The Diabetes Prevention Program (DPP)

Description of lifestyle intervention

THE DIABETES PREVENTION PROGRAM (DPP) RESEARCH GROUP

The purpose of the present article is to provide a detailed description of the highly successful lifestyle intervention administered to 1,079 participants, which included 45% racial and ethnic minorities and resulted in a 58% reduction in the incidence rate of diabetes (2). The two major goals of the Diabetes Prevention Program (DPP) lifestyle intervention were a minimum of 7% weight loss/weight maintenance and a minimum of 150 min of physical activity similar in intensity to brisk walking. Both goals were hypothesized to be feasible, safe, and effective based on previous clinical trials in other countries (3–7). The methods used to achieve these lifestyle goals include the following key features: *1*) individual case managers or "lifestyle coaches;" *2*) frequent contact with participants; *3*) a structured, state-of-the-art, 16-session core-curriculum that taught behavioral self-management strategies for weight loss and physical activity; *4*) supervised physical activity sessions; *5*) a more flexible maintenance intervention, combining group and individual approaches, motivational campaigns, and "restarts;" *6*) individualization through a "toolbox" of adherence strategies; *7*) tailoring of materials and strategies to address ethnic diversity; and finally *8*) an extensive network of training, feedback, and clinical support.

***Diabetes Care* 25:2165–2171, 2002**

The Diabetes Prevention Program (DPP) was a 27-center randomized clinical trial to determine whether lifestyle intervention or pharmacological therapy (metformin) would prevent or delay the onset of diabetes in individuals with impaired glucose tolerance (IGT) who are at high risk for the disease (1). Recently, it was reported that both the lifestyle intervention and metformin were effective in decreasing the incidence of diabetes. Lifestyle intervention decreased the incidence of type 2 diabetes by 58% compared with 31% in the metformin-treated group, and information on adherence to these interventions has already been reported (2). The purpose of this manuscript is to provide a more detailed description of the lifestyle intervention protocol used in the DPP. For further information about lifestyle sessions, materials, and learning objectives, please see http://www.bsc.gwu.edu/dpp/manuals.htmlvdoc.

RATIONALE FOR DPP LIFESTYLE INTERVENTION

At the time the DPP was being designed, evidence from a number of observational studies and three intervention studies (3–5) suggested that lifestyle intervention might reduce the risk of developing diabetes. Although none of the three intervention studies was a randomized controlled trial, they all suggested that modest changes in lifestyle could lower the risk of diabetes. In the Malmo study (3), participants in the lifestyle intervention increased their estimated maximal oxygen uptake by 10%, whereas it decreased by 4.9% in control subjects. BMI decreased by 2.4% in the intervention group and increased by 0.5% in the control group. These changes in lifestyle resulted in large changes in diabetes risk: 10.6% of the intervention group developed diabetes over 5 years compared with 28.6% of the control group. Improvements in glucose tolerance were related to both increased fitness and weight reduction; both contributed equally and independently to reduction in risk of diabetes. Based on these results, the DPP Steering Committee chose to include a lifestyle arm in the trial and to focus on modifying both body weight and physical activity.

Since initiating the DPP in 1996, two randomized trials have been published that report positive effects from lifestyle intervention (6,7). The Da Qing study (6) compared diet, exercise, and diet plus exercise with a no-treatment control group and found that all three lifestyle approaches reduced the risk of developing diabetes by 31–46%. More recently, the Finnish Diabetes Prevention Study (7) of 522 overweight subjects with IGT showed that a lifestyle intervention designed to produce weight loss improved dietary intake and physical activity and reduced the risk of diabetes by 58%.

KEY FEATURES OF THE LIFESTYLE BALANCE INTERVENTION

The DPP intensive lifestyle intervention program, entitled "Lifestyle Balance," was developed by the DPP Lifestyle Resource Core at the University of Pittsburgh Medical Center, working in close collaboration with the DPP Interventions Committee, which included nutritionists, behavioral psychologists, exercise physiologists, nurses, and physicians. All lifestyle procedures and materials were reviewed and approved by the DPP Steering and/or Executive Committees before implementation.

Key features of the Lifestyle Balance program are outlined in Table 1 and included the following elements: *1*) a goal-based behavioral intervention, *2*) case managers or "lifestyle coaches" to deliver the intervention, *3*) frequent contact and ongoing intervention throughout the trial

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Received for publication 6 June 2002 and accepted in revised form 7 September 2002.

