Metabolic Risk Factor Reduction Through A Worksite Health Campaign: A Case Study Design

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Abstract

The purpose of this intervention study was to measure the impact of an onsite and online 12-week worksite heart-health campaign designed to reduce metabolic risk factors for employees at BMW of North America, LLC. All participants received three coaching sessions by a registered dietitian (RD), participated in eight educational sessions led by an RD, viewed their pre, midpoint and final biometric data online, and had access to other web-based tools and educational booklets. The program used team-based competition. At baseline and week 12, blood pressure, anthropometric and hematologic parameters were measured, including changes in weight, blood pressure, fasting blood glucose, waist circumference, total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, and smoking habits. Of the 100 individuals that enrolled, 95 completed the program, and 87 met criteria to be eligible for data analysis. Paired t tests demonstrated significant reductions in weight (p<.0001), body mass index (p=.0047), waist circumference (p <.0001), diastolic blood pressure (p=.0018), and systolic blood pressure (p=.0012). Paired t tests for total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, and fasting blood glucose did not indicate any significant improvements. There was an improvement in body mass index and blood pressure classifications after completion of the program. A Friedman's test of blood pressure classification demonstrated significant improvements in participants' blood pressure classification from pre-program to midpoint, midpoint to end, and pre-program to end. These results support the effectiveness of a dietitian-led, team-based, worksite heart-health campaign with web-based education to reduce risk factors for metabolic syndrome.

MeSH Keywords: nutrition, worksite, online, registered dietitian, heart health, metabolic syndrome.

Introduction

The 2003-2004 National Health and Nutrition Examination Survey (NHANES) found that approximately 66% of US adults are considered overweight or obese, with almost 33% being classified as obese [1]. Obesity increases the risk of many health conditions, including coronary heart disease, type 2 diabetes, hypertension, dyslipidemia, stroke and certain types of cancer. As

per the National Heart Lung and Blood Institute, the following group of risk factors, that are linked to overweight and obesity, increase an individual's risk of heart disease, stroke and diabetes: abdominal obesity, elevated triglycerides (TG), lower HDL cholesterol, high blood pressure (BP), and high fasting blood glucose (FBG) levels [2]. A person is considered to have diagnosis of metabolic syndrome when three out of five of these risk factors are present. Almost 25%, or an estimated that 47 million adults, in the United States have this condition [2].

Metabolic syndrome may negatively impact the working adult's health and increase health care costs. Burton, et al., studied the prevalence of metabolic syndrome in a financial services company employing over 5,500 people, and found that the 22.6% with metabolic syndrome were more likely to have increased days absent from work due to illness, poorer self-reported health perception, and report more lifestyle health risks, such as smoking, a sedentary lifestyle, and stress [3].

Effectiveness of worksite wellness programs

To address the financial burden of unhealthy workers, effective health promotion programs are ideal for a company's budget. Reviews of recent peer-reviewed studies show the effectiveness of worksite wellness programs that focus on nutrition and weight control. Touger-Decker, et al., measured the impact of a twelve-week workplace intervention focusing on weight management at an Academic Health Sciences University [4]. Individual and group sessions were held by an RD, and results of the 117 individuals were evaluated. Significant improvements were documented in weight, body mass index (BMI), waist circumference (WC), waist-hip ratio (WHR), cholesterol, and BP. Furthermore, weight loss was significantly correlated with reduction in BP, percentage body fat, and cholesterol [4].

In another study, changes in BP and weight in a control group of 94 employees were compared with an experimental group of 47 employees who participated in a one-year program led by nurses using the five E's intervention strategy: Evidence, Engage, Educate, Environment, and Evaluate [5]. There was no statistically significant difference in baseline demographics, BMI or BP between the control and experimental groups. The quasi-experimental study design showed significant improvements in BMI and systolic BP in the experimental group versus the control group, and 38.3% of the experimental group reported vigorous physical activity (at least 3 or more times per week) at one year, a 100% increase compared to baseline [5].

