HHS Public Access

Author manuscript

Obesity (Silver Spring). Author manuscript; available in PMC 2014 May 01.

Published in final edited form as:

Obesity (Silver Spring). 2013 November ; 21(11): 2157–2162. doi:10.1002/oby.20597.

The impact of a managed care obesity intervention on clinical outcomes and costs: A prospective observational study

Amy E. Rothberg[1], **Laura N. McEwen**[1], **Tom Fraser**[2], **Charles F. Burant**[1], and **William H. Herman**[1,2,3]

[1]Department of Internal Medicine, University of Michigan

[2]Blue Care Network

[3]Department of Epidemiology, University of Michigan

Abstract

Objective—To evaluate the impact of a managed care obesity intervention that requires enrollment in an intensive medical weight management program, a commercial weight loss program, or a commercial pedometer-based walking program to maintain enhanced benefits.

Design and Methods—Prospective observational study involving 1,138 adults with BMI ≥32 kg/m^2 with one or more comorbidities or BMI ≥35 kg/m^2 enrolled in a commercial, independent practice association-model health maintenance organization. Body mass index, blood pressure, lipids, HbA1c or fasting glucose, and per-member per-month costs were assessed one year before and one year after program implementation.

Results—Program uptake (90%) and one year adherence (79%) were excellent. Enrollees in all three programs exhibited improved clinical outcomes and reduced rates of increase in direct medical costs compared to members who did not enroll in any program.

Conclusions—A managed care obesity intervention that offered financial incentives for participation and a variety of programs was associated with excellent program uptake and adherence, improvements in cardiovascular risk factors, and a lower rate of increase in direct medical costs over one year.

Keywords

weight loss; cost analysis; managed care

Corresponding Author: Amy E. Rothberg, MD, PhD, University of Michigan, 24 Frank Lloyd Wright Drive, PO Box 451, Lobby C, Suite 1300, Ann Arbor, MI 48106-0451.

Conflicts of interest: A portion of Dr. Herman's University of Michigan salary is funded by Blue Care Network for his services as Associate Medical Director. Tom Fraser is a Blue Care Network employee. The costs of the weight management interventions were paid by Blue Care Network.

Introduction

Between 1980 and 2004, the prevalence of obesity doubled among U.S. adults (1). Approximately 33% of U.S. adults are overweight (body mass index (BMI) 25.0–29.9 kg/m^2), 28% are obese (BMI 30.0–39.9 kg/m^2), and nearly 6% are extremely obese (BMI ≥40.0 kg/m^2) (1). Similarly, more than half of all U.S. adults do not get adequate physical activity and approximately one-quarter do not get any leisure-time physical activity (1). Being overweight or obese and sedentary increase the risk for many chronic conditions including stroke, heart disease, hypertension, dyslipidemia, insulin resistance, type 2 diabetes, and depression.

Both obesity and sedentary lifestyle are also associated with increased medical spending. In 2008, 9.1% of all medical spending in the U.S., an estimated $147 billion, was attributed to obesity (2). It has been estimated that if 10% of U.S. adults began regular walking programs, heart disease costs could be reduced by nearly $6 billion (1). Reversing the U.S. epidemic of obesity and sedentary lifestyle and their attendant costs will require innovative approaches to support and promote healthy lifestyle choices (3).

When implemented within organized systems of health care, weight loss and physical activity programs have an enormous potential to improve clinical outcomes. Managed care organizations can use information systems to target interventions to patients who need them and can modify benefit structures or provide financial incentives to encourage participation. In managed care organizations, patients have access to primary care, laboratory testing, and medications. Because managed care organizations pay all direct medical costs (and track co-payments), managed care data can be used to assess return-on-investment. In addition, because managed care organizations are ultimately businesses, a “business case” can be made for effective and cost-effective disease management strategies to ensure their sustainability.

