

# Translating the Diabetes Prevention Program Into Practice

## A Review of Community Interventions

### Purpose

The purpose of this review is to summarize community interventions based on the National Institutes of Health (NIH) Diabetes Prevention Program (DPP) curriculum and to describe differences in curriculum and its effect on outcome measurements.

### Methods

A keyword search of PubMed and review of citation lists of relevant articles yielded 161 articles. Primary outcomes of interest were achievement of the DPP study goals: 5% to 7% loss of body weight and increased moderate physical activity to at least 150 minutes per week. A secondary outcome of improvement in metabolic syndrome components was also included. Inclusion criteria included application of a DPP-based curriculum to a community setting and publication in English.

### Results

Seven articles were included in the review. Interventions were conducted across a variety of settings. All showed a significant amount of weight loss immediately following a DPP-based curriculum, varying in length from 6 to 24 weeks. Three held significance by 12 months. Two articles reported on physical activity improvements. Two articles reported improvement in metabolic syndrome components.

Lindsey Jackson, BS

From the School of Public Health, Division of Epidemiology and Community Health, University of Minnesota, Minneapolis.

Correspondence to Lindsey Jackson, University of Minnesota School of Public Health, Department of Epidemiology and Community Health, 1300 S. Second Street, Suite 300, Minneapolis, MN 55454-1015 (jacks626@umn.edu).

*Acknowledgment:* Kim Robien, PhD, RD, University of Minnesota School of Public Health.

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## Conclusion

Although the most effective intervention for type 2 diabetes prevention may not yet be identified, DPP-based interventions show promise for long-term sustainability. The DPP intervention is effective in treating overweight and obesity across a variety of settings and thus may prevent chronic diseases in which overweight and obesity are risk factors. Public health practitioners can use this successful intervention to help individuals lead healthier lives.

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**T**ype 2 diabetes is a leading cause of death and disability in the United States. It cost Americans and their employers \$174 billion in direct and indirect medical costs in 2007.<sup>1</sup> Nearly 24 million people, or 7.8% of the population, were estimated to have type 2 diabetes in 2007, with minority populations having a disproportionately large part of the burden.<sup>1</sup> This burden is magnified by the prevalence of prediabetes, estimated to be 57 million Americans in 2007. These rates are expected to continue to increase unless action is taken.<sup>1</sup>

Lifestyle modification interventions have been shown to be effective in preventing and delaying the progression from prediabetes to type 2 diabetes under controlled research conditions.<sup>2-4</sup> The National Institutes of Health (NIH)-funded Diabetes Prevention Program (DPP) decreased the incidence of diabetes by 58% in the intensive lifestyle intervention arm of its trial, compared to a 31% reduction in the metformin arm with 2.8 years of follow-up.<sup>3</sup> Fifty percent of participants met the 7% weight loss goal, and 74% met the 150-minute per week physical activity goal at the end of the 24-week core curriculum.<sup>3</sup> Participants in the lifestyle modification arm were 68% female, 53.8% white, and 18.9% African American and were on average  $50.6 \pm 11.3$  (SD) years old.<sup>3</sup>

The DPP's lifestyle intervention was delivered in 16 individual sessions over 24 weeks by a trained lifestyle coach.<sup>5</sup> Lifestyle coaching uses techniques such as motivational interviewing to allow the participant to find solutions, rather than being told how to change behavior. Lifestyle coaches were registered dietitians or held master's degrees in exercise physiology, behavioral psychology, or health education. The sessions focused on

improving diet, increasing physical activity, and overcoming barriers. The primary goal was to achieve and maintain a 7% loss of body weight by restricting dietary fat to <25% of calories and increasing physical activity to at least 150 minutes per week of moderate-intensity exercise, promoting weight loss of 1 to 2 pounds per week. Calorie restriction was encouraged if fat restriction did not produce weight loss. Two supervised exercise classes were offered each week. A maintenance program began after the core curriculum, comprising individual sessions, group courses, and motivational campaigns.<sup>6</sup>

In an analysis comparing costs of each arm of the DPP, the lifestyle intervention was the most costly in the first year, compared to the metformin group and the placebo group (\$1399, \$1019, and \$43 per participant, respectively), with costs slightly decreasing over time.<sup>7</sup> Most of the cost in the lifestyle intervention group was from staff time.<sup>7</sup> A cost-effectiveness model has shown the lifestyle intervention to be cost saving for people younger than 45 years of age and cost-effective for all ages, whereas treatment with metformin was not cost-effective for those older than 65 years of age.<sup>8</sup> Costs to society were more favorable with lifestyle intervention than with metformin (\$8800 vs \$29 900 per quality-adjusted life year).<sup>8</sup> These results provide evidence that lifestyle interventions are worth pursuing and that if staff time can be reduced, costs could potentially be reduced further.

