Cardiovascular Disease Risk Reduction for Tenth Graders

A Multiple-Factor School-Based Approach

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All tenth graders in four senior high schools (N = 1447) from two school districts participated in a cardiovascular disease risk-reduction trial. Within each district, one school was assigned at random to receive a special 20-session risk-reduction intervention and one school served as a control. At a two-month follow-up, risk factor knowledge scores were significantly greater for students in the treatment group. Compared with controls, a higher proportion of those in the treatment group who were not exercising regularly at baseline reported regular exercise at follow-up. Almost twice as many baseline experimental smokers in the treatment group reported quitting at follow-up, while only 5.6% of baseline experimental smokers in the treatment group graduated to regular smoking compared with 10.3% in the control group. Students in the treatment group were more likely to report that they would choose "heart-healthy" snack items. Beneficial treatment effects were observed for resting heart rate, body mass index, triceps skin fold thickness, and subscapular skin fold thickness. The results suggest that it is feasible to provide cardiovascular disease risk-reduction training to a large segment of the population through school-based primary prevention approaches.

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EPIDEMIOLOGIC research demonstrates that our modern life-style (ie, cigarette smoking, a diet rich in saturated fat and cholesterol, and sedentary habits) contributes to the development of cardiovascular disease (CVD).[1] The available evidence suggests that behaviors associated with increased CVD risks are acquired early in life and may accelerate the development of CVD.[1-4] Elevated blood pressure, cigarette smoking, and a sedentary life-style in college students predict both fatal and nonfatal coronary heart disease.[5,6] Between 10% and 25% of adolescents are at least moderately overweight.[7] Sizable numbers of children and adolescents show evidence of elevations in blood cholesterol level.[8] Analyses of children's diets suggest that over 40% of the energy intake is from fat; saturated fats account for 15% to 18% of the energy intake and dietary cholesterol intake is well in excess of 300 mg/d.[9,10] Smoking rates among teenagers escalate sharply beginning in junior high school and continue to rise into early adulthood.[11] As Berenson[2] notes, "If today's children grow up like their parents, 20-30% of them will have hypertension as adults. Ninety percent will develop significant atherosclerotic lesions, and over 50% will die from hypertension and atherosclerotic lesions." Thus, there is a clear need for early preventive interventions.

Primary prevention programs may prevent CVD, delay the onset and reduce the severity of the disease, and reduce the associated costs of medical care. However, research is needed to develop procedures to help young people reduce risk behaviors and acquire and practice positive health behaviors.

To date, the most promising prevention research has focused on the development of school-based cigarette smoking prevention programs for children in elementary and middle grades.[12] Although single-factor interventions in the field of smoking prevention have produced encouraging results, comprehensive, multiple risk factor reduction interventions are largely lacking. The few comprehensive programs that have been conducted under controlled research conditions and with adequate evaluation components were designed

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for younger adolescents and/or children.[13,14]

However, there is no evidence that interventions with younger children are more successful in achieving prevention goals than programs designed for older adolescents. Indeed, older adolescents may benefit more from prevention education because they possess the cognitive and behavioral competencies necessary to understand and act on health and behavior-change instruction. In addition, there is no guarantee that programs designed to produce health behavior change at one point in life will protect against the return of or shift to other less healthful life-styles in later years. Training at one period of development may well require upgrading to be effective in new and perhaps more complex psychosocial environments.[12]

To study the impact of CVD prevention education on older adolescents, we conducted an investigation designed to create, implement, and test a school-based multiple risk factor reduction curriculum for tenth-grade high school students. Our primary aim was to examine the effectiveness of the curriculum in (*a*) increasing students' knowledge of CVD risk factor concepts; (*b*) decreasing CVD risk behaviors, such as cigarette smoking and consumption of foods high in saturated fat, cholesterol, and salt; (*c*) increasing levels of aerobic physical activity and consumption of complex carbohydrates; and (*d*) lowering heart rate, blood pressure, body mass index, and skin fold thickness.

SUBJECTS AND METHODS

All tenth graders (N = 1447) enrolled in four northern California high schools were asked to complete a survey designed to detect the presence of physical characteristics and behaviors related to risk for coronary heart disease. Seventy percent of the students were 15, 14% were 14, and 14% were 16 years old. Self-reported ethnic distribution was as follows: white, 69.0%; black, 2.0%; Asian, 13.1%; Hispanic, 6.4%; American Indian, 0.3%; Pacific Islander, 0.4%; and other, 8.9%. (Percentages do not add up to 100% because of rounding.) Fifty percent of the students' fathers had completed four or more years of college.

