Current Research

Effects of an Intensive Diet and Physical Activity Modification Program on the Health Risks of Adults

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ABSTRACT

Background This study assessed the clinical impact of lifestyle change education on chronic disease risk factors within a community.

Design Randomized clinical trial.

Setting/Participants Participants included 337 volunteers age 43 to 81 years from the Rockford, IL, metropolitan area.

Intervention The intervention group attended a 40-hour educational course delivered over a 4-week period. Participants learned the importance of making healthful lifestyle choices and how to make improvements in nutrition and physical activity.

Main Outcome Measures Changes in health knowledge, nutrition, and physical activity behavior, and several chronic disease risk factors were assessed at baseline and 6 weeks.

Results Beneficial mean changes in scores tended to be significant for the intervention group but not for the control group. Variables with improved scores included health knowledge, percent body fat, total steps per week, and most nutrition variables. Clinical improvements were seen in resting heart rate, total cholesterol, low-density lipoprotein cholesterol, and systolic and diastolic blood pressure. The control group experienced comparatively small but significant improvements in health knowledge, systolic and diastolic blood pressure, glucose, and in some nutrition variables. For almost all variables, the intervention group showed significantly greater improvements.

Conclusions This lifestyle modification program is an efficacious nutrition and physical activity intervention in the short term and has the potential to dramatically reduce the risks associated with common chronic diseases in the long term.

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Chronic diseases, such as cancer, cardiovascular disease, stroke, and diabetes, are responsible for most deaths in the United States (1). Approximately 70% to 90% of these deaths are estimated to be caused by poor nutrition, sedentary living, and tobacco use and are largely preventable (2-4). Despite remarkable pharmacological and technological advances, the greatest improvements in public health in the United States will be made by helping individuals adopt and maintain more healthful lifestyles. This would include avoidance of tobacco, healthful eating, and more consistent physical activity. Such lifestyles are causally linked to the prevention and arrest of cardiovascular diseases, diabetes, and to certain adult cancers. Yet, within the United States, 23% of adults smoke, 77% fail to consume a healthful diet, and 78% are at elevated health risk because they do not get enough physical activity (5).

In an effort to move beyond the treatment-centered medical care model, a progressive health care provider in Rockford, IL (SwedishAmerican Health System) has actively supported a variety of lifestyle intervention programs not traditionally found in health care settings. These include the Dr Dean Ornish Program for Reversing Heart Disease and the Coronary Health Improvement Project (CHIP). Findings from the Ornish program in Rockford have demonstrated that patients with coronary disease can markedly improve their nutritional and physical activity profiles for at least 1 year. This, in turn, dramatically reduced their coronary risk (6,7).

CHIP is designed for adults in the community. Its intent is to reduce chronic disease incidence and to improve the overall health of the public by providing a lifestyle change program within a community setting. The program highlights the importance of making more healthful lifestyle choices for preventing, arresting, and reversing many diseases common among people of industrialized nations and teaches participants how to implement these

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choices through a change in diet, physical activity, and smoking cessation. Two evaluations of CHIP using one-group pretest/posttest analysis showed that participants were able to significantly reduce blood pressure, body weight, and total and low-density lipoprotein (LDL) cholesterol within 4 weeks (8,9). These descriptive studies have demonstrated that the program seemed to help reduce not only coronary risk factors, but also reduce the risks associated with cancer, diabetes, and the metabolic syndrome.

Later, a videotaped version of the program was offered to 453 employees at six geographically different worksites. Research from SwedishAmerican Health System on the effect of the videos mirrored previous reports. Participants experienced significantly reduced chronic disease health risks (10). None of these published evaluations, however, used randomization or a control group.

Despite remarkable pharmacological and technological advances, the greatest improvements in public health in the United States will be made by helping individuals adopt and maintain more healthful lifestyles.

Using CHIP as the intervention, SwedishAmerican Health System initiated a large randomized clinical trial in March 2003 to answer the following questions: Do program participants improve their cognitive understanding of the importance of healthful lifestyles? Do participants improve their nutrition and physical activity behavior? Do participants experience significant improvements in a variety of factors associated with diabetes, hypertension, cardiovascular disease, and cancer? The trial is scheduled to be completed in the fall of 2005. This paper reports on the initial short-term results of the trial as it relates to these questions.

METHODS

Subject Recruitment and Design

The SwedishAmerican Center for Complementary Medicine recruited study subjects using targeted advertising, marketed through the Centers of Excellence, CHIP alumni groups, corporate client sites, and the Swedish-American Medical Group. Recruitment efforts targeted adults in the greater Rockford, IL, metropolitan area. The Figure shows the participant progress through the study. To be included, each participant had to be willing to begin the program starting in 1 month or in 7 months, and be at least 18 years of age. Eligible and interested participants provided informed consent. Potential participants were excluded if they had any significant systemic or major illnesses, including congestive heart failure, coronary artery disease, cerebrovascular disease, pulmonary disease with hypoxia, renal failure, organ transplantation, serious psychiatric disease, malignancy that (in the opinion of the investigators) would preclude adequate follow-up, or any other condition that, in the opinion of the investigators, would impede participation in regular physical activity.