In an effort to make the DPP curriculum applicable for use in the community, the authors of the DPP collaborated with the YMCA of Greater Indianapolis to adapt the DPP lifestyle intervention into a group-based program, called the Group Organized YMCA Diabetes Prevention Program (GO-YDPP). The GO-YDPP retains the same weight loss and physical activity goals as the original DPP. The materials also cover the same topics: diet, exercise, and overcoming barriers. Sessions are meant to be delivered over 16 weeks to groups of 10 to 12 individuals. GO-YDPP also includes a 4-week refinement phase and a long-term maintenance phase after the core curriculum. Importantly, the GO-YDPP is estimated to cost \$275 to \$325 per participant in the first year, compared to \$1399 in the original DPP.<sup>9</sup>

There have been a number of review articles published speculating on the effectiveness of lifestyle intervention programs in weight loss and diabetes prevention, but none reviewing the DPP as a community intervention has been published to the author's knowledge.<sup>10-13</sup> The DPP curriculum is freely available online and is beginning to

be used in modified versions across the country in a variety of settings.<sup>14</sup> The authors of the DPP have also held at least 3 standardized trainings on the GO-YDPP in different states that the author is aware of for dietitians, community health educators, YMCA staff, and volunteer health workers to implement a group-based DPP in their communities. The results of one of these interventions are described below. The purpose of this review is to summarize community interventions that have used a DPP-based curriculum and to describe differences in curriculum and the ability to meet the DPP study goals.

## Methods

Articles were obtained by searching the keywords *Diabetes Prevention Program* in the PubMed database ( $n = 157$ ), along with thorough inspection of citation lists of relevant articles ( $n = 4$ ). For the purpose of this review, published studies were included if they were available in English and applied the DPP curriculum to a community intervention setting. The primary outcomes of interest were achievement of the DPP study goals: 5% to 7% loss of body weight over 16 weeks and an increase in moderate physical activity to at least 150 minutes per week.<sup>6</sup> Secondary outcomes of improvement in metabolic syndrome symptoms and appropriate diet modifications were also included.

## Results

An initial search of PubMed identified 161 potentially eligible articles. Following a review of the abstracts, 24 were initially identified as meeting the inclusion criteria. Nineteen were subsequently excluded for the following reasons: analyzing the results from the original DPP, not a community intervention setting, and the intervention was not based on the DPP curriculum. Seven studies were ultimately included in the review.<sup>15-21</sup> Table 1 provides an overview of the articles selected for this review, displaying sample characteristics, study design, intervention location, and dropout rate.

Three interventions included overweight individuals with prediabetes, criteria similar to that in the DPP.<sup>15,17,20</sup> One intervention included individuals at high risk for prediabetes based on a screening event.<sup>21</sup> One intervention included overweight people regardless of diabetes status,<sup>19</sup> and 2 interventions only included people with type 2 diabetes.<sup>16,18</sup>

All interventions were provided at no cost to the participants except one, which charged a one-time \$800 fee per participant.<sup>19</sup> The core curriculum length varied from the original 16 sessions in the DPP to between 6<sup>17</sup> and 24 sessions.<sup>15</sup> All 7 of the interventions used the basic content of the DPP curriculum (diet, physical activity, and overcoming barriers). Six interventions used health care professionals to teach the curriculum, varying from registered dietitians to nurses to certified health educators.<sup>15-20</sup> One intervention used YMCA staff.<sup>21</sup> Two interventions offered memberships to fitness facilities as an incentive.<sup>15,20</sup> One intervention offered limited access to a fitness facility.<sup>21</sup> Table 2 summarizes the intervention instructor, study length, changes in the original DPP materials mentioned in the article, outcome measurements, and the results.

