Impact of the Coronary Health Improvement Project (CHIP) on Several Employee Populations

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*The greatest potential to improve public health lies in the ability of individuals to adopt healthful behaviors. The purpose of this study was to determine whether participation in a facilitator-based video version of the Coronary Health Improvement Project (CHIP) would improve health behaviors and significantly reduce employee health risks. Employees (*n = *442) from six worksites in metropolitan Rockford, Illinois, were used in a pretest/posttest design. Employees self-selected to participate in a facilitator-based, CHIP video program. Participants received instruction twice a week, for 8 weeks, via 15 videos shown at each participating worksite. Demographic and biometric data (body weight, body mass index, blood lipids, blood pressure, and fasting blood glucose) were evaluated at baseline and at 8 weeks. All sites individually and collectively demonstrated significant and meaningful reductions in body weight, body mass index, total cholesterol, low-density lipoprotein cholesterol, triglycerides, and fasting blood glucose. Men demonstrated greater improvement than women, and individuals with higher baseline health risks experienced the greatest reductions in risk. The CHIP video program appears to be an effective method of lowering employee health risks. Future research is needed to determine how long these reductions may persist.* (J Occup Environ Med. *2002;44:831–839*)

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Atherosclerosis-related diseases such as coronary artery and cerebrovascular disease are two of the three leading causes of death in the United States.[1] The major modifiable risk factors for these circulatory diseases are hypercholesterolemia, hypertension, smoking, elevated triglyceride and glucose levels, obesity, and sedentary living. The majority of these risk factors are lifestyle related. Among these risk factors, hypercholesterolemia has the greatest independent causal effect on cardiovascular disease.[2–4] The National Cholesterol Education Program (NCEP) has set serum cholesterol standards, advising adults to get their total cholesterol and low density lipoprotein (LDL) cholesterol levels to <200 mg/dL and <100 mg/dL, respectively.[5] The NCEP has also stressed the importance of making therapeutic lifestyle changes—the primary treatment in reducing cholesterol levels.[5]

Therapeutic lifestyle change has been the focus of a variety of lifestyle-intervention programs. Many of these have been conducted in a residential or live-in environment.[2,4,6] Evaluations of these programs have been conducted, with their postintervention data indicating reductions in total cholesterol, LDL cholesterol, blood pressure, and body weight and some reductions in triglyceride and glucose levels.[2–4,6–9] These studies all had varying degrees of success in reducing risk factors and showed that lifestyle-intervention programs do produce desirable effects on health risk factors.

Although successful, many of these programs are generally expensive, require participants to relocate for a time, and often have difficulty with long-term participant adherence to the recommended lifestyle. More important, some of these interventions are not feasible with large populations and do little to alter community and environmental supports and barriers to healthy living.

The Coronary Health Improvement Project (CHIP) was created with the goal of reducing atherosclerosis-related diseases and improving the overall health of the public by providing a lifestyle-change program to both the community and the workplace.[3] The CHIP program, originally developed as a 30-day, 40-hour live-lecture educational course, highlights the importance of making better lifestyle choices for preventing and reducing coronary heart disease. The program also teaches participants how to implement these choices through a change in dietary, physical activity, and smoking habits.

While conducting the program in a community setting, Diehl[3] was able to use a one-group pretest/posttest design to document significant reductions in several coronary heart disease risk factors. Pre- and postintervention (4-week) data from 288 participants were gathered and analyzed. Results indicated significant ($P < 0.001$) decreases in blood pressure, body mass index (BMI), and body weight. Participants also experienced significant ($P < 0.05$) reductions in total serum cholesterol and LDL cholesterol levels. Men and women with the highest baseline LDL cholesterol levels (>189 mg/dL) exhibited the largest decreases (34% and 19%, respectively). In additional, 83% of the male participants who had elevated triglyceride levels at baseline were able to lower their triglyceride levels. These results suggest that the live CHIP program was able to lower many coronary risk factors.

In attempts to make the program more accessible to a wider audience, a video version was developed. These video presentations are used in conjunction with trained and certified group facilitators who work with the video program participants to help them understand and process the information. The video version allows individuals in a variety of settings to participate in the program; as opposed to the live sessions, which are limited to the availability of a qualified speaker/lecturer. The purpose of this study was to determine whether participation in a facilitator-based video version of the CHIP program would significantly reduce employee health risks.