Research Design

Four senior high schools from two school districts participated in the study. Within each district, one school was assigned at random to receive the special intervention and one school served as a control. Within each district, the schools were matched for size and distribution of ethnic groups before randomization. All tenth graders in each treatment school were scheduled to attend the special intervention sessions three days each week for seven weeks. The intervention was delivered as part of the regular physical education curriculum.

Special Intervention

The special intervention consisted of 20 classroom sessions, each lasting 50 minutes. The 20 sessions were divided among five program modules: Physical Activity, Nutrition, Cigarette Smoking, Stress, and Personal Problem Solving. Bandura's[15] social-cognitive theory served as a guide in the development of the intervention program. Each module provided students with (*a*) information on the effects of different health practices designed to increase the attractiveness of healthful life-styles, (*b*) cognitive and behavioral skills enabling them to change personal behavior, (*c*) additional specific skills for resisting social influences to adopt or readopt unhealthful habits, and (*d*) specific practice in using skills to improve performance. As part of the sessions devoted to problem-solving training, each student was asked to carry out a self-change project.

Classroom instruction was provided by eight special full-time teachers. One additional staff person served as coordinator and backup teacher in each of the treatment schools. Coordinators attended classroom sessions and were responsible for monitoring the implementation of the intervention. The teaching staff was composed of young women and men in their early 20s on staff with the Stanford Center for Research in Disease Prevention. All teachers had previous training in health studies and/or previous experience in health care/health research settings.

Measures

Assessments were performed by trained staff over two days in each of the four schools. Boys and girls were separated into two large classrooms and completed self-administered questionnaires and physical measures in groups of 40 to 50 during each class period. Regular school personnel did not participate in any part of the data collection. Measurements were collected at baseline and at a follow-up assessment conducted two months after the completion of the seven-week special intervention (ie, four months after baseline data collection).

Demographic Variables.—*Parents' Education.*—This was measured as the higher of the mother's or father's education level. The preponderance of whites in our population precluded meaningful ethnic comparisons.

College Plans.—Students indicated their intention to enroll in college on a five-point Likert-type scale.

Knowledge of Cardiovascular Disease Risk Concepts.—Multiple-choice knowledge tests based on information presented in the curriculum were developed to assess knowledge in the following areas: physical activity, nutrition/diet, and cigarette smoking. (Maximum possible scores: physical activity, 30; nutrition, 30; and smoking, 8.)

Self-reported Behavior.—*Physical Activity.*—A checklist was developed featuring 19 different forms of physical activity. Students were asked to indicate (*a*) which of the activities they engaged in for at least 20 minutes nonstop and (*b*) the frequency with which they performed these activities. Five of these activities were designated as activities that would provide an aerobic training effect if performed for at least 20 minutes nonstop three times per week. Students who reported performing one or more of these activities at the rate of 20 minutes nonstop three times per week or at least three activities at the rate of 20 minutes nonstop one or two times per week were classified as aerobic exercisers.

Nutrition/Diet.—A checklist presenting 32 food pairs was developed. One food in each pair was superior with respect to diet-CVD relationships. Students were asked to indicate which food in each of the 32 pairs they would usually choose to eat if given the choice.

Cigarette Smoking.—Students reported frequency of use of tobacco cigarettes. Six frequency levels were provided: never, at least once in my life, at least once per month, at least once per week, almost every day, and every day. Students also reported frequency of alcohol and marijuana use. The use prevalences for alcohol and marijuana in our sample have been presented in an earlier report.[16] While the intervention did not target these substances for behavior change, we included them to assess prevalence and to establish treatment and control group equivalence. Response rates to these potentially sensitive questions were between 90% and 92% for each of the individual substances.