Another successful worksite wellness program was the "Healthyroads" program, an obesity management worksite program led by RDs, certified health education specialists, and other health professionals was implemented in 119 companies [6]. A pre-test/post-test was used to evaluate changes in health risks of 890 employees with a BMI of 30 or greater, or a BMI between 25-30 with a co-morbid condition, such as type 2 diabetes, hypertension, or cardiovascular disease. After a year's participation in the program, statistically significant reductions were seen in poor eating and exercise behaviors, cholesterol, BP, and BMI [6].

The cost of obesity and ROI (Return on Investment)

In 2009, the Centers for Disease Control and Prevention (CDC) indicated that the annual health cost of obesity in the United States is 147 billion [7]. The study also found that obese individuals spent 42% more on medical care than normal weight people in 2006 [7]. As healthcare costs continue to rise, and while most companies' desire continued financial growth, worksite wellness programs provide a way to lower an organization's health related costs. For example, the Highmark Employee Wellness Programs offered health promotion services, including on-line nutrition, stress management, and tobacco cessation programs, and various health classes, coaching sessions, screenings, and campaigns. After a 4-year study period, return on investment (ROI) was $1.65 for every dollar spent [8].

Not only can worksite wellness programs decrease a company's healthcare costs, but they can also improve worker productivity, and so further decrease organizational costs. Baker et al., found a $1.17 to $1.00 ROI from an obesity management worksite program, and of the total projected financial savings, 59% were from decreased healthcare costs, while 41% resulted from "productivity improvements." [6].

A 2008 meta-analysis reviewed 46 studies and showed that work health promotion increased work ability, job and mental well-being, and decreased sickness absenteeism [9].

Worksite wellness programs appear to benefit both the employee and the employer, as they contribute positively to employees' health and the company's financial health. Williams, et al., states, "A recent systematic review concluded that multi-component worksite interventions were the only population-based obesity prevention programs with sufficient evidence of effectiveness to warrant recommendation." [10].

Health First^{SM}: A Worksite Wellness Program Intervention

The Health First^{SM} program is a worksite wellness campaign that was provided to employees at the headquarters of BMW of North America, LLC. The program is a lifestyle and weight management program designed and delivered by RDs using evidence-based guidelines from the National Cancer Institute [11], National Heart Lung and Blood Institute [12], American Heart Association [13], and American Association of Diabetes Educators [14]. The program incorporates teaching points of the health belief model to conditions including obesity, hypertension, diabetes and heart disease, and the respective biometric data. Questionnaires are used to discover where individuals are at in the transtheoretical model, and the cognitive behavior theory is used to make individuals aware of habits, with ideas to change behavior to healthier habits provided in educational sessions and RD counseling. The BMW worksite offered an online tool: participants had the choice to attend live sessions or access PowerPoint sessions online. Also, personal health records, team and individual points and weekly recipes were available online.

The goal of Health First^{SM} is to decrease metabolic risk factors, regardless of weight status. Depending on the needs of the participant, the targeted program objective may be losing weight (or maintaining a healthy weight), decreasing BP, improving blood lipid and glucose levels,

smoking cessation, and increasing awareness of how lifestyle choices impact health and disease (such as increasing activity level and encouraging increased fiber intake.

Study Design

A pre-post design was used to evaluate results of the program for participants' improvement in metabolic risk factors, including measurements for weight, BMI, WC (waist circumference), hip circumference (HC), total cholesterol, HDL cholesterol (high-density lipoprotein cholesterol, LDL cholesterol (low-density lipoprotein cholesterol), TG levels, fasting blood glucose (FBG), non-fasting blood glucose (NFBG), and blood pressure (BP). Participants' self-reported data on smoking habits, cardiovascular and diabetic prescription medication use, and exercise participation. The primary outcome measures were changes in BP, BMI, weight, WC, total cholesterol, HDL cholesterol, LDL cholesterol, FBG, non-FBG, and TG levels. The program implementers' hypotheses were that participants' in the Health First[SM] program would experience a decrease in metabolic risk factors.