Methods

Subject Recruitment

In early 2000, CHIP personnel initiated discussions with the health promotion directors of many corporations located in the metropolitan Rockford, Illinois, area. During the previous 18 months, >1000 Rockford residents had participated in three 4-week CHIP live-lecture courses. Many of these CHIP graduates were instrumental in introducing the CHIP program to their respective employers. In addition, several company managers and administrators were among these graduates. Because of this prior exposure, many companies were somewhat familiar with the program or had employees whose health had been influenced by the program.

By October 2000, six companies had agreed to participate in the study; these included Ingersoll, Pfizer/Adams, Rockford Products, the Swedish-American Center for Complementary Medicine (SACCM), the Woodward Corporation, and an international automobile manufacturer. The employees within these companies received information about the CHIP video program and were encouraged to participate by contacting their on-site health promotion administrators. Depending on classroom size and availability, each company was able to recruit as many participants as it deemed feasible. The cost of providing the video program was shared between the employer and the employee. At most sites, each party initially paid 50% of the cost. On graduation, most companies reimbursed participating employees a portion of their cost. In addition, some companies offered their participants full reimbursement on the program cost at the end of 1 year, provided they continued to adhere to the program. None of the video classes were conducted on company time.

A total of 453 employees chose to participate. They were evenly divided between blue- and white-collar job descriptions, and almost all participants had at least a high school education. Their average age was 52.1 ± 9.5 years (mean ± standard deviation), and 62% ($n = 275$) were female. Table 1 shows the employee demographics and health risks at baseline for each of the six intervention sites. Of employees who participated in the study, ten (2.3%) were smokers. Before participation, each employee provided informed consent.

Design

A pretest/posttest design with multiple cohorts was used. Although the program start dates were scattered among cohorts and sites, programs were conducted in a 10-month period beginning October 1, 2000, and ending on July 31, 2001. At baseline, each participant completed the *Heart Screen,* a self-reported questionnaire that gathered information on demographics, lifestyle habits, medication use, and a short medical history. On this same form, a registered nurse would enter all biometric data, including height, weight, blood pressure, blood lipids, and fasting blood glucose. All completed *Heart Screen* forms were reviewed by a nurse; those participants identified as having medical issues were referred to a physician or to their medical care provider. The attending nurse made written, individualized recommendations on each

TABLE 1
Employee Characteristics by Site at Baseline

Site	n	Age (yr)	Female (%)	Weight (lbs)	BMI (kg/m²)	Systolic BP (mm Hg)	Diastolic BP (mm Hg)	Total Chol (mg/dL)	HDL (mg/dL)	Chol/HDL	LDL (mg/dL)	TG (mg/dL)	Glucose (mg/dL)
1	104	51.7	74	189.8	31.5	137	83	205.6	53.1	4.16	122.7	154.5	94.5
2	18	44.1*	50†	184.2	29.2	119	76	194.8	48.4	4.30	120.1	131.8	92.4
3	70	53.0	71	211.9	33.5	133	77	194.8	49.2	4.12	117.0	143.1	108.7
4	43	52.7	56	197.0	30.4	128	81	217.6	53.8	4.34	135.0	155.2	101.5
5	90	51.4	58	210.2	32.9	141	82	200.6	50.8	4.15	116.9	180.6	110.3
6	117	53.4	54	201.3	31.9	135	83	212.0	50.0	4.52	129.3	168.5	102.8
All	442	52.1	62.2	201.0	32.0	135.0	81.4	205.3	51.1	4.30	123.5	160.8	102.8

BP = blood pressure; Chol = cholesterol; TG = triglycerides.
* The average age of participants in site 2 was significantly lower ($P \leq 0.05$) than at the other five sites.
† Site 2 had significantly fewer women than the other five sites (chi-square = 14.8, $P \leq 0.01$).

form, and a copy was returned to each participant. After completion of the baseline *Heart Screen*, participants began 8 weeks of educational lectures delivered via video and augmented by CHIP facilitators. At the end of the 8-week intervention, the second *Heart Screen*—identical to the one used at baseline—was administered.

