Employer-Funded Complete Health Improvement Program: Preliminary Results of Biomarker Changes

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Disclaimer: Dr Drozek is a volunteer facilitator with the Complete Health Improvement Program (CHIP) and facilitated some of the CHIP classes in the present study. He was a member of the Live Healthy Appalachia/CHIP management team. Dr Drozek did not directly participate in the statistical analysis of this study, and he receives no financial compensation for his role in CHIP. Dr Shubrook, a *JAOA* associate editor, was not involved in the editorial review or decision to publish this article.

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Context: Previous studies of the Complete Health Improvement Program (CHIP) have demonstrated short-term improvements in select metabolic and cardiovascular biomarkers in community-based programs. However, less is known about the benefits of an employer-funded lifestyle intervention program.

Objectives: To determine if participation in employer-provided CHIP would result in improvements in short-term metabolic and cardiovascular biomarkers, and to compare the results of the current study to a larger national study.

Methods: This observational study evaluated metabolic and cardiovascular biomarker changes in employer health insurance beneficiaries enrolled in CHIP between August 2012 and November 2014. Body mass index; blood pressure (systolic and diastolic); total cholesterol, low-density lipoprotein, high-density lipoprotein, fasting plasma glucose, and triglyceride levels; and weight were measured at baseline and after CHIP.

Results: Of 160 employees enrolled in CHIP, 115 women and 45 men agreed to participate in the study. Overall, the participants demonstrated significant reductions in body mass index, from a baseline average of 31.5 to a post-CHIP average of 30.5 (P<.001), systolic blood pressure from 124.5 to 119.4 mm Hg (P=.017), diastolic blood pressure from 77.3 to 74.5 mm Hg (P=.046), total cholesterol from 186.0 to 168.8 mg/dL (P<.001), low-density lipoprotein from 112.9 to 99.3 mg/dL (P<.001), high-density lipoprotein from 48.8 to 46.4 mg/dL (P<.001), and fasting plasma glucose from 100.8 to 96.5 mg/dL (P<.001).

Conclusion: When funded by an employer, CHIP demonstrated short-term improvements in select metabolic and cardiovascular biomarkers. Future studies will analyze these data to determine whether these findings translate into subsequent decreased employee absenteeism and reduced beneficiary health claims.

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Many lifestyle-related chronic diseases cause long-term health problems with far-reaching negative consequences. Lifestyle factors are implicated in type 2 diabetes mellitus (T2DM), cardiovascular disease, cancer, and many other chronic diseases.[1] Evidence exists that therapeutic lifestyle modification can prevent, improve, and even reverse many of these chronic diseases.[2-4] The Complete Health Improvement Program (CHIP), a plant-based, whole-food lifestyle modification program, demonstrated reduction in body mass index (BMI), blood pressure (BP), fasting plasma glucose (FPG), and cholesterol.[1,2] The Diabetes Prevention Program found that weight loss by means of lifestyle modification is more effective in management of high-risk T2DM than medication alone.[2] A plant-based diet was also found to be beneficial for patients with cardiovascular disease, obesity, and other chronic diseases.[5]

Lifestyle-related chronic diseases have clinically significant negative consequences on individual workplace productivity, leading to increased absenteeism and presenteeism (ie, being present but at suboptimal levels of productivity), which affect the employer's bottom line. Correlations between employee sick days, obesity, and stress have also been found.[6,7] Other studies demonstrate that employer-funded lifestyle intervention programs decrease absenteeism, resulting in a positive return on investment (ROI). In the United Kingdom, a lifestyle intervention program in the workplace reduced absenteeism by more than 1 day per year for each employee, providing a financial benefit for the employer.[8] Large-scale health initiatives can provide cost savings for companies while improving employee health.[9] Workplace wellness programs have been found to decrease a company's health care cost by $176 per person per year and $3.27 for every $1 spent on the wellness program, respectively.[10,11]

Although lifestyle modification programs have repeatedly demonstrated short-term benefits for employers and employees, less is known about the long-term impact on health and its relationship to subsequent health claims. The purpose of the current study was to determine if an employer-funded CHIP in a small rural Appalachian college town would result in short-term improvements in metabolic and cardiovascular biomarkers and long-term reductions in health care costs and absenteeism. This article addresses the preliminary short-term results in select biomarkers. We also compared the results of the current study to those of Rankin et al,[13] which examined 5070 people who participated in 176 CHIP classes throughout North America from 2006 to 2009. The study by Rankin et al[13] represented many different locations and demographics and was therefore a good baseline for comparison of the current study.