Participants were highly encouraged to participate with a spouse or partner. For couples who agreed to participate, the unit of randomization was the couple. For individuals who wished to participate, the unit of randomization was the individual. Final enrollment included 58 pairs evenly distributed across the treatment and control group. The unit of analysis in the statistical evaluation was individuals. By completing the 6-week data collection follow-up participants became eligible to receive a $50 incentive. The allocation sequence was created using a random number generator. Program sign-up and randomization to groups were made by the study coordinator. The study was approved by the Institutional Review Board of SwedishAmerican Health System, and is in compliance with the Health Insurance Portability and Accountability Act guidelines.

Intervention

The intervention consisted of the live lecture version of CHIP (8,9). Participants met for 4 weeks—four times each week for 2 hours each time—when they received instruction. The curriculum topics covered 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 (8), and self-worth.

In conjunction with the lectures, participants received workbooks that closely follow the discussion topics and contain assignments with learning objectives for each topic. These assignments were designed to help in the understanding and integration of the concepts and information presented. In addition, dietetics professionals and medical professionals spoke to the group weekly about the prevention, arrest, and reversibility of chronic diseases. Participants had access to scheduled shopping tours at local supermarkets and cooking demonstrations given by a dietetics professional.

The presenter of the educational sessions was available to answer questions regarding the presentations, workbook assignments, and the program, with assistance of program staff. Participants were encouraged to follow preset dietary and exercise goals. The dietary goal involved adopting a more plant-based diet that emphasizes largely unrefined "food-as-grown." These foods (such as grains, legumes, fresh fruits, and vegetables), usually high in unrefined complex carbohydrates, were encouraged. A whole-food diet—low in fat, animal protein, sugar, and salt; high in fiber, antioxidants, and micronutrients; and very low in cholesterol—is in contrast to the typical Western diet. Participants were encouraged to eat some nuts and were introduced to the idea of topping cereal with ground flax seed. At the same time, program participants were encouraged to progressively implement an exercise program (30 min/day) of walking and general fitness. At the completion of the program, participants were encouraged to join the Rockford CHIP Alumni Organization for a cost of $35 per year. The group receives a monthly newsletter, which contains news of health-promoting community events such as healthful dinners, walking groups, and support group meetings. The alumni

