The Effects of a Worksite Chronic Disease Prevention Program

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Learning Objectives

- Describe the content and administration of the intervention used in this trial to promote wellness and lessen the risk of serious chronic diseases, the Coronary Health Improvement Project (CHIP).
- Summarize any post-CHIP changes in cognitive understanding of what employees must do to minimize risk factors for, and possibly prevent, cardiovascular disease and other common chronic diseases.
- Outline changes in disease risk factors and health behaviors that were apparent 6 weeks and 6 months after participation in the CHIP.

Abstract

Objective: *This study determined the behavioral and clinical impact of a worksite chronic disease prevention program.* ***Methods:*** *Working adults participated in randomized clinical trial of an intensive lifestyle intervention. Nutrition and physical activity behavior and several chronic disease risk factors were assessed at baseline, 6 weeks, and 6 months.* ***Results:*** *Cognitive understanding of the requirements for a healthy lifestyle increased at the end of the program. Program participants significantly improved their cognitive understanding of good nutrition and physical activity and had significantly better nutrition and physical activity behavior at both 6 weeks and 6 months. Participants had significantly lower body fat, blood pressure, and cholesterol.* ***Conclusions:*** *This worksite chronic disease prevention program can significantly increase health knowledge, can improve nutrition and physical activity, and can improve many employee health risks in the short term.* (J Occup Environ Med. *2005;47:558–564*)

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In 2003, health care costs for companies across the United States increased an average of 14%, the largest single-year increase since 1990.[1] In that same year, the premiums for employer-sponsored health plans rose to $3383 for single coverage and $9068 for family coverage.[1] As companies continue to bear these costs, many initiate employee health-promotion programs in an attempt to help employees prevent chronic disease and hopefully reduce medical care expenses. This reduction is especially important for worksites that are self-insured. Approximately 90% of all workplaces in the United States with 50 or more employees have some form of health-promotion program.[2]

The SwedishAmerican Health System (SAHS) is the largest medical care provider in Rockford, Illinois, and employs 2744 medical personnel and staff. Like many other worksites, SAHS offers its employees medical care insurance but is also the provider of that medical care and is not immune to the increased medical costs experienced by other employers. Because of the increased medical care cost burden and its desire to improve the health if its employees, SAHS initiated an employee wellness program. One component of the wellness program was the adoption of the Coronary Health Improvement Project (CHIP). The CHIP program is a 40-hour, live-lecture educational course that highlights the importance of making better lifestyle choices for preventing chronic diseases. It was created with the goal of reducing chronic diseases and improving the overall health of the public.[3] To determine whether SAHS employees who participated in the program could improve their cognitive understanding of good health, healthy behaviors, and chronic disease risk factors through 6 weeks and 6 months, a large randomized clinical trial was initiated.

Materials and Methods

Subject Recruitment and Design

Recruitment efforts included "lunch and learn" presentations, intranet communications, posting flyers, word of mouth, and newsletter announcements to all SAHS employees. To be included in the study, each participant had to be willing to participate in the program starting in 1 month or in 7 months. To encourage participation, SAHS shared the cost of program participation. SAHS paid $295 of the initial $395 program cost, with employees responsible for paying the $100 difference. Upon successful completion of the program, SAHS refunded the $100 employee portion, so there was no cost. Employees received further incentive to participate by being paid an additional $100 and, if they were diabetic, they were paid another $100. Because spouses of employees also are covered by the SAHS health plan, they too were encouraged to participate. Insured spouses paid $100 and the health plan paid the balance after successful completion.

Eligible and interested participants provided informed consent. Participants were encouraged to participate with a spouse or significant other. If an employee decided to participate with a partner, the employee and the partner were assigned randomly as a paired unit. All other participants were assigned randomly as individuals. The allocation sequence was created using a random number generator. Program sign-up, randomization, and group assignments were made by the study coordinator. The study was approved by the Institutional Review Board of the SwedishAmerican Health System on August 29, 2002.

