



## The effect of a community-based coronary risk reduction: The Rockford CHIP

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### Abstract

**Objective.** The aim of this study was to assess the clinical effects of a community-based lifestyle intervention program in reducing coronary risk, especially in a high risk group.

**Method.** The 40-hour educational curriculum of the Coronary Health Improvement Project (CHIP) delivered over a 30-day period with clinical and nutritional assessments before and after was offered in the spring and fall of 2000 to 2002 through the Center for Complementary Medicine of the SwedishAmerican Health System in Rockford, Illinois to its employees and the general public. The participants were instructed to optimize their diet, quit smoking and exercise daily (walking 30 min/day).

**Results.** The data of the 5 CHIP programs were pooled and analyzed. 544 men and 973 women (almost all Caucasian; mean age 55 years) were eligible for analysis. At the end of the 30-day intervention period, stratified analyses of total cholesterol, LDL, triglycerides, blood glucose, blood pressure and weight showed highly significant reductions with the greatest improvements among those at highest risk.

**Conclusion.** Well-designed community-based intervention programs can improve lifestyle choices and health habits. They can also markedly and rather quickly reduce the level of coronary risk factors in a non-randomized population.

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**Keywords:** Community-based lifestyle intervention strategies; Coronary risk reduction; Diet; Exercise; Healthy communities; Lifestyle medicine

### Introduction

Cardiovascular disease (CVD) is the leading cause of death and disability in developed countries worldwide and accounts for almost 40% of all deaths in the United States (American Heart Association, 2005). At the same time the explosive increase in the prevalence of obesity and type 2 diabetes will continue to fuel this coronary epidemic for years to come (Bonow et al., 2002).

Worldwide research conducted over several decades has identified genetic and environmental hypercholesterolemia, overweight, hypertension, diabetes, smoking, sedentary living

and stress. Several studies suggest that coronary risk factors tend to cluster in individuals (Criqui et al., 1980; Daviglus et al., 1998; Jousilahti et al., 1994). This clustering, in turn, is related to greater morbidity and mortality, whereas a reduction in the number of coronary risk factors and the lowering of their levels is related to improved morbidity, lower medical costs in later years and reduced mortality (Greenlund et al., 2004). Nearly 1/3 of adult Americans have two or more of the main risk factors for heart disease.

More recent efforts have shown that many of these classic coronary risk factors are largely lifestyle-related and can be improved through behavioral and lifestyle changes, often with major effects on clinical outcomes. Public health analysts have suggested that improving the health habits of Americans may be the most cost-effective strategy to reduce their coronary risk and improve their health. At the same time, the percentage of adults engaging in healthy lifestyles appears to be quite low (Dekker et

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al., 2005). While consensus has been building towards this end, it is unclear how this may best be accomplished. Some favor legislative initiatives and financial incentives, while others favor interventional, educational strategies designed to improve health-erosive behaviors and lifestyles.

Among this latter group, intensive residential lifestyle intervention programs using innovative educational and behavioral approaches have demonstrated remarkable success in substantially lowering coronary risk and medication requirements (Barnard, 1991; Diehl, 1981; McDougall et al., 1995).

Participants most often with existing coronary disease usually spend from 10 to 26 days in these medically supervised residential centers (e.g. McDougall Program, Pritikin Longevity Center, Lifestyle Center of America, Weimar Institute) where a multi-disciplinary staff facilitates a strict diet and exercise regimen. These live-in programs, however, are time- and cost-intensive, highly individualized and limited to the treatment of 10 to 70 participants at a time. While clinically very meaningful and important to the individual they have little impact on public health concerns because they can do little to reach larger populations, build community and environmental support and reduce barriers to healthy living (Roberts and Barnard, 2005; Roberts et al., 2002; Ornish, 1998a,b).

Similarly, outpatient programs usually lack the community support that could lead to cultural transformation, which in turn requires a critical mass of participants to increase the potential to succeed (Esselstyn, 1999; Aldana et al., 2004; Ornish et al., 1998; Vale et al., 2003).

Against this background, the comprehensive, community-based CHIP program was developed that may offer a population-based alternative. The rationale, design and the results of the limited pilot project have been reported by Englert et al. (2004). The following report extends the earlier pilot project, which examined the feasibility of reducing the levels of modifiable coronary risk factors, such as blood lipids, blood sugar, blood pressure, smoking, sedentary lifestyle, overweight and stress in a community setting. This paper reports the impact of the community-based lifestyle intervention program by assessing the relevant clinical data of 1517 self-selected participants between “before” and “after” the 40-hour educational curriculum over a 30-day period.