As a check on reported substance use, expired-air carbon monoxide was measured with a carbon monoxide monitor. Measurement of carbon monoxide has been shown to increase the accuracy of self-reporting of drug use.[17] After holding a deep breath for 10 s, students expired approximately half of their air into the room, emptying the remainder of

Mean Values (±SD) for Measures of CVD* Risk at Baseline and at Two-Month Follow-up

Measures of CVD Risk	Boys: Treatment Group Baseline	Boys: Treatment Group Follow-up	Boys: Control Group Baseline	Boys: Control Group Follow-up	Girls: Treatment Group Baseline	Girls: Treatment Group Follow-up	Girls: Control Group Baseline	Girls: Control Group Follow-up	Treatment Group vs Control Group
Exercise score	12.8 (5.3)	17.4 (6.8)	13.0 (5.0)	11.4 (5.9)	13.6 (4.4)	19.6 (5.1)	13.9 (5.2)	13.9 (5.5)	.0001
Nutrition score	6.4 (4.6)	11.3 (6.7)	6.5 (4.9)	6.0 (4.6)	7.4 (4.3)	14.5 (6.2)	8.2 (4.8)	8.2 (4.9)	.0001
Smoking score	3.1 (1.3)	4.6 (2.1)	3.2 (1.5)	3.3 (1.5)	3.1 (1.3)	5.0 (1.7)	3.2 (1.4)	3.6 (1.7)	.0001
Food choice	10.7 (5.4)	12.8 (6.5)	11.4 (5.9)	10.9 (5.1)	13.2 (5.5)	15.6 (6.1)	13.6 (5.4)	12.7 (5.1)	.0001
Body mass index	21.6 (3.5)	21.7 (3.6)	20.9 (2.7)	21.3 (2.7)	22.1 (3.9)	21.9 (3.8)	21.4 (3.0)	21.4 (3.1)	.05
Heart rate, beats/min	75.2 (12.2)	72.9 (11.3)	75.9 (11.4)	76.3 (11.7)	82.7 (12.9)	78.6 (11.4)	78.2 (11.3)	78.6 (10.6)	.0001
Triceps skin fold thickness, mm	11.3 (5.1)	11.2 (5.3)	11.2 (4.9)	10.6 (4.8)	20.4 (6.5)	20.0 (6.3)	18.8 (5.2)	20.3 (5.6)	.004
Subscapular skin fold thickness, mm	9.7 (4.3)	9.6 (4.6)	9.3 (4.1)	9.1 (3.5)	13.9 (6.0)	13.4 (5.6)	12.1 (4.7)	13.0 (4.7)	.01
Systolic blood pressure, mm Hg	119.0 (12.1)	123.0 (12.0)	122.2 (12.6)	124.1 (12.8)	116.0 (11.0)	114.2 (11.3)	113.4 (9.6)	113.7 (9.5)	.84
Diastolic blood pressure, mm Hg	58.5 (9.1)	59.5 (8.9)	59.5 (8.5)	59.7 (8.3)	60.6 (7.5)	60.1 (9.2)	59.2 (7.7)	57.2 (8.3)	.009

*CVD indicates cardiovascular disease.

the breath into a polyvinyl breath-sample bag. The breath-sample bag was attached to the carbon monoxide monitor through a charcoal filter. Measurements were recorded to the nearest part per million of carbon monoxide.

Anthropometric/Physiological Variables.—*Height and Weight.*—These were measured on a standard balance beam scale. Students wore lightweight gym clothing with overgarments and shoes removed.

Body Mass Index.—This was computed from the formula weight/height^2, which is generally considered to be the preferred index of relative body weight as an estimate of adiposity.[18,19]

Subcutaneous Skin Fold Thicknesses.—These were measured with skin fold calipers according to established guidelines.[20] Two sites—the triceps and subscapular muscles—were measured on the right side of the body.

Resting Heart Rate and Blood Pressure.—These were measured with an automated blood pressure device. Before measurements were started, students sat quietly for three minutes. Measurements were made on the right arm at the approximate level of the heart. Heart rate and mean arterial, systolic, and diastolic blood pressures were each measured three times, at one-minute intervals. The means of the second and third measurements were used in the analyses.

Statistical Analysis

Of the 1447 students responding to the baseline survey, 1130 were available at follow-up (for treatment group, n = 622; for control group, n = 508). Analyses of baseline variables and program effects were restricted to students providing data at both baseline and follow-up assessments. To examine the equivalence of the treatment and control groups at baseline, a one-way analysis of variance was conducted with continuous variables and χ^2 tests were conducted with categorical variables.