Methods

Participants were beneficiaries of Ohio University health insurance and were recruited to CHIP via announcements in the workplace, churches, and the local media, or from local health care providers. They attended 1 of several informational sessions presented throughout the community on various dates and times, where they received a mixed video and live presentation, had their questions addressed, and were offered an opportunity to enroll. All participants were informed that their results would be aggregated and reported for research purposes. Inclusion criteria were adults who were not pregnant and were beneficiaries of Ohio University health insurance. Approval for the study was obtained from the local CHIP administration and the Ohio University institutional review board.

Description of CHIP

An intensive lifestyle modification program, CHIP is focused on food and diet, activity and exercise, stress management, and alleviation of unhealthy habits. A thorough review of the history and effectiveness of CHIP worldwide has been published.[12] For the current study, CHIP classes were facilitated by volunteers trained and authorized by the Lifestyle Medicine Institute and CHIP through the Athens CHIP and were administered locally by Live Healthy Appalachia, a 501(c)(3) organization, in Athens, Ohio. Each class was conducted over 8 to 20 weeks and involved 16 to 18 two-hour group sessions between August 2012 and December 2014. In January 2013, CHIP changed from a 16-session format to 18 sessions. Most classes were provided to the community at large, with the Ohio

University beneficiaries making up a part of the class. Two classes were designated for Ohio University beneficiaries and were held on campus.

A typical session included an instructional video viewing, a cooking demonstration, group discussion, and an exercise component. The intent of the intervention was to nurture intelligent self-care through enhanced understanding of the epidemiology, cause, and risk factors associated with chronic lifestyle-related diseases.

The primary focus of CHIP was the consumption of plant-based whole foods *ad libitum*, such as fresh fruits, vegetables, whole grains, legumes, and some nuts. The goal was to keep overall dietary fat content below 20% of the total calories, daily intake of added sugar below 10 tsp, sodium below 2000 mg, and cholesterol below 50 mg. Water consumption (at least 8 glasses/d) and high-fiber food intake (>35 g/d) were encouraged, along with flexibility exercises, a daily walk of 30 minutes or 10,000 steps on the pedometer, and daily use of stress management techniques.

A baseline health screen was performed at the beginning of the course, consisting of BMI, systolic BP, diastolic BP, and levels of total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglyceride, and FPG. The results were reviewed with the participants as a group during a class session to help them understand their risk status and to set goals for the program. Before the 12th class session, the health screen was repeated. Personal and deidentified aggregated class health screen results were given to participants to review their individual improvements and how they compared with the group as a whole. A presentation on the meaning of the results and encouragement to continue with the newly acquired lifestyle changes followed.

The course was paid for by Ohio University ($450 per person before April 2013 or $599 afterward) and provided free of charge to beneficiaries who agreed to be part of this study. Those who participated in CHIP but elected not to enroll in this study had 80% of the expense covered. As an additional incentive, participants who attended 14 of 16 or 16 of 18 classes and completed both health screens received a reduction of $10 per month in university health care insurance cost for 12 months ($120 total), even if they did not participate in the study. The cost of the course covered 2 biomedical assessments (performed at the beginning of the course and again before the 12th session), food samples, textbook, workbook, cookbook, water bottle, pedometer, and supplementary reading and reference material.

Data Collection and Reporting

The biomedical assessments included weight, height, systolic BP, and diastolic BP, which were obtained by medical professionals. Fasting blood samples were collected by trained phlebotomists and analyzed for total cholesterol, LDL, HDL, FPG, and triglyceride levels in a pathology laboratory. Data for each participant were entered into a password-protected proprietary access-based database maintained on the CHIP administration computer at the Live Healthy Appalachia office as part of the CHIP routine and separate from the data collection. For this study, CHIP administration provided identified data on a password-protected Excel (Microsoft Corporation) file.