## Methods

CHIP is a four-week community-based intensive educational lifestyle intervention program, designed to assess to what extent a self-selected population may be able to contribute to a shift in coronary risk factors in the community-at-large aiming at primary and secondary prevention.

The 7-year project with a total enrollment goal of 7000 is divided into four phases: Pilot Phase ( $n=250$ ); Consolidation Phase ( $n=2000$ ); Randomized Clinical Trial Phase ( $n=500$ ); Government-Funded Expansion Phase with a 3-year follow-up ( $n=4000$ ) (Englert et al., 2004).

This study evaluates the data generated and collected during the Consolidation Phase using a pre/post-test design with multiple cohorts. It consisted of 5 CHIP programs, with 250 to 350 participants who enrolled in either spring or fall programs between 2000 and 2002.

The participants were recruited from the general population through presentations at service clubs, churches, corporations, through media exposure, billboards, brochures and health care providers.

To be included in the program, participants had to be at least 21 years of age, free of current cancer treatment, at least 3 months post-bypass surgery, not afflicted by alcoholism and able to engage in walking exercises. Eligible and interested participants provided informed consent. All participants were advised to work closely with their personal physicians to monitor clinical changes and to facilitate medication adjustments.

The 40-hour educational intervention with behavioral and skill development content consisted of a carefully crafted 16-lecture series offered daily for 2 h over a 4-week period (for details please see Englert et al., 2004). In addition, several workshops (cooking classes, food shopping-tours, clinical breakout sessions) were offered during the program, before the participants entered the monthly alumni meetings for support and maintenance.

Through the daily lectures, clinical Q–A sessions and substantial reading assignments (syllabus, text- and workbooks), the participants became acquainted with some of the extensive epidemiological literature suggesting the importance of lifestyle factors in the etiology of chronic circulatory diseases with a focus on a simpler, more optimal, plant based diet, low in fat and sugar and high in fiber (Table 1; Diehl, 1998).

In addition, the CHIP program promoted smoking cessation and recommended a daily exercise program of 30 min of walking and general fitness. At the completion of the program, participants were encouraged to join the Rockford CHIP Alumni Organization and to attend the monthly educational and support meetings.

Prior to the educational intervention, all participants underwent blood testing for fasting lipids (measured by the enzymatic assay: Hitachi 917 Multi-Task Analyzer) and glucose (measured by the hexokinase method: Hitachi 917), blood pressure and resting heart rate (measured with standardized sphygmomanometers after at least 5 min resting). Anthropometric data as weight and height were measured with calibrated scales. The second biometric assessment took place at the conclusion of the 4-week program. Blood drawing, screening and surveys were done by the same trained clinical team to guarantee a standardized procedure and quality control (for details see Englert et al., 2004).

As part of the before and after screening, the participants were required to complete a lifestyle/nutrition knowledge test and a compact personal lifestyle evaluation sheet before and after the program. This included a self-reported medical history, socio-economic details, food-frequency diary, exercise frequency and stress level inventory. Before each lecture/presentation, the participants signed in at the registration desk. Those who attended fewer than 13 out of the 16 meetings did not meet the graduation requirements and their data were not included in this analysis.

For this particular study, coronary risk factors at baseline and at the end of the 30-day intervention included elevated levels of blood pressure, cholesterol, fasting glucose, overweight, smoking and sedentary lifestyle. “At risk” was defined as follows: hypertension: systolic blood pressure  $\geq 130$  and/or diastolic blood pressure  $\geq 85$  (Chobanian et al., 2003); overweight: BMI  $>25$  (WHO Expert Consultation, 2004); impaired glucose tolerance/diabetes: blood glucose  $\geq 110$  mg% (Nathan et al., 2007); LDL-cholesterol  $\geq 100$  mg% (Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III), 2001); sedentary lifestyle (self-reported): no physical activity at all; smoking (self-reported): smoker. Coronary risk categories were assigned to all participants as follows: no risk: Zero Risk factor; Moderate Risk: 1 or 2 risk factors; High Risk: 3 or more risk factors.