To examine program effects, a two-way (treatment times sex) analysis of covariance was conducted with continuous variables. Baseline values were used as covariates. χ^2 tests were conducted with categorical variables. Analyses were conducted using the individual as the unit of analysis.

RESULTS

Analyses of Baseline Variables

At baseline, the treatment and control groups were compared on a variety of treatment and treatment-related variables. Ethnic distributions did not differ significantly ($P = .17$) and there was no significant difference in the proportion of students planning to enroll in college ($P = .16$). There was no significant difference at baseline with respect to the proportion of boys and girls participating in each group (the treatment group consisted of 55.5% boys and 44.5% girls; the control group consisted of 52.5% boys and 47.5% girls [$P = .26$]). Parents of students in the control group had received more years of education than parents of students in the treatment group ($\chi^2 = 15.8$; $P < .008$).

With respect to knowledge, mean scores on the combined knowledge test were very similar at baseline. Whereas boys in the treatment and control groups were similar on physiological and anthropometric measures (with the exception of body mass index), girls were somewhat different. In general, girls in the control group had less body fat, lower heart rates, and lower blood pressures at baseline. Expired-air carbon monoxide levels correlated ($r = .44$) with reported daily or almost daily cigarette smoking.

With respect to self-reported behavior, boys and girls in the treatment and control groups (again, comparing within sex) did not differ in reported cigarette or alcohol consumption or on the food choice score. Boys were similar with respect to the proportion reporting regular aerobic physical activity (treatment group, 30.9%; control group, 32.9% [$P = .60$]). A higher proportion of girls in the control group reported regular aerobic physical activity (treatment group, 35.8%; control group, 53.9% [$P = .0001$]). Regular exercisers had significantly lower mean resting heart rates than nonregular exercisers (regular exercisers, 76.1 beats per minute; nonregular exercisers, 78.4 beats per minute [$t = 2.9$; $P < .003$]).

Dropout Analysis: Treatment Dropouts vs Control Dropouts

We examined the baseline values of students in both groups who failed to attend the follow-up in order to evaluate the potential threat to internal validity associated with differential attrition. No differences were found between dropouts on knowledge or self-report variables. Differences between groups were observed for mean triceps skin fold thickness (treatment group, 14.7 mm; control group, 17.2 mm [$P = .02$]).

Analysis of Program Effects

Changes in Knowledge Scores: Treatment vs Control.—The Table shows mean scores at baseline and follow-up. Knowledge gains were significantly greater for students in the treatment group on each of the risk

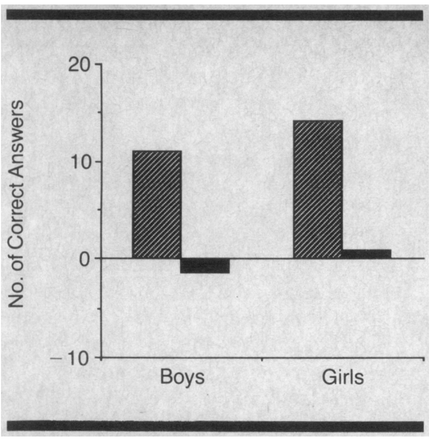

Fig 1.—Mean increase in number of correct answers given on knowledge test. Slashed bars indicate treatment group; black bars, control group ($P = .0001$).

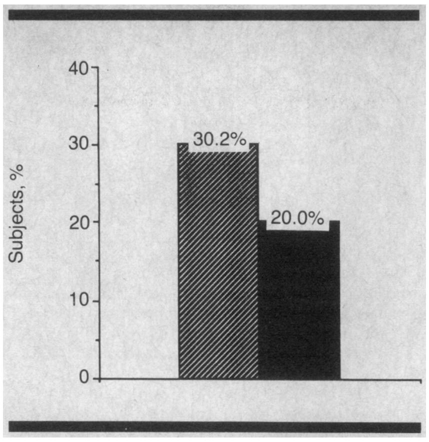

Fig 2.—Percent of subjects who became regular exercisers at follow-up. Slashed bar indicates treatment group; black bar, control group ($P = .0003$).

