Abstract

This study evaluated weight loss and cardiometabolic risk reduction achieved through an adapted Diabetes Prevention Program lifestyle intervention among adults at high risk for cardiovascular disease (CVD) and diabetes. A 16-session lifestyle intervention was delivered through a partnership between a diabetes self-management education (DSME) program and the Young Men’s Christian Association (YMCA). Overweight adults with ≥ 1 additional risk factors for CVD or diabetes were enrolled (n = 265). Lifestyle coaches from the DSME program coordinated intervention delivery and taught the curriculum. YMCA staff delivered the physical activity component of the intervention. Two-hundred and nineteen participants (83%) completed the program. Seventy-five percent of participants achieved the physical activity goal (≥ 150 minutes/week), 34% achieved the 7% weight loss goal, and 60% achieved weight loss ≥ 5%. There were significant improvements in cardiometabolic risk factors among participants completing the intervention. Our findings suggest that an adapted lifestyle intervention can be successfully implemented through collaboration between a DSME program and a YMCA. Implementation of effective prevention programs in multiple settings throughout the United States will be needed to ensure that the large subpopulation of adults at high risk for CVD and diabetes have access to this prevention service.

The prevalence of type 2 diabetes continues to increase in the United States. If the current trend continues, approximately one in three individuals born in this country in 2000 will develop type 2 diabetes in their lifetime.1-2 Randomized clinical trials from multiple countries have demonstrated that a lifestyle intervention targeting reduced fat and calorie consumption and increased physical activity in people at high risk for diabetes can prevent or delay the development of type 2 diabetes.3-7 In the United States, the Diabetes Prevention Program (DPP) study found that the incidence of type 2 diabetes among participants in the lifestyle intervention group was reduced by 58% compared to that in the placebo group at the completion of the study and by 34% a decade after enrollment.5,8 Since the publication of the DPP, multiple translation studies have been conducted showing that it is feasible to recruit and retain adults at high risk for cardiovascular disease (CVD) and type 2 diabetes into lifestyle intervention programs similar to the DPP and to achieve weight loss and physical activity goals similar to those achieved by DPP participants.9-15 These translation studies were implemented in various community settings including diabetes self-management education programs, primary care practices, hospitals, worksites, cardiac rehabilitation programs, Young Men’s Christian Association (YMCA) sites, and churches.

Beginning in 2008, the Montana Department of Public Health and Human Services (DPHHS) implemented an adapted group-based
CVD and diabetes prevention program. The findings from this program suggest that participants can achieve weight loss and physical activity goals and cardiometabolic risk reduction similar to the DPP. One of the eight sites providing this lifestyle intervention in Montana is a collaboration between the St. Vincent Healthcare Diabetes Center’s diabetes self-management education (DSME) program and the Billings Family YMCA. This article describes the establishment of this collaboration and the weight loss and cardiometabolic risk factor outcomes among participants enrolled in the intervention.

Methods

The Montana DPHHS funded eight health care facilities with recognized DSME programs to implement an adapted CVD and diabetes prevention program in Montana. One of these sites, initiated in January 2008, is a collaboration between the St. Vincent Healthcare DSME program and the local YMCA.

The DSME program provided two lifestyle coaches (1.0 full-time equivalent) to deliver an adapted group-based DPP lifestyle intervention. The coaches are both dietitians and completed a 2-day training to learn how to deliver the adapted DPP curriculum. The lifestyle coaches also received training in motivational interviewing. The YMCA’s community wellness coordinator supervised the physical activity component of the intervention, and YMCA staff also provided administrative support for the program. The roles and responsibilities of the lifestyle coaches and YMCA staff are described in Table 1.

The program is housed at the YMCA through a joint agreement between the YMCA and the DSME program. St. Vincent Healthcare and the YMCA had established a partnership in 2005 to implement the national YMCA’s “Activate America” program. The goal of this program is to support members of the community who are not currently physically active in getting started. The collaboration between these entities to implement the CVD and diabetes prevention program was an extension of this initial partnership.

Participants

A complete description of the eligibility criteria, adapted intervention, and data collection has been published previously. Briefly, adults who were ≥ 18 years of age, overweight (BMI ≥ 25 kg/m²), had medical clearance from their referring provider, and had one or more risk factors for CVD and type 2 diabetes were eligible to participate in the program. Risk factors included a previous diagnosis of pre-diabetes; impaired glucose tolerance (IGT) or impaired fasting glucose (IFG); high blood pressure (≥ 130/85 mmHg or treatment); dyslipidemia (triglycerides > 150 mg/dl, LDL cholesterol > 130 mg/dl or treatment, or HDL cholesterol < 40 mg/dl for men or < 50 mg/dl for women); a history of gestational diabetes mellitus (GDM); and birth of a baby > 9 lb.