Intervention

The intervention for this study was a live version of the Coronary Health Improvement Project (CHIP).[3] Participants met for 4 weeks—four times each week for 2 hours each session—where they received instruction. Meetings were held off-site at a local college. The curriculum included the following topics: modern medicine and health 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 lectures, participants received a textbook and workbooks that closely followed the discussion 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. Dietitians and medical professionals spoke to the group weekly, introducing them to the latest nutritional and medical information related to the prevention of chronic diseases. In addition, participants had access to scheduled shopping tours and cooking demonstrations given by a dietitian. Finally, the lecturer and program staff presided at each of the educational sessions and were available to answer questions regarding the presentations, workbook assignments, and the program.

Participants were encouraged to follow preset dietary and exercise goals. The dietary goal involved adopting a more plant-food based diet that emphasizes "as-grown," unrefined food. Participants were encouraged to increase their consumption of whole grains, legumes, vegetables, and fresh fruits. The recommended diet was low in fat (less than 20% of energy), animal protein, sugar, and salt, very low in cholesterol, and high in fiber. Concurrently, program participants were encouraged to progressively work toward walking or other exercises at least 30 minutes a day. Participants were given a pedometer and encouraged to keep an exercise log to record the miles walked each day. At the completion of the program, participants were encouraged to join the Rockford CHIP Alumni Organization for after-program support.

The primary objectives of this program are to improve participants' cognitive understanding of the importance of healthy lifestyles, nutrition and physical activity behavior, risk factors associated with diabetes, hypertension, cardiovascular disease, and cancer.

Measures

Variables included cognitive and behavioral measurements and physiological outcomes related to chronic disease. Demographic data were collected at baseline. Attendance at each of the classes was tracked and averaged. Participants attended 87% of the classes on average. A first step in behavior change may involve increasing awareness of proper health behaviors and knowledge. Specific knowledge regarding health risks, proper eating and physical activity behaviors, and an understanding of the benefits of a healthy lifestyle was assessed with a multiple-choice health knowledge test. The test has previously demonstrated validity and reliability.[3] Information about each of the 30 questions is contained in the workbook, handout materials, and in a CHIP video lending library, so that participants who missed a lecture could obtain the information. The percent of correct responses was recorded at baseline and after 6 weeks.

To assess dietary intake, the Block 98 full-length dietary questionnaire was used (Block 98.2, Block Dietary Data Systems, Berkeley, CA). This questionnaire has been extensively studied and validated.[4–6] It is self-reported and optically scanned and scored. The variables measured by this survey include, but are not limited to, the following: daily nutrients from food, percent of calories, fiber from different sources, and food group servings per day.

To ascertain energy expenditure contributed by physical activity, a 7-day self-recorded pedometer log was maintained by each participant. Participants wore the Walk4Life Model 2000 Life Stepper pedometer (Plainfield, IL) on a belt at the right hip directly above the right knee cap each day for 7 days. Immediately before going to bed, the pedometer counts for the day were recorded and the number reset. Strike counts from pedometers are a valid and reliable method of monitoring and measuring free-living physical activity.[7–9]

The primary outcome variables included several chronic disease risk factors. After a 12-hour fast, blood was drawn using a vacutainer (Becton-Dickinson Vacutainer Systems, Rutherford, NJ) by phlebotomists from the SAHS's outpatient laboratory. Samples were allowed to clot and centrifuged. Clinical analyses were completed at the SAHS laboratory. Lipid analysis followed 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 Beckman-Coulter LX-20 instrumentation. Glucose was obtained using oxygen rate method employing Beckman oxygen electrode, cholesterol was obtained using timed endpoint enzymatic method using cholesterol oxidase, triglyceride used timed endpoint enzymatic method using glycerol kinase, and HDL was obtained using homogeneous timed endpoint method using polyanion detergent to separate HDL from non-HDL lipids. For participants with triglyceride values less than 400 mg/dL, low-density lipoprotein (LDL) values were calculated as follows: LDL = total cholesterol − HDL − (triglycerides/5).[10–12] High-sensitivity C-reactive protein was determined using a microplate protocol based on a latex bead enhanced immunoturbidity assay.[13,14] Trained program staff took blood pressure measures; after resting for 5 minutes, participants' blood pressure was measured using the guidelines set forth by the American Heart Association.[15] Weight and height were measured using standard medical weight and height scales recently calibrated by the Biometrics Department of the SAHS. Body mass index (BMI) was determined using the formula: weight (kg)/height (m^2).

