Effectiveness of a Volunteer-Delivered Lifestyle Modification Program for Reducing Cardiovascular Disease Risk Factors

Paul Rankin, MPH[a], Darren P. Morton, PhD[a,*], Hans Diehl, DrHSc[b], John Gobble, DrPH[c], Peter Morey, EdD[a], and Esther Chang, PhD[d]

Lifestyle modification has been demonstrated to effectively reduce the risk factors associated with cardiovascular disease, but there is a perception that it is costly to administer and resource. The present study examined the results achieved by a 30-day lifestyle modification program (Coronary Health Improvement Project) delivered by volunteers in a community setting. Changes in selected biometric measures of 5,070 participants in the Coronary Health Improvement Project programs delivered throughout North America (January 2006 to October 2009), were assessed. Overall, significant reductions ($p < 0.001$) were recorded in body mass (−3.2%), systolic and diastolic blood pressure (−4.9% and −5.3%, respectively), total cholesterol (−11.0%), low-density lipoprotein cholesterol (−13.0%), triglycerides (−7.7%), and fasting plasma glucose (−6.1%). Stratification of the data revealed more dramatic responses in those presenting with the greatest risk factor levels. Those presenting with cholesterol levels >280 mg/dl recorded an average reduction of 19.8%. A mean decrease of 16.1% in low-density lipoprotein levels was observed among those who entered the program with a low-density lipoprotein level >190 mg/dl. Individuals who presented with triglycerides >500 mg/dl recorded a mean reduction of 44.1%. The Framingham assessment forecast that approximately 70 cardiac events would be averted during the subsequent decade in the cohort because of the program. In conclusion, significant reductions in cardiovascular disease risk factors can be achieved in a 30-day lifestyle intervention delivered by volunteers, providing a cost-effective mode of administering lifestyle medicine. **(Am J Cardiol 2011;xx:xxx)**

Lifestyle modification programs have been shown to be effective in the treatment of cardiovascular disease (CVD).[1] One cost-effective, community-based lifestyle modification program that has demonstrated meaningful reductions in CVD risk factors is the Coronary Health Improvement Project (CHIP),[2] which has been delivered by health professionals in hospitals[3] and workplace environments.[4] Although CHIP has been successfully delivered by health professionals since 1987, a video-taped version of the program has been made available more recently for volunteers to conduct CHIP programs in their local community. The delivery of lifestyle modification programs by harnessing the energies of trained and certified volunteer directors who might be well-placed to nurture relations with participants in their community has the potential to elevate lifestyle medicine resourcing issues, while also making the programs more cost-effective. The aim of the present study was to determine the effectiveness of volunteer-directed, community-based CHIP programs on participants' CVD risk factors and other biometric measures.

Methods

The study was observational and evaluated the pre- to postbiometric changes of 5,070 subjects who had self-selected to participate in a CHIP program. A total of 176 CHIP programs (mean group size 29, range 3 to 228) were conducted at 136 sites throughout North America from January 2006 to October 2009. The Avondale College human research ethics committee approved the study (approval number 20:10:07).

The CHIP programs were facilitated by volunteer directors, sourced primarily through the Seventh-Day Adventist Church, who had an interest in positively influencing the health of their local community. The volunteers underwent a 2-day training workshop at a cost of $250 per team of 3, during which they received instruction and detailed manuals regarding the program's philosophy, content, and method. They were then provided with a comprehensive resource package that included all the materials required to deliver the program.

During the 30 days of the program, the participants received comprehensive lifestyle counseling through 16 two-hour group sessions. Each session typically included a 1-hour recorded lecture by an epidemiologically trained lifestyle interventionist (Dr. Hans Diehl), cooking demonstrations, group discussion, and an exercise component. Also incorporated into the program were shopping tours and

[a]Lifestyle Education Research Group, Faculty of Education and Science, Avondale College of Higher Education, New South Wales, Australia; [b]Lifestyle Medicine Institute, Loma Linda, California; [c]Medical Nutrition Therapy Northwest, Clackamas, Oregon; and [d]University of Western Sydney, School of Nursing and Midwifery, New South Wales, Australia. Manuscript received May 6, 2011; revised manuscript received and accepted July 29, 2011.