Statistical Analysis

For overall and stratified data, means and SDs were computed for each baseline and post-CHIP measurement. Mean change (baseline mean−post-CHIP mean) and percent mean change (100×mean change/baseline mean) were also computed to show relative magnitudes of changes. One-sample *t* tests were applied to the percent mean changes to test whether these changes were statistically significant. The Cohen *d* was computed in each stratum to show effect sizes. McNemar tests were also used to examine whether frequency distributions of participants across the risk factor strata changed from baseline to after CHIP. For a reference purpose, 2-sample *t* tests were used to compare the magnitude of changes between the current study and the results of the study by Rankin et al.[13]

Results

A total of 160 people enrolled in this pilot study, with a mean age of 49.9 years (range, 24-70 years). Forty-five of 160 participants (28%) were men, and 115 (72%) were women. One hundred fifty-two participants (95%) partook in all aspects of both health screens. One hundred fifty-eight (99%) completed the first and at least part of the second health screen.

The participants achieved clinically significant reductions in many risk factors as demonstrated by the *P* values: BMI ($P<.001$), systolic BP ($P=.017$), diastolic BP ($P=.046$), total cholesterol ($P<.001$), LDL ($P<.001$), HDL ($P<.001$), and FPG ($P<.001$). *Table 1* displays the mean changes in 5066 participants who attended CHIP classes throughout the United States, excluding those attending the Athens classes, as reported by Rankin et al.[13] The current study's findings of statistically significant changes in BMI, total cholesterol, LDL, HDL, FPG, and weight corresponded with the findings of Rankin et al.[13] However, Rankin et al[13] also found statistically significant changes in systolic BP, diastolic BP, and triglyceride levels.

Table 2 displays the stratified data using conventional risk factor categories. The data in all substrata improved in all risk factors except those in the normal range: systolic BP, diastolic BP, and triglyceride levels, as demonstrated by the *P* values and Cohen *d*. The higher the risk strata when entering CHIP, the greater the improvements by the end of CHIP.

Discussion

Several health biomarkers improved in all 160 participants in the current study, including BMI, BP, cholesterol, and FPG, comparing favorably to the results of Rankin et al.[13,14]

In a similar study,[15] the Rockford CHIP program directly supported the interaction between health and workplace improvements by implementing CHIP classes in several companies in their community. Trust for America's Health also supported funding lifestyle programs focused on physical activity, nutrition, and smoking that could reduce conditions such as T2DM, heart disease, kidney disease, strokes, and some cancers, possibly saving billions in health care costs.[16] Trust for America's Health concluded that investing $10 per person per year in a disease prevention program could save $16 billion in health care costs and a 5-year ROI of 5.6 for every $1 invested.[16] Shurney et al[17] found that a workplace CHIP class for beneficiaries with T2DM produced beneficial changes in hemoglobin A_{1c} and total cholesterol. The ROI for participants in the program was $1.38 for every dollar spent after 6 months.[17] Total paid claims for CHIP members decreased while claims for nonmembers increased.[17]

The beneficial health results of lifestyle modification programs have the potential to affect productivity as well. Obesity and diabetes have a direct correlation with absenteeism.[7] Adams and Cowen[6] established that excess body weight and higher amounts of stress increased worker absenteeism and that men who were more physically active had fewer sick days. Their findings support the use of targeted health interventions.[6] Serxner et al[18] reinforced this idea and determined that risk factors such as unhealthy eating, overweight, stress, and low physical activity increased worker absenteeism. Furthermore, those who reduced their risk factors lowered their sick days 1.25 times more than those who did not.[18]

Although the present study provides results for the short-term effects of CHIP, the health results and consequent changes in the workplace may be long lasting as well. Kent et al[19] found that the beneficial effects of CHIP can be experienced long term with persistently lowered BMI, diastolic BP, total cholesterol, and triglyceride levels after 4 years.[19] Hinderliter et al[20] concluded that 8 months after completing a lifestyle modification program with focus on diet, participants retained beneficial changes in weight and BP. The Look AHEAD trial, which implemented an intensive lifestyle intervention in participants with T2DM, found that 4 years after the study, the group with the intensive lifestyle modification maintained greater

Table 1.
Mean Changes in Selected Risk Factors in Participants in an Employer-Funded CHIP vs a National CHIP Group