Methods

A rally was held to inform employees about the Health First[SM] program; flyers and posters were used to recruit participants. Enrollment was open to all current employees and retirees. This study was a prospective intervention pilot study; participants served as their own control and volunteered for the program. Ninety-eight current employees, and two retirees enrolled in the program, and a total of 95 completed the program. Reasons such as retirement, disability leave, and being transferred accounted for the five people who did not finish Health First[SM]. Initial baseline measurements were taken. Two graduate dietetic students were trained to perform weight, WC, HC and height measurements using a stadiometer, while registered nurses performed the BP measurement and another vendor, Impact Health, provided the finger-stick blood draw for hematological analysis of total cholesterol, HDL and LDL cholesterol, TG levels and FBG. If FBG was elevated, a HgA1C was performed. Employees were encouraged to fast, and all blood levels were tracked as fasting or non-fasting. Once blood test results were available (within eight minutes), RDs provided health coaching, and reviewed results with each participant, setting midpoint and final goals. Counseling sessions were based on the participants' needs, and included use of appropriate health behavior theories. During counseling sessions, the RDs would ask questions about participants' readiness to change, and target messages to move individuals through the transtheoretical model. Based on biometric data, RDs would also use constructs of the health belief model to educate participants on their potential risk for disease and its consequences, and geared individuals toward overcoming barriers to behavior change, while assessing the benefits of healthier habits. RDs helped participants set goals and encouraged participants to work on health issues important to them.

A pre-evaluation questionnaire was also completed online at baseline, and reviewed by the RD. The survey gathered information including self-reported smoking and exercise habits, and use of medication (cardiovascular and diabetic).

After enrolling in the program, participants were encouraged to become a member of a team, ranging from two to six people. However, individuals were also permitted. Each team chose a

team name and team captain. Team captains logged team points in the web-based program. Throughout the 12 week program, team standings were posted online. Emphasis was placed on providing a team atmosphere promoted friendly competition, improved communication, and built a new "team" health support network. All team members were able to receive points for weight loss, attendance at the weekly sessions, for meeting exercise goals, achieving health goals, and for completion of pre and post-evaluations.

All program participants had access to the Health First[SM] website, where they could view each team's total points, download education materials, and view power-point presentations from the live sessions. The custom website allowed participants to view his/her personal health records, and any respective changes to these levels throughout the program.

In addition to the web-based program components, participants were also given educational booklets that complemented the live sessions. The booklets contained information on nutrition, exercise, metabolic syndrome, and sample eating plans. All of the program components were customized in a theme that matched the client's workplace.

Over the first four weeks, informational sessions were held for employees during the lunch hour. Led by RDs, the interactive sessions covered topics including proper nutrition and healthy eating, portion control, snacking, exercise, metabolic syndrome, and optional food plans such as the DASH diet and Mediterranean food plan. At the program's midpoint, a RD measured weight, and a registered nurse took blood pressure, and participants again received individual coaching from a RD. Then, four more weekly lunch sessions were held. At week 12 biometric measurements were repeated: blood was drawn for another hematological analysis, and participants received a final coaching session from a RD. An award ceremony was held to recognize winning teams and provide incentives to those who completed the program.

Of the 95 employees who finished the program, 87 met criteria for data analysis and receiving an incentive prize. These criteria are as follows: completed all initial, midpoint, and final biometric and hematological measurements, completed pre/post evaluations and assessments, attended at least six of eight weekly sessions, exercised at least six weeks, and received three individual coaching sessions. The incentive prize, a fitness bag, was provided to all 87 meeting these criteria, and a raffle was done for a weekend trip to New York City, an additional reward to motivate participants to complete the program. The top three teams scoring the most points throughout the program were also given monetary gift certificates.

Results

Eighty-seven participants revealed their age and family medical history for conditions including hypertension, heart disease, diabetes and cancer on the pre-evaluation form. Thirteen (14.9%) participants were older than age 60, 15 (17.2%) were ages 51-60, 30 (34.5%) were ages 41-50, 20 (23%) were ages 31-40, and 9 (10.3%) were under age 30. Forty-three (49.4%) indicated a family history of hypertension, 35 (40.2%) for heart disease, 31 (35.6%) for diabetes, 30 (34.5%) for cancer, and 16 (23.9%) indicated no family history for the above conditions (e.g. Figure 1).