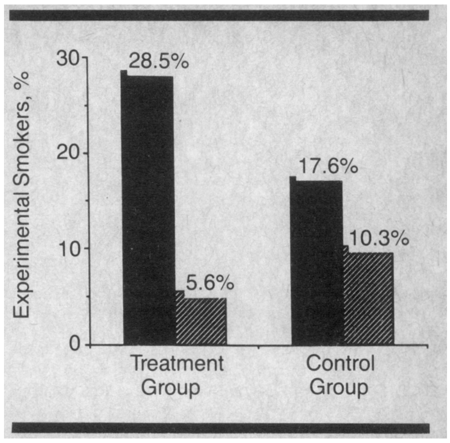

Fig 3.—Percent of baseline experimental smokers who changed status—baseline to follow-up. Black bars indicate subjects who stopped smoking; slashed bars, subjects whose smoking increased ($P = .009$).

factor domains tested: nutrition/diet (main effect, $F[1,946] = 369.2$ [$P < .0001$]; sex effect, $F[1,946] = 27.8$ [$P < .0001$]), physical activity (main effect, $F[1,1078] = 371.8$ [$P < .0001$]; sex effect, $F[1,1078] = 33.8$ [$P < .0001$]), and cigarette smoking (main effect, $F[1,965] = 177.2$ [$P < .0001$]; sex effect, $F[1,965] = 10.9$ [$P = .001$]). Results are presented graphically as an increase in combined knowledge score in Fig 1. In the treatment group, boys increased their combined score an average of 11.1 points and girls an average of 14.2 points. By contrast, in the control group, boys' scores decreased an average of 1.4 points and girls' scores increased an average of only 0.8 points.

Changes in Self-reported Behavior: Treatment vs Control.—*Exercise.*—Students who, at baseline, were classified as nonregular exercisers were a principal target of the intervention. A higher proportion of those in the treatment group who were not exercising regularly at baseline became regular exercisers at follow-up (treatment group, 30.2%; control group, 20.0% [$\chi^2(1) = 8.6$; $P < .0003$]) (Fig 2).

Nutrition/Diet.—At follow-up, students in the treatment group were more likely to report that they would choose "heart-healthy" snack items than their control group counterparts. The mean increase in selection of heart-healthy food alternatives for boys and girls in the treatment group was, respectively, 2.1 and 2.3. Reported selection for boys and girls in the control group actually decreased (main effect, $F[1,850] = 56.6$ [$P < .0001$]; sex effect, $F[1,850] = 10.4$ [$P = .001$]).

Cigarette Smoking.—We classified students into three groups according to their baseline smoking status: (*a*) those who had never smoked, (*b*) experimental smokers (those smoking on a monthly basis or less often), and (*c*) regular smokers (those smoking weekly or more often). There were no significant differences between groups in (*a*) the proportion of those who had never smoked "graduating" to smoking at follow-up (treatment group, 9.7%; control group, 14.5% [$P = .25$]) or (*b*) the proportion of regular smokers reporting cessation at follow-up (treatment group, 3.5%; control group, 9.3% [$P = .39$]). However, in the treatment group, more of those students who, at baseline, were experimental smokers reported quitting at follow-up (treatment group, 28.5%; control group, 17.6%) (Fig 3). In addition, only 5.6% of baseline experimental smokers in the treatment group graduated to regular smoking, compared with 10.3% in the control group. The overall χ^2 for the analysis examining change in status of baseline experimental smokers was significant ($\chi^2[2] = 9.4$; $P = .009$).

Changes in Physiological/Anthropometric Variables: Treatment vs Control.—The strongest and most consistent effects were achieved with resting heart rate. Both boys and girls in the treatment group reduced their resting heart rate compared with their control group counterparts (Fig 4). The resting heart rate of boys and girls in the treatment group decreased an average of 2.3 and 4.1 beats per minute, respectively. The resting heart rate of students in the control group increased an average of 0.4 beats per minute for both boys and girls (main effect, $F[1,1065] = 19.9$ [$P < .0001$]; sex effect, $F[1,1065] = 5.8$ [$P < .02$]). Beneficial treatment effects also were observed for body mass index (main effect, $F[1,1060] = 3.7$ [$P = .05$]; sex effect, $F[1,1060] = 21.9$ [$P < .0001$]) (Fig 5), triceps skin fold thickness (main effect, $F[1,1059] = 8.4$ [$P = .004$]; sex effect, $F[1,1059] = 80.9$ [$P < .0001$]; and sex times treatment effect, $F[1,1059] = 36.3$ [$P < .0001$]), and subscapular skin fold thickness (main effect, $F[1,1058] = 6.4$ [$P = .01$]; sex effect, $F[1,1058] = 37.5$ [$P < .0001$]; and sex times treatment effect, $F[1,1058] = 15.9$ [$P = .0001$]).