Table 1

Comparison of diet composition: the typical US diet versus the CHIP optimal diet

	US diet	CHIP optimal diet
Fats and oils	37% <sup>a</sup>	<15–20% <sup>a</sup>
Protein	15% <sup>a</sup>	10–15% <sup>a</sup>
Complex carbohydrates	25% <sup>a</sup>	65–70% <sup>a</sup>
Simple carbohydrates	23% <sup>a</sup>	<10% <sup>a</sup>
Cholesterol (mg/day)	400	<50
Sugar (tsp/day)	35	<10
Salt (g/day)	12	<5
Fiber (g/day)	12	>40
Water (glasses/day)	Minimal	>8

<sup>a</sup> Percent of total energy intake.

### Statistical analyses

The data were entered twice for accuracy and then analyzed using the SPSS 13.0. After a positive testing for homogeneity, the 5 data sets were pooled and analyzed. Wilcoxon tests were performed for before and after differences in the number of risk factors.  $\chi^2$  tests were performed for differences in men and women at baseline according to risk categories and  $\chi^2$  trend test for changes in risk factor categories. Paired *t*-tests were used to detect before and after changes in the continuous variables. A multiple logistic regression model was used, where improvement of risk categories was the dependent variable, and gender, age and number of risk factors at baseline were used as independent variables.

### Results

The following data resulted from the Consolidation Phase of the 7-year Rockford CHIP project. Of 1569 subjects enrolled between 2000 and 2002 in 5 CHIP community projects, 1517 participants graduated and delivered complete clinical data sets for evaluation. 52 subjects (37 men and 25 women) dropped out due to low compliance (participation less than 13 lectures) or missing clinical data. Therefore the response rate was 97%.

Between-group baseline and 4-week follow-up comparisons revealed no significant differences within the 5 cohorts, so that the data were pooled and analyzed.

The gender composition was 973 (64%) women and 544 men (36%). The age span ranged from 21 to 81 years. The mean age in men was 57 (SD 11) years and in women 54 (SD 11) years.

The socio-demographics of the cohort are presented in Table 2. Table 3 depicts the coronary risk profile at admission, while Table 4 shows the self-reported frequencies of cardiovascular diseases and comorbidities of the cohort.

### Effect of CHIP on coronary risk profile

Fig. 1 shows the change in the distribution of the Coronary Risk Profile over the 4-week program. The intervention caused a substantial shift to the left in the curves for both men and women

with the means for the number of coronary risk factors shifting significantly from 3.4 to 2.3. Gender-specific changes in coronary risk categories according to level of risk at admission are shown in Table 5. There was a significant improvement ( $p < 0.001$ ) in both men and women. The improvements in men (39%), however, were significantly higher compared to women (29%). The multiple logistic regression model, adjusted for number of risk factors at baseline and age, showed a highly significant influence of gender on risk improvement (OR: 1.6 [CI: 1.3–2.0]).

Table 6 displays the mean changes for some of the clinically important parameters in the high coronary risk group. Weight, systolic and diastolic blood pressure, glucose levels, total cholesterol and LDL all clinically improved significantly in both men and women, while triglycerides improved significantly only in men ( $p < 0.001$ ). Those with fewer than three risk factors also showed improvements. Here, both women and men lost an average of 6 lb., while total cholesterol means dropped 15 mg% and 22 mg%, and LDL came down 8 mg% and 17 mg% for women and men respectively.

Participants reported a significant improvement in physical activity. At the beginning, 74% women and 64% men reported “none” or “little”, 22% women and 29% men reported “moderate” (3–5 days/week) and 4% women and 7% men reported “vigorous” physical activity (>5 days/week). After the 4-week program, 38% of women and 41% of men had increased their physical activity. The total cohort walked 59,987 miles averaging 2 miles/day (self-reported).

Out of the 1517 analyzed participants, only 29 (3%) women and 22 (4%) men reported to be smokers. Of these 9 women and 5 men reported having quit smoking after 4 weeks (short-term quit rate: 27%).

The correct scores of the lifestyle/nutrition knowledge test improved from 13 to 22 out of 30 possible.

### Discussion

The educationally intense CHIP program is designed as an ecological template for community-based strategies to educate participants about circulation-related diseases that are powerfully impacted by their lifestyle, and how improvements in diet, exercise, smoking and stress can improve the risk factor profile and thus potentially affect the coronary disease process.

In this study the majority (73%) of the participants had 3 or more coronary risk factors at admission with overweight, sedentary living, hypercholesterolemia and hypertension being the most prevalent. At the end of the 4-week intervention program, only 46% of the participants had 3 or more coronary risk factors (44% for men and 47% for women). It needs to be mentioned that the 27% quit rate in smokers is only a short-term effect. Other studies show that the relapse rate during the first 6 months is expected to be high.