Statistical Analyses

Cross-tabulations were used to perform bivariate analyses between selected demographic variables, with statistical significance based on the chi-square test for independence.[16] Differences in independent means were evaluated using the *t* test.[17] Wilks' lambda was used to evaluate differences in means across time between intervention and control groups.[18] Analyses were performed using SAS version 9.0 (SAS Institute Inc., Cary, NC). Procedure statements used in SAS for assessing the data were PROC UNIVARIATE, PROC FREQ, PROC TTEST, and PROC GLM. Statistical significance was based on the 0.05 level.

Results

Of the 145 randomized participants, 8 were lost to follow-up (Fig. 1). Dropout rates between groups were similar, and the analysis was based on intent-to-treat. Mean ages did not significantly differ between intervention (M, 46.1; SD, 10.8) and control (M, 45.9; SD, 9.3) participants (t-statistic $P = 0.9091$). Descriptions of participants in the intervention and control groups are

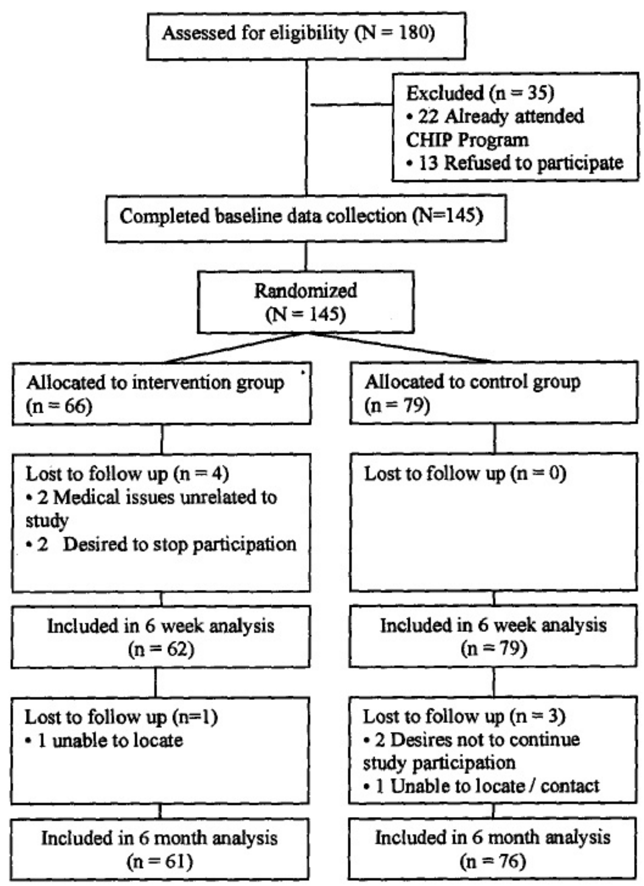

Fig. 1. Flow diagram of participant progress.

TABLE 1
Mean and Frequency Distributions for Intervention and Control Groups According to Selected Demographic Variables

	Intervention		Control		
	No.	**%**	**No.**	**%**	**Chi-Square *P* Value**
Gender					
Male	9	14.1	11	13.9	<0.001
Female	55	85.9	68	86.1	0.981
Race					
White alone	62	96.9	74	96.1	
Black alone	1	1.6	2	2.6	0.195
Other	1	1.6	1	1.3	0.907
Marital status					
Never married	5	7.8	9	11.4	
Married	50	78.1	59	74.7	
Divorced	6	9.4	10	12.7	2.338
Widowed	3	4.7	1	1.3	0.505
Annual family income					
$0–$20,000	4	6.4	2	2.5	
$20,001–$40,000	9	14.5	14	17.7	
$40,001–$60,000	13	21.0	20	25.3	1.836
$60,000 +	36	58.1	43	54.4	0.607
Education					
< High school	1	1.6	4	5.1	
High school	10	15.6	12	15.4	
Some college	27	42.2	26	33.3	
College degree	19	29.7	17	21.8	6.332
Post college degree	7	10.9	19	24.4	0.176

presented according to gender, race, marital status, income, and education in Table 1. There were no statistically significant differences between participants in the intervention and control groups for these variables. Most participants were women, were white, were married, had an annual family income greater than $60,000, and had at least some college education.