Although expensive, medical weight management programs have been shown to be effective for weight loss. The University of Michigan Weight Management Program is a two-year program that employs intensive energy restriction for the first 12 weeks to promote 15% weight loss, followed by interventions to support behavior change and promote regular physical activity. Prior to enrollment, patients are asked to attend an orientation session that reviews the scope of the obesity problem, the epidemiology and biology of obesity, and the requirements of the program. Patients who elect to enroll must sign a contract agreeing to attend >80% of their scheduled appointments. Patients are seen by a physician for an initial assessment, at one month, and quarterly thereafter. Patients are seen weekly by a dietitian during the first month, twice monthly for the next 2 months, and monthly thereafter. The initial 12 weeks of the program employs a very low calorie diet (VLCD, 800 kcal/day) in the form of total meal replacement (800 solutions, HMR®, Boston, MA). Over the first 12 weeks of the program, patients are also asked to gradually increase their physical activity (low to moderate intensity) to 40 minutes per day. Patients are asked to keep diaries to record the number of meal replacement shakes consumed per day and any deviations from the prescribed diet, their feelings of hunger and satiety, and their physical activity. These diaries are reviewed each week with the dietitian either in person, by telephone, or by email.

Following the initial weight loss with VLCD, patients are transitioned to regular food stuffs. An exercise physiologist is available to provide a one-time, one-hour, exercise consultation to develop an activity program that incorporates patient preferences. Participants are subsequently asked to perform 40 to 90 minutes of moderate to vigorous physical activity per day.

Less intensive, commercial medical weight management programs have also been shown to be effective for weight loss. In a randomized controlled clinical trial, Dansinger and colleagues assessed adherence rates and the effectiveness of four popular diets for weight loss and cardiac risk factor reduction (4). These included Weight Watchers, and the Atkins, Zone, and Ornish diets. At one year, continuation rates tended to be higher for the more moderate diets (65% for Weight Watchers and Zone) and lower for the more extreme diets (52% for Atkins and 50% for Ornish). Each diet modestly reduced body weight and several cardiac risk factors at one year. In general, greater effects were observed in study completers. A systematic review that described the effectiveness and cost of major commercial weight loss programs that provide structured in-person or online counseling cited three randomized controlled trials of Weight Watchers, the largest of which reported a loss of 3.2% of initial weight at two years (5). Internet-based interventions and organized self-help programs produced minimal weight loss (5).

There are also a number of commercial pedometer-based walking programs that use dual axial accelerometer mechanism pedometers. WalkingSpree is one such program that incorporates pedometers with web-based interfaces to assess activity, food consumption, and body weight, and to support social networking. The literature evaluating the impact of commercial physical activity intervention programs on fitness is limited and the outcomes are largely predicated on subject selection. Motivated patients who adhere to intervention programs are much more likely to be successful (6). Cross-sectional observational studies have shown that people who walk more tend to be more fit and thinner than those who walk less (7). In a recent systematic review, the most important participant characteristics associated with increased physical activity were younger age and lower baseline physical activity (8). The intervention characteristics most strongly associated with increased physical activity were having a step goal and requiring participants to use a step diary (8).

Beginning in November 2006, Blue Care Network (BCN), the largest health management organization in Michigan, collaborated with its employer groups to offer Healthy Blue Living (HBL), a commercial health insurance product that includes strong incentives for patients, providers, and employers to work towards improved health in six high-impact areas including obesity. Under Michigan state law, insurance benefits cannot be predicated on health outcomes but can be based on processes of care. Members who participate in HBL must complete a HBL Qualification Form, commit to maintain or adopt a healthy lifestyle, and work to achieve their wellness plan. Members who adhere to HBL program requirements receive additional benefits and reduced co-payments for office, urgent care, and emergency room visits and for prescription drugs. Those who do not adhere to the program requirements revert to standard benefits. The difference in out-of-pockets costs between HBL enhanced and standard benefits is approximately $800 per member per year. The HBL program compensates providers for their participation and offers a 10% reduction

in premiums to employers for their employees who elect HBL. Providers who participate in HBL agree to validate all patient-reported information on the HBL Qualification Forms and to schedule follow-up appointments as needed. Employers who offer HBL are required to support the goals of the program. Since its introduction, HBL has had the largest uptake of any commercial program offered by BCN.

In 2006, HBL Qualification Forms indicated that one-third of members were overweight or obese. Despite patients' commitment to actively participate in physician-supervised weight loss interventions, analyses of HBL Qualification Forms from 2006 to 2009 indicated no progress with respect to weight management. Additional analyses demonstrated that obese members incurred consistently higher per capita medical costs than normal weight members. Compared to members without obesity, members with obesity incurred 31% higher annual per capita medical costs. Obese members with diabetes incurred average annual per capita medical costs nearly 175% higher than members without obesity and diabetes.