For a complete list of the members of the DPP Research Group, please see reference 2.

Abbreviations: DPP, Diabetes Prevention Program; IGT, impaired glucose tolerance.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*Key aspects of the DPP lifestyle protocol*

- Clearly defined weight loss and physical activity goals
- Individual case managers or "lifestyle coaches"
- Intensive, ongoing intervention
  - Initial core curriculum to achieve standardization of the intervention
  - Supervised exercise sessions offered at least two times per week throughout the trial
  - A flexible maintenance program with supplemental group classes, motivational campaigns, and restart opportunities
- Individualization through a "toolbox" of adherence strategies
- Materials and strategies that addressed the needs of an ethnically diverse population
- An extensive local and national network of training, feedback, and clinical support

to help participants achieve and maintain the weight and physical activity goals, *4*) "toolbox" strategies to tailor the intervention to the individual participant, *5*) intervention materials and strategies to address the needs of an ethnically diverse population, and *6*) an extensive local and national network that provided training, feedback, and clinical support for the interventionists. Each of these features is described below.

Goal-based behavioral intervention

The DPP lifestyle intervention was designed to be administered consistently across the 27 centers and 1,079 participants in this arm of the trial and to allow maximum flexibility, given the heterogeneity of the participants. The 3,234 participants randomized to the three-arm trial in the DPP (1,079 randomized to lifestyle intervention) averaged 51 years of age at baseline, with 20% aged ≥60 years; 68% were women, 55% were Caucasian, 20% were African American, 16% were Hispanic American, 5% were American Indian, and 4% were Asian American (8). There was also a range of education: 25.8% of the population had <13 years of education, 48.1% had 13–16 years, and 26.1% had ≥17 years. To provide an intervention that would be appropriate for the diverse population, a decision was made to use a goal-based behavioral intervention, where all participants at all centers were given the same weight loss and physical activity goal, but individualization was permitted in the specific methods used to achieve these goals.

Weight loss goal. The weight loss goal for all DPP participants was to lose 7% of initial body weight and to maintain this weight loss throughout the trial. The decision to use 7% of initial body weight as the goal was based on epidemiological data and results of previous weight loss trials. The risk of developing diabetes appears to increase with increased levels of BMI (9,10); thus, any decrease in BMI might be anticipated to decrease risk of diabetes. Moore et al. (11) reported that weight losses of 3.7–6.8 kg in overweight individuals aged 30–50 years decreased risk of diabetes by 33% compared with those who remained weight-stable over two consecutive 8-year periods. Behavioral weight loss studies achieve an average weight loss of 8.5 kg (9% of body weight) at the end of the 6 months of intensive treatment, and participants maintain weight losses of ~5.6 kg (6% of body weight) at 18 months (12,13). Multicenter clinical trials typically achieve somewhat lower weight losses (5%) (14–16). A hypertension treatment trial that examined nonpharmacologic interventions in the elderly, TONE, produced a weight loss of 4.5 kg (5% of initial body weight) that was maintained through 3 years (15). Given the previously published data, the 7% weight loss goal was selected because it appeared feasible to achieve and maintain in a multicenter trial and likely to lessen the risk of developing diabetes.

Participants were encouraged to achieve the 7% weight loss in the first 6 months of the DPP lifestyle intervention, since previous behavioral weight loss studies have suggested that most individuals achieve their maximum weight loss within the first 20–24 weeks of a lifestyle intervention (17). The recommended pace of weight loss was 1–2 lbs per week. Participants who wished to lose >7% of their baseline weight were encouraged to do so, as long as they continued to have a BMI of >21 kg/m^2. To achieve the 7% weight loss goal, participants were taught behavioral strategies to realize and maintain long-term changes in their fat and calorie intake (see details below). Physical activity was seen as important for long-term weight loss maintenance and also as a way to possibly prevent diabetes, independent of weight loss. Weight loss medications were not used as part of the trial.