While the majority of men and women reduced their number of coronary risk factors, 29% of women and 39% of men improved their risk factor category, 68% remained in their risk

Table 2  
Socio demographics: the 4-week CHIP program in Rockford, Illinois (2000 to 2002)

	Total (n=1517)
Gender	36% men, 64% women
Age (years)	55 (SD 11)
Marital status	
Married	80%
Single	7%
Divorced	8%
Widowed	5%
Education	
<12 years	6%
12 years	21%
Some college	59%
College or more	14%
Household income/year	
\$<20,000	8%
\$20,000–35,000	15%
\$35,000–50,000	22%
\$>50,000	55%

Table 3  
Coronary risk profile at admission: the 4-week CHIP program in Rockford, Illinois (2000 to 2002)

	Men (n=544) %	Women (n=973) %	Total (n=1517) %
Overweight (BMI >25)	86	76	80
Hypertension (SBP ≥ 130 or DBP ≥ 85)	76	61	67
Hypercholesterolemia			
LDL ≥ 100 mg% <sup>a</sup>	68	69	69
LDL ≥ 130 mg% <sup>a</sup>	34	38	36
IGT/Diabetes (glucose ≥ 110 mg%) <sup>b</sup>	33	22	26
Smoking	4	3	3
Sedentary lifestyle	65	74	71

<sup>a</sup> To convert mg% to mmol/L, divide by 38.7.

<sup>b</sup> To convert mg% to mmol/L, divide by 18.

category and 2% moved to a higher risk category. For reasons to be explored, being “male” turned out to be an independent factor for higher improvement in risk factor category than being “female”.

What clinical significance can be assigned to this short-term results? Yusuf and his team found that the coronary risk of a cohort of 55 years and older without coronary risk factors is 39 times lower compared to men with more than 3 risk factors and about 10 times lower compared to men with 1 or 2 risk factors (Yusuf et al., 1998). Jeremiah Stamler and coworkers compellingly showed in their large prospective cohort study, assessing the impact of coronary risk factors on the incidence of CHD, the impact of the different levels of blood pressure, serum cholesterol, fasting glucose and overweight thus laying the foundation for a better understanding of how a metabolic template can translate into chronic disease (Stamler et al., 1999). Moreover, their study showed how coronary risk almost exponentially increases with the increase in the number of coronary risk factors, and how these risk factor aggregates can powerfully affect groups of people and their communities (Stamler et al., 1999). Similarly, Unal and coworkers recently reported their findings analyzing the steep reductions in coronary deaths in England and Wales between 1980 and 2000. Nearly 60% of the total decrease in cardiovascular-related deaths was attributable to reductions in serum cholesterol, blood pressure and smoking. A healthier diet emerged as the main contributor to the improved serum cholesterol and blood pressure levels. In their study, primary prevention accounted for 82% of the total number of deaths prevented by improvements in serum cholesterol, blood pressure and smoking (Unal et al., 2005).

In our study, those in the high risk group (≥3 risk factors) had mean total cholesterol drops of 32 mg% (16%) for men and 20 mg% (9%) for women. Similarly, mean diastolic blood pressure levels dropped 5 and 4 mm Hg for men and women, respectively. In her review article, Manson estimates that for every 1% reduction in elevated serum cholesterol the coronary risk declines by up to 3%, and for every 1 mm Hg reduction in elevated diastolic blood pressure, the coronary risk drops another 2 to 3% (Manson et al., 1992). Taken together, these

reductions translate into a possible coronary risk reduction of 60% for men and 37% for women in our study.

#### Possible contributors to success

##### Diet and exercise changes

Improvements in diet and exercise are increasingly being associated with significant improvements in body weight, in the levels of blood pressure, serum lipids and cardiac function and in the lowering of diabetes risk (Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III), 2001; Roberts and Barnard, 2005; Roberts et al., 2002; Ornish, 1998a,b).

The shift from the typical rich American Diet to a more whole-food, plant-centered diet was a major focus of this intervention study. The dietary changes of a sample of the total cohort have been reported elsewhere (Englert et al., 2004). Participants markedly reduced their consumption of animal products and refined, processed foods while increasing their intake of fruits, vegetables, whole grain products and legumes. At the same time, the cohort walked 59,987 miles averaging 2 miles/day (self-reported).

##### Intensive education

This project was an intensive and educational program where participants became aware of the potential benefits of making lifestyle changes (the “why”) and they learned how best to accomplish this (the “how to”).