Intervention

The intervention used for this study was the facilitator-based video version of the CHIP.[3] Participants met for 8 weeks—twice each week for 2 hours—at which they received instruction via 15 CHIP video tapes. The CHIP curriculum via video included the following topics: modern medicine and medical myths, atherosclerosis, coronary risk factors, obesity, dietary fiber, dietary fat, diabetes, hypertension, cholesterol, exercise, osteoporosis, cancer, lifestyle and health, the optimal diet, behavioral change, and self-worth.

In conjunction with the CHIP videos, participants received a textbook and workbooks that closely followed the video topics and contained assignments with learning objectives for every topic presented. These assignments were designed to help in the understanding and integration of the concepts and information presented in the videos. Participants also had access to scheduled shopping tours and cooking demonstrations given by a dietitian. Additionally, dietitians and medical professionals were invited to speak to each cohort, providing nutritional and medical advice.

A trained facilitator presided at each of the intervention sites and was responsible to answer questions regarding the video presentations, workbook assignments, and the program. The training and certification of the facilitators involved attending two half-day sessions (5 hours each day) to acquire an overview of the program and the screening procedures. In additional, facilitators were required to spend 2 full days to learn how to administer and interpret the *Heart Screen* results, follow standardized CHIP protocols, and understand learning procedures as outlined in the Facilitator Manual. Most program facilitators were nurses, dietitians, or corporate health promotion professionals. One worksite had two physicians who shared in the facilitation. Because this site was being facilitated by physicians, it is possible that greater changes might be seen among the participants at this site. Therefore, between-site analyses were conducted.

Along with the educational video program, participants were encouraged to follow preset dietary and exercise goals. The dietary goal involved adopting the more plant-food–based Optimal Diet.[3] This largely unrefined complex-carbohydrate–centered diet (65% to 70% of total calories) emphasizes foods such as grains, legumes, vegetables, and fresh fruits ad libitum. The Optimal Diet is low in fat (<20% of energy), animal protein, sugar, and salt, yet high in fiber and virtually free of cholesterol. At the same time, CHIP program participants were encouraged to build up toward walking or exercising at least 30 minutes a day. Participants kept an exercise log to record the miles walked each day. During each class, exercise logs were checked by program facilitators.

Measures

In addition to the demographic information, biometric data were gathered. After a 5-minute rest, blood pressure was measured using the guidelines set forth by the American Heart Association.[10] After a 12-hour fast, phlebotomists conducted a venipuncture. The samples were drawn into a Vacutainer (Becton-Dickinson Vacutainer Systems, Rutherford, NJ), allowed to clot, centrifuged, and taken to the Swedish-American Health System's (Rockford, IL) outpatient laboratory for analysis following the lipid standards provided by the Centers for Disease Control and Prevention. Glucose, total cholesterol, high density lipoprotein (HDL) cholesterol, and triglyceride concentrations were determined using Kodak Ektachem serum cholesterol oxidase assays. LDL values were calculated as follows: LDL = total cholesterol − HDL − (triglycerides × 0.16).[11] LDL could not be calculated when triglyceride values exceeded 400 mg/dL.

BMI was determined using the formula: weight (kg)/height (m^2).[12] Weight and height were measured using standard medical weight and height scales recently calibrated by the Biometrics Department of the Swedish-American Health System. Smoking was assessed by self-report.

To determine whether the program would increase knowledge of healthful behaviors, each participant completed a multiple-choice test consisting of 25 questions on healthful lifestyles. The same questions were used at follow-up, but the order and the number of questions asked were scrambled.

Program attendance was monitored each day, as participants signed attendance rolls. To successfully complete the program and graduate, participants had to attend at least 80% of the sessions. Participants who missed a session could check out the appropriate video, view it at home, and turn in a one-page summary highlighting the information discussed in the video.