No treatment effect was observed for systolic blood pressure ($P = .84$). Changes in diastolic blood pressure actually favored controls. The diastolic blood pressure of boys in the treatment and control groups increased an average of 1.0 mm Hg and 0.2 mm Hg, respectively. The diastolic blood pressure of girls in the treatment group decreased an average of 0.5 mm Hg, while among girls in the control group it decreased an average of 2.0 mm Hg (treatment effect, $F[1,1065] = 6.7$ [$P = .009$]).

COMMENT

This study is one of the first controlled trials of a school-based CVD risk factor reduction program for high school–age adolescents. The results to date are very promising. Knowledge gains were pronounced. Students in the treatment group increased their knowledge of CVD risk factor concepts an average of 50%. The knowledge gains are evidence that the curriculum was well designed, well delivered, and well received.

Students' self-reports suggest that significant changes were made in several important CVD risk–related behaviors. With respect to physical activity, a significantly greater proportion of students in the treatment group who were initially classified as nonregular exer-

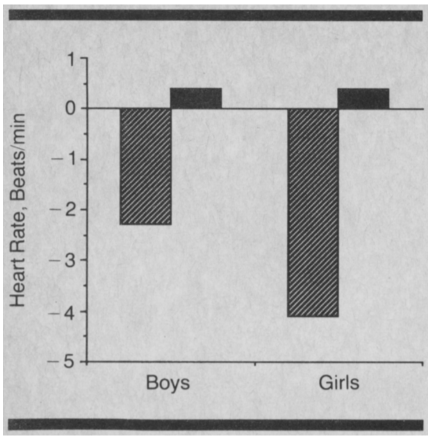

Fig 4.—Mean change in resting heart rate. Slashed bars indicate treatment group; black bars, control group ($P = .0001$).

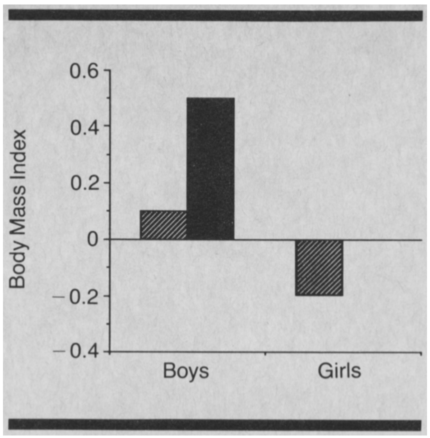

Fig 5.—Mean change in body mass index. Slashed bars indicate treatment group; black bar, control group ($P = .05$).

cisers reported regular physical activity at follow-up. The finding that regular exercisers had significantly lower resting heart rates than nonregular exercisers lends credibility to the validity of the self-report measure.

The impact of the program on cigarette smoking was also encouraging. While smokers with daily habits were largely unaffected, the quit rate among experimental smokers in the treatment group was significantly greater than the quit rate for experimental smokers in the control group. Smoking prevention programs have targeted younger age groups because attempts to modify smoking behavior during the high school years typically prove unsuccessful. Our results suggest that a comprehensive program may be one approach to the problem of reducing smoking among older adolescents who have not adopted smoking on a daily basis.

Self-reports of smoking and use of other substances may be unreliable.[21] However, strong correlations between self-reports and biochemical and observational measures have been consistently reported.[22,23] Extensive efforts were undertaken to ensure confidentiality to all participating students. This is reflected in the high response rates to the substance use items. We also included a validation measure in the form of expired-air carbon monoxide, a useful measure of recent cigarette use. Although measurement of expired-air carbon monoxide is not sensitive enough to detect the occasional use of cigarettes by experimental smokers, the correlation between carbon monoxide and frequent smoking increases our confidence in the validity of the self-reported smoking in this study.

The program also had an impact on important physiological variables. Effects were particularly strong for resting heart rate. Both boys and girls in the treatment group significantly reduced their resting heart rate compared with controls. This finding is encouraging, since resting heart rate provides a reasonably good index of physical fitness.