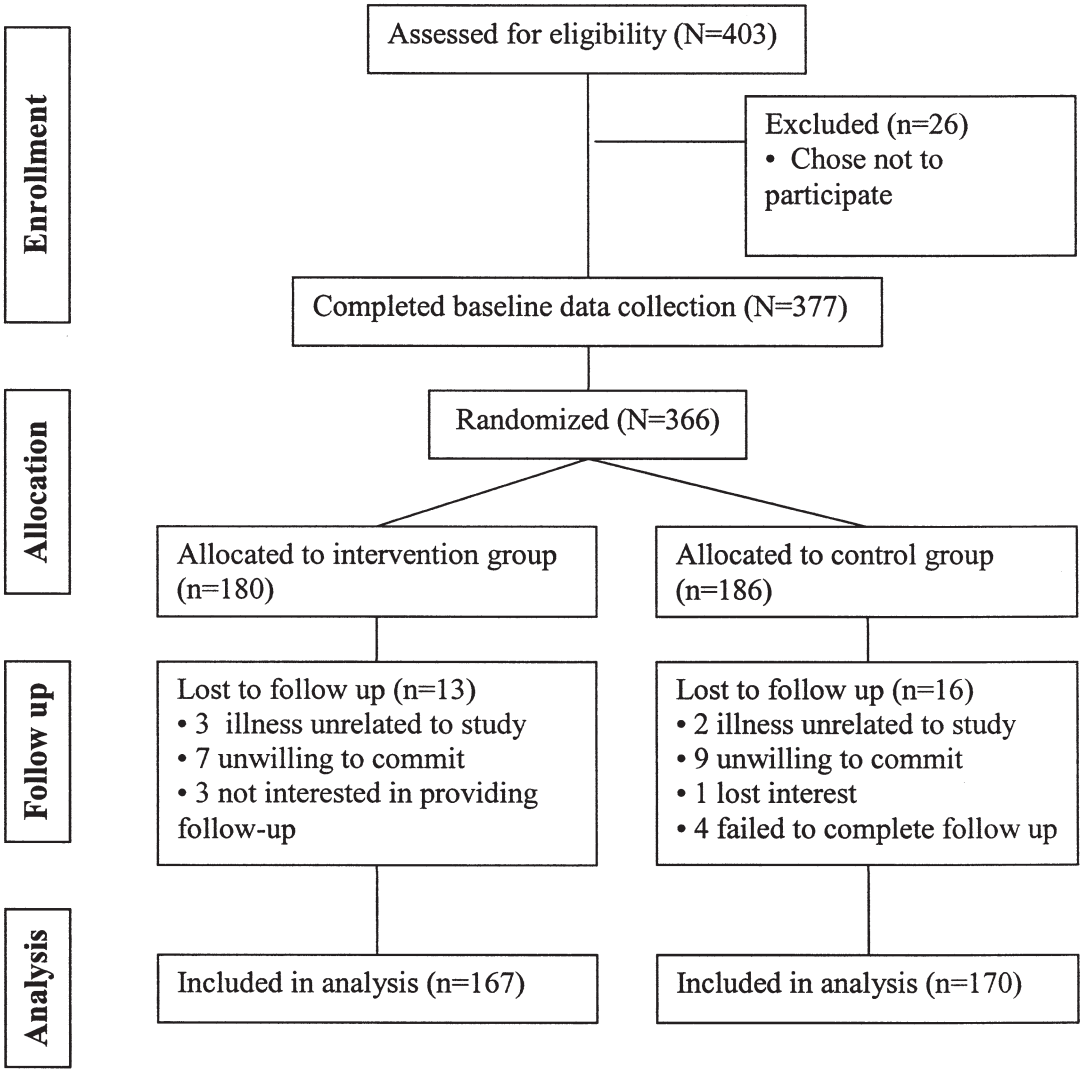

Figure. Flow of participants through each stage of study of an intensive diet and physical activity program on the health risks of adults.

are encouraged to attend special lectures on healthful living and relapse prevention.

Participants assigned to the control group were screened at baseline and told they would be able to participate in the program in 6 months. They were again screened after 6 weeks.

Measures

Data collection personnel were blinded to group assignment. Data gathered included demographic, cognitive, and behavioral measurements, and physiological outcomes related to chronic disease. Demographic data were collected at baseline. 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 healthful lifestyle were assessed with a multiple-choice health knowledge test. The test has previously demonstrated validity and reliability (8). Information about each of the 30 questions is contained in the textbook, handout materials, and in a CHIP video lending library, so that participants who missed a lecture could obtain the information. The number of correct responses was recorded. Attendance at each of the classes was tracked.

The intervention was designed to assist individuals in adopting healthful eating and physical activity behaviors. To assess dietary intake, the Block 98 full-length dietary questionnaire (Block 98.2, 1998, Block Dietary Data Systems, Berkeley, CA) was used. It was originally developed with the National Cancer Institute for research into the role of diet in health and disease and has been continually updated and improved. The questionnaire has been extensively studied and validated (11-13). 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 energy from different nutrients, 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 (Walk4Life Inc, Plainfield, IL) on a belt at the right hip directly above the right kneecap 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 (14-16).

The main outcome variables for this study 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 SwedishAmerican Health System's outpatient laboratory. Samples were allowed to clot and then centrifuged. Clinical analyses were completed at the Swedish-American Health System laboratory. Lipid analysis followed the lipid standards provided by the Centers for Disease Control and Prevention. Total cholesterol, high-density lipoprotein (HDL), and triglyceride concentrations were determined using Beckman-Coulter instrumentation and methodology. LDL values were calculated as follows: LDL=total cholesterol−HDL−(triglycerides/5) (17). High-sensitivity C-reactive protein was determined using a microplate protocol based on a latex bead enhanced immunoturbidity assay (18,19). Glucose was determined using a Kodak Ektachem (Eastman Kodak, Rochester, NY). Trained program staff took blood pressure measures; after resting for 5 minutes, blood pressure was measured using the guidelines and protocol set forth by the American Heart Association (20). Weight and height were measured using standard medical weight and height scales recently calibrated by the Biometrics Department of SwedishAmerican Health System. Percent body fat was estimated using the Tanita TBF-300A electrical impedance scale (Tanita Corp, Arlington Heights, IL) (21). Any participants who were high risk for any of the risk factors measured were encouraged to see their physician.

Statistical Analyses

Cross-tabulations were used to perform bivariate analyses between selected variables, with statistical significance based on the χ^2 test for independence (22). The t test method was used for testing differences in means (23). Risk factor cut points (Tables 1 and 2) were previously established (24,25) and categorized accordingly. Analyses were performed using SAS version 8.2 (SAS Institute Inc, Cary, NC, 2001). Procedure statements used in SAS for assessing the data were PROC UNIVARIATE, PROC FREQ, PROC TTEST, and PROC GLM.