Physical activity goal. The goal for physical activity was selected to approximate at least 700 kcal/week expenditure from physical activities. For ease of translation to participants, this goal was described as at least 150 min of moderate physical activities similar in intensity to brisk walking. This goal was adopted for the DPP because it was determined to be achievable and likely to be beneficial in preventing diabetes based on previous studies. For example, in a study of 6,000 men followed for 14 years, each 500 kcal/week increase in physical activity reduced the age-adjusted risk of diabetes by 6% (18). Behavioral weight loss studies with diabetic (19) and nondiabetic participants (13) have often used a 1,000 kcal/week activity goal. In the DPP, the 150-min weekly physical activity goal was selected because it was similar to the newest public health recommendations (20) as well as the Surgeon General's Report on Physical Activity and Health (21). Moreover, in a 10-year follow-up study of older women who participated in a 3-year clinical trial of walking, those who were randomized to the walking intervention were not only more active at the end of the study but also maintained higher physical activity levels compared with control women 10 years later (22). In summary, the DPP 150-min weekly physical activity goal was chosen because evidence supported its feasibility, effectiveness, and long-term maintenance.

The DPP lifestyle intervention stressed brisk walking as the means to achieve the activity goal, but participants were given examples of other activities that are usually equivalent in intensity to brisk walking, including aerobic dance, bicycle riding, skating, and swimming. Participants were encouraged to distribute their activity throughout the week with a minimum frequency of three times per week, with at least 10 min per session. A maximum of 75 min of strength training could be applied toward the total 150-min weekly physical activity goal. The importance of lifestyle activities, such as using the stairs (instead of elevators), stretching, and gardening, was discussed;

however, participants were instructed not to apply these types of activities toward the 150-min goal.

Participants at high risk for cardiovascular disease were given an exercise tolerance test before starting the activity interventions. Sedentary individuals were instructed to increase their activity in 30-min increments over 5 weeks. Those who were active at baseline were not required to add further exercise but rather had the same 150-min/weekly goal. However, the physical activity goal was stated as a minimum, and participants who wished to be more active were strongly encouraged to do so, as long as there were no medical contraindications.

Individual case managers or "coaches"

The DPP primarily used an individual model of treatment, rather than a group-based approach, as had been used in many behavioral weight loss studies (12,13). This decision was based on the extensive screening process and number of arms in the trial (which limited the number of participants randomized to lifestyle each month) and the desire to intervene before a participant had the possibility of developing diabetes or losing interest in the program. The individual approach to therapy also allowed tailoring of intervention activities to the ethnically diverse population and those with low literacy. Adherence and maintenance activities included both individual and group approaches, based on the approaches used in the TONE trial (15).

At randomization, each lifestyle participant was assigned a case manager, called a "lifestyle coach." The lifestyle coach had primary responsibility for delivering the core curriculum, conducting postcore maintenance sessions, eliciting motivation from the participant to achieve the lifestyle goals, and assuring completion of required data collection. There were typically one and a half to two lifestyle coaches (or full-time equivalents) at each clinical center responsible for ~40 participants. The majority of lifestyle coaches were registered dietitians, with the remainder typically having at least Master's degree training in exercise physiology, behavioral psychology, or health education.

Frequent contact and ongoing intervention

The DPP was designed as a study of the efficacy of lifestyle changes in preventing or delaying diabetes. Therefore, to maximize the possibility of achieving lifestyle change, an intensive approach to lifestyle was used throughout the trial. A large number of studies have been conducted to compare approaches to produce weight loss and increase physical activity and to maintain these behavior changes in the long term. These studies were carefully reviewed and formed the basis for the development of the DPP intervention. The DPP was not designed to compare different behavioral approaches to long-term behavior change or to test the effectiveness of a lifestyle intervention that could be "translated" for use in community settings. To achieve standardization of the intervention, an initial structured core curriculum was given to all participants. A more flexible maintenance program of individual sessions, group classes, motivational campaigns, and restart opportunities followed this.

Core curriculum. The lifestyle intervention commenced with a 16-session core curriculum that was to be completed within the first 24 weeks after randomization. The 16-session core curriculum was the most structured phase of the DPP lifestyle intervention and ensured that all participants were taught the same basic information about nutrition, physical activity, and behavioral self-management (Table 2). Similar to other state-of-the-art behavioral weight control programs, the first eight sessions presented the goals for the DPP lifestyle intervention, taught fundamental information about modifying energy intake and increasing energy output, and helped participants to self-monitor their intake and physical activity. The latter eight sessions focused on the psychological, social, and motivational challenges involved in maintaining these healthy lifestyle behaviors in the long term. The "DPP Lifestyle Intervention Manual of Operations" (copyright 1996) provides detailed information and instructions for each of the 16 sessions. The manual was designed to be used in conjunction with the DPP Protocol and the "DPP Lifestyle Balance Participant Notebook," which provided companion worksheets for each of the 16 core-curriculum sessions. Spanish translations of the participant materials were available (see http://www.bsc.gwu.edu/dpp/manualsb.htmlvdoc).