##### Curriculum

The educational curriculum was structured to build progressively and incrementally the concepts of lifestyle medicine. Since habits are best built through daily practice, the program was purposely conducted on an almost daily basis over a period of 4 weeks.

##### Social support and community transformation

The group setting for each of the sessions provided strong social support and may have contributed to the low drop-out

Table 4  
Self-reported comorbidities: the 4-week CHIP program in Rockford, Illinois (2000 to 2002)

	Men <sup>a</sup> (n=544) %	Women <sup>a</sup> (n=973) %	Total <sup>a</sup> (n=1517) %
CVD	29	21	24
Myocardial infarction	27	13	19
Angina pectoris	14	18	16
Bypass/Angioplasty	53	22	36
Stroke	3	6	5
Irregular heart beat	38	53	46
Heart failure	3	4	3
Gallbladder trouble	10	18	16
Depression	9	19	16
Osteoporosis	6	13	11
Rheumatoid arthritis	6	7	6
Ulcers	5	4	5
Thyroid disorder	4	9	8

<sup>a</sup> Since more than one answer is correct, the number can exceed the 100%.

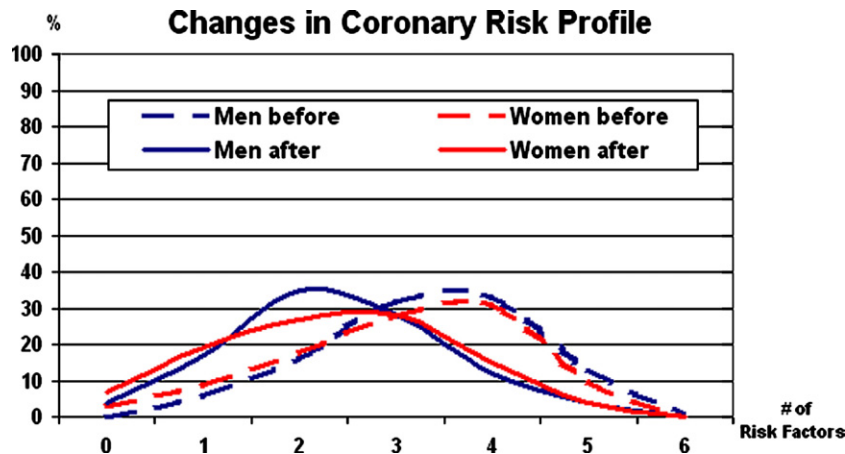


Fig. 1. Gender-specific coronary risk changes over 4 weeks according to admission levels of risk in 1517 participants attending the CHIP program in Rockford, Illinois (2000 to 2002).

rate of 3%. Since we evaluated the comprehensive program, we cannot specify to what extent social support may have played a role in effecting the outcomes of the intervention. However, this assumption was supported by the article of Boutin-Foster that togetherness, peer reinforcement and encouragement strengthen the adherence of interventional trials (Boutin-Foster, 2005; Williamson and Stewart, 2005). This social support was evident in the interactive portion of the educational curriculum. It was also felt in the fact that the large number of CHIP participants became a critical mass in the community that began to look for healthier food items in the supermarkets and for healthier menus in the restaurants. These consumer driven expectations soon found reflection in several major grocery stores and in more than 25 CHIP-approved restaurants in the community of Rockford, including a major fast food chain that began to offer healthier fare. This cultural/community transformation with a supportive environment designed to help people to make healthier choices was powerfully demonstrated in Denmark (Mikkelsen and Trolle, 2004) and in Finland (Puska, 2002). The Finish North Karelia Project showed how behavioral changes can be made in a community setting, which resulted in major reductions in the level and number of coronary risk factors and in subsequent coronary deaths (Vartiainen et al., 2000).

Bandura, of Stanford University, suggested that the development of new behavior is a result of exposure to

significant role models and is sustained over time through reinforcement at both the individual and societal level (Bandura, 2004). He and others emphasized the importance of a favorable social setting for learning and of key opinion leaders in shaping new attitudes and behaviors that can be introduced into a community (Bandura, 2004; Butterfoss et al., 1993; MacLean, 1994). To make the community organizations more successful, CHIP involved individual community members and organizations, thus facilitating progressive community ownership.