Because multiple pair-wise tests were performed, an adjusted α should be referred to in order to minimize the overall probability of committing a type 1 error. The modified α based on the Bonferroni correction (27), pair-wise tests, and α=.05 is .0001. This conservative α should be used when determining significance in Tables 1 and 2. For all other results, statistical significance was based on the .05 level.

RESULTS

Analyses are based on 337 participants who completed both baseline and 6-week data screenings. Of the 366 participants that were randomized, 29 were lost to follow-up (Figure). Dropout rates between groups were similar. A description of participants in the intervention and control groups is presented according to age, sex, race, marital status, income, and education in Table 3. There were no statistically significant differences between participants in the intervention and control groups for these variables. Ages ranged from 43 to 81 years. The majority of participants were female, white, married, had an annual family income more than $40,000, and had at least some college education. Program attendance from the intervention group averaged 79% across all lecture sessions.

Baseline means and mean change scores are presented according to group assignment in Table 4. The mean change in scores within groups through 6 weeks tended to be significant for the intervention group but not for the control group. This included the following variables: total steps per week, resting heart rate, weight, percent body fat, percentage of energy from fat and carbohydrates, fiber from vegetables and fruits, vegetable servings, fruit servings, grain servings, meat servings, and dietary cholesterol. For several variables, the change was significant for both groups: health knowledge, energy, total dietary fat, saturated fat, polyunsaturated fat, monounsaturated fat, sodium, systolic and diastolic blood pressure, glucose, serum cholesterol, HDL, and LDL. Mean change in scores through 6 weeks was not significant for either intervention or control for triglycerides and C-reactive protein. We also considered whether the change scores were significantly different between intervention and control groups for each variable. Significantly greater changes were experienced by the intervention group for all variables except sodium, triglycerides, and C-reactive protein. The control group had significantly higher total cholesterol, LDL, and HDL at 6 weeks.

Mean baseline, 6-week, and change scores are presented according to standard health risk cut points for the risk factor variables and intervention (Table 1) and control status (Table 2). This analysis stratifies results according to risk status. Individuals with low risk would not be expected to experience large changes, but risk values considered to be high would be expected to change significantly. For the intervention group, the distributions favorably changed between baseline and 6 weeks for systolic and diastolic blood pressure, total cholesterol, LDL cholesterol, and fruit and vegetable consumption. Corresponding significant changes in the distributions between baseline and 6 weeks were not observed in the control group. Mean change scores within baseline risk categories tended to be significant for both intervention and control groups. They were, however, more significant in the intervention group and the favorable changes in risk behaviors were generally higher for those in the intervention group.

DISCUSSION

Findings from this study indicate that lifestyle change can result in significant short-term improvements in

Table 1. Health risk prevalence and baseline means, follow-up means, and change scores through 6 weeks for the intervention group

	Baseline		6 Weeks		χ^2 (trend)	Baseline	Follow-up	Mean	T statistic
	n	%	n	%	*P* value[a]	mean	mean[b]	change	*P* value
BMI[c]									
Underweight (<18.5)	0	0.00	0	0.00	.3066	—	—	—	—
Normal (18.5-24.9)	24	14.37	29	17.37		22.74	22.00	−0.74	<.0001
Overweight (25.0-29.9)	43	25.75	47	28.14		27.72	26.63	−1.09	<.0001
Obese (≥30.0)	100	59.88	91	54.49		38.31	36.91	−1.40	<.0001
Systolic BP[d] (mm Hg)									
Normal (<120)	49	29.34	79	47.31	.0003	111.08	109.15	−1.93	.2458
Prehypertensive (120-139)	78	46.71	67	40.12		129.31	122.14	−7.17	<.0001
High (140-159)	32	19.16	17	10.18		147.77	134.56	−13.21	<.0001
Dangerous (≥160)	8	4.79	4	2.40		167.50	152.12	−15.38	.0001
Diastolic BP (mm Hg)									
Normal (<80)	92	55.09	127	76.05	<.0001	71.90	69.67	−2.23	.0046
Prehypertensive (80-89)	53	31.74	36	21.56		83.45	77.00	−6.45	<.0001
High (90-99)	20	11.98	3	1.80		93.25	79.20	−14.05	<.0001
Dangerous (≥100)	2	1.20	1	0.60		—	—	—	—
Total CHOL[e] (mg/dL)									
Normal (<200)	99	59.28	135	80.84	<.0001	172.0	166.0	−6.0	.0144
Borderline (200-239)	19	11.38	12	7.19		214.8	191.6	−23.2	<.0001
High risk (≥240)	49	29.34	20	11.98		257.3	214.2	−43.1	<.0001
LDL[f] (mg/dL)									
Optimal (<100)	42	25.15	56	33.53	.0102	85.02	87.90	2.88	.6289
Above optimal (100-129)	67	40.12	73	43.71		115.76	107.96	−7.80	.0019
Borderline (130-159)	42	25.15	30	17.96		142.57	123.21	−19.36	<.0001
High (160-189)	14	8.38	7	4.19		172.64	133.93	−38.71	<.0001
Very high (≥190)	2	1.20	1	0.60		—	—	—	—
HDL[g] (mg/dL)									
High (≥60)	17	10.18	15	8.98	.2716	70.00	61.29	−8.71	<.0001
Normal (40-59)	82	49.10	73	43.71		48.38	44.34	−4.04	<.0001
Low (<40)	68	40.72	79	47.31		34.48	33.50	0.98	.2222
Triglycerides[h] (mg/dL)									
Normal (<150)	119	71.26	115	68.86	.6749	88.96	103.75	14.79	.0026
Borderline (150-199)	26	15.57	30	17.96		171.23	158.38	−12.85	.2084
High (200-499)	20	11.98	21	12.57		286.35	213.55	−72.80	<.0001
Very high (≥500)	1	1.20	1	0.60		—	—	—	—
Glucose (mg/dL)									
Normal (<110)	132	79.04	137	82.04	.2686	93.72	92.35	−1.37	.3022
IFG[i] (110-125)	14	8.38	17	10.18		113.93	106.79	−7.14	.0691
Diabetes (≥126)	21	12.57	13	7.78		152.00	132.52	−19.48	<.0001
Fruit and vegetable (servings/d)									
Low (<5/day)	108	64.67	47	28.14	<.0001	3.20	6.66	3.46	<.0001
Healthy (≥5/day)	59	35.33	120	71.86		7.74	9.17	1.43	.0015