Cramer et al<sup>16</sup> used a randomized control trial design with a total of 67 high-risk minority patients with type 2 diabetes. The 7-week intervention aimed to achieve increased activity levels, loss of 7% body weight, and appropriate dietary modifications. They found a nonsignificant increase in activity levels between groups as walking increased in the intervention group by an average of  $34 \pm 54$  minutes and decreased in the usual-care group by an average of  $19 \pm 18$  minutes. Weight loss was significant between the groups postintervention, with the mean loss of  $2.47 \pm 1.87$  kg in the intervention group and a mean gain of  $0.88 \pm 1.84$  kg in the usual-care group. This weight loss was only 2.69%, well below the DPP program goal of 7% weight loss. However, the intervention was considerably shorter in duration than the original DPP (7 vs 24 weeks respectively), and thus a lower percentage of weight loss would be expected. If weight loss continued at the same rate for an additional 17 weeks, weight loss would be comparable to 7% after 24 weeks. Data from dietary questionnaires indicated that the intervention group made more dietary modifications (decreasing fat and calorie intake) compared to the usual-care group. Participant dropout rates were not available.

Mayer-Davis et al<sup>18</sup> conducted a randomized control trial with 16 weeks of core curriculum consistent with the DPP. All participants had type 2 diabetes and lived in a rural, medically underserved community. One hundred eighty-seven participants were enrolled into 1 of 3 arms: the usual-care control group, the reimbursable lifestyle group, and the intensive lifestyle group (modeled after the DPP). Of the 152 participants completing the 12-month trial (19% dropout rate), 80% were

Table 1

## Summary of DPP-Based Interventions Study Design, Location, and Sample Characteristics

Author	Study Design	Intervention Location	Sample Characteristics <sup>a</sup> (n, Mean Age in Years [SD], Gender, Ethnicity) if Available	Sample Dropout Rate
Knowler et al <sup>3</sup> (Original DPP)	Randomized control trial 3 arms: lifestyle intervention (DPP), metformin, and control	Study sites across the United States	Total of 3234 participants randomized Characteristics of 1079 in lifestyle intervention arm: 68% female 53.8% white 18.9% African American	7.5%
Aldana et al <sup>15</sup>	Single-group time series	Worksite	35 obese adults (31 with prediabetes, 4 with provisional diabetes diagnosis) 65.7% female 48.6% white, 28.6% Asian, 14.3% Hispanic/Latino, 8.6% Pacific Islander	0%
Cramer et al <sup>16</sup>	Randomized control trial 2 arms: case management and usual-care control group	Inner city	67 adults diagnosed with type 2 diabetes Majority ethnic minorities	Not available
Davis-Smith et al <sup>17</sup>	Nonrandomized prospective intervention (1 group); based on a focus group	Rural church	10 adults with prediabetes 70% women 100% African Americans	10% at 6 months 20% at 12 months
Mayer-Davis et al <sup>18</sup>	Randomized control trial 3 arms: intensive lifestyle intervention (based on DPP), reimbursable-lifestyle intervention, and usual care	Rural, medically underserved community	187 adults age 45 or older with type 2 diabetes and overweight Characteristics of 152 participants retained through 12 months: 60 years 80% women 82% black	19% at 12 months
Pagoto et al <sup>19</sup>	Nonrandomized prospective intervention (1 group)	Hospital	118 obese adults 48.7 (11.1) years 72% female 90.7% white, 5.9% Hispanic, 2.4% African American, 0.8% Asian	17% (failed to attend final 2 core sessions and could not be contacted for maintenance phase)

*(continued)*

Table 1 (continued)

Author	Study Design	Intervention Location	Sample Characteristics <sup>a</sup> (n, Mean Age in Years [SD], Gender, Ethnicity) if Available	Sample Dropout Rate
Seidel et al <sup>20</sup>	Nonrandomized prospective intervention (1 group)	Urban, medically underserved neighborhoods	88 overweight adults with 3 of 5 components of metabolic syndrome defined by NCEP ATP III <sup>22</sup> 54.0 (10.5) years 84.1% female 72.7% non-Hispanic white	21.6% at 3 months 43.3% at 6 months
Ackermann et al <sup>21</sup>	Matched-pair, group-randomized intervention 2 arms: DPP intervention and advice alone (control)	Semiurban YMCA facility	92 overweight adults at high risk for prediabetes were randomized 60.1 (10.5) years (control), 56.5 (9.7) years (intervention) 61% female (control), 50% female (intervention) 29% nonwhite (control), 7% nonwhite (intervention)	Intervention arm: 24% failed to attend at least 1 session. At 4- to 6-month follow-up, 15% of intervention and 13% of control dropped out. At 12- to 14-month follow-up, 37% of intervention and 28% of control dropped out.