Core-curriculum sessions ranged from 30 min to 1 h and included a private weigh-in, review of self-monitoring records, presentation of a new topic, ongoing identification of personal barriers to weight loss and activity, and the development of action plan/goals for the next session. Key behavioral and nutrition strategies that were introduced in the core curriculum included the following:

Self-monitoring of weight. Participants were weighed privately at the start of every individual session and were encouraged to weigh themselves at home daily or a minimum of once per week. If participants did not have a bathroom scale at home, they were given one. Emphasis was placed on using the scale as an important feedback and learning tool for how to better regulate personal diet and exercise behaviors.

Dietary modification. The initial focus of the dietary intervention was on reducing total fat rather than calories. This allowed participants to accomplish a reduction in caloric intake while at the same time emphasizing overall healthy eating and streamlined the self-monitoring requirements, which was important given the diversity of educational and literacy levels among participants. After several weeks, the concept of calorie balance and the need to restrict calories as well as fat was introduced.

The calorie goals were calculated by estimating the daily calories needed to maintain the participant's starting weight and subtracting 500–1,000 calories/day (depending on initial body weight) to achieve a 1–2 pound per week weight loss. The fat goals, given in grams of fat per day, were based on 25% of calories from fat. Four standard calorie levels were used: 1,200 kcal/day (33 g fat) for participants with an initial weight of 120–170 lbs, 1,500 kcal/day (42 g fat) for participants with a weight of 175–215 lbs, 1,800 kcal/day (50 g fat) for participants with a weight of 220–245 lbs and 2,000 kcal/day (55 g fat) for participants weighing >250 lbs. The fat and calorie goals were used as a means to achieve the weight loss goal rather than as a goal in and of itself. Therefore, if a participant reported consuming more than the calorie or fat goal but was losing weight as planned, the coach did not emphasize greater calorie or fat reduction. Participants were encour-

Table 2—*DPP 16-session core curriculum*

Session 1. Welcome to the Lifestyle Balance Program
Build commitment to the DPP lifestyle change program by recording personal reasons for joining the DPP and perceived benefits to self, family, and others. Highlight the two study goals: 7% weight loss and 150 minutes of weekly physical activity and review key aspects of the relationship between the lifestyle coach and participant in working towards these goals. Introduce self-monitoring of food intake.

Session 2. Be a Fat Detective
Introduce regular self-monitoring of weight at home. Help participants find the main sources of fat in their diet through self-monitoring fat grams using the "DPP Fat Counter" and by reading food labels. Assign a fat gram goal based on starting weight.

Session 3. Three Ways to Eat Less Fat
Practice self-monitoring skills, including weighing and measuring foods and estimating portion size of foods. Teach three ways to eat less fat: eat high-fat foods less often, eat smaller portions, and substitute lower fat foods and cooking methods.

Session 4. Healthy Eating
Emphasize the importance of a regular meal pattern and eating slowly. Use the Food Guide Pyramid (USDA) as a model for healthy eating and compare personal eating patterns to these recommendations. Recommend specific low-fat, low-calorie substitutes at each level of the Food Pyramid.

Session 5. Move Those Muscles
Introduce physical activity and begin to build to 150 minutes of physical activity over the next 4 weeks, using activities such as brisk walking. Begin self-monitoring of physical activity as well as food intake. Review personal activity history and likes and dislikes about physical activity. Encourage attendance at group supervised activity sessions.

Session 6. Being Active: A Way of Life
Help participants learn to find the time to be physically active each day by including short bouts (10–15 min) and healthy lifestyle activities, e.g., climbing stairs and walking extra blocks from the bus stop. Teach the basic principles for exercising safely, what to do in the event of injury, and knowing when to stop.

Session 7. Tip the Calorie Balance
Teach the fundamental principle of energy balance and what it takes to lose 1–2 lbs per week. For those individuals who have made little progress with weight loss, assign self-monitoring of calories as well as fat grams or provide a structured meal plan at reduced calorie levels.

Session 8. Take Charge of What's Around You
Introduce the principle of stimulus control. Identify cues in the participant's home environment that lead to unhealthy food and activity choices and discuss ways to change them.