The intervention group scored 64% on the cognitive baseline test. At the completion of the program, the same participants averaged 95%. Baseline means and mean change scores for selected physical activity and nutrition variables are presented according to intervention status in Table 2. Mean change scores within groups tended to be significantly greater for the intervention group compared with the control group at both 6 weeks and 6 months. However, for a few variables, significant differences in change scores were observed at 6 weeks but not at 6 months (total steps and whole grains). For other variables, significant differences in mean change scores were not observed at 6 weeks but they were seen at 6 months (ie, total energy, meat servings, polyunsaturated fat, and sodium). The effect of time on mean scores is significantly different between the intervention and control groups for each of the variables.

Baseline means and mean change scores for selected cardiovascular risk factor variables are presented according to intervention status in Table 3. Significantly more pronounced decreases in mean scores were observed in the intervention group compared with the control group at both 6 weeks and 6 months for BMI, weight, body fat, cholesterol, and HDL. Between-group mean change scores were significant at 6 weeks but not 6 months for resting heart rate and LDL. None of the variables had significant between-group mean scores at 6 months that had insignificant between-group mean scores at 6 weeks. The effect of time on mean scores is significantly different between the intervention and control groups for BMI, weight, body fat, resting heart rate, cholesterol, HDL, and LDL.

Many of the improvements in health behavior showed large 6-week improvements that diminished somewhat after 6 months, but still remained significantly better than baseline. For example, the average number of steps as measured by pedometer increased and peaked at 6-weeks. This was a 25% increase in steps from baseline. By 6 months, this increase had dropped to a 16% overall increase from baseline. Step counts for the control group were essentially unchanged during the same period. Similarly, intervention participants reported vegetable serving consumption increased from 3.2 servings per day at baseline to 4.8 servings per day at 6 weeks, a 50% increase. By 6 months, vegetable servings consumed per day still averaged 4.7 servings with only a slight decline from the 6 week peak. Vegetable consumption in the control group was unchanged.

Discussion

Employees who participated in this intensive lifestyle change program improved their health knowledge, adopted and maintained healthy eating and physical activity behaviors, and experienced favorable improvements in many chronic disease risk factors. SAHS was able to improve the health of many of its employees by encouraging them to participate in this lifestyle change program. Participants in the control group were allowed to participate in the CHIP program after completing the 6-month follow-up period.

At 6 weeks, many participants may have reached the maximum amount of improvement for many behaviors, including steps, fruit and vegetable fiber, fruit servings, and whole grain servings. Healthy behavior maintenance or continued improvement was seen in percent of calories from fat, meat servings, di-

TABLE 2

Mean Change Scores for Intervention and Control Groups through 6 Weeks and 6 Months Among Swedish American Employees According to Physical Activity and Nutrition Variables