	Athens, Ohio (n=160)[a]				North America[13] (n=5066)[a]				
Variable	Baseline	After CHIP	Δ (%)	SD	Baseline	After CHIP	Δ (%)	SD	Athens vs North America *P* Value
BMI	31.5	30.5	−1.0 (−3.3)	18.8	31.0	30.0	−1.0 (−3.2)	3.0	>.2
Systolic BP, mm Hg	124.5	119.4	−5.1 (−4.1)	20.1	133.2	126.7	−6.5 (−4.9)	18.7	>.2
Diastolic BP, mm Hg	77.3	74.5	−2.8 (−3.6)	21.6	79.9	75.7	−4.2 (−5.3)	12.9	>.2
Total cholesterol, mg/dL	186.0	168.8	−17.2 (−8.5)	12.5	193.6	172.3	−21.3 (−11.0)	13.8	.015
LDL, mg/dL	112.9	99.3	−13.6 (−10.7)	18.1	131.0	114.0	−17.0 (−13.0)	21.1	.124
HDL, mg/dL	48.8	46.4	−2.4 (−3.7)	12.2	54.8	50.1	−4.7 (−8.6)	8.8	>.2
Triglyceride, mg/dL	113.0	112.8	−0.2 (−0.2)	31.8	143.5	132.5	−11.0 (−7.7)	42.8	.003
FPG, mg/dL	100.8	96.5	−4.3 (−2.9)	10.8	101.1	101.1	−6.2 (−6.1)	21.3	.001
Weight, lb	197.0	191.1	−5.9 (−3.0)	2.4	192.3	192.3	−6.1 (−3.2)	3.1	>.2

[a] Not all participants' risk factors were recorded. Changes from baseline to after CHIP were found to be statistically significant ($P \leq .001$) for all risk factors except systolic blood pressure (BP), diastolic BP, and triglyceride levels in the Athens study.

Abbreviations: BMI, body mass index; CHIP, Complete Health Improvement Program; FPG, fasting plasma glucose; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

improvements in weight loss, hemoglobin A_{1c}, HDL, triglycerides, systolic BP, diastolic BP, and total cholesterol compared with the control group.[21]

Compared with the results of Rankin et al,[13] the current employer-provided CHIP study showed no statistically significant difference between sexes but, generally, the health differences between sexes may be important in the workplace. A study looking at several CHIP courses across the United States found that men have greater reductions in LDL, total cholesterol, triglyceride, FPG, BMI, and diastolic BP compared with women, although women had reduction in these health biomarkers as well.[22] Leigh[23] also found that, in general, women are more likely to have greater absenteeism than men. However, men and women with poor health have been reported to have increased absenteeism.[23] Rabacow et al[24] found women to have more sick days after adjusting for type of work, indicating that younger employees, those with lower education levels, and employees with more stress had increased absenteeism as well.[24]

Of note is the sex disparity reported in the study by Rankin et al,[13] which was also apparent in the results of the current study and another CHIP study.[22] Further research should clarify why female participants outnumber male participants in CHIP courses to encourage men who would benefit from attending CHIP and similar programs.

Osteopathic physicians are uniquely situated to promote lifestyle medicine. Lifestyle medicine focuses on using food, activity and exercise, and stress management to tap into the self-healing and maintenance mechanisms intrinsic in the body. This approach addresses multiple chronic disease states simultaneously, free of notable adverse effects, and represents a rational approach to medicine that needs to be