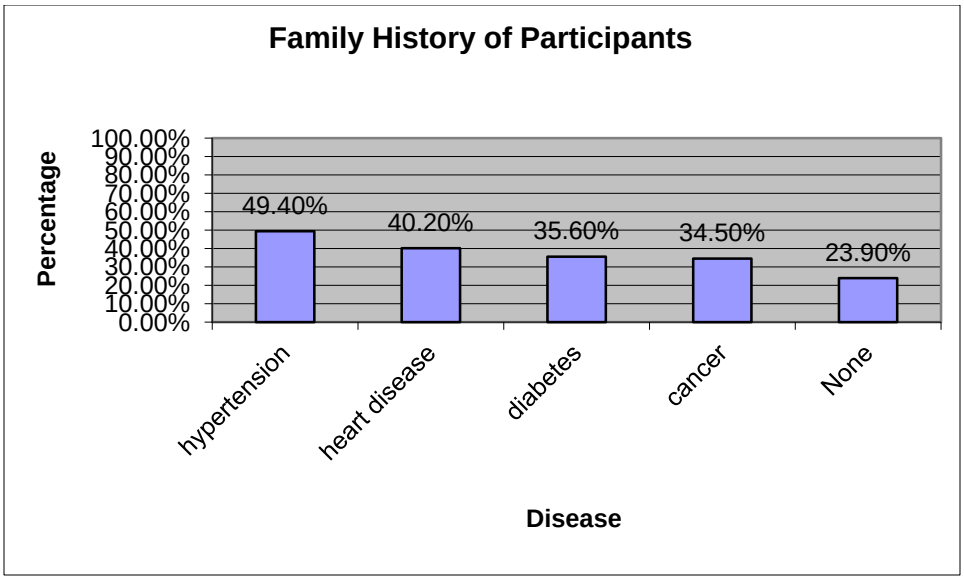

Figure 1: Family History of Participants

One hundred employees enrolled in the program, 95 completed the program (44 males and 51 females), and 87 met criteria for data analysis (39 males and 48 females). Measured weight, height, WC, HC, BP, cholesterol, HDL and LDL cholesterol, FBG, and TG were collected. Self-reported data gathered included exercise and smoking habits, and medication use. The Health First[SM] software automatically calculated BMI and BP categories. Using the statistical analysis software (SAS) version 9.1 for data entry, analyses were performed to determine whether there were significant improvements in anthropometrical and hematological after the completion of the Health First[SM] program.

A paired samples *t* test was used to evaluate the significance of changes in the dependent variables from baseline to completion of the program. The independent variable is the program itself, while dependent variables are weight, WC, BP, cholesterol, HDL and LDL cholesterol, fasting glucose, and TG.

The Bonnferroni correction equation was used to protect against Type 1 error rate, thus setting the level of significance at $p<.005$. There were significant reductions in outcome measures including WC ($t=5.68$, $p<.0001$), weight ($t=4.25$, $p<.0001$), BMI ($t=2.90$, $P=.0047$), diastolic BP ($t=3.24$, $P=.0018$), and systolic BP ($t=3.36$, $P=.0012$). Changes in FBG ($t=0.28$, $P=0.78$), Non-FBG ($t=0.18$, $P=0.86$), TG ($t=1.53$, $P=0.13$), HDL cholesterol ($t=-2.05$, $P=0.04$), LDL cholesterol ($t=-0.09$, $p=0.93$), and total cholesterol ($t=-0.91$, $P=0.37$) were not significant (e.g. Table 1).