In 2009, BCN elected to require participation in either Weight Watchers or WalkingSpree for HBL members with BMI ≥30 kg/m^2 in order for them to maintain enhanced benefits. A subgroup of members with BMI ≥32 kg/m^2 with one or more comorbidities or BMI ≥35 kg/m^2 who lived in southeastern Michigan and worked for employer groups that agreed to offer the program was also offered the opportunity to enroll in the University of Michigan Weight Management Program (WMP). All programs were offered to eligible members with no out-of-pocket costs except that members had to pay the cost of meal replacements in the WMP, which was approximately $805 for 12 weeks. The goal of this study was to evaluate the impact of a benefit structure and financial incentives that encouraged participation in these weight management programs on body mass index (BMI) and direct medical costs; as well as blood pressure, lipids, and measures of glycemia, and to perform a rigorous cost-benefit analysis of the program.

Methods

The study was reviewed and approved by the University of Michigan Institutional Review Board. Using HBL Qualification Forms, we identified all adult members with BMI ≥30 kg/m^2. In this analysis, we studied the subgroup of adult HBL members who had BMI ≥32 kg/m^2 with one or more comorbidities or BMI ≥35 kg/m^2 who lived in southeastern Michigan and who were enrolled in employer groups that agreed to offer the WMP, Weight Watchers, and WalkingSpree to members between January 1, 2010 and December 20, 2012. We included all members who were eligible to participate in the three programs and who were sent notification letters to join the WMP, Weight Watchers, or WalkingSpree. We then classified them according to the program in which they first enrolled (WMP, Weight Watchers, WalkingSpree, none).

For each member, we determined an anchor date. For members who enrolled in a weight management program, this was the date of first enrollment after the notification letter was sent. For members who did not enroll in a program, the anchor date was defined as the date the notification letter was sent plus the mode number of days to enrollment for those who enrolled in a weight management program.

Members were then assigned to cohorts based on their initial program selection. Demographic and clinical data were collected from HBL enrollment forms completed immediately before and 12 months after the anchor date. Utilization data were also summarized for the time period 12 months before and 12 months after the anchor date. Member paid amounts and plan paid amounts (using standard costs across provider groups and hospitals) were summarized for services received during each time interval. Costs were categorized into seven mutually exclusive bins including inpatient medical, outpatient medical, emergency room, diagnostic testing, laboratory testing, pharmacy, and other.

Per-member per-month (PMPM) costs of the WMP, Weight Watchers, and WalkingSpree were added to the "other" cost category for each participant according to the program in which they enrolled and their duration of enrollment. Because we adopted a health system perspective and considered only direct medical costs and because all members paid for their own food (including meal replacements), we did not include the cost of meal replacements in the cost of the WMP. Based upon the published retail cost of meal replacement shakes and US Department of Agriculture estimates of daily per capita costs of food eaten at home and away from home, the average daily cost of meal replacements and regular food stuffs was comparable ($9.58 per day vs. $11.59 per day, respectively).

Analyses were performed for the total population and for the subsets of individuals who remained enrolled in the WMP, Weight Watchers, or WalkingSpree for the entire 12 month follow-up period. To compare risk factor levels and costs before enrollment and 12 months after enrollment, we performed paired t-tests. Because of the short time horizon of our study (two years), we did not perform discounting. Analyses were performed using SAS version 9.1 (SAS Institute, Cary, NC). Results are expressed as mean ± standard deviation or as percent.

Results

There were 1,138 HBL members with BMI ≥32 kg/m^2 and one or more comorbidities, or BMI ≥35 kg/m^2, who met eligibility requirements and were invited to participate in the University of Michigan Weight Management Program (WMP), Weight Watchers, or WalkingSpree (Table 1). One hundred fifty-three members (13%) elected to participate in the WMP, 439 (39%) in Weight Watchers, and 432 (38%) in WalkingSpree. Only 114 members (10%) chose not to participate in any of the weight management programs.