Data Analysis

Because this study involved the use of a repeated-measures design, the data were checked to see whether they met the assumptions associated with repeated measures. For this study, the assumption of sphericity was violated, precluding the use of parametric repeated-measures analyses of variance. For this reason, these data were analyzed using growth-curve analysis, more specifically, covariance matrices based on the autoregressive Lag 1 (AR[1]) structure. This technique permits the analysis of change across time (slope) without violating the requisite assumptions of parametric repeated-measures analyses.[13] To determine whether there were between-site differences across any of the dependent variables, the variable "site" was treated as a random effect, and the variable "time" and the intercept were treated as fixed effects. With this analysis, it was possible to determine whether the slope of any one site was significantly different from the slopes of the other five sites. To implement this analysis, the SAS (version 6.12) MIXED procedure was used (SAS Institute, Cary, NC).[14]

Participant biometric scores were stratified according to established health risk cut points. The number of participants in each health risk category at baseline was compared with the number of participants in each health risk category at follow-up. These comparisons, as well as baseline differences in gender, were evaluated using chi-square.

Results

Because the initial cost of the program was shared between the employer and the employee, rates of recidivism were very low. Of the 453 employees enrolled at the start of the program, only 11 individuals (2.4%) failed to attend the required 80% of all group meetings. Each site had at least one of these 11 dropouts. The final number of program participants was 442. Healthful-lifestyles knowledge improved significantly, as the average percentage of correct answers on the healthful-lifestyle test improved from 65% at baseline to 89% at follow-up ($P < 0.01$).

Between-group baseline comparisons revealed that participants from site 2 had a significantly lower average age than the other five sites (Table 1). Baseline chi-square analysis of demographics showed that this site also had significantly fewer female participants ($P < 0.01$). Comparisons of baseline health risks between each of the six sites revealed no differences.

Table 2 shows the baseline to 8-week average changes and P values for each health risk. The table also displays the mean health risk change scores for the pooled data (all sites combined). The pooled data reported significant improvements in all health risks measured except for the total cholesterol–HDL ratio and HDL cholesterol. Based on a site-specific analysis, all sites were able to demonstrate significant improvements in weight, BMI, total cholesterol, and LDL. All sites also experienced significant reductions in HDL cholesterol. Sites 3 and 6 demonstrated significant changes in total cholesterol–HDL ratios, with site 3 actually showing a slight increase. Significant and meaningful reductions in systolic blood pressure occurred at sites 1, 5, and 6, and all sites except site 4 demonstrated significant reductions in diastolic blood pressure. Significant reductions in triglycerides were measured at sites 1, 5, and 6, and significant reductions in fasting blood glucose were reported at sites 3, 5, and 6.

To determine whether there were significant differences in the rates of risk reduction between the six sites, between-site slope comparisons were made. Site 3 had a less dramatic drop in total cholesterol when compared with the other five sites, and site 6 had a significantly greater decline in the total cholesterol–HDL ratio and a significantly steeper decline in diastolic blood pressure when compared with the other five sites. There were no other significant differences in the rates of change between the six sites for any of the health risks, suggesting that groups that have facilitators who are physicians may not have larger improvements in health risks.

Further slope analyses were completed to determine whether there were different rates of risk reduction between male and female participants. At the end of the 8-week program, men displayed significantly greater improvements in health risk scores compared with women (Table 3). Only glucose score reductions were not significantly different between men and women (−7.3 and −4.1, respectively). Some of the most noteworthy differences between male and female participants were seen in the reduction of body

TABLE 2
Eight-Week Changes for All Health Risk Measures by Site

Site	*n*	Weight (lbs)	BMI (kg/m²)	Systolic BP (mm Hg)	Diastolic BP (mm Hg)	Total Chol (mg/dL)	HDL (mg/dL)	Chol/HDL	LDL (mg/dL)	Triglycerides (mg/dL)	Glucose (mg/dL)
1	104	−8.5	−1.4	−11.4	−6.0	−22.4	−6.7	0.1	−12.1	−19.4	0.1
		0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.2088	0.0001	0.0119	0.9475
2	18	−6.8	−1.1	1.6	−5.1	−32.8	−6.9	−0.1	−21.3	−23.2	1.2
		0.0001	0.0001	0.6702	0.0325	0.0001	0.0001	0.4144	0.0002	0.2096	0.8245
3	70	−8.5	−1.3	−3.4	−2.4	−14.1*	−5.9	0.2	−9.9	10.8	−10.4
		0.0001	0.0001	0.0624	0.0275	0.0001	0.0001	0.0323	0.0005	0.2493	0.0001
4	43	−8.9	−1.3	−4.3	−1.8	−37.7	−10.2	0.0	−26.4	−8.1	−3.6
		0.0001	0.0001	0.0652	0.2070	0.0001	0.0001	0.8149	0.0001	0.4991	0.2962
5	90	−10.6	−1.7	−10.7	−3.7	−24.4	−6.3	0.0	−16.8	−31.5	−9.2
		0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.5268	0.0001	0.0002	0.0001
6	117	−8.6	−1.3	−10.4	−9.0†	−33.3	−5.4	−0.3†	−24.6	−19.2	−5.7
		0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0082	0.0066
All	442	−8.9	−1.4	−7.3	−4.9	−27.1	−6.8	0.0	−18.1	−15.7	−5.2
		0.0001	0.0001	0.0197	0.0175	0.0021	0.0006	0.6742	0.0022	0.0446	0.0263