	Intervention Group (n = 64)			Control Group (n = 79)			Between Group Δ Scores *t*-test *P* Value		Wilks' Lambda F Test *P* Value
	Baseline	Δ 6 Weeks	Δ 6 Months	Baseline	Δ 6 Weeks	Δ 6 Months	6 Weeks	6 Months	Time by Group
Total steps per week	47172.4	11607.4	7505.9	48273.8	−89.9	2132.5	0.0003	0.0803	0.0017
Total energy	2093.0	−266.8	−580.3	1793.3	−136.0	−119.7	0.2435	0.0004	0.0011
Calories from fat, %	34.5	27.5	27.8	34.3	33.2	35.6	<0.0001	<0.0001	<0.0001
Calories from protein, %	15.1	−0.8	−0.7	14.8	0.1	0.7	0.0337	0.0013	0.0048
Carbohydrates, %	51.5	9.6	8.6	51.2	1.1	−1.9	<0.0001	<0.0001	<0.0001
Fruit and vegetable fiber, g	7.6	5.6	3.6	8.0	0.2	−0.3	<0.0001	<0.0001	<0.0001
Vegetable servings	3.2	1.6	1.5	3.3	0.0	0.1	<0.0001	0.0002	<0.0001
Fruit servings	1.4	1.3	0.6	1.5	0.1	0.0	<0.0001	<0.0001	<0.0001
Whole grain serving	6.0	1.0	0.0	4.9	−0.4	−0.6	0.0010	0.1358	0.0027
Meat servings	1.9	−0.3	−0.7	1.7	−0.1	0.0	0.4316	<0.0001	<0.0001
Total dietary fat, g	83.5	−23.1	−34.6	71.1	−7.9	−2.6	0.0107	<0.0001	<0.0001
Dietary cholesterol, mg	205.2	−70.2	−110.4	161.6	−7.6	15.4	0.0006	<0.0001	<0.0001
Polyunsaturated fat, g	19.8	−4.1	−6.9	17.5	−2.0	−1.1	0.1652	0.0003	0.0006
Monounsaturated fat, g	32.0	−9.4	−13.7	27.6	−3.3	−0.9	0.0113	<0.0001	<0.0001
Saturated fat, g	25.0	−8.4	−12.1	20.5	−2.4	−0.8	0.0009	<0.0001	<0.0001
Sodium, mg	3003.0	−209.3	−689.3	2521.7	−184.1	−197.9	0.8824	0.0097	0.0202

TABLE 3

Mean Change Scores for Intervention and Control Groups Through 6 Weeks and 6 Months Among Swedish American Employees According to Cardiovascular Risk Factors Variables

	Intervention Group (n= 64)			Control Group (n= 79)			Between Group Δ Scores T-test P-value		Wilks' Lambda F test P-value
	Baseline	Δ 6 Weeks	Δ 6 Months	Baseline	Δ 6 Weeks	Δ 6 Months	6 Weeks	6 Months	Time by Group
BMI	32.1	−1.1	−1.6	31.3	−0.2	−0.03	<0.0001	<0.0001	<0.0001
Weight, kg	89.3	−2.9	−4.4	85.9	−0.4	−1.0	<0.0001	<0.0001	<0.0001
Body fat, %	40.0	−1.1	−2.4	38.4	−0.3	−0.4	0.0202	0.0008	0.0033
SBP, mm Hg	126.5	−7.2	−5.9	124.6	−5.4	−3.9	0.3028	0.3050	0.5071
DBP, mm Hg	77.6	−4.9	−6.5	75.6	−2.6	−3.8	0.0819	0.0506	0.1082
Resting heart rate, beats/min	73.4	−4.6	−4.7	72.4	−0.1	−1.8	0.0111	0.0729	0.0471
Glucose, mg/dL	97.6	−3.9	−2.0	99.7	−3.2	−2.0	0.7129	1.0000	0.8615
Cholesterol, mg/dL	199.6	−16.0	0.8	185.8	10.4	13.7	<0.0001	0.0153	<0.0001
HDL, mg/dL	45.8	−3.1	0.3	45.2	4.2	4.4	<0.0001	0.0006	<0.0001
LDL, mg/dL	128.4	−12.3	2.6	120.4	7.2	9.7	<0.0001	0.1237	<0.0001
Triglycerides, mg/dL	126.3	−3.2	−9.6	100.7	−4.7	−1.2	0.8599	0.4411	0.4239
hs-CRP, mg/dL	3.79	−0.1	−0.2	3.6	−0.6	−0.5	0.3045	0.6006	0.6348

SBP, systolic blood pressure; DBP, diastolic blood pressure; hs-CRP, high-sensitivity C-reactive protein.

etary fat grams, dietary cholesterol, saturated fat, and sodium. Campbell et al. [19] also reported significant increases in fruit and vegetable consumption at 6 months, but no differences after 18 months. Reductions in the percent of dietary calories from fat and increases in fruits and vegetable servings reported were three and two times greater, respectively, than similar measures improvements reported by Stevens et al.[20] who used an equally short follow-up time and counseling sessions to improve nutrition among working adults. These greater improvements in behavior from SAHS employees are probably due to the more intense nature of the CHIP program.