The mean age of the 1,138 members was 49 ± 9 years and 53% were women (Table 1). Patient characteristics were associated with their choice of program. Members who selected the WMP tended to be older. Women were more likely to select Weight Watchers and men were more likely to select WalkingSpree. To remain in the weight management programs and to maintain enhanced benefits, members were required to attend ≥80% of scheduled WMP visits, 11 of 13 weekly Weight Watchers meetings every 3 months, or to walk an average of 5,000 steps per day in the WalkingSpree program every 3 months. Those who failed to meet these requirements reverted to standard benefits. Program retention was good with 70% of WMP, 71% of Weight Watchers, and 90% of WalkingSpree participants completing 12 months in the programs.

Table 2 shows the characteristics of the study populations before enrollment and 12 months after enrollment in the programs. At baseline, mean BMI was 38.3 ± 5.5 kg/m^2. Systolic and diastolic blood pressure and HDL and total cholesterol levels were generally well-controlled. Mean HbA1c (performed for diabetic members) was 7.0 ± 1.6% and mean fasting glucose (performed for non-diabetic members) was 98 ± 26 mg/dl. Six percent of members reported being treated for depression. At follow-up, there was a 1.3 kg/m^2 reduction in BMI. For a 5 feet 10 inch tall man with a BMI of 38 kg/m^2, this would represent a loss of 9 pounds, from 264 pounds to 255 pounds. For a 5 feet 4 inch tall woman with a BMI of 38 kg/m^2, this would represent a loss of 8 pounds, from 221 pounds to 213 pounds. At follow-up, there was also a 0.3% reduction in HbA1c. Blood pressure, lipids, fasting glucose, and rates of treatment for depression did not change substantially.

When we compared clinical outcomes among members who elected a program to those who elected no program, it was apparent that members who elected the WMP demonstrated a consistent and substantial improvement in all of the risk factors assessed (Table 2). BMI decreased from 40.4 ± 5.3 kg/m^2 to 36.2 ± 6.1 kg/m^2 and HbA1c decreased from 6.9 ± 1.1 to 6.3 ± 0.8%. There were also improvements in systolic and diastolic blood pressure, HDL-cholesterol, total cholesterol, and fasting glucose. The prevalence of treated depression, which was initially highest in the WMP population, decreased from 13% to 10% at follow-up.

Members who elected Weight Watchers and WalkingSpree showed more modest improvements in BMI and HbA1c, and variable improvements in blood pressure, HDL-cholesterol, and total cholesterol (Table 2). Rates of treated depression remained unchanged. Members who chose not to participate in any weight management program showed an increase in HbA1c and an increase in treated depression at follow-up (Table 2).

At baseline, per-member per-month (PMPM) direct medical costs, including both costs paid by the health plan and member copayments, were substantial. Total direct medical costs were $448 PMPM or almost $5,400 per member per year (Table 2). The largest proportion of costs was attributable to outpatient care and pharmacy. At baseline, PMPM costs were greatest for members who selected the WMP ($545 PMPM), lower for those who selected Weight Watchers ($488 PMPM), lower for those who selected WalkingSpree ($396 PMPM), and lowest for those who chose not to participate in any weight management program ($357 PMPM). In multivariate analysis adjusting for baseline age, BMI, systolic and diastolic blood pressure, and HDL and total cholesterol, baseline PMPM costs tended to be higher for members who chose the WMP (p=0.06) but did not differ significantly among the groups. Over 12 months, PMPM costs increased by 13% for the entire population, from $448 to $506. PMPM costs increased by 7% for those who selected the WMP, 13% for those who selected Weight Watchers, 12% for those who selected WalkingSpree, and 28% for those who chose not to participate in any program. After adjusting for baseline differences in age, BMI, blood pressure, and lipids, PMPM costs increased by 4% for those who selected the WMP, 10% for those who selected Weight Watchers, 16% for those who selected WalkingSpree, and 29% for those who chose not to participate in any program. For members who selected the WMP, Weight Watchers, and WalkingSpree, the increase in costs was driven largely by the costs of the programs themselves (included in the “other”

category). Pharmacy costs were largely unchanged. Although the costs of the WMP were substantially greater than the costs of Weight Watchers or WalkingSpree, the mean annual cost per unit reduction in BMI for members who were enrolled for the entire 12 month follow-up was only $232 for participants in the WMP compared to $380 for participants in Weight Watchers and $378 for participants in WalkingSpree.