The second number within each cell is the *P* value for the risk change score above it.
* The decrease in total cholesterol (chol) within site 3 was significantly less than the decreases in the other five sites.
† Site 6 had a significantly greater decrease in diastolic blood pressure (BP) and Chol-HDL ratio than the other five sites.

TABLE 3
Change in Health Risk Scores Between Men and Women

Variable	Men (*n* = 167)	Women (*n* = 275)	*t*	*P Value**
Weight (lbs)	−11.7	−7.2	−7.28	0.0001
BMI (kg/m²)	−1.7	−1.2	−5.01	0.0001
Systolic BP (mm Hg)	−10.6	−7.3	−2.26	0.0246
Diastolic BP (mm Hg)	−6.7	−4.5	−2.33	0.0204
Total Chol (mg/dL)	−34.9	−21.1	−4.87	0.0001
HDL (mg/dL)	−5.2	−7.3	3.06	0.0023
LDL (mg/dL)	−25.5	−13.2	−5.16	0.0001
Triglycerides (mg/dL)	−31.2	−6.9	−3.17	0.0016
Glucose (mg/dL)	−7.3	−4.1	−1.45	0.1484
Chol/HDL	−0.3	0.1	−5.59	0.0001

* *P* values are for differences in health risk reductions between men and women.
BP = blood pressure; Chol = cholesterol.

weight (−11.7 lbs and −7.2 lbs, respectively), BMI (−1.7 and −1.2), total cholesterol (−34.9 mg/dL and −21.1 mg/dL), and triglycerides (−31.2 mg/dL and −6.9 mg/dL).

With the pooled data, changes in health risks were also evaluated using standard health risk cut points (Table 4). At baseline, individuals were classified into health risk categories for each health risk, and at follow-up the number of individuals in each category was again determined. Chi-square analyses showed a significant reduction in the number of employees who had been high risk in every health risk except triglycerides ($P < 0.09$).

To determine how the video program affected individuals who had different degrees of baseline risk, a baseline/follow-up comparison was calculated for all scores within each baseline risk category. For example, as shown in Table 4, 19 individuals had a baseline BMI classified as underweight (<18.5). The mean baseline BMI score (18.2) for these 19 individuals was subtracted from their mean follow-up BMI score (17.2), and this average difference (−1.0) is shown in the last column of Table 4. The difference column shows that within BMI scores, the higher the baseline BMI, the greater the reduction at follow-up. At baseline, pooled participants included ten smokers; at follow-up, there were eight smokers. This reduction was not significant.

Discussion

The CHIP video program consisted of 32 hours of video and facilitated group discussion designed to educate participants about lifestyle-related circulatory diseases and how modifications in diet and exercise can prevent their occurrence, halt their progression, and possibly lead to regression. Employees who graduated from the program experienced significant and clinically meaningful reductions in a variety of health risks. Several conclusions can be drawn from this analysis: (1) reductions in health risks were documented at all six sites; (2) there were few significant between-site differences in the magnitude of risk reductions; (3) health risks for men improved more than forwomen; and (4) the greatest improvements in health risks were experienced by participants who had the highest risk at baseline. This dramatic improvement from high-risk participants can be seen in each of the eight health risks included in Table 4. For example, individuals with "normal" total cho-

TABLE 4
Health Risk Prevalence and Change Scores Across Time for All Sites Combined