DPP, Diabetes Prevention Program; NCEP ATP III, National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults.  
<sup>a</sup>Obese: BMI >30; overweight: BMI >25.

women, 82% were black, and the average age was 60. The study goal was to achieve and maintain a 10% weight loss by 12 months. Weight loss was significantly different from baseline among the intensive lifestyle group, with average weight loss of 1 kg postintervention, 3 kg at 6 months, and 2.2 kg at 12 months. Forty-nine percent of participants in the intensive lifestyle group lost at least 2 kg by 12 months compared to 25% of the usual-care group. H1C also significantly decreased in the intensive lifestyle group by an average of 1.6 points at 6 months.

Seidel et al<sup>20</sup> conducted a 14-week intervention in urban, medically underserved neighborhoods with 88 participants with at least 3 of 5 metabolic syndrome components, as designated by the National Cholesterol

Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (NCEP ATP III).<sup>22</sup> Participants were 84% female and 72.7% non-Hispanic whites. They aimed for a 5% to 7% weight loss and improvement in at least 1 metabolic syndrome component from baseline to 3- and 6-month follow-ups. Of the 69 participants providing data at a 3-month follow-up, 32 lost at least 5% and 18 lost at least 7% of their body weight. Of these participants, 28 sustained the 5% weight loss and 12 sustained the 7% weight loss at 6 months. In regards to metabolic syndrome components, 30 participants improved in at least 1 component at 3 months, and 22 participants improved in at least 1 component at 6 months. Dropout rate was 21.6% at 6 months and 43.3% at 12 months.

Table 2

## Summary of Modified DPP Intervention Methods and Results

Author	Instructor	Program Length	Modifications to DPP	Outcome/Measurement	Results
Knowler et al <sup>3</sup> (Original DPP)	Case managers (taught one-on-one)	16 core curriculum sessions over 24 weeks, plus follow-up individual and group sessions	NA	Goals for those in the intensive lifestyle intervention group: 1. Achieve and maintain at least 7% weight loss 2. Increase activity up to 150 minutes per week	50% of participants in lifestyle intervention met 7% weight loss goal by 24 weeks 74% met 150-minute physical activity goal by 24 weeks
Aldana et al <sup>15</sup>	2 registered nurses and 1 certified health educator	24-week core curriculum, plus monthly follow-up sessions to 1 year	Met as a group once per week for 24 weeks (16 times minimum), then once per month for last 6 months Same session topics as original DPP Small incentive for screening and 12-month follow-up One-year membership to employee fitness facility	1. Achieve and maintain at least 7% weight loss 2. Increase activity up to 150 minutes per week	6.3 lbs (2.86 kg) <sup>a</sup> and 10.58 lbs (4.80 kg) <sup>a</sup> weight loss at 6 and 12 months, respectively Weight, BMI, and aerobic fitness significantly improved at 6 and 12 months
Cramer et al <sup>16</sup>	Nurse case manager	7 weeks	Initial group session: basic diabetes education 7 individual sessions (remade participant and instructor materials: available online) 2 on physical activity, 4 on weight loss focused on fat intake, last visit on staying on track, setbacks, barriers	1. Achieve increased activity levels 2. Lose 7% body weight 3. Appropriate diet modification	Increase of 34 minutes of walking in intervention vs decrease of 19 minutes in control Weight loss was significant between the groups, loss of 2.47 kg vs gain of 0.88 kg in intervention and control,

*(continued)*

Table 2 (continued)