To more rigorously assess the impact of program participation on both clinical outcomes and costs, we compared clinical outcomes and costs within individuals before enrollment and 12 months after enrollment using paired t-tests (Table 3). Within the total population, there were statistically significant improvements in all the clinical outcomes assessed. There was a statistically significant decrease in the PMPM cost of laboratory testing and an increase in other costs driven primarily by the costs of the weight management programs themselves. For members who participated in the WMP, there was improvement in all of the clinical outcomes assessed. Total PMPM costs increased by $38. For members who participated in Weight Watchers, there were improvements in BMI, diastolic blood pressure, and HbA1c. Total PMPM costs increased by $63. For members who participated in WalkingSpree, there were improvements in BMI and total cholesterol. Total PMPM costs increased by $49. For members who chose not to participate in any weight management program, there were improvements in BMI and fasting glucose. Total PMPM costs increased by $100. After adjusting for baseline differences in age, BMI, blood pressure and lipids, total PMPM costs increased by $20 for WMP participants, $49 for Weight Watchers participants, $62 for WalkingSpree participants and $106 for members who chose not to participate in any weight management program.

Discussion

In the United States, the prevalence and costs of obesity are enormous and are growing rapidly. Health systems must remove barriers and provide incentives to encourage the adoption of effective interventions to prevent and treat obesity. Complimentary societal interventions must address education, advertising, food availability and price, and the built and workplace environments.

One promising approach to obesity treatment comes from the behavioral economic theory of loss aversion (9,10). The theory states that people make decisions based on the potential value of losses and gains rather than final outcomes. In general, losses may be a more powerful motivator than gains. People react powerfully to the threat of even small financial losses in part because they consider them in isolation and fail to integrate them into their larger financial pictures. Loss aversion may thus provide a strong incentive for behavior change. In this report, we have evaluated the clinical effectiveness and cost implications of using loss aversion to encourage high-risk individuals to participate in medical weight management, weight loss, and physical activity programs. Compared to non-participants, individuals who participated demonstrated reductions in body mass index, improvements in blood pressure, lipid levels, and measures of glycemia, and a lower rate of increase in total PMPM health care costs.

Ninety percent of eligible participants selected one of the three weight management programs and 79% remained in the program they selected for at least 1 year. Health plan members were free to choose the program in which they participated and selection did not occur at random. Older and more obese patients were more likely to select the WMP. Women were more likely to select Weight Watchers and men were more likely to select the pedometer-based walking program. Offering a choice of programs that appeal to different subpopulations appears to be important for program uptake. Perhaps due to both the freedom of choice and the financial incentives, longer-term program participation was also excellent. Members who did not participate or failed to meet program requirements lost benefits and incurred increased out-ofpocket costs.

Taken as a whole, the target population achieved significant improvements in all of the risk factors assessed. The extent and degree of improvement were greatest for participants in the WMP, intermediate for Weight Watchers, and least for WalkingSpree. Improvement in all groups was greater than for members who chose not to participate. Although the WMP was the most expensive, it produced the best clinical outcomes and was associated with both the smallest percentage increase and the lowest absolute increase in direct medical costs over one year. In the Look AHEAD study, weight loss in the first year was the strongest predictor of sustained weight loss at year 4 (11). This suggests that with continued reinforcement, the WMP may have the most sustained impact. Although no program was cost-saving, in large part due to the program costs themselves, all programs cost only $230 to $380 per unit reduction in BMI over one year. For patients who participated in any weight management program, total PMPM direct medical costs increased by only $38 to $63. Over one year, this increase in total PMPM cost was less than for members who chose not to participate in any weight management program ($100 increase in total PMPM costs).

There were a number of limitations to our study. The study was not a randomized, controlled, clinical trial. Patients' clinical characteristics and preferences clearly influenced their choice of programs and may have impacted their outcomes. The fact that more patients who chose not to participate in any weight management program were identified as having treated depression at follow-up suggests that mental health issues may have been more frequent among nonparticipants. Second, the clinical outcomes assessed including BMI may not have fully captured the health benefits of the interventions, especially the pedometer-based walking program. Third, PMPM costs were based on health plan administrative data and did not include out-ofplan costs. In an insured population, it is unlikely that such costs would have been substantial.