[a]Mantel-Haenszel χ^2 test.
[b]Follow-up means are from the same individuals in each baseline risk category.
[c]BMI=body mass index.
[d]BP=blood pressure.
[e]CHOL=cholesterol.
[f]LDL=low-density lipoprotein.
[g]HDL=high-density lipoprotein.
[h]n does not equal 167 due to missing data point.
[i]IFG=impaired fasting glucose.

health knowledge, nutrition, and physical activity behavior, and significant improvements in many chronic disease risk factors. Significant improvements in health knowledge among the intervention group were concurrent with improvements in nutrition and physical activity. The number of participants who consumed five servings of fruits and/or vegetables per day doubled as the average participant doubled the number of servings con-

Table 2. Health risk prevalence and baseline means, follow-up means, and change scores through 6 weeks for the control group

	Baseline		6 Weeks		χ^2 (trend)	Baseline	Follow-up	Mean	T statistic
	n	%	n	%	*P* value[a]	mean	mean[b]	change	*P* value
BMI[c]									
Underweight (<18.5)	1	0.59	1	0.59	≈1.0000	—	—	—	—
Normal (18.5-24.9)	43	25.29	45	26.47		23.15	23.06	−0.09	.3680
Overweight (25.0-29.9)	54	31.76	50	29.41		27.41	27.14	−0.27	.0035
Obese (≥30.0)	72	42.35	74	43.53		38.44	38.38	−0.06	.4543
Systolic BP[d] (mm Hg)									
Normal (<120)	60	35.29	81	47.65	.0656	111.07	109.92	−1.15	.4245
Prehypertensive (120-139)	66	38.82	55	32.35		128.73	123.23	−5.50	<.0001
High (140-159)	39	22.94	27	15.88		149.50	143.56	−5.94	.0011
Dangerous (≥160)	5	2.94	7	4.12		165.40	144.60	−20.80	<.0001
Diastolic BP (mm Hg)									
Normal (<80)	100	58.82	115	67.65	.1514	70.47	69.60	−0.87	.2811
Prehypertensive (80-89)	50	29.41	40	23.53		82.12	78.44	−3.68	.0015
High (90-99)	18	10.59	12	7.06		93.33	86.94	−6.39	.0009
Dangerous (≥100)	2	1.18	3	1.76		—	—	—	—
Total CHOL[e] (mg/dL)									
Normal (<200)	112	65.88	123	72.35	.3137	164.6	179.8	15.2	<.0001
Borderline (200-239)	22	12.94	15	8.82		219.8	222.8	3.0	.4284
High risk (≥240)	36	21.18	32	18.82		259.9	247.1	−12.8	.0611
LDL[f] (mg/dL)									
Optimal (<100)	46	27.06	34	20.00	.1255	82.02	93.98	11.96	.0072
Above optimal (100-129)	57	33.53	62	36.47		113.54	127.30	13.76	<.0001
Borderline (130-159)	46	27.06	45	26.47		142.67	144.89	2.22	.5381
High (160-189)	17	10.00	22	12.94		170.35	166.76	−3.59	.5020
Very high (≥190)	4	2.35	7	4.12		—	—	—	—
HDL[g] (mg/dL)									
High (≥60)	16	9.41	25	14.71	.0565	65.06	61.56	−3.5	.0450
Normal (40-59)	96	56.47	100	58.82		48.16	51.25	3.09	<.0001
Low (<40)	58	34.12	45	26.47		34.02	39.12	5.10	<.0001
Triglycerides (mg/dL)									
Normal (<150)	136	80.00	133	78.24	≈1.0000	83.56	90.65	7.09	.0738
Borderline (150-199)	17	10.00	23	13.53		171.94	171.38	−0.56	.9645
High (200-499)	16	9.41	13	7.65		262.75	215.94	−46.81	.0003
Very high (≥500)	1	0.59	1	0.59		—	—	—	—
Glucose (mg/dL)									
Normal (<110)	149	87.65	145	85.29	.5100	94.64	93.44	−1.2	.1658
IFG[h] (110-125)	14	8.24	16	9.41		113.21	109.93	3.28	.3272
Diabetes (≥126)	7	4.12	9	5.29		175.57	155.43	20.14	<.0001
Fruit and vegetable (servings/d)									
Low (<5/day)	105	61.76	96	56.47	.3215	3.22	3.78	0.56	.0077
Healthy (≥5/day)	65	38.24	74	43.53		7.82	7.28	−0.54	.0460