*Corresponding author: Tel: (+61) 24-980-2161; fax: (+61) 24-980-2166.

E-mail address: darren.morton@avondale.edu.au (D. Morton).

0002-9149/11/$ – see front matter
doi:10.1016/j.amjcard.2011.07.069

Table 1
Mean changes in selected risk factors from baseline to after intervention for various risk factors

Factor	Participants (n)	Baseline	After Intervention	Mean Change	% Change	t Statistic	p Value
Weight (lb)	4,607	192.3 ± 50.4	186.2 ± 48.2	−6.1	−3.2%	69.8	<0.001
Body mass index (kg/m^2)	4,536	31.0 ± 7.3	30.0 ± 7.0	−1.0	−3.2%	72.3	<0.001
Systolic blood pressure (mm Hg)	4,579	133.2 ± 19.3	126.7 ± 25.5	−6.5	−4.9%	17.7	<0.001
Diastolic blood pressure (mm Hg)	4,577	79.9 ± 11.3	75.7 ± 10.0	−4.2	−5.3%	27.7	<0.001
Total cholesterol (mg/dl)	4,674	193.6 ± 41.7	172.3 ± 39.9	−21.3	−11.0%	54.3	<0.001
Low-density lipoprotein (mg/dl)	4,568	131.0 ± 62.0	114.0 ± 54.8	−17.0	−13.0%	41.7	<0.001
High-density lipoprotein (mg/dl)	4,673	54.8 ± 25.7	50.1 ± 23.1	−4.7	−8.6%	36.4	<0.001
Triglycerides (mg/dl)	4,669	143.5 ± 90.0	132.5 ± 74.7	−11.0	−7.7%	12.3	<0.001
Fasting plasma glucose (mg/dl)	4,631	101.1 ± 28.9	94.9 ± 31.1	−6.2	−6.1%	23.0	<0.001
Framingham score	3,689	12.2 ± 9.3	10.4 ± 7.8	−1.8	−14.7%	17.4	<0.001

Data are presented as mean ± SD, unless noted otherwise.

nutrition workshops. The participants paid a fee of $250 to cover the costs of the biomedical assessments, food samples distributed throughout the program, and resources, including a textbook and supplementary reading.

The program encouraged participants to move toward a whole-food, plant-based diet ad libitum, with emphasis on the consumption of grains, legumes, fresh fruits, and vegetables. Specifically, the program recommended <15% of calories be derived from fat, with <10 teaspoons of added sugar, <5,000 mg of salt (2,000 mg sodium), and <50 mg of cholesterol per day. The participants were also encouraged to consume 2 to 2.5 L (eight 10-oz glasses) of water daily.[5] At least 30 minutes of daily aerobic exercise (or 10,000 steps) was prescribed, and stress reduction techniques were advocated.

The intent of the CHIP program was to nurture intelligent self-care through enhanced understanding of the epidemiology, etiology, and risk factors associated with CVD. The CHIP curriculum included the following topics: modern medicine's accomplishments and limitations, atherosclerosis, cardiovascular risk factors, smoking, exercise, dietary fiber, cholesterol, plant-based nutrition, obesity, diabetes, hypertension, dyslipidemia, lifestyle and health, behavioral change, and self-worth.[5]

The participants were encouraged to consult their physician throughout the program, because previous experience has demonstrated that it is necessary to modify medication use because of the intervention.

The participants who attended a minimum of 13 of the 16 sessions and completed the pre- and postassessments "graduated" from the program and were encouraged to join a CHIP alumni group, which met monthly to provide ongoing support for the lifestyle changes initiated during the intervention.

Before participating in the CHIP program (baseline) and again at its conclusion (postintervention), the participants' height, weight, and blood pressure were taken and fasting (12-hour) blood samples were collected. The blood samples were collected by trained phlebotomists and analyzed by local pathology laboratories for determination of the total cholesterol, low-density lipoprotein, high-density lipoprotein, triglycerides, and fasting plasma glucose levels. In addition, the participants completed a self-reported medical/lifestyle questionnaire. The questionnaire included demographic data, a brief medical and family history, details of medication use, and various measures of lifestyle habits such as dietary behavior, activity level, rest, and the use of alcohol, caffeine, and tobacco.