In summary, we have demonstrated that a managed care benefit structure that offered a variety of weight management programs to obese members, and financially penalized those who did not participate resulted in a 90% program uptake and 79% one year retention. Program participation was associated with significant reductions in BMI and improvements in cardiovascular risk factors including blood pressure, lipids, and glycemia with no increase in pharmacy costs. Although not cost-saving, this benefit design and behavioral economic approach employing loss aversion reduced the rate of increase in direct medical costs over one year and appeared to be cost-effective, providing good value for money. With extended

follow-up, the observed reductions in BMI and cardiovascular risk factors may translate into costsavings.

Acknowledgments

AR was responsible for study design, data collection, data analysis, data interpretation, the literature search, and writing the manuscript. LM was responsible for data analysis and generation of the tables. TF was responsible for data collection and data analysis. CB was responsible for the study design and data interpretation. WH was responsible for study design, data interpretation, and the literature search. All authors were involved in writing the manuscript and had final approval of the submitted and published versions. The study was supported by the Michigan Nutrition Obesity Research Center (Grant Number DK089503) and the Michigan Center for Diabetes Translational Research (Grant Number P30DK092926). Additional support was provided by the A. Alfred Taubman Medical Institute and the Robert C. and Veronica Atkins Foundation.

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What is already known about this subject

- Randomized controlled clinical trials have demonstrated the efficacy of short-term weight loss interventions
- Behavioral economic theory has suggested that aversion to losing money can be a good motivator
- Managed care organizations provide an excellent setting to test the effectiveness of weight loss interventions supported by behavioral economic theory

What this study adds

- When a variety of weight management programs are offered to obese managed care enrollees and when failure to participate is associated with reduced benefits and increased out-of-pocket costs, participation is high and adherence at one year is excellent
- Participation in any one of the programs, an intensive medical weight management program, a commercial weight loss program, and a commercial pedometer-based walking program, is associated with lower BMI and improved cardiovascular risk factors
- Even after intervention costs are considered, program participation is associated with a lower rate of increase in per-member per-month direct medical costs compared to nonparticipation

Table 1

Characteristics of the study population, N=1,138.

Characteristic	Total	WMP	Weight Watchers	WalkingSpree	None
N	*1,138*	*153 (13%)*	*439 (39%)*	*432 (38%)*	*114 (10%)*
Age at anchor date (years)	49 ± 9	51 ± 8	50 ± 9	49 ± 9	49 ± 9
Sex (female)	608 (53%)	89 (58%)	286 (65%)	179 (41%)	54 (47%)
Time in program					
12 months	--	107 (70%)	313 (71%)	388 (90%)	--
Less than 12 months	--	46 (30%)	126 (29%)	44 (10%)	--

WMP = University of Michigan Weight Management Program

Obesity (Silver Spring). Author manuscript; available in PMC 2014 May 01.

Table 2

Characteristics of the study population before enrollment and 12 months after enrollment in the weight management programs