[a]Mantel-Haenszel χ^2 test.
[b]Follow-up means are from the same individuals in each baseline risk category.
[c]BMI=body mass index.
[d]BP=blood pressure.
[e]CHOL=cholesterol.
[f]LDL=low-density lipoprotein.
[g]HDL=high-density lipoprotein.
[h]IFG=impaired fasting glucose.

Table 3. Mean and frequency distributions for selected demographic variables according to intervention- and control-group status

	Intervention[a]		Control[b]		T statistic	*P* value
Age	50.4±11.1[c]		50.8±11.1[c]		−0.35	.7149
	n	%	n	%	χ^2	
Sex					0.15	.7008
Male	45	27.0	49	28.8		
Female	122	73.1	121	71.2		
Race					4.04	.1323
White	161	96.4	156	92.9		
Black	3	1.8	10	6.0		
Other	3	1.8	2	1.2		
Marital status					3.40	.3345
Never married	12	7.2	20	11.8		
Married	133	80.1	123	72.8		
Divorced	15	9.0	16	9.5		
Widowed	6	3.6	10	5.9		
Annual family income ($)					1.74	.6268
0-20,000	13	8.0	12	7.2		
20,001-40,000	35	21.5	27	16.3		
40,001-60,000	34	20.9	40	24.1		
>60,000+	81	49.7	87	52.4		
Education					7.36	.1179
< High school	6	3.6	7	4.1		
High school	34	20.4	45	26.5		
Some college	58	34.7	38	22.4		
College degree	37	22.2	37	21.8		
Post college degree	21	19.2	43	25.3		

[a]n may not equal 167 due to missing data points.
[b]n may not equal 170 due to missing data points.
[c]Mean±standard deviation.

sumed per day, leaving only 24% of the intervention group still eating fewer than five servings a day at follow-up. This is in contrast to Behavior Risk Factor Surveillance data from the state of Illinois, which shows that 79% of Illinoisans fail to get five servings a day (5).

Pedometer data show that the program participants increased pedometer monitored movement by 30%. This improvement in physical activity is corroborated with a significant decrease in resting heart rate, a correlated measure of cardiorespiratory fitness (26). Increases in physical activity can increase heart size, blood volume, stroke volume, and cardiac output (27).

Poor nutrition and sedentary living are associated with a constellation of risk factors, some of which have been identified in the metabolic syndrome, and all of which are known to be linked to diabetes, cardiovascular disease, and cancer. Improvements in nutrition and physical activity are associated with significant improvements in diabetes risk as whole body glucose tolerance improves, insulin sensitivity increases, and the amount of glucose transporter (GLUT4) increases (28). The Glucose section of Table 1 shows that the number of individuals in the intervention group who were diabetic (glucose≥126)* at baseline was reduced from 21 to 13, representing a 38% reduction in diabetes prevalence and a significant reduction in fasting blood glucose. The reductions in fasting blood glucose, body fat, and body weight reported here are similar to improvements reported from other evaluations of the program (8-10).