The data were entered into a specially developed Microsoft Access program, exported into Microsoft Excel (Microsoft, Redmond, Washington) and then imported into PASW Statistics, version 18 (SAS Institute, Cary, North Carolina), for analysis. The data are expressed as the mean ± SD. The extent of the changes (from baseline to postintervention) in the biometric measures and risk factors, for both the overall and the stratified data, were assessed using paired *t* tests. The McNemar chi-square test was used to determine the changes from before to after the intervention in the distribution of participants across the various risk factor categories. The participants were classified as having the metabolic syndrome at baseline and after intervention, according to the "harmonized definition,"[6] and a Mantel-Haenszel chi-square test was used to test the assumption that there was no significant difference between the number of participants with the metabolic syndrome from baseline to after the intervention.

Results

The 5,070 participants (mean age 57.2 ± 12.9 years) included 1,694 men (57.8 ± 13.0 years) and 3,372 women (56.9 ± 12.9 years). Of these participants, 210 (4.1%) self-reported a history of myocardial infarction, 111 (2.1%) had undergone bypass surgery, 101 (2.0%) had experienced a stroke, and 439 (8.7%) had a history of cancer.

The mean changes from baseline to after the intervention for all participants combined are presented in Table 1. Significant reductions were recorded in all the risk factors, with the most notable being in total cholesterol (−11%). High-density lipoprotein cholesterol also decreased after the intervention but not to the same magnitude as total cholesterol, reducing the total cholesterol/high-density lipoprotein ratio from 4.02:1 to 3.89:1 ($p < 0.001$).

A significant reduction ($p < 0.001$) was found in the number of participants requiring medication because of the program, with 1,085 participants (21.4%) reporting medication use at the start of the intervention and 879 (17.4%) at its conclusion. The most common medications taken by the

Table 2
Changes in risk factor levels within 30 days according to initial risk factor classification