Reductions in body fatness were also achieved, although the impact of the program was consistent only for girls. Reductions in all measures of body fatness were observed among girls in the treatment group, while girls in the control group showed increases on skin fold thickness measures. Boys in both groups showed reductions on measures of skin fold thickness, but increases in body mass index were greater for boys in the control group.

The intervention had no apparent impact on blood pressure. Systolic blood pressure dropped substantially in girls in the treatment group, but diastolic blood pressure dropped substantially in girls in the control group. Between-visit variance of blood pressure is very large in adolescents and probably accounts for these findings.[24]

The relationship between self-reported behavior change and the various related physical measures is worth emphasizing. Resting heart rate is an indirect measure of aerobic capacity and thus related to physical activity. Body mass index and skin fold thicknesses, as measures of adiposity, may be related to both dietary intake and physical activity. Finding differential group changes in these secondary variables that correspond to self-reported changes in behavior greatly strengthens our confidence in the validity of our self-reported measures, as well as the demonstrated treatment effects.

Although the results of this trial are promising, several limitations should be mentioned. Follow-up assessments were conducted two months after the completion of the educational program. It is unclear whether the gains observed in the treatment group will be maintained over a longer period of time. However, it would seem reasonable to integrate risk-reduction programs into the general school curricula at more than one grade level to achieve maximum benefit. We plan to collect longer-term follow-up data to assess the durability of treatment effects.

Treatment and control group equivalence on potentially confounding variables is less certain when only a few schools are included in the research design.[25] Ideally, we would wish to randomize schools to treatment and control conditions from a large pool of participating schools. However, practical concerns (ie, funding limitations and the logistic difficulties of managing multisite studies) have traditionally limited studies to a small number of schools. This somewhat undermines the primary intent of randomization, for equivalence between comparison schools resulting from randomization is potentially limited when a small number of schools are involved.

Several approaches were used to control for potential confounding variables. These methods served to increase confidence that the demonstrated effects were due to the interventions by addressing threats to internal validity. First of all, extreme care was taken to choose schools that were similar in terms of a variety of demographic variables. Then, schools were randomly assigned to treatment and control groups from within school districts. The decision to randomize from within districts was based on evidence indicating that intradistrict homogeneity was greater than interdistrict homogeneity.

Graham et al[26] have described a number of variables that, if not equated across experimental conditions, may make interpretation of school-based prevention research difficult. Important correlates include ethnic distribution in the school population, total enrollment, percent of students bused in, percent of students not in school a full year, and extent of cooperation with researchers. In our study, ethnic group proportions and total enrollments were well matched for schools within each district, no students were bused into the districts, there was no substantial differential attrition between treatment and control groups, and cooperation between the schools and our research team was excellent.

In addition to the school characteristics discussed above, schools should ideally be comparable on pretest variables that may be related to the chosen outcome variables. In our study, the treatment and control groups were compared, and found to be comparable, on a variety of baseline treatment and treatment-related variables such as use prevalences of cigarettes, marijuana, and alcohol and baseline CVD knowledge scores. These data suggest good baseline comparability of the experimental groups, despite randomization of only four schools in all. Further, the finding that dropouts from the treatment and control groups were similar on most baseline measures adds to our confidence that the internal validity of the research was maintained. While dropouts did differ on triceps skin fold thickness, the difference favored controls, making detection of a treatment effect more difficult.

The generalizability of these findings depends, in part, on the representativeness of the study population. Our study schools were chosen to reflect a fairly broad range with respect to ethnicity and socioeconomic status. While the school districts contained few black students (2.0%), other minorities accounted for almost 30% of the sample. Other data also suggest the comparability of our sample to the general populace. For example, we have reported data on substance use in this population.[16] About 47% of the boys and 45% of the girls reported monthly or more frequent current use of alcohol. About 22% of the boys and 30% of the girls reported smoking at least monthly. These data are quite similar to results reported from larger-scale regional or national samples.[27,28]

In summary, the results of this trial strongly suggest that it is possible to increase adolescents' understanding of CVD risk factor concepts, to modify a number of relevant CVD risk behaviors, and to effect changes in certain physiological parameters. Taken together, the findings indicate that potentially effective CVD risk-reduction training may be provided to a large segment of the population through school-based primary prevention education.

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