Author	Instructor	Program Length	Modifications to DPP	Outcome/ Measurement	Results
Davis-Smith et al <sup>17</sup>	Volunteer health care professional	6-week core curriculum with 6- and 12-month follow-up sessions	Focus groups determined number, length, and timing of sessions 6 sessions (2 from each section: nutrition, PA, and behavior change) 6- and 12-month follow-up sessions: took measurements, evaluated retainment of lessons, discussed future roles of church and further lifestyle goals, provided support to one another	1. Achieve and maintain at least 7% weight loss 2. Increase activity up to 150 minutes per week	respectively, but below the 7% goal (2.69%) Appropriate dietary modifications were significantly different between the groups 8.8 lbs (3.99 kg) <sup>a</sup> weight loss (3.8%) and 1.7 kg/m <sup>2</sup> decrease in BMI postintervention No significant weight loss or BMI change at 6- and 12-month follow-ups
Mayer-Davis et al <sup>18</sup>	Nutritionist	12 months total: 16 weekly core sessions, biweekly follow-up for 2 months, and monthly follow-up for the remaining 6 months	Regular use of group setting (3 group classes to 1 individual class) Considerable simplification and reduction in the amount of written materials	1. Achieve and maintain a 10% weight loss over 12 months 2. Improvements in H1C, lipid profile, and blood pressure	Significantly greater weight loss in intensive lifestyle intervention group of 1 kg postintervention <sup>a</sup> , 3 kg at 6 months <sup>a</sup> , and 2.2 kg at 12 months <sup>a</sup>

*(continued)*

Table 2 (continued)

Author	Instructor	Program Length	Modifications to DPP	Outcome/Measurement	Results
			Encouragement of physical activity at low to moderate intensity for those with sedentary lifestyles		1.6-point reduction in H1C in intensive lifestyle group
			Inclusion of regionally/culturally appropriate examples		49% lost at least 2 kg by 12 months compared to 25% in usual-care group
			Suggestions for physical activity		
Pagoto et al <sup>19</sup>	Dietitian, exercise physiologist, and clinical health psychologist	16 weekly core sessions with monthly follow-up sessions	Fee of \$800 to participate 6 small group exercise classes to individualize exercise program and practice exercises under supervision Monthly "alumni" groups for follow-up Wording specific to diabetes changed to weight loss	1. Achieve and maintain at least 7% weight loss 2. Increase activity up to 150 minutes per week	30% met 7% weight loss goal after 16-week core sessions <sup>a</sup> 40% of those without comorbidities met 7% weight loss goal <sup>b</sup> 49% achieved clinically significant weight loss (>5%) after 16-week core sessions <sup>a</sup>
Seidel et al <sup>20</sup>	Registered dietitian and exercise specialist	14-week core curriculum	12 weekly group sessions over 12 to 14 weeks More emphasis on pedometer than DPP 90-minute classes with 5 to 13 participants each 6-month YMCA membership	1. 5% to 7% weight loss from baseline to 3- and 6-month follow-ups 2. Improvement in at least 1 metabolic syndrome component <sup>25</sup> from baseline to 3- and 6-month follow-ups	At 3 months, 46.4% lost 5%, 26.1% lost 7% At 6 months, 87.5% kept 5% loss, 66.7% kept 7% loss At 3 months, 43.5% improved $\geq$ 1 metabolic syndrome component <sup>25</sup> At 6 months, 73.3% kept improvement

(continued)

Table 2 (continued)

Author	Instructor	Program Length	Modifications to DPP	Outcome/ Measurement	Results
Ackermann et al <sup>21</sup>	YMCA staff	16 core curriculum sessions delivered over 16 to 20 weeks	Met in groups of 8 to 12 people for 60 to 90 minutes per week Monthly large group meetings at the YMCA for follow-up	1. Percent change in body weight after 4 to 6 months 2. Changes in body weight at 12 months, changes in H1C, total cholesterol, and HDL cholesterol	At 4- to 6-month follow-up, significant between-group weight loss of 6% in intervention and 2% in control and change in total cholesterol Between-group difference was still significant at the 12- to 14-month follow-up
<p>BMI, body mass index; DPP, Diabetes Prevention Program; HDL, high-density lipoprotein; NA, not applicable; PA, physical activity. *<i>P</i> &lt; .05.</p>					