Risk Factor	Participants (n)		McNemar Chi-square Test (p Value)	Baseline	After Intervention	Mean Change	% Mean Change	p Value
	Baseline	After Intervention						
Body mass index (kg/m^2)								
<18.5	27	33	449 (<0.001)	17.6 ± 0.9	17.5 ± 0.8	−0.1	−0.8%	0.144
18.5–24.9	884	1,086		22.7 ± 1.6	22.3 ± 1.7	−0.5	−2.1%	<0.001
25–30	1,470	1,539		27.5 ± 1.4	26.6 ± 1.5	−0.9	−3.1%	<0.001
>30	2,242	1,965		36.6 ± 6.1	35.4 ± 6.0	−1.3	−3.4%	<0.001
Systolic blood pressure (mm Hg)								
<120	1,279	1,866	662 (<0.001)	111.8 ± 9.0	114.5 ± 27.0	2.7	2.4%	<0.001
120–139	1,719	1,788		129.9 ± 5.1	125.2 ± 27.0	−4.7	−3.6%	<0.001
140–160	1,127	743		147.2 ± 5.8	134.3 ± 13.1	−12.9	−8.7%	<0.001
>160	454	182		170.7 ± 11.9	147.3 ± 17.6	−23.3	−13.7%	<0.001
Diastolic blood pressure (mm Hg)								
<80	2,619	3,364	560 (<0.001)	72.4 ± 6.9	71.8 ± 8.9	−0.7	−0.9%	<0.001
80–89	1,060	822		84.8 ± 2.3	78.3 ± 7.7	−6.4	−7.6%	<0.001
90–100	688	322		92.9 ± 3.0	82.7 ± 8.4	−10.2	−10.9%	<0.001
>100	210	69		106.2 ± 13.0	87.7 ± 10.3	−18.5	−17.4%	<0.001
Total cholesterol (mg/dl)								
<160	631	1,862	1,950 (<0.001)	141.0 ± 18.7	133.2 ± 24.8	−7.8	−5.6%	<0.001
160–199	2,116	1,781		182.5 ± 15.7	165.5 ± 24.4	−17.0	−9.3%	<0.001
200–239	1,261	756		215.6 ± 10.5	188.5 ± 25.5	−27.1	−12.6%	<0.001
240–280	478	183		254.7 ± 10.7	215.2 ± 30.7	−39.5	−15.5%	<0.001
>280	126	30		306.6 ± 27.2	245.9 ± 43.4	−60.7	−19.8%	<0.001
Low-density lipoprotein (mg/dl)								
<100	1,453	2,115	1,008 (<0.001)	80.6 ± 15.1	75.3 ± 209.1	−5.3	−6.6%	<0.001
100–129	1,345	1,326		114.6 ± 8.3	102.1 ± 20.2	−12.5	−10.9%	<0.001
130–159	905	588		142.4 ± 8.5	120.1 ± 21.8	−22.3	−15.7%	<0.001
160–190	377	197		172.0 ± 8.2	141.6 ± 27.1	−30.4	−17.7%	<0.001
>190	488	342		273.9 ± 67.9	229.8 ± 73.1	−44.1	−16.1%	<0.001
High-density lipoprotein (mg/dl)								
<40	1,316	1,814	539 (<0.001)	34.2 ± 4.8	33.2 ± 7.0	−1.0	−3.0%	<0.001
40–60	2,097	1,912		48.9 ± 5.3	45.0 ± 7.8	−3.8	−7.8%	<0.001
≥60	1,261	948		86.3 ± 29.8	76.2 ± 28.5	−10.1	−11.8%	<0.001
Triglycerides (mg/dl)								
<100	3,053	3,232	109 (<0.001)	95.5 ± 29.7	99.7 ± 41.8	4.2	4.4%	<0.001
100–199	753	765		171.9 ± 13.9	158.1 ± 53.0	−13.8	−8.1%	<0.001
200–500	820	663		270.5 ± 62.4	220.1 ± 81.8	−50.3	−18.6%	<0.001
>500	45	11		634.7 ± 114.2	354.8 ± 158.5	−279.9	−44.1%	<0.001
Fasting plasma glucose (mg/dl)								
<110	3,716	4,026	265 (<0.001)	90.7 ± 9.9	88.6 ± 10.9	−2.1	−2.3%	<0.001
110–125	390	304		116.1 ± 15.5	106.0 ± 15.5	−10.1	−8.7%	<0.001
>125	525	301		164.0 ± 42.2	131.4 ± 34.5	−32.6	−19.9%	<0.001

Data are presented as mean ± SD, unless noted otherwise.

participants were to lower cholesterol and/or blood pressure. Of the 102 smokers at baseline, only 64 were still smoking at the end of the 30-day program.

The effect of the intervention on the various risk factors was analyzed further, with the results listed in Table 2; the data were stratified by conventional risk factor categories. The National Cholesterol Education Program Adult Treatment Panel III classification system[7] was used to categorize the participants for all risk factors, except total cholesterol, for which the Framingham risk classification[8] was used. The Framingham classification was used for stratification of the cholesterol data, because it includes 5 categories compared to only 3 in the National Cholesterol Education Program Adult Treatment Panel III classification system and thus allowing a more detailed analysis of the effect of the intervention on the highest risk participants.

The chi-square analyses were highly significant for all risk factors, indicating substantive changes in the distribution of participants across the various categories. Of the participants presenting with the highest category total cholesterol levels of >280 mg/dl at baseline, 77% no longer belonged in this classification by the end of the intervention. Similarly, 224 (43%) of those with fasting plasma glucose levels >125 mg/dl at baseline had reduced their risk factor categorization after the intervention. There was a significant ($p < 0.001$) 10.4% reduction in the number of participants classified as having the metabolic syndrome from baseline (n = 2,111) to after the intervention (n = 1,891).