People were not eligible to participate in the program if they were diagnosed with diabetes, had unstable cardiac disease, had cancer and were currently undergoing treatment, had end-stage renal disease or currently were on dialysis, were unable to participate in regular moderate physical activity, or were pregnant or

<table>
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<tr>
<th>Program Staff Responsibilities and Functions</th>
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<tr>
<td>Health care professional lifestyle coaches</td>
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<tr>
<td>• Recruitment of participants</td>
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<tr>
<td>• Overall program development and management</td>
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<td>• Screening and assessment of participants at intake</td>
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<td>• Individual counseling with participants</td>
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<td>• Presentation of class material</td>
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<td>• Development of supplemental educational material</td>
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<td>• Collaboration with interdisciplinary team members (physician, social worker, counselor, nursing staff, physical therapist) who present selected components of the curriculum</td>
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<tr>
<td>• Review and assessment of participants’ food, exercise, and weight journals</td>
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<td>• Coordination with YMCA staff for class scheduling and administrative needs</td>
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<td>• Data entry and submission</td>
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<td>• Follow-up with participants after completion of the intervention</td>
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<td>YMCA staff</td>
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<td>• Initial and final physical fitness assessment, including body measurements</td>
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<tr>
<td>• Provision of structured twice-weekly group physical activity sessions (weeks 6–16)</td>
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<tr>
<td>• Coordination with lifestyle coaches for class scheduling and material</td>
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<td>• Provision of administrative support for the program</td>
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planning to become pregnant within the next 6 months.

Potentially eligible participants were recruited through local primary care and specialty clinicians, advertising in paid and unpaid media, word-of-mouth recommendations of successful participants who completed the program, inter-hospital e-mail messages to employees, and coordination with local employer groups (e.g., banks and city, county, and state government offices).

Participants enrolling in the program initially were not charged a fee. However, starting in the fall of 2009, participants were charged $50, and in the fall of 2010, that fee was increased to $100. Any potentially eligible participant who is unable to pay the fee is provided a scholarship to participate in the program.

Lifestyle Intervention
The core lifestyle intervention was based on an adaptation of the original DPP curriculum developed by the Healthy Native Community Partnership and delivered by the lifestyle coaches.17 The program focused on the same goals as the DPP (7% weight loss and moderately intense physical activity for ≥150 minutes per week).4 The 16-week core sessions were offered by six monthly after-core sessions, for a total intervention length of 10 months. The group size ranged from 8 to 15 participants. Each group session was ~1 hour in length, and the program offered two weekly physical activity sessions for participants beginning at week 6. After-core session topics were determined by the lifestyle coaches’ assessment of participants’ educational needs and specific feedback from their groups.

Beginning in week 6, YMCA instructors led two weekly structured physical activity sessions for participants in an established physical activity program at the YMCA called “Get Started.” Participants underwent individual assessments to help them develop an appropriate physical activity plan and get started exercising. The assessment was completed before week 6 when the physical activity component of the curriculum was initiated.

This program was overseen by the Community Wellness Coordinator and was intended to guide people who were not currently active in developing a regular exercise routine. The small-group classes consisted of no more than 12 individuals, and the groups followed a curriculum of cardiovascular, strength, and flexibility training. Class participants used various exercise equipment, including treadmills, stationary bicycles, elliptical trainers, resistance bands, hand weights, and stability balls. Participants were encouraged to attend other group exercise classes at the YMCA as well, such as water aerobics, indoor cycling, or Zumba. This allowed them to experience a variety of exercise programs and to learn what types of exercise might be best for them.

Institutional review board approval for this project was not required by the Montana DPHHS because previous research had established the safety and efficacy of the lifestyle intervention, and only de-identified data were used for the analyses.

Data Collection and Follow-Up
Participants’ height, weight, blood pressure, fasting blood glucose, and lipid values were collected at enrollment, at the completion of the 16-week core, and at completion of the 6-month after-core program. Participants were considered to have completed the 16-week core program if they did not formally drop out or miss more than three consecutive core sessions.