Table 1: Paired Samples t-Tests for Eleven Dependent Variables

VARIABLE	N	MEAN DIFF	SD	t-SCORE	95% CI
FBG	20	-0.80	12.69	0.28	(-6.74, 5.14)
Non-FBG	41	1.10	38.84	0.18	(-11.16, 13.36)
TG	72	9.64	53.49	1.53	(-2.93, 22.21)
WC	72	0.74**	1.10	5.68	(0.48, 0.99)
Weight	87	1.90**	4.17	4.25	(1.01, 2.79)
BP Dia	74	3.16**	8.39	3.24	(1.22, 5.11)
BP Sys	74	3.84**	9.82	3.36	(1.56, 6.11)
HDL Chol	74	-2.01	8.44	-2.05	(-3.97, -0.06)
LDL Chol	72	-0.25	24.73	-0.09	(-6.06, 24.73)
Total Chol	74	-2.54	24.1	-0.91	(-8.12, 3.04)
BMI	86	0.17**	0.56	2.90	(0.06, 0.29)

*p < .005. **p < .001.

Frequency procedures were also performed in BMI and BP categories to demonstrate improvement in each classification. As per the National Heart, Lung, and Blood Institute standards, BMI classification standards are as follows: underweight BMI: <18.5, normal body weight BMI: 18.5-24.9, pre-obese BMI: 25-29.9, Class I Obese BMI: 30-34.9, Class II Obese BMI: 35-39.9, and Class III Obese BMI: 40 and above [15]. Initially, 4.21% of individuals were Class III Obese, 7.37% were Class II Obese, 25.26% were Class I Obese, 38.95% were pre-obese, 24.21% were normal, and 0% were underweight. At the conclusion of the program, improvement in BMI categories can be seen with 2.30% Class III Obese, 5.75% Class II Obese, 21,84% Class I Obese, 42.53% pre-obese, 27.59% normal, and 0% underweight (e.g. Table 2).

Table 2: Frequency Procedures for BMI

BMI Category	Frequency and Percent	
	Initial (n=95)	**Final (n=87)**
Normal	23 (24.2%)	24 (27.59%)
Preobese	37 (38.95%)	37 (42.53%)
Class I	24 (25.26%)	19 (21.84%)
Class II	7 (7.37%)	5 (5.75%)
Class III	4 (4.21%)	2 (2.30%)

Blood pressure classification standards are: normal: <120 mmHg (millimeters of mercury) systolic and <80mmHg diastolic, prehypertension: 120-139 mmHg systolic or 80-89 mmHg diastolic, Stage 1 hypertension: 140-159 mmHg systolic or 90-99 mmHg diastolic, and Stage 2 hypertension: 160 mmHg or higher systolic, and 100 mmHg or higher diastolic [16]. Initially,

24.2% fell in the normal BP classification, 54.9% had prehypertension, 18.7% had Stage 1 hypertension, and 2.2% had Stage 2 hypertension. At program's end improvements in BP classification can be seen as follows: 50% had normal blood pressure, 36.8% had prehypertension, 11.8% Stage 1 hypertension, and 1.3% had Stage 2 hypertension (e.g. Table 3).

Table 3: Frequency Procedures for BP

BP Category	Frequency and Percent	
	Initial (n=91)	**Final (n=76)**
Normal	22 (24.2%)	38 (50.0%)
Prehypertension	50 (54.9%)	28 (36.8%)
Stage 1	17 (18.7%)	9 (11.8%)
Stage 2	2 (2.2%)	1 (1.3%)

The blood pressure classifications had to be coded for completion of the Friedman's test. This was done as follows: normal was coded as one, prehypertension as two, Stage 1 hypertension as three, and Stage 2 hypertension as four. Thus, a low average ranking favors a more normal level, and the higher the ranking, the poorer the prognosis.

The three time periods for the blood pressure classification data-pre-program, midpoint, and post-were compared with a Friedman's test. The test statistic for this test is the Cochran-Mantel-Haenszel (CMH) statistic, and the results of this test showed a significant difference across the three time periods (e.g. Table 4).