	Total N=1,138		WMP N=153		Weight Watchers N=439		WalkingSpree N=432		None N=114	
Characteristic	***Pre***	***Post***	***Pre***	***Post***	***Pre***	***Post***	***Pre***	***Post***	***Pre***	***Post***
BMI (kg/m^2)	38.3 ± 5.5	37.0 ± 5.8	40.4 ± 5.3	36.2 ± 6.1	39.3 ± 6.0	38.1 ± 6.4	36.4 ± 4.5	35.9 ± 4.6	38.6 ± 5.5	37.9 ± 6.6
Systolic blood pressure (mmHg) (missing=4/0)	126 ± 13	125 ± 12	126 ± 12	122 ± 12	126 ± 14	125 ± 13	125 ± 12	125 ± 12	127 ± 15	127 ± 12
Diastolic blood pressure (mmHg) (missing=4/0)	79 ± 8	78 ± 8	79 ± 9	75 ± 8	79 ± 8	78 ± 8	79 ± 8	78 ± 8	80 ± 9	80 ± 7
HDL cholesterol (mg/dl) (missing=8/4)	47 ± 13	47 ± 13	46 ± 13	47 ± 13	48 ± 13	48 ± 12	46 ± 13	47 ± 13	44 ± 12	45 ± 11
Total cholesterol (mg/dl) (missing=10/13)	184 ± 35	181 ± 36	183 ± 36	174 ± 37	184 ± 32	182 ± 32	183 ± 36	180 ± 36	191 ± 36	191 ± 40
HbA1c (%)(missing=913/960)	7.0 ± 1.6	6.7 ± 1.6	6.9 ± 1.1	6.3 ± 0.8	7.0 ± 1.8	6.5 ± 1.3	7.0 ± 1.6	6.7 ± 1.4	7.4 ± 2.1	7.9 ± 2.9
Fasting glucose (mg/dl) (missing=486/704)	98 ± 26	96 ± 19	103 ± 21	97 ± 14	96 ± 24	97 ± 23	96 ± 23	96 ± 16	106 ± 42	94 ± 16
Treated depression (missing=294/46)	54 (6%)	75 (7%)	7 (13%)	14 (10%)	30 (8%)	33 (8%)	16 (4%)	17 (4%)	1 (6%)	11 (15%)
PMPM Cost*										
Inpatient	$71	$87	$112	$79	$71	$103	$60	$76	$60	$74
Outpatient	$169	$167	$182	$171	$184	$166	$166	$173	$106	$140
Diagnostic testing	$37	$51	$60	$41	$43	$62	$26	$39	$28	$64
Laboratory testing	$15	$14	$15	$13	$17	$14	$14	$12	$18	$17
Emergency room	$25	$24	$19	$30	$28	$20	$25	$21	$22	$45
Pharmacy	$108	$107	$133	$129	$115	$112	$93	$96	$108	$105
Other	$21	$57	$24	$119	$30	$74	$12	$29	$15	$12
Total	$448	$506	$545	$584	$488	$551	$396	$445	$357	$457

WMP = University of Michigan Weight Management Program

PMPM = per-member per-month

* includes both plan and member costs

Missing=number missing pre/number missing post

Table 3

Within individual comparison of risk factor levels and costs before enrollment and 12 months after enrollment in the weight management programs

	Total N=1,138		WMP N=153		Weight Watchers N=439		Walking Spree N=432		None N=114	
Characteristic	***Difference post-pre***	***p-value***	***Difference post-pre***	***p-value***	***Difference post-pre***	***p-value***	***Difference post-pre***	***p-value***	***Difference post-pre***	***p-value***
BMI (kg/m^2)	−1.3	<0.0001	−4.1	<0.0001	−1.2	<0.0001	−0.4	<0.0001	−0.7	0.0099
Systolic blood pressure (mmHg)	−1	0.0093	−4	0.0017	−1	0.0641	0	0.8796	−1	0.5534
Diastolic blood pressure (mmHg)	−1	0.0011	−4	<0.0001	−1	0.0292	0	0.7851	0	0.7207
HDL cholesterol (mg/dl)	1	0.0113	2	0.0367	0	0.4002	0	0.2646	1	0.0960
Total cholesterol (mg/dl)	−3	<0.0001	−10	0.0003	−2	0.0589	−3	0.0125	0	0.9539
HbA1c (%)	−0.3	0.0055	−0.4	0.0445	−0.5	0.0126	−0.2	0.2713	0.2	0.6848
Fasting glucose (mg/dl)	−2	0.0188	−5	0.0066	−2	0.4355	0	0.7771	−5	0.0300
PMPM Cost*										
Inpatient	15	0.3259	−32	0.5113	32	0.2064	15	0.5088	14	0.7719
Outpatient	−2	0.8370	−11	0.7696	−18	0.1899	7	0.7486	35	0.2084
Diagnostic testing	13	0.0874	−19	0.0213	19	0.2869	12	0.0032	36	0.1779
Laboratory testing	−2	0.0111	−1	0.3116	−2	0.0572	−2	0.1175	−1	0.6856
Emergency room	−1	0.7849	11	0.2314	−8	0.2638	−4	0.4342	23	0.0909
Pharmacy	−1	0.7816	−4	0.7913	−3	0.5980	2	0.7243	−4	0.5427
Other	36	<0.0001	95	<0.0001	44	<0.0001	17	<0.0001	−2	0.6489
Total	58	0.0209	38	0.6154	63	0.0961	49	0.2344	100	0.2397

WMP = University of Michigan Weight Management Program

PMPM = per-member per-month

* includes both plan and member costs