Participants’ self-monitoring data were collected by lifestyle coaches assessing daily fat intake and weight beginning at session 2, physical activity at session 5, and, if necessary, calories at session 7. Physical activity was reported as minutes per week. Fat gram and calorie intake were reported as a weekly average. Participants who self-monitored their weight, fat grams, physical activity minutes, and calorie intake ≥4 days per week were considered regular self-monitors. Participants were also weighed at the beginning of each core session by the lifestyle coaches and at the completion of the after-core sessions.

Data Analysis
Participant data were analyzed using SAS 9.1 (Cary, N.C.). Descriptive statistics were used to describe the characteristics of all enrolled participants and those completing the core. T tests were used to compare continuous variables and χ² tests were used to compare dichotomous variables. We calculated the proportion of participants enrolled in the program (intent-to-treat analyses) who met the physical activity goal of ≥150 minutes per week in the core, met the 7% weight loss goal in the core and after-core sessions, and met a 5% weight loss in the core program. The last observed weight of enrolled participants was carried forward to calculate mean weight loss. Paired t tests were used to assess mean weight loss and mean systolic and diastolic blood pressure, HDL cholesterol, LDL cholesterol, and fasting blood glucose from baseline to the end of the core among participants with both measures.

Results
A total of 265 participants were enrolled in the intervention between 2008 and 2010, and 219 (83%) completed the 16-week core curriculum. Eighty percent of those enrolled in the intervention were female, and the mean age was 52.6 years (SD 11.5). The mean BMI of enrolled participants was 36.7 kg/m² (SD 7.3). Sixty-four percent of those enrolled had pre-diabetes, IGT, or IGT; 65% had low HDL cholesterol; 55% had elevated LDL cholesterol; 56% had elevated triglycerides; 31% had hypertension; 9% had had a baby with a birth weight >9 lb; and 6% had a history of GDM.

Participants who enrolled but did not complete the program were significantly younger (mean age 44.8 [SD 11.1] vs. 54.2 [SD 10.9] years, P < 0.001) and had a lower prevalence of pre-diabetes, IGT, or IGT at baseline (47% vs. 66%, P = 0.03) compared to participants who completed the program (data not shown).

Fifty-six percent (147/262) of participants enrolled in the program monitored their fat intake for ≥7 weeks. Seventy-five percent (182/242) achieved the physical activity goal of ≥150 minutes per...
week, and the mean minutes of activity achieved was 217 per week (SD 97). Thirty-four percent (88/260) of participants achieved the 7% weight loss goal, and 60% (157/260) achieved a 5% weight loss. The mean weight and BMI of enrolled participants decreased significantly from baseline (weight 100.5 kg [SD 21.5] vs. 95.1 kg [SD 20.90], P < 0.001; BMI 36.7 kg/m² [SD 7.3] vs. 34.8 kg/m² [SD 7.1], P < 0.001).

Participants completing the core also had significant improvements in systolic and diastolic blood pressure, LDL cholesterol, and fasting blood glucose (Table 2). HDL cholesterol levels had decreased significantly at the end of the core.

Discussion
Our findings suggest that collaboration between a DSME program and a YMCA can effectively deliver an adapted group-based version of the DPP. At the end of the core intervention, participants had achieved a mean weight loss of 5.4 kg, and 75% achieved the physical activity goal. This was similar to the achievement by lifestyle intervention group participants in the original DPP, who had a mean weight loss of 5.6 kg, with 74% achieving the physical activity goal.14 Our finding of significant reductions in cardiometabolic risk factors was also similar to those in the DPP.14 Participants’ HDL cholesterol levels decreased significantly by the end of the core. Previous weight loss intervention studies have found similar results, indicating that HDL cholesterol levels can decrease during an initial weight loss period, followed by increased HDL levels occurring during a weight maintenance period.18,19

Other recent DPP translation studies in the United States have used various adaptations of the DPP curriculum in different settings and have achieved results comparable to ours. In an adapted 12-session lifestyle intervention delivered through primary care practices in Pittsburgh, Pa., 24% of participants achieved the 7% weight loss, and 52% achieved a 5% weight loss.12 These participants also achieved significant improvements in blood pressure and lipid control. In Massachusetts, 30 and 49% of participants completing a hospital-based 16-session lifestyle intervention achieved 7 and 5% weight loss, respectively.11 Participants enrolled in a 16-session adapted DPP delivered through the YMCA in Indiana achieved a mean 5.7-kg weight loss and a significant reduction in total cholesterol at 4- to 6-month follow-up.10 Participants in a church-based 16-session lifestyle intervention achieved a mean 3.4-kg weight loss and significant reductions in blood pressure and fasting glucose.15 Participants enrolled in a 24-week adapted DPP intervention delivered through a worksite achieved a mean 2.9-kg weight loss 6 months from baseline and improvements in lipid levels.14 Similarly, a 12-week lifestyle intervention delivered through a cardiac rehabilitation program achieved a mean 5.0-kg weight loss among participants and significant improvement in blood pressure.13