To show the clinical significance of the results, Table 3 presents the stratified results using the Framingham 10-year heart risk score assessment,[8] which has been shown to be an indicator of the potential risk of a coronary event in the next

Table 3
Framingham assessment at baseline and postintervention

Variable	Patients (n)	Baseline	After Intervention	Mean Change	% Change	t Statistic	p Value
Framingham scores							
Category 1 (<2)	800	0.4 ± 1.8	0.3 ± 2.3	0.1	25.9%	−1.1	0.294
Category 2 (3–6)	1,553	4.6 ± 1.1	4.2 ± 2.1	−0.4	−8.5%	8.1	<0.001
Category 3 (7–10)	1,131	8.2 ± 1.1	6.9 ± 2.0	−1.3	−15.7%	21.4	<0.001
Category 4 (>11)	205	11.8 ± 1.0	9.3 ± 2.3	−2.4	−20.7%	16.8	<0.001
Combined	3,689	5.2 ± 3.5	4.5 ± 3.4	−0.7	−13.2%	20.1	<0.001
Framingham 10-year risk of myocardial infarction (%)							
Category 1 (1–5%)	800	3.2 ± 1.0	3.7 ± 1.8	0.5	15.5%	−8.0	<0.001
Category 2 (6–11%)	1,553	8.4 ± 1.9	8.4 ± 4.3	−0.04	−0.5%	0.5	0.639
Category 3 (12–27%)	1,131	18.8 ± 4.5	15.1 ± 6.9	−3.8	−20.0%	18.0	<0.001
Category 4 (>28%)	205	38.4 ± 7.2	25.7 ± 11.4	−12.7	−33.2%	16.9	<0.001
Combined	3,689	12.2 ± 9.3	10.4 ± 7.8	−1.8	−4.7%	17.4	<0.001

Data are presented as mean ± SD, unless noted otherwise.

10 years.[7,9,10] As with the risk factors listed in Table 2, the greatest improvements were observed among participants ranked in the greatest risk categories at baseline. The mean 1.8% reduction in the predicted likelihood of experiencing a cardiac event during the 10 years after the CHIP program suggests that the intervention would save approximately 70 coronary episodes for this cohort.

Discussion

Although the study results represent observational data in that the participants were self-selected and no control group was included, the results are nonetheless noteworthy. Clearly, significant reductions in body weight and CVD risk factors can be achieved through a lifestyle intervention program delivered in a community setting by volunteers. Furthermore, those with the greatest risk benefited the most. Harnessing the energy of volunteer directors, who need not be health professionals, presents a potentially powerful and cost-effective mode for administering lifestyle medicine. Sourcing volunteers might be best achieved through community-oriented groups such as faith-based organizations and other community interest groups.

The mean changes in body mass and CVD risk factors observed in the study were substantive when considering the period during which they were achieved. The 6.1-lb reduction in body mass, equating to a 3% decrease, might in itself be clinically significant. Although in the combat of the metabolic syndrome and associated CVD, a 10% reduction in body mass is the goal during the first year, 5% can be helpful,[11] and the participant in the present study made good progress toward this goal within the 30 days. Also, the observed changes in the blood lipid profile compared favorably to those achieved with statin medication.[12]

The merits of volunteer-directed, community-based lifestyle interventions, such as CHIP, are evident, given that they are inexpensive to administer while potentially yielding substantive reductions in the fiscal burden associated with lifestyle diseases. Importantly, these outcomes are achieved without adverse side effects. The potential savings from reducing total cholesterol alone in the present study are noteworthy. The results of a meta-analysis conducted by Gould et al[12] indicate that the mean decrease of 21.3 mg/dl in total cholesterol observed among the participants in the present study would translate to a 20% reduction in relative risk for all-cause mortality. The Framingham assessment, which predicted the avoidance of almost 70 cardiac events during the following decade for the cohort, further adds to the economic rationale for the program. The cost of diabetes care and medications would also have been reduced, given that almost ½ of the participants who entered the program with "diabetic" fasting glucose levels reduced their classification within the 30 days. Although the extent of economic savings arising from the program is difficult to estimate, it is likely to be substantial.