	Baseline		Follow-Up		Chi-Square	P	Baseline Mean	Follow-Up* Mean	Diff
	n	%	n	%					
BMI (kg/m²)					7.8	0.05			
Underweight (<18.5)	19	4.3	21	4.8			18.2	17.2	−1.0
Normal (18.5–24.9)	48	10.9	71	16.1			23.0	22.2	−0.8
Overweight (25.0–29.9)	130	29.4	141	31.9			27.7	26.5	−1.3
Obese (≥30.0)	245	55.4	209	47.3			36.2	34.7	−1.6
Systolic BP (mm Hg)					29.7	0.001			
Ideal (<140)	286	64.7	348	78.7			124.6	121.1	−3.6
High (140–159)	115	26.0	84	19.0			147.3	134.3	−12.9
Dangerous (≥160)	41	9.3	10	2.3			170.1	141.4	−28.8
Diastolic BP (mm Hg)					24.5	0.001			
Ideal (<90)	349	79.0	400	90.5			77.8	74.3	−3.5
High (90–94)	57	12.9	31	7.0			91.2	80.8	−10.4
Dangerous (≥95)	36	8.1	11	2.5			99.8	85.9	−14.0
Total Chol (mg/dL)					73.1	0.001			
Normal (<200)	200	45.2	320	72.4			171.4	155.6	−15.8
Borderline (200–239)	161	36.4	97	21.9			218.0	189.2	−28.8
High risk (≥240)	81	18.3	25	5.7			263.8	216.5	−47.3
LDL (mg/dL)					51.7	0.001			
Optimal (<90)	125	28.3	203	45.9			83.3	80.0	−3.4
Above optimal (90–109)	141	31.9	149	33.7			115.2	101.0	−14.2
Borderline (110–149)	118	26.7	71	16.1			143.9	120.0	−23.8
High (150–189)	47	10.6	18	4.1			170.0	134.6	−35.4
Very high (≥190)	11	2.5	1	0.0			206.3	144.5	−61.7
HDL (mg/dL)					31.8	0.001			
High (≥60)	101	22.9	50	11.3			72.5	59.9	−12.6
Normal (>40 & <60)	242	54.8	232	52.5			48.8	43.0	−5.8
Low (<40)	99	22.4	160	36.2			34.9	32.6	−1.9
Triglycerides (mg/dL)					6.6	0.09			
Normal (<150)	254	57.4	275	62.2			97.3	107.4	10.1
Borderline (150–199)	71	16.1	73	16.5			170.4	148.1	−22.3
High (200–499)	108	24.4	92	20.8			265.3	217.0	−48.3
Very high (≥500)	9	2.0	2	0.0			625.1	305.9	−319.2
Glucose (mg/dL)					8.8	0.012			
Normal (<110)	345	78.0	379	85.7			91.8	92.1	0.3
IFG (110–125)	55	12.4	35	7.9			115.7	106.7	−9.0
Diabetes (≥126)	42	9.5	28	6.3			175.4	129.4	−46.0

* These follow-up means are based on baseline risk category. For example, the follow-up mean for the underweight BMI category is the average follow-up score for the 19 individuals who started at baseline in the underweight category, regardless of which risk category they occupied at follow-up.
BP = blood pressure; Chol = cholesterol; IFG = impaired fasting glucose.

lesterol at baseline experienced a 15.8 mg/dL decrease, whereas those at high risk at baseline experienced a 47.3 mg/dL decrease on average. This last conclusion suggests that participants with the greatest baseline risk experienced the greatest improvement in raw score and in percent reduction.

Participants at high risk with total blood cholesterol levels ≥240 mg/dL at baseline experienced on average an 18% drop in their total cholesterol, which exceeds reductions reported by other researchers.[15–18] Using group settings and interventions, these researchers reported cholesterol reductions ranging from 9% to 14%. Although considerable differences in study designs, interventions, and follow-up periods exist, these reductions do provide a crude reference point from which to evaluate the findings of data reported here.