Aldana et al<sup>15</sup> conducted a worksite intervention with outcome measurements and a 16-week core curriculum consistent with the DPP. Of the 35 participants, 31 had prediabetes and 4 had a provisional diagnosis of diabetes. Other sample characteristics were 65.7% female, 48.6% white, and 28.6% Asian. They found a significant weight loss of 6.3 lbs (2.86 kg) and 10.58 lbs (4.80 kg) on average at 6 and 12 months postintervention, respectively. Although they did not report on the change in minutes of physical activity over the intervention period, they did report a significant increase in  $\text{VO}_2$  max, a measure of aerobic fitness, of 8.49 mL/kg/min and 11.90 mL/kg min at 6 and 12 months postintervention, respectively. Dropout rate was 0% at the 12-month follow-up.

Davis-Smith et al<sup>17</sup> conducted their 6-session intervention with 10 participants (70% women, 100% African American) in a rural church and had outcome measurements consistent with the DPP. They found a significant average weight loss of 8.8 lbs (3.99 kg), or 3.8%, immediately postintervention. Given that the participants in this intervention would continue losing weight at the same rate if the intervention was extended to 24 weeks, they would have exceeded the 7% weight loss goal of the

original DPP. Weight loss was not significantly different than baseline by the 6-month follow-up assessment. They did not report on change in physical activity. Dropout rate was 10% at 6 months and 20% at 12 months.

Pagoto et al<sup>19</sup> conducted a hospital-based intervention with people who were overweight, regardless of diabetes status, and reported on outcomes consistent with the DPP. Of the 118 participants, more than 90% were white and 70% were women. They found that 30% of intervention participants met the 7% weight loss goal, and 49% met a clinically significant weight loss goal of 5% at the end of the 16 weekly core sessions. When participants with one or more comorbidities were excluded from the analysis, the outcome increased to 40% of participants meeting the 7% weight loss goal. They did not report on change in physical activity. Dropout rate was 17%.

Ackermann et al<sup>21</sup> conducted a matched-pair, group-randomized pilot intervention at 2 semiurban YMCA facilities using a modified version of the GO-YDPP curriculum that they developed. The primary outcome of interest was weight loss at 4 to 6 months. Ninety-two adults were randomized into the DPP intervention or an

advice-alone (control) group. More participants in the control group were female (61% vs 50%) and of non-white race (29% vs 7%) than the intervention group. The core curriculum was delivered in 16 sessions over 16 to 20 weeks. Eleven participants (24%) in the intervention group did not attend at least 1 of the core sessions. A significant between-group difference in weight loss was found at both the 4- to 6-month (6% intervention vs 2% control) and 12- to 14-month (6% intervention vs 1.8% control) follow-up. Significant between-group differences in total cholesterol levels were also found at both 4- to 6-month and 12- to 14-month follow-ups. Dropout rate at 4 to 6 months was 15% and 13% in the intervention and control groups, respectively. At 12 to 14 months, the dropout rate increased to 37% and 28% in the intervention and control groups, respectively.

## Conclusions

The DPP-based community interventions conducted thus far show promising results for long-term sustainability of DPP-based programs. Significant results were observed across the original DPP outcomes as well as a reduction of metabolic syndrome components and appropriate diet modifications.

The original DPP participants in the intensive lifestyle arm have continued to show a decreased incidence of type 2 diabetes and improvements in weight after 5 years of follow-up.<sup>23</sup> It is unknown whether the community interventions will have a comparable level of success because none of the interventions had follow-up periods of more than 1 year. Although preventing or delaying the onset of type 2 diabetes for even a short period of time is beneficial to individuals, it is most cost-effective to society to prevent or delay type 2 diabetes as long as possible.<sup>8</sup> Decreasing the number of core curriculum sessions may have had an effect on the significance of long-term outcomes. However, it is premature to draw any conclusions from this finding, considering the small sample size of each of the interventions. Further research needs to be done to determine the most effective, cost-efficient length of a lifestyle intervention program. This information is critical to the sustainability of community-based DPP interventions.

The DPP, as well as the articles in this review, included only adults. The prevalence of obesity and insulin resistance in children is increasing at an alarming rate.<sup>24,25</sup> It

is unknown if the DPP curriculum can be modified to be effective for weight loss and/or type 2 diabetes prevention in children. It is imperative to the health of future generations to instill healthy lifestyle habits and prevent type 2 diabetes as early as possible.