Two important factors might have confounded the results observed in the present study. First, compliance was not assessed; therefore, the extent to which the participants adhered to the lifestyle changes advocated by the program is not known. Additional studies will gather valid measures of the various lifestyle changes made by participants during the CHIP program to elucidate the contributions of these behavioral changes to the results achieved. Undoubtedly, not all participants completely embraced the behavioral changes recommended in the program; however, this would have only diluted the overall effectiveness of the results.

A second confounding factor was that many participants decreased or even ceased their medication use, in consultation with their personal physician, throughout the 30-day CHIP program. Although this is a desirable outcome, it too would have had the effect of diminishing the observed effectiveness of the program as reflected in the mean changes from baseline to after intervention.

The results observed in the present study using volunteer directors are comparable with those achieved by CHIP programs delivered by health professionals.[3,13] Although this might be surprising, the volunteer directors were resourced with professionally generated materials. For example, a cardiovascular epidemiologist presented the prerecorded lectures viewed by the participants at each session. Furthermore, it has been documented that passionate volunteers can possess strong motivational properties and have the ability to incite their peers to action.[14] Many of the volunteer

directors of the CHIP programs in the present study were CHIP alumni and therefore had a strong investment and bond with the program. Conceivably, the volunteer director with experiential and emotional ties to a program might even be able to establish better rapport and be more inspirational to participants than certain health professionals.

The results of the present study have demonstrated that volunteers can be valuable social capital in the combat of CVD. Resourced with appropriate, well-developed materials and programs, volunteers can act as powerful agents of change for health promotion within their community.

1. Esselstyn CB Jr. Updating a 12-year experience with arrest and reversal therapy for coronary heart disease (an overdue requiem for palliative cardiology). *Am J Cardiol* 1999;84:A338.
2. Diehl HA. Coronary risk reduction through intensive community-based lifestyle intervention: the CHIP experience. *Am J Cardiol* 1998; 82:83T–87T.
3. Merrill RM, Aldana SG. Cardiovascular risk reduction and factors influencing loss to follow-up in the coronary health improvement project. *Med Sci Monit* 2008;14:PH17–25.
4. Aldana SG, Greenlaw R, Diehl HA, Englert H, Jackson R. Impact of the coronary health improvement project (CHIP) on several employee populations. *J Occup Environ Med* 2002;44:831–839.
5. Englert HS, Dhiel HA, Greenlaw RL. Rationale and design of the Rockford CHIP, a community-based coronary risk reduction program: results of pilot phase. *Prevent Med* 2004;38:432–441.
6. Alberti KG, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, Fruchart J-C, James WPT, Loria CM, Smith SC Jr; International Diabetes Federation Task Force on Epidemiology and Prevention, National Heart, Lung, and Blood Institute, American Heart Association, World Heart Federation, International Atherosclerosis Society, International Association for the Study of Obesity. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute, American Heart Association; World Heart Federation; International Atherosclerosis Society and International Association for the Study of Obesity. *Circulation* 2009;120:1640–1645.
7. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation* 2002;106:3143–3421.
8. Wilson PWF, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. *Circulation* 1998;97:1837–1847.
9. Kohli P, Greenland P. Role of the metabolic syndrome in risk assessment for coronary heart disease. *JAMA* 2006;295:819–821.
10. Borch-Johnsen K, Wareham N. The rise and fall of the metabolic syndrome. *Diabetologia* 2010;53:597–599.
11. McClendon DA, Dunbar SB, Clark PC, Coverson DL. An analysis of popular weight loss diet types in relation to metabolic syndrome therapeutic guidelines. *Medsurg Nurs* 2010;19:17–24.
12. Gould AL, Davies GM, Alemao E, Yin DD, Cook JR. Cholesterol reduction yields clinical benefits: meta-analysis including recent trials. *Clin Ther* 2007;29:778–794.
13. Englert HS, Diehl HA, Greenlaw RL, Willich SN, Aldana S. The effect of a community-based coronary risk reduction: the Rockford Chip. *Prevent Med* 2007;44:513–519.
14. Kong BW. Community-based hypertension control programs that work. *J Health Care Poor Underserved* 1997;8:409–415.