Research published by Manson et al.[19] in 1992 suggested that for every 1% drop in total cholesterol or for every 1 mm Hg drop in elevated diastolic blood pressure, there is a subsequent 2% to 3% reduction in coronary risk. Participants in this study with high diastolic blood pressures (90 to 94 mm Hg) had an average diastolic blood pressure decrease of 10.4 mm Hg (see Table 4). Furthermore, participants with borderline-high cholesterol levels (200 to 239 mg/dL) had an average cholesterol decrease of 28.8 mg/dL, or 13.2%. Taken together, these two reductions translate into a possible coronary risk reduction of 47% to 71%. Moreover, participants who had dangerously high diastolic blood pressure (≥95 mm Hg) at baseline reduced their pressure by an average of 14.0 mm Hg (a 28% to 42% reduction in risk), and participants who had high blood cholesterol at baseline (≥240 mg/dL) reduced their cholesterol levels by 47.3 mg/dL, or 18.1%, a 36% to 54% reduction in coronary risk. Highly optimistic health promotion professionals could envision the possibility of participants who were both diastolic-hypertensive and hypercholesterolemic who would participate in the program and experience a 64% to 96% reduction in overall risk of myocardial infarction. Although these estimations of percent risk reduction are only theoretical, they nevertheless suggest that the CHIP video program does have considerable potential to reduce the burden of cardiovascular disease.

Among the lipids results, the triglyceride data deserve special attention. Several studies using very-low-fat, high-carbohydrate diets have reported an increase in triglyceride levels.[3,4] The data reported here demonstrate that increases in triglyceride levels were almost exclusively found in participants whose levels at baseline were <150 mg/dL. In general, the average increase in this "normal" category was mild, increasing from 97 to 107 mg/dL, which is probably of minimal clinical consequence.

The reductions in HDL cholesterol are directly associated with reductions in LDL and total cholesterol. Even though many participants had significant reductions in HDL levels, these changes must be clinically assessed in light of the overall improvement in blood lipids. The extent to which these HDL reductions are clinically relevant is unknown.

The potential of this program to alter the incidence of diabetes is equally compelling. Exactly one third of the participants with fasting blood glucose levels >125 mg/dL (diabetic) at baseline were no longer in that category at follow-up. Within 8 weeks, these baseline diabetics experienced an average reduction of 26% in their fasting blood glucose. These changes were also supported by reductions in body weight. The average weight loss was 8.9 pounds, with greater reductions in weight being experienced by those with greater baseline weights. Participants in the highest quartile for weight at baseline (mean = 262.5 lbs) were tracked at the follow-up screening (mean = 250.3 lbs) and were able to demonstrate an average weight loss of 12.2 lbs. The combination of changes in weight and fasting glucose should reduce the overall risk of diabetes.

Each of the six sites evaluated in this study shared a common geographic location but employed individuals with differing demographics and educational levels. Some sites had predominantly more manufacturing and production jobs, while other sites could be characterized as having mostly white-collar positions. Each site began the program on different dates throughout the 10-month period covered by this study; each site also had different program facilitators. Regardless of different company environments, program facilitators, and start dates, reductions in health risks experienced by CHIP program participants were remarkably consistent. The fact that the results were so similar across sites suggests that the effects of the CHIP program are likely a result of the intervention, although without controlled trials, this cannot be known for certain.

There are a number of factors that could have contributed to the program's apparent success. Participants were encouraged to walk for at least 30 minutes each day, recording the miles they covered in that time period. Though exercise was not a major emphasis of the program, it is assumed that employees in the program did engage in regular physical activity.

The major focus of the program was to encourage participants to adopt the Optimal Diet. Participants were educated on the benefits of the diet and how to implement it in their individual lives. Several different approaches were used to instruct the participants on how to effectively apply the Optimal Diet, including the CHIP videos, shopping tours, cooking demonstrations, workbook assignments, and some personal counseling by professionals. Unfortunately, the data gathered from this study did not include valid measures of diet. However, CHIP video programs that are currently in session are now collecting both diet and physical activity data.

The group setting for each of the sessions may have led to increased social support, which can be an important variable in behavior change.[20,21] Although the effects of social support were not measured, it is possible that peer reinforcement and encouragement might have played a role in effecting the outcomes of the intervention. Improvements in cognitive understanding of healthful lifestyles suggests that actual behaviors might have changed and resulted in improved health risks.