Worksite nutrition trials such as 5 a Day for Better Health,[21] Working

Healthy Project,[22] Next Step Trial,[23] Working Well Trial,[24] Health Works for Women,[19] and others[25–27] all had follow up periods of at least 12 months, and many lasted for 2 years. Most of these trials were able to show significant short-term improvement in nutrition, but after 2 years, healthy nutrition behaviors had attenuated to the point that there was either no significant change over baseline or only modest improvements. It would appear that worksite nutrition interventions can cause short-term behavior change, but as with other healthy human behaviors that are new, long-term compliance is difficult. Even though the SAHS employees were able to demonstrate dramatic changes after six months, long-term behavior compliance is yet to be determined.

SAHS employees were able to increase pedometer measured baseline physical activity by 25% at 6 weeks and by 16% at 6 months. The average number of steps for the intervention group after six months did not meet the recommended 10,000 steps per day.[28] However, when combined with dietary changes, improvements in physical activity are the likely explanation for 6 month decreases in weight (5%) and percent body fat (6%). Improved physical activity was also associated with significant decreases in resting heart rate, a correlated measure of cardiorespiratory fitness thought to be caused by increased heart size, blood volume, stroke volume, and cardiac output.[29,30] These increases in physical activity are in agreement with what Proper et al[31] found in their review of 26 worksite physical activity interventions.

Total cholesterol levels were dramatically lower at 6 weeks; however, despite significant 6-month reductions in dietary saturated fat and cholesterol, blood cholesterol returned to baseline values. A return to baseline lipid levels in the presence of reduced dietary cholesterol precursors suggests that program participants must be experiencing a significant increase in endogenous cholesterol, most of which appears to be LDL cholesterol.[32] Other lifestyle trials that lasted longer than 3 months have reported similar findings.[33–36]

SAHS employees who completed the program were able to demonstrate significant reductions in blood pressure and body fat. From baseline to 6 months, there was a 31% increase in the number of participants who were classified as systolic normotensive (systolic blood pressure $\leq$120 mm Hg) and a 46% increase in the number of participants who were classified as diastolic normotensive (diastolic blood pressure $\leq$80 mm Hg). Corresponding percentages for the control group are 25% and 9%, respectively. Theses findings are similar to those reported in the PREMIER Clinical feeding trial.[37]

At 6 months, the number of obese program participants decreased from 32 at baseline to 27. In the control group, 2 of the 33 members of the control group who were obese at baseline no longer had a BMI $\geq$30 kg/m^2 at 6 months. Reductions in excessive weight continued through the 6-month period. Participants averaged 1.5 pounds of weight loss per month, which is ideal for individuals who are trying to maintain long-term healthy weight. The American College of Sports Medicine recommends that weight loss not exceed 1 to 2 pounds per month.[38]

The participants in this study were mostly white and sufficiently self-motivated to volunteer to participate in the intervention. This delimitation threatens the generalizability of these findings. Both the physical activity and nutrition data were self-reported, and the follow-up period of the study was short. SAHS employees who were members of the control group also experienced some improvement in nutrition and physical activity behaviors and blood pressure. Because the control group was asked to wait 6 months before beginning the program, it is possible that members of the control group anticipated program participation and began to make behavior changes on their own.

The results of this study indicate that a worksite lifestyle change intervention can improve nutrition and physical activity behavior and can reduce many chronic disease risk factors. These findings add to the growing body of evidence that recognizes worksite efforts to improve nutrition and physical activity behavior and reduce many chronic disease risk factors. Further research is needed to determine how long these beneficial changes will last.

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