A study done by Johnson et al<sup>26</sup> estimated the willingness of individuals at high risk of type 2 diabetes to pay for a service such as a DPP-based program. They found that people were willing to pay up to \$1500 for 3 years. Only one study in this review required payment from the participants (\$800) and was effective for 30% of the participants.<sup>19</sup> Comparison of the relative effectiveness of this study to the others included in this review is difficult due to differing outcome measurements as previously described. Further research is needed to determine if community interventions would be more effective if participants were required to pay a fee.

For those studies that did use the same outcome measurements, lack of reported data on the physical activity outcome made comparison of relative effectiveness difficult. Davis-Smith et al<sup>17</sup> and Pagoto et al<sup>19</sup> both included increasing moderate physical activity to 150 minutes per week as an outcome measurement, consistent with the original DPP outcome, but did not report results of this measure. In addition, 6 studies did not completely reveal the modifications they made to the DPP curriculum.<sup>15-20</sup> Lack of reported program curriculum also made comparison of intervention effectiveness difficult.

Each of the 7 interventions was implemented in different settings. The study populations ranged from mainly minorities in both rural<sup>18</sup> and urban<sup>16</sup> medically underserved communities and a rural church<sup>17</sup> to mainly white in the worksite,<sup>15</sup> medically underserved neighborhoods,<sup>20</sup> hospital,<sup>19</sup> and YMCA<sup>21</sup> settings. Each site was able to demonstrate weight loss in at least a portion of its population. Because each intervention modified the original DPP in different ways, it is unknown whether each intervention curriculum can be extrapolated to other populations. Further research is needed to determine whether the DPP-based intervention should be adapted to individual populations and settings.

## Implications for Diabetes Educators

A DPP-based lifestyle modification curriculum has been shown to be effective in promoting weight loss among adults across all socioeconomic classes, sex, gender, and race/ethnicity. Jones et al<sup>12</sup> described how lifestyle interventions

are effective in the treatment of overweight and obesity. As the DPP curriculum ultimately aims to reduce weight, it appears to be an effective tool to prevent or manage any chronic diseases in which overweight and obesity are risk factors. In addition to type 2 diabetes, weight management is currently recommended in the prevention and/or management of cardiovascular diseases<sup>22,27</sup> and cancer.<sup>28</sup> Thus, the DPP curriculum's original intent of being a primary prevention program has great potential to be expanded into secondary and tertiary programs as well.

For any diabetes prevention efforts to be successful, it is imperative for the participants to believe they are at risk of poor health outcomes to gain full participation. Fisher et al<sup>29</sup> describe the importance of having a well-articulated model of what diabetes is and the risks associated with it. The gap between risk perception in laypeople and experts is problematic. Diabetes educators need to be effective in communicating to patients when they should be tested for prediabetes, as well as what the risk factors are, and fully support participation in a lifestyle modification program such as a DPP-based program. Ackermann et al<sup>21</sup> used a screening event and immediate education to address this issue. This may have been a reason that even their control group showed some weight loss.

The DPP used a style of teaching known as lifestyle coaching. Lifestyle coaching takes factors beyond the individual into account to make significant changes in one's eating and activity habits. The style uses techniques such as motivational interviewing to coach participants to find solutions rather than telling how to change behavior. In a group setting, solutions often come from other members of the group in addition to the individual. All 7 of the articles reviewed preserved this aspect of the original DPP.<sup>15-21</sup> The lifestyle coaching approach was also used by Tuomilehto et al<sup>4</sup> in the Finnish Diabetes Prevention Study Group with similar results. Lifestyle coaching can be implemented effectively at no additional cost in the daily work of many health professionals, including dietitians<sup>13</sup> and nurses.<sup>30</sup>

Significant results were observed across the original DPP outcomes<sup>3</sup> as well as a reduction of metabolic syndrome components<sup>22</sup> and appropriate diet modifications. Although the most effective intervention for type 2 diabetes prevention may not yet be identified, DPP-based interventions show great promise for long-term sustainability. Public health practitioners can use this successful intervention to help individuals lead healthier lives.

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