The program facilitator is also thought to have had an impact on the results of the study. Program facilitators provided important services to the group, such as asking and answering questions, inviting professionals to address the participants, providing feedback, leading group discussions, assisting in understanding and completing workbook assignments, and providing advice and encouragement when needed. The facilitators for site 3 were two board-certified physicians. Because of these facilitators' advanced medical credentials and the possible doctor-patient relationship that may have existed within this site, it is feasible that the program offered at that site may have been more effective than programs offered under different facilitators. Table 2 compares the results of each site and reveals no distinct advantage for the participants in site3; in fact, those participants did not experience as great a decline in total cholesterol compared with the other five sites.

Limitations

Self-selection is the most obvious limitation to these results. It can be assumed that because the participants volunteered for the program, they may have already been contemplating the need for lifestyle change. It is unknown, but likely true, that the participants in this study may have possessed motivational, health, and economic characteristics not shared by other employed adults. For employees to be enrolled, they had to pay part of the initial cost. This cost may have limited the number of employees who selected to participate in the program. Also, because of the strong correlation between income and education, it is possible that participants represented a more educated or higher-paid cohort. Regression to the mean is also an explanation for the results shown.

During the course of the intervention, it is possible that participants might have initiated or terminated medication use. If a participant stopped taking a hypercholesterolemic medication during the program, the follow-up cholesterol measures would have underrepresented the actual impact of the program. Examination of each *Heart Screen* revealed that no participants had been recently prescribed any new risk-reducing medications, nor were any of the dosages of current medications increased. Although the medication data are subject to self-report errors and classification problems, there is some evidence that some participants' physicians may have either completely stopped a prescription or reduced the dosage of several medications. Thus, the results documented here may actually underreport the impact of the program. Without use of a control group and strict documentation of medication usage, it is not possible to remove pharmacological influences that may have impacted the data.

In a previously published description of the live CHIP program,[3] the average age of participants was 55 years. In the current study, the average age was slightly lower, at 52 years. This age is somewhat higher than the average age of working adults. It is postulated that older adults are more likely to participate because they may have higher incomes and can afford the cost of the program. Another possible explanation is that they may have evidence (ie, anginal pain or diabetes) or early symptoms of a lifestyle-related chronic disease and are sufficiently motivated to change their behaviors in an attempt to improve their health.

One of the most valid criticisms of this study is the relatively short follow-up period that was used; all of the changes reported here were experienced in an 8-week period. Long-term studies of behavior change have demonstrated that it is difficult to sustain lifestyle modifications. With the passage of time, most newly adopted behaviors tend to revert to previous behaviors. This phenomenon is clearly a threat to the sustainability of the risk reductions demonstrated in this study and places in doubt any actual reductions in future disease that might occur.

Without further research, it is not possible to estimate long-term reductions in risk; however, 36 of the 90 participants at site 5 were evaluated at baseline and at 2 and 6 months. Data from these 36 participants were used to examine the long-term effects of the program. Admittedly, this is not a rigorous method of determining long-term compliance, but it does shed some light on the issue of sustainability. At 6 months, weight, BMI, systolic and diastolic blood pressure, and fasting blood glucose levels were actually below their 8-week values. For these variables, it appears that the behaviors that caused the initial reductions were maintained or even enhanced. All blood lipid measures (total cholesterol, HDL, LDL, and triglycerides) experienced substantial reductions from baseline to 8 weeks but experienced some decay at 6 months. At 6 months, total cholesterol and LDL levels were near baseline values, and HDL and triglycerides had experienced some reversions toward prior values. Future research on the CHIP video program should include designs that will enable researchers to more accurately quantify long-term changes in risk and behavior adherence. This research should also measure diet, physical activity, and other lifestyle behaviors that are thought to mediate the outcomes reported here.

Conclusions

It appears that the CHIP video program can empower participants with the cognitive content and behavioral skills needed to make lifestyle changes. Results from 8 weeks of program participation demonstrate that significant and meaningful reductions in weight, BMI, blood pressure, total cholesterol, LDL and HDL cholesterol, triglycerides, and glucose can be experienced among self-selected participants from a variety of worksites. Many of these risk reductions are the largest ever reported from a worksite intervention. Even though these findings were remarkably consistent across sites, causality cannot be demonstrated without evaluating the program in a randomized controlled design. Lack of a randomized controlled group should not diminish the fact that 442 employees who participated in the program have significantly reduced their health risks.

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