Table 4: *Friedman Test for the Three Time Periods of BP Classification*

Cochran-Mantel-Haenszel Statistic (Based on Rank Scores)

Alternative Hypothesis	df	Value
Row Mean Scores Differ	2	17.78***
Mean Rankings	*Post Hoc* Comparisons	
$\overline{R}_{pre}$ = 46.0	($\overline{R}_{pre} - \overline{R}_{mid}$) = 5.0***	
$\overline{R}_{mid}$ = 41.0	($\overline{R}_{mid} - \overline{R}_{post}$) = 2.5***	
$\overline{R}_{post}$ = 38.5	($\overline{R}_{pre} - \overline{R}_{post}$) = 7.5***	

Note. *Post hoc* comparisons were computed on mean rank score differences for pairs of time periods.
***$p < .001$.

A *post hoc* test, described by Siegel and Castellan [17], was performed on the three time periods to determine which time periods were significantly different. From Table 4, it can be seen that for all three-time periods differences were significant, with the order of the mean rankings getting increasingly smaller from the pre to post time periods.

Two of the five factors that contribute to metabolic syndrome, WC and BP, were significant improvements. Of the 14 individuals who met criteria for metabolic syndrome at baseline, only eight of those participants had metabolic syndrome at the program's end. Six (43%) were no longer at risk for metabolic syndrome.

Other information gathered included self-reported data on smoking habits and prescription medication use. Seven individuals reported smoking on the pre-evaluation. On the post-evaluation, four quit smoking, two reduced how much they smoked, and only one had no change. Fifteen participants reported being on BP medication at the program's start. At the end of Health First[SM], four participants stated they reduced their BP medication use, and three reported they stopped taking BP medication, as instructed by their physician. A total of ten participants reported being on medication to control cholesterol at the beginning of the program, and one individual reported decreased use of his or her cholesterol-lowering medication after the program. And, five participants reported taking medication to control diabetes initially, and after the program two reported decreased use, while one reported discontinued use of diabetic medication.

Sixty-seven participants responded to post-evaluation questions about improved eating and exercise habits compared to before the program. The remainder of participants did not complete the post-evaluation. Sixty-one (91%) participants self reported improved eating habits, five (7.5%) were unsure if eating habits changed, and one (1.5%) indicated no change in eating habits after the Health First[SM] program (e.g. Figure 2). Fifty-six (83.6%) of participants stated they improved exercise habits as compared to before the program, seven (10.4%) were unsure if physical activity level changed, and four (6%) indicated no change in exercise after the program (e.g. Figure 3).