This adaptation of the DPP lifestyle intervention through collaboration between a DSME program and a YMCA had a number of strengths that facilitated translating the DPP into practice. First, recruitment of participants was not limited only to people with impaired glucose levels. We included the referral of overweight adults with one or more risk factors for diabetes or CVD, including dyslipidemia and hypertension, which are independent risk factors for both diabetes and CVD. We also recruited women with a history of GDM to broaden the subpopulation of adults who could benefit from this intervention. Second, the lifestyle coaches from the DSME program have an established relationship with primary care providers and specialists within the community that expedited the referral of eligible participants. Broadening eligibility and relying on the established referral link with community physicians avoided the potential barriers and additional costs related to distributing risk assessment questionnaires, screening for pre-diabetes, testing blood, and following up. Third, the lifestyle coaches have the education and expertise to ensure the effective delivery of the curriculum, particularly the dietary components. Fourth, the collaboration with and delivery of the program through the local YMCA allowed for the use of an existing exercise facility and staff for both the structured and unstructured physical activity component of the curriculum. The YMCA provides a wide variety of exercise options for users, day care for parents with children, and an environment that supports family and intergenerational use of the facilities.

There are a number of limitations to our study. First, a pre- and post-intervention evaluation was conducted, but there was no comparison group. Second, self-reported physical activity and diet measures

<table>
<thead>
<tr>
<th>Cardiometabolic Risk Factors</th>
<th>n</th>
<th>Baseline (mean ± SD)</th>
<th>Completed Core (mean ± SD)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>146</td>
<td>137.8 ± 15.9</td>
<td>128.5 ± 15.2</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Diastolic blood pressure (mmHg)</td>
<td>145</td>
<td>84.2 ± 10.0</td>
<td>80.5 ± 9.6</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>HDL cholesterol (mg/dl)</td>
<td>148</td>
<td>45.8 ± 12.5</td>
<td>44.4 ± 10.6</td>
<td>0.003</td>
</tr>
<tr>
<td>LDL cholesterol (mg/dl)</td>
<td>124</td>
<td>128.9 ± 38.7</td>
<td>115.2 ± 32.5</td>
<td>0.002</td>
</tr>
<tr>
<td>Fasting glucose (mg/dl)</td>
<td>166</td>
<td>105.0 ± 13.6</td>
<td>99.6 ± 13.6</td>
<td>&lt; 0.001</td>
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Table 2. Cardiometabolic Risk Factor Outcomes Among Participants Enrolled in the Lifestyle Intervention at 4 Months in Montana, 2008–2010
were collected as part of the intervention. Third, we were unable to obtain laboratory and blood pressure measurements for some participants. However, the majority of participants completing the core had complete laboratory and blood pressure measurements. Fourth, changes in blood pressure and lipid-lowering medications from baseline were not assessed. Therefore, we could not adjust changes in blood pressure or lipid results for medication use at completion of the core.

This collaboration between a DSME program and a local YMCA provides another model for the delivery of an adapted DPP intervention. One potential barrier to implementation of this model in other communities is that YMCA’s are not equally accessible across the United States, particularly in the Northern Plains and Southwest regions. For example, only seven communities in Montana have a YMCA. However, there are 21 recognized DSME programs in the state and 11 tribal, Indian Health Service, and urban Indian Health Centers in the state. In the United States, an estimated 30% of adults who are ≥20 years of age have pre-diabetes.3 Therefore implementation of effective diabetes prevention programs in multiple settings will be needed to ensure that this large subpopulation of high-risk adults has adequate access to these services.

Another primary barrier to implementing diabetes prevention lifestyle services in any setting is that these services are not currently reimbursed by Medicaid or Medicare. A recent assessment of DSME programs in Montana indicates that the lack of reimbursement for these services is the primary barrier to initiating and expanding this crucial prevention service in the community.20

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