Table 2.
Changes in Selected Risk Factors in an Employer-Funded CHIP

	No. of Participants				Mean (SD)				
Risk Factor	Baseline	After CHIP	χ^2	*P* Value	Baseline	After CHIP	Δ, Mean (Δ%)	*P* Value	Cohen *d*
BMI			21.0	<.001					
18.5-24.9	24	31			22.1 (1.9)	21.6 (1.8)	−0.4 (−2.0)	<.001	0.98
25-30	39	44			27.4 (1.3)	26.5 (1.4)	−0.9 (−3.2)	<.001	1.29
>30	88	76			35.9 (4.8)	34.6 (4.8)	−1.3 (−3.5)	<.001	1.53
Systolic BP, mm Hg			3.6	.057					
<120	68	77			111.2 (8.4)	114.3 (11.2)	3.1 (3.1)	.023	-0.28
120-139	62	60			129.4 (5.9)	126.5 (9.8)	−2.9 (−2.2)	.015	0.32
140-160	18	12			149.7 (5.9)	137.6 (13.9)	−12.1 (−8.0)	.002	0.84
>160	3	2			169.0 (5.6)	152.0 (25.1)	−17.0 (−9.7)	>.2	0.56
Diastolic BP, mm Hg			1.1	>.2					
<80	103	109			72.2 (6.7)	73.2 (8.8)	1.0 (2.0)	>.2	0.12
80-89	39	35			85.2 (3.3)	81.9 (8.0)	−3.3 (−3.8)	.014	−0.41
≥90	9	7			101.8 (10.9)	88.8 (8.4)	−13.0 (−12.0)	.027	−0.90
Total Cholesterol, mg/dL			33	<.001					
<160	41	67			135.3 (19.7)	127.0 (25.3)	−8.3 (−6.1)	.006	0.45
160-199	65	59			182.2 (11.7)	168.2 (24.0)	−14.0 (−7.7)	<.001	0.65
200-239	40	27			217.6 (11.1)	198.6 (22.9)	−19.0 (−8.8)	<.001	0.95
240-280	9	5			257.4 (10.7)	211.6 (39.9)	−45.9 (−17.4)	.017	1.00
>280	3	0			327.7 (32.2)	228.3 (53.5)	−99.3 (−29.3)	.151	1.31
LDL, mg/dL			31	<.001					
<100	56	86			76.9 (18.4)	73.1 (24.8)	−3.9 (−5.5)	.096	0.23
100-129	57	46			115.4 (8.3)	99.6 (17.8)	−15.9 (−13.7)	<.001	0.96
130-159	33	19			143.9 (9.3)	125.0 (19.8)	−18.9 (−12.8)	<.001	0.86
160-190	6	3			167.8 (5.9)	158.5 (20.9)	−9.3 (−5.4)	>.2	0.42
>190	5	3			217.2 (27.2)	150.4 (38.9)	−66.8 (−29.5)	.044	1.29
HDL, mg/dL			4.7	.030					
<40	49	51			35.2 (3.7)	34.8 (5.6)	−0.4 (−0.9)	>.2	0.08
40-60	81	90			49.0 (5.9)	47.9 (7.1)	−1.2 (−2.2)	.046	0.23
>60	28	17			71.9 (10.4)	62.5 (10.8)	−9.4 (−12.9)	<.001	1.27
Triglyceride, mg/dL			3.0	.080					
<100	75	79			70.5 (18.7)	75.2 (27.5)	4.7 (8.5)	.075	−0.21
100-199	61	62			131.7 (23.1)	125.3 (39.0)	−6.4 (−4.6)	.139	0.19
200-299	16	14			241.6 (34.9)	209.1 (78.5)	−32.6 (−13.0)	.106	0.43
≥300	6	3			348.7 (43.3)	267.7 (120.7)	−81.0 (−24.9)	.073	0.92
FPG, mg/dL			3.1	.076					
<110	137	139			95.9 (8.2)	94.3 (8.0)	−1.6 (−1.3)	.015	0.21
100-125	9	13			116.3 (4.3)	105.1 (7.7)	−11.2 (−9.5)	.007	1.19
>125	11	5			148.6 (37.7)	116.3 (25.6)	−32.3 (−17.3)	.079	0.59

Abbreviations: BMI, body mass index; CHIP, Complete Health Improvement Program, FPG, fasting plasma glucose; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

considered before more risky treatments, such as medications and invasive procedures. A 2016 study reported that medical error is the third leading cause of death in the United States, after heart disease and cancer.[25] Further evidence that the US disease-based health care system is failing our society includes soaring rates of diabetes, obesity, and associated illnesses.[26,27] Led by physicians, the US health care system emphasizes managing diseases with pills and procedures.[25] Lifestyle medicine may be effective in countering the unsustainable burden of disease and loss of productivity.

The present study demonstrated that the application of the principles of lifestyle medicine beneficially addresses the whole person, providing the tools necessary for healing and maintenance.

Limitations

Although the changes in biomarkers were statistically significant in the present study, no control group was used for comparison. Furthermore, the data were taken from several CHIP classes that occurred during different times of the year and of varying class length. Participants were self-selected, were motivated to participate, and may not represent the general population. Participants may also have had changes in medication between the data points, which could have either blunted or exaggerated the changes in biometrics.

Conclusion

The short-term results of the present study showed statistically significant improvements in metabolic and cardiovascular biomarkers as a result of participation in the CHIP course. These beneficial health results and evidence from various other studies support the action of employers implementing lifestyle programs to improve their ROI, to decrease absenteeism, and to increase the overall health of their employees. Future data will be analyzed to determine if these findings translate into subsequent decreased employee absenteeism and reduced beneficiary health claims.

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Author Contributions

Drs Shubrook, Nakazawa, and Drozek provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; all authors drafted the article or revised it critically for important intellectual content; all authors gave final approval of the version of the article to be published; and Drs Shubrook, Nakazawa, and Drozek agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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