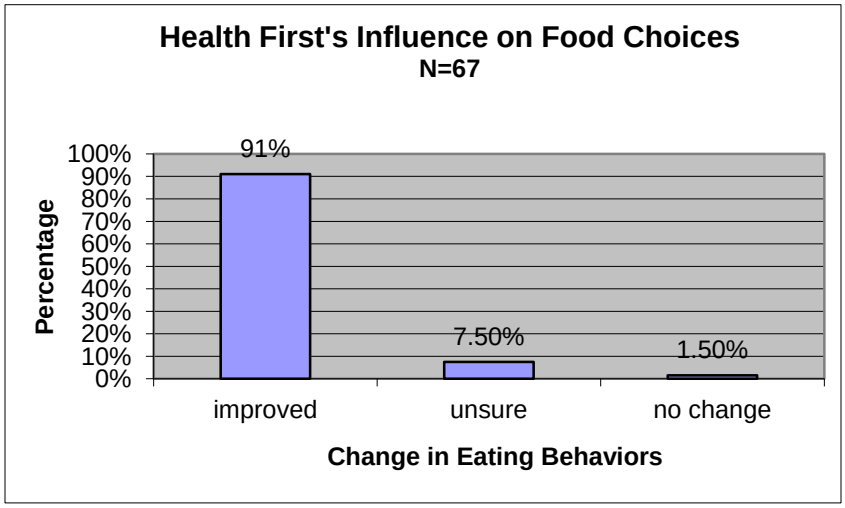

Figure 2: Health First's Influence on Food Choices

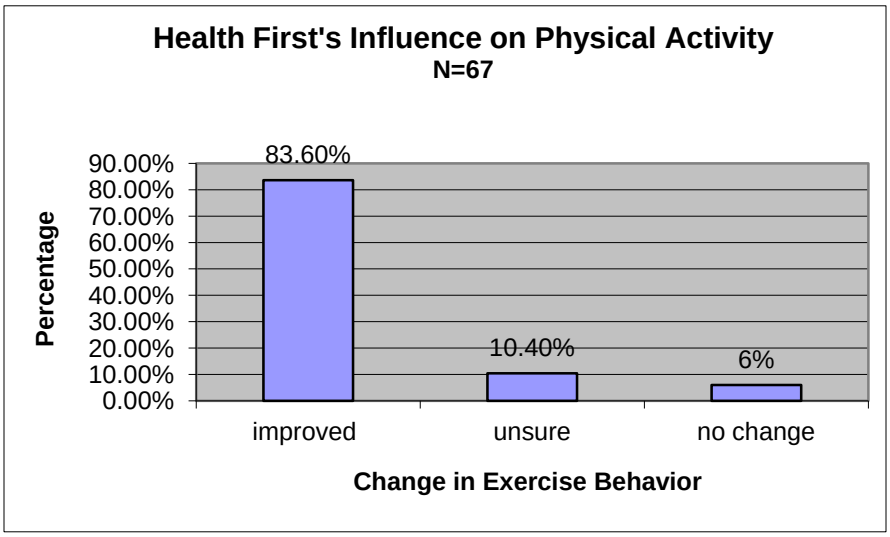

Figure 3: Health First's Influence on Physical Activity

Discussion

The data analysis showed statistically significant improvements in weight, BMI, WC and BP of participants enrolled in the Health First[SM] program. BMI classification and BP categories of participants improved, and BP classification of participants got significantly better across the three measured time periods. The findings showed significant improvements from each data collection period, demonstrating that some attrition was noted in the frequency procedures for BMI and BP, which is a limitation. Regardless of attrition, the percentages are a reflection of the proportion of change.

Although the number of smokers in the program was small (seven initially), four smokers quit, and two reduced the amount of cigarettes smoked. Quitting smoking has major health benefits, including lower risk of heart disease, stroke, respiratory illness, lung cancer, and other cancers [18].

Two unique components of this program is the use of teams to foster support among its members and the ability to view personal health data and aggregate team data online. These aspects may increase participation and completion rates, and also provides a source of fun and safe competition with rival teams. Rules are in place to reward safe health behaviors, such as weight loss of no more than 2 pounds per week. The team dynamics and the online information are likely to be strong forces behind program participants' motivation to change behaviors and to complete the program.

Study Limitations

The outcomes are notably positive, yet there are some limitations to this study. No control group threatens internal validity. The lack of a control group makes it difficult to determine how history, maturation, or other influences may have impacted the results. Future research needs to ascertain opportunities for a controlled study using a delayed control design.

Conclusion

The Health First[SM] worksite wellness program can significantly improve employee health and potentially decrease health care costs. The benefits of using a program with online components may include cost and convenience, and it should be noted that weight loss in web-based programs is comparable to that of traditional programs [19,20]. As cited by University of Michigan faculty member Dee Edington, PhD, "…there is a tremendous danger in following a 'do nothing' strategy that allows individuals to flow into high risk, high cost categories." [21]. Wellness programs that reach the total population, not excluding those in good health, will help to lower healthcare costs by delaying onset of disease and metabolic risk factors.

In summary, a well-designed program, use of knowledgeable healthcare professionals such as RDs to provide employees with sound nutrition coaching, health education based on proven theories, thorough and carefully planned evaluation, use of team dynamics, and offering incentives are all steps in the development and execution of a successful program that will reduce both employer costs and employee health risk factors.

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Conflict of Interest

The authors Hayley Daubert, David Rheinheimer, and Christina Brecht disclose no significant financial relationships or affiliations. Denice Ferko-Adams developed the Health First[SM] program and provided information on the content of the program for this paper. Raw data was also provided to East Stroudsburg for the independent analysis.

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