in coronary heart disease and all-cause mortality risk in control cities from I-1 to I-4, for both women and men, leveled out or rebounded. Net differences, however, were not significant except in coronary heart disease risk for women, for which a slight improvement in treatment cities coupled with a slight worsening in control cities resulted in a significant net treatment effect ($P = .034$).



Note. Coronary heart disease risk = estimated morbidity and mortality events per 1000 persons in 12 years. Net treatment/control differences from the end of the intervention to follow-up were significant for women at $P = .034$ but not for men.

FIGURE 1—Mean coronary heart disease risk differences for men and women ages 25 to 74 at three time periods in the Stanford Five-City Project cross-sectional surveys, 1979 through 1990.

Discussion

The Stanford Five-City Project is one of the most comprehensive cardiovascular disease risk reduction studies undertaken in the United States. This study, the Minnesota Heart Health Program,[25–27] and the Pawtucket Heart Health Program[28,29] are the three main community-based cardiovascular disease intervention trials funded by the National Heart, Lung, and Blood Institute during the 1980s. Although morbidity and mortality have yet to be reported, the main risk factor changes have been published.[7,27,29] Because the Five-City Project was the first of the three studies to be funded, it is the first to conduct a long-term follow-up of the main intervention effects.

In general, the cardiovascular disease risk reduction effects observed during the Five-City intervention were maintained in the treatment cities at follow-up 3 years later. Blood pressure improvements in the treatment and control cities from baseline to the end of the intervention were maintained during follow-up in the treatment cities only. Cholesterol levels continued to decline in both the treatment and control cities. Smoking rates leveled out or increased slightly in the treatment cities but continued to decline in the control cities. Both coronary heart disease and all-cause mortality risk scores were maintained or continued to improve in the treatment cities; in contrast, they leveled out or rebounded in the control cities.

Although the Five-City Project was not funded to evaluate the association between the maintenance of specific programs and the maintenance of risk factor change, the project was designed to create a self-sustaining structure following the educational intervention. There were two approaches to creating this structure, one at the individual level and one at the community level. At the individual level, the focus of the print and other media interventions was on teaching people the skills needed to maintain their risk factor changes. At the community level, the focus was on community organizations maintaining the educational interventions without direct assistance from the project.[13] The most successful community strategy was one of "capacity building," which included a focus on health educators and the application of a training-of-trainers model, as well as cooperative learning methods to provide professional development, technical assistance, and other resources to target groups of community health educators. Much of this work occurred through the Monterey County Health Department, which experienced a growth from 2 to 18 individuals involved in health promotion and a commensurate increase in its annual budget through external grants after the Five-City Project ended. This county health department has maintained collaborative links with other organizations within the community and is now acting as a major site for technology transfer to other counties and organizations throughout California. These institutionalization efforts were not expected to produce additional risk factor reductions; however, it was hoped that the efforts would prevent recidivism that could remove the study's main effects.

Secular Trends

The secular trends observed following the conclusion of the Five-City Project intervention are noteworthy.[12,30] Perhaps the most striking is the increase in cardiovascular disease knowledge in the control cities. This may reflect the acceleration of health promotion through the popular press, the increased health promotion activities by voluntary agencies such as the American Heart Association and American Cancer Society, and the advent of broad-based federal programs such as the National High Blood Pressure Education Program[31] and the National Cholesterol Educational Program.[32] Although the continued maintenance and perhaps even reduction in cholesterol levels in both the treatment and the control cities are difficult to interpret because of changes in assessment methods, communitywide reductions in cholesterol have been observed recently in other longitudinal samples.[33]

Positive secular trends were also noted for smoking. At the end of follow-up, only 15.2% of women and 21.6% of men were smoking in the control cities. These rates are partially accounted for by the large declines in smoking rates in one control city, San Luis Obispo, which has a history of strong antismoking legislation and education. This city, for instance, was one of the first in California to ban smoking in restaurants. Although these smoking changes in the control cities are independent of the Five-City Project's intervention, they reflect important community trends and give hope to the possibility that the entire state may achieve smoking rates below 20% by the year 2000.

Unlike the positive trends in cardiovascular disease knowledge, cholesterol, and smoking, there were negative trends in body mass index. During the follow-up, body mass index continued to increase in women in both the treatment and the control cities and in men in the treatment cities. This reflects a disturbing national trend. The 10-year follow-up of the first National Health and Nutrition Examination, completed in 1984, illustrates this national trend; among those 25 to 34 years old, 8.4% of women and 3.9% of men gained more than 5 kg/m^2.[34] Rose suggests that this weight gain occurs uniformly across the population[35] and not solely among heavier individuals. While the causes for the increases in body mass index at the population level are unknown, it is likely that body mass index changes are due to increases in sedentary lifestyle and calorie consumption, perhaps related to the availability of inexpensive high-caloric foods.[9,36]

Despite the positive trends and sustained effects for some risk factors, the net intervention effects were modest. This is due, in part, to the strong secular trends in both health promotion and risk factors. Still, the public health contributions of the Stanford, Minnesota, and Pawtucket studies are numerous. As noted by investigators from the three studies,[3,28,29,37] the ultimate value of these broad-based, community intervention trials may lie in accelerating positive risk factor change, developing effective models and strategies for communitywide cardiovascular disease health education, and providing direction for future collaborative efforts in public health and public policy.

Implications

In summary, these findings suggest that community-based cardiovascular disease prevention trials can have sustained effects. However, the modest net differences in risk factors suggest the need for new designs and interventions. More powerful designs include the use of smaller, more frequent surveys; interventions of shorter duration; longitudinal follow-up of high-risk cohort samples; and evaluation of qualitative parameters at the individual, organizational, and community levels. More focused intervention strategies are needed that will induce broader support of cardiovascular disease lifestyle change, accelerate positive change in cardiovascular disease risk factors, and sustain interventions over longer periods of time.[37–40] This includes strategies that involve special populations with high levels of cardiovascular disease risk factors.[41] Among those in most need of special strategies are lower socioeconomic groups that continue to show disproportionately high levels of smoking, hypertension, high cholesterol, and obesity. It is important to note that most individuals from low socioeconomic groups who participated in the Five-City Project[41] and in the Minnesota[42] and Pawtucket Heart Health Programs[43] were nonminority Whites; these individuals have high levels of cardiovascular disease risk factors and are part of the largest subgroup of America's poor.[44] Newer community-based intervention models may therefore need a combination of approaches in which interventions are offered on a more sustained level, methods incorporate collaborative efforts in the area of public health and public policy, and strategies are tailored to accelerate change in those at highest risk of cardiovascular disease. □

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