Lower blood pressure, improved blood lipids, and improved cardiac function are directly linked to reduced risk of cardiovascular disease. For every 1% drop in total cholesterol, the coronary risk drops by 2% to 3%; and for every 1 mm Hg drop in elevated diastolic blood pressure, there is another 2% to 3% drop in coronary risk (29). On average, the net decrease (between intervention and control group) was 3 mm Hg for diastolic blood pressure and 12% for total cholesterol. When only those with elevated baseline diastolic blood pressure (90 to 99 mm Hg) or cholesterol (>200 mg/dL)† were considered, then the net reductions were 7 mm Hg and 27 mg/dL (12.2% cholesterol reduction), respectively. Interventions with hypercholesterolemic patients using the National Cholesterol Education Program's step 1 and step 2 dietary interventions reported,

**To convert mmol/L glucose to mg/dL, multiply mmol/L by 18.0. To convert mg/dL glucose to mmol/L, multiply mg/dL by 0.0555. Glucose of 6.0 mmol/L=108 mg/dL.*

†To convert mmol/L cholesterol to mg/dL, multiply mmol/L by 38.7. To convert mg/dL cholesterol to mmol/L, multiply mg/dL by 0.026. Cholesterol of 5.00 mmol/L=193 mg/dL.

Table 4. Mean baseline scores and mean change in scores through 6 weeks by intervention and control groups

Variable	No.	Baseline		6 Weeks		T statistic
		Mean	Standard deviation	Mean change	Standard deviation	*P* value[a]
Health knowledge***						
Intervention	167	15.95	3.54	7.92	5.01	<.0001
Control	170	14.84	3.26	0.85	3.21	.0087
Total steps***						
Intervention	167	40,583	22,777	12,080	16,909	<.0001
Control	170	44,136	23,545	2,057	15,936	.1044
% of energy from fat***						
Intervention	163	36.26	6.59	−7.95	10.64	<.0001
Control	168	34.65	6.68	−0.64	5.36	.3257
% Carbohydrates***						
Intervention	163	49.26	8.39	10.57	12.54	<.0001
Control	168	51.01	8.07	0.51	6.12	.4994
Fruit and vegetable fiber (g)***						
Intervention	163	7.96	4.42	5.41	6.62	<.0001
Control	168	8.36	4.98	0.21	3.66	.6175
Vegetable servings***						
Intervention	163	3.37	2.14	1.58	2.60	<.0001
Control	168	3.42	2.20	0.03	1.80	.8735
Fruit servings***						
Intervention	163	1.47	1.07	1.15	1.46	<.0001
Control	168	1.58	1.05	0.11	0.87	.2162
Whole-grain servings***						
Intervention	163	5.52	3.08	1.04	2.93	<.0001
Control	168	5.04	2.44	−0.33	1.82	.0773
Meat servings*						
Intervention	163	2.07	1.40	−0.48	1.39	<.0001
Control	168	1.89	1.19	−0.10	1.12	.3114
Total dietary fat (g)***						
Intervention	163	87.02	55.58	−28.93	51.64	<.0001
Control	168	76.73	42.48	−7.83	29.03	.0155
Dietary cholesterol (mg)***						
Intervention	163	209.60	143.09	−84.02	157.16	<.0001
Control	168	179.00	109.01	−11.97	81.15	.2138
Polyunsaturated fat (g)**						
Intervention	163	20.93	14.20	−5.91	12.38	<.0001
Control	168	19.24	11.93	−1.79	8.60	.0305
Monounsaturated fat (g)***						
Intervention	163	33.67	21.61	−11.65	23.51	<.0001
Control	168	29.79	17.05	−3.23	13.46	.0144
Saturated fat (g)***						
Intervention	163	25.70	17.40	−9.97	16.54	<.0001
Control	168	21.78	12.01	−2.51	7.89	.0120
Sodium (mg)						
Intervention	163	2,921	1,524	−326	1181	<.0001
Control	168	2,700	1,223	−204	903	.0124
Calories						
Intervention	163	2,079	1,031	−350	859	<.0001
Control	168	1,917	802	−146	554	.0091
Weight (lb)***						
Intervention	167	205.44	53.56	−7.55	4.72	<.0001
Control	170	192.31	56.23	−0.29	8.51	.5817
Percent body fat***						
Intervention	163	36.26	7.31	−7.95	10.64	<.0001
Control	168	34.65	7.39	−0.64	5.36	.3257

Table 4. Mean baseline scores and mean change in scores through 6 weeks by intervention and control groups (continued)