#### Limitations

##### Self-selection

This is an obvious limitation, which reduces the generalizability of these results. The study cohort represents a better educated and higher income group. The CHIP program with its goal of cultural transformation purposefully aimed at enrolling participants who are probably more motivated and better informed about the need to implement the healthier lifestyle choices. The goal was to build a foundation with motivated people in the community, who, in turn, would become the role models for the community-at-large.

##### Regression to the mean

This phenomenon cannot be excluded as a contributor to the favorable results.

##### Lack of control group and short-term results

Although these risk factor improvements were homogeneous throughout the 5 CHIP programs over a period of 3 years, causality and long-term effectiveness cannot be demonstrated without evaluating the program in a randomized controlled trial. Moreover, the extent to which the CHIP Alumni Association with its refresher courses and monthly meetings can contribute to sustaining these short-term results remains to be subject of further investigation. Even so, the current lack of a randomized control group

Table 5

Gender-specific coronary risk changes over 4 weeks according to admission levels of risk (in %): the CHIP program in Rockford, Illinois (2000 to 2002)

	Men (n=511) <sup>a</sup> %		Women (n=932) <sup>a</sup> %		Total (n=1443) <sup>a</sup> %	
	Before	After	Before	After	Before	After
No risk (no risk factor)	0	4	3	7	2	6
Moderate risk (1–2 risk factors)	21	52	27	46	25	48
High risk (≥3 risk factors)	78	44	70	47	73	46

<sup>a</sup> 33 men and 41 women had missing LDL data as a result of TG exceeding 400 mg%, which made it impossible to calculate LDL values.

Table 6  
Gender-specific, mean changes over 4 weeks in participants with high coronary risk ( $\geq 3$  risk factors): the CHIP program in Rockford, Illinois (2000 to 2002)

	Men ( $n=400$ )				Women ( $n=649$ )			
	Means				Means			
	Before	After	Change	$p$ -value	Before	After	Change	$p$ -value
Weight (lb)	226	216	-10	<0.001	195	188	-7	<0.001
Body mass index <sup>a</sup>	32	31	-1	<0.001	33	32	-1	<0.001
Systolic BP <sup>b</sup> (mm Hg)	141	132	-9	<0.001	140	132	-8	<0.001
Diastolic BP <sup>2</sup> (mm Hg)	86	81	-5	<0.001	84	79	-5	<0.001
Glucose (mg%) <sup>c</sup>	114	106	-8	<0.001	110	105	-5	<0.001
Total cholesterol (mg%) <sup>d</sup>	200	168	-32	<0.001	215	195	-20	<0.001
LDL-cholesterol (mg%) <sup>e</sup>	124	101	-23	<0.001	128	116	-12	<0.001
Triglycerides (mg%) <sup>f</sup>	154	138	-16	<0.001	153	150	-3	0.113

<sup>a</sup> Weight (kg/m<sup>2</sup>).

<sup>b</sup> BP=blood pressure.

<sup>c</sup> To convert mg% to mmol/L, divide by 18.

<sup>d</sup> To convert mg% to mmol/L, divide by 38.7.

<sup>e</sup> To convert mg% to mmol/L, divide by 38.7.

<sup>f</sup> To convert mg% to mmol/L, divide by 98.

should not diminish the fact that 1517 CHIP participants with multiple coronary risk factors were able to markedly reduce their risk factor profiles in 4 weeks.

#### Pretest treatment

There is a possibility that the effects of the intervention yielded in this study might be biased by the HeartScreen pretest. A more complex, randomized design needs to be done to control for this problem in which half of the participants will not receive the HeartScreen pretest.

#### Conclusions

This pooled analysis of 5 CHIP lifestyle intervention programs showed the short-term impact that an ecologically templated, community-based educational program can have on self-selected middle aged adults with multiple coronary risk factors. Large beneficial changes in health behaviors were observed with often dramatic and consistent measurable improvements in the elevated levels of total cholesterol, triglycerides, blood pressure, and fasting glucose. At the same time, excess weight was lost with ease following the Optimal Diet guidelines. Until long-term evaluations are completed, however, it remains to be seen if these improvements and the shift in coronary risk can be maintained over time.

#### Outlook

This descriptive study completed the consolidation phase of the CHIP program in Rockford. We are now looking forward towards a government-funded expansion phase to complete the project. This next phase then will explore the feasibility of enrolling a large enough cohort over time that can facilitate a cultural transformation. It is anticipated that this transformation then may influence the approaches to chronic disease management and its attendant costs by creating a greater sense of responsibility for one's own health in the individual and greater

cultural support for health affirming behaviors throughout the community.

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