Variable	No.	Baseline		6 Weeks		T statistic *P* value[a]
		Mean	Standard deviation	Mean change	Standard deviation	
Systolic BP[b] (mm Hg)						
Intervention	167	129.33	16.37	−7.20	11.86	<.0001
Control	170	128.34	16.83	−4.52	11.59	<.0001
Diastolic BP (mm Hg)*						
Intervention	167	78.49	9.30	−5.04	8.11	<.0001
Control	170	76.68	9.67	−2.31	8.19	.0003
Resting heart rate (beats/min)						
Intervention	162	73.26	10.20	−2.83	10.32	.0009
Control	166	72.06	10.55	0.16	11.18	.8458
Glucose (mg/dL)						
Intervention	166	102.80	23.08	−4.11	15.74	.0003
Control	166	99.62	19.45	−2.40	13.00	.0335
Cholesterol (mg/dL)***						
Intervention	166	191.86	31.82	−14.43	28.22	<.0001
Control	166	189.93	38.14	8.86	26.50	<.0001
HDL[c] (mg/dL)***						
Intervention	166	44.98	12.14	−3.39	7.13	<.0001
Control	166	45.19	10.39	2.85	7.22	<.0001
LDL[d] (mg/dL)***						
Intervention	165	120.96	28.96	−11.22	22.95	<.0001
Control	166	121.70	32.60	6.03	24.30	.0012
Triglycerides (mg/dL)						
Intervention	166	133.28	102.19	0.35	59.24	.9513
Control	166	114.40	86.90	0.47	55.50	.9032
CRP[e] (mg/dL)						
Intervention	162	4.04	3.56	−0.28	2.88	.2407
Control	164	3.70	3.45	0.03	3.20	.9071

[a]Evaluating the change in means from baseline through 6 weeks within categories of group.
[b]BP=blood pressure.
[c]HDL=high-density lipoprotein.
[d]LDL=low-density lipoprotein.
[e]CRP=C-reactive protein.
*$P<.01$, based on the T statistic assessing difference in mean change scores between groups.
**$P<.001$, based on the T statistic assessing difference in mean change scores between groups.
***$P<.0001$, based on the T statistic assessing difference in mean change scores between groups.

on average, total cholesterol reductions of 10% and 13%, respectively (30,31).

Blood pressure changes among program participants were equally dramatic. The baseline prevalence of hypertension in the intervention group was 18.5%; at follow up the prevalence was reduced to 7.5%. The PREMIER Clinical trial used a 6-month comprehensive lifestyle modification trial to reduce blood pressure (32). Hypertension prevalence at baseline and 6 months in this study was 38% and 12%, respectively, providing further support that change in nutrition and physical activity can directly impact blood pressure, especially among those who are hypertensive. Medication monitoring revealed that 12 program participants reduced their blood pressure medication during the intervention, suggesting that the program could have produced reductions in blood pressure greater than what was measured.

Ideally, individuals who participate in lifestyle interventions would adopt and maintain healthful behaviors for life. In reality, once the lifestyle interventions are completed, many individuals eventually fail to completely embrace new lifestyle habits and revert to pretreatment behavior. This phenomenon could be called healthful lifestyle decay and is thought to begin sometime after the completion of a lifestyle intervention. The short-term nature of this study sheds little light on long-term adherence, but it does allow for an accurate assessment of the acute benefit of the intervention. If follow-up data had only been collected at 12 months, it is likely that the data could have missed the period of greatest behavior change and risk factor improvement.

The observed improvements in behavior and risk reported here are not unexpected. The participants were mostly white and sufficiently self motivated to volunteer to participate in the intervention. On average, participants were slightly more educated than the community average. Participants had lifestyles that permitted them to attend most, if not all, of the classes. This is evident in

the high rate of attendance to this time-intensive program. These delimitations do threaten the generalizability of these findings and make application of the intervention to other populations problematic. Because the participants were somewhat select, the results from this intervention may represent a best-case scenario.

Other factors may explain the impact of this program. In the intervention, participants attended highly interactive lectures structured around the health belief and transtheoretical models (33,34). Video clips, testimonials, role playing, short presentations from physicians, social support strategies, food selection and planning activities, and other behavior-change-driven pedagogical activities all helped to encourage participants to enthusiastically evaluate personal behaviors and commit to make changes. To prevent relapse and help participants maintain their new behaviors, the program graduates were invited to participate in the alumni program. This group received a monthly newsletter, held socials, dinners, and special events designed to help participants maintain their new behaviors.

Despite the observed efficacy of this intervention, shortcomings of the study warrant discussion. Both the physical activity and nutrition data were self-reported. Also, for some variables the control group experienced significant improvement. Small but significant decreases in energy intake, percent of energy from fat, and sodium intake were found as well as small reductions in blood pressure and glucose. It is plausible that members of the control group may have made some positive lifestyle changes as they anticipated their own program participation some 6 months later. Further confounding may have occurred in that they may have frequented some of the 30 restaurants in the Rockford area that offer healthful CHIP menu items.

Ideally, individuals who participate in lifestyle interventions would adopt and maintain healthful behaviors for life.

This intervention, with a free-living though self-selected population, is an efficacious behavior-change intervention in the short term. Large beneficial changes in health behavior and risk factor levels were observed. Until long-term evaluations are completed, it remains to be seen if these improvements can be maintained and if long-term chronic disease incidence can be reduced.

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