Session 9. Problem Solving
Present the five-step model of problem solving: describe the problem as links in a behavior chain, brainstorm possible solutions, pick one solution to try, make a positive action plan, evaluate the success of the solution. Apply the problem-solving model to eating and exercise problems.

Session 10. The Four Keys to Healthy Eating Out
Introduce four basic skills for managing eating away from home: anticipating and planning ahead, positive assertion, stimulus control, and making healthy food choices.

Session 11. Talk Back to Negative Thoughts
Practice identifying common patterns of self-defeating, negative thoughts and learn to counter these thoughts with positive statements.

Session 12. The Slippery Slope of Lifestyle Change
Stress that slips are normal and learning to recover quickly is the key to success. Teach participants to recognize personal triggers for slips, their reactions to those slips, and what it takes to get back on track.

Session 13. Jump Start Your Activity Plan
Introduce the basic principles of aerobic fitness: frequency, intensity, time, type of activity (FITT). Teach participants to measure their heart rate and perceived level of exertion as a way of determining the appropriate levels of activity. Discuss ways to cope with boredom by adding variety to the physical activity plan.

Session 14. Make Social Cues Work for You
Present strategies for managing problem social cues, e.g., being pressured to overeat, and help participants learn to use social cues to promote healthy behaviors, e.g., making regular dates with a walking partner or group. Review specific strategies for coping with social events such as parties, vacations, and holidays.

Session 15. You Can Manage Stress
Highlight the importance of coping with stress, including stress caused by the DPP, by using all of the skills previously taught, e.g., positive assertion, engaging social support, problem solving, planning, talking back to negative thoughts, and being physically active.

Session 16. Ways to Stay Motivated
Enhance motivation to maintain behavior change by reviewing participants' personal reasons for joining DPP and by recognizing personal successes thus far. Introduce other strategies for staying motivated including posting signs of progress, setting new goals, creating friendly competition, and seeking social support from DPP staff and others.

aged to gradually achieve the fat and calorie levels through better choices of meals and snack items, healthier food preparation techniques, and careful selection of restaurants, including fast food, and the items offered.

Self-monitoring fat and/or calorie intake and physical activity. All participants were instructed to self-monitor fat and calorie intake daily throughout the first 24 weeks of the study and to record their minutes of physical activity. Self-monitoring was stressed as one of, if not the most, important strategy for changing diet and exercise behaviors. At the start of the core curriculum sessions, participants were given a food scale and measuring cups and spoons. They used a pocket sized "Keeping Track" booklet, developed for the DPP that had spaces for recording 7 days of food intake with fat and calorie values, as well as physical activity. Participants were also given "The DPP Lifestyle Balance Fat Counter" booklet, which indicated the fat and calorie content for >1,500 alphabetized food names, including regional/ethnic foods suggested by DPP sites for their local population.

Self-monitoring skills were taught gradually over the first few weeks of the core curriculum. The lifestyle coach briefly reviewed the self-monitoring booklets with the participants during each session, reinforcing any noticeable positive behavior change and avoiding criticism. The booklets were more thoroughly reviewed between sessions and written constructive comments were provided.

Adherence/maintenance intervention

The maintenance program used in the DPP was more intensive than that used in other clinical trials (6,7) and combined both group and individual contact. After completing the 16-session core curriculum, the protocol required that participants be seen face-to-face at least once every 2 months for the remainder of the trial and be contacted by phone at least once between visits. Although these in-person contacts were usually one-on-one, they could occur in a group as long as there was an opportunity to weigh the participant and assist the individual with problem-solving regarding adherence. Based on behavioral literature showing the importance of continued contact during maintenance (23), coaches were encouraged to meet with participants as often as needed to support participant adherence and transition gradually from more frequent to less frequent contact if decreased frequency of contact did not adversely affect maintenance. The majority of participants were seen more frequently than the minimum, with some participants continuing to attend weekly or biweekly sessions.

The postcore adherence/maintenance phase was less structured than the core curriculum. The Lifestyle Resource Core developed a variety of lessons and participant handouts, and lifestyle coaches were encouraged to use materials related to the topics of greatest interest and concern to their individual participants. Sessions were typically shorter (~15–45 min), but the framework of the maintenance sessions paralleled that of the core curriculum. The "DPP Lifestyle Intervention Manual for Contacts After Core" (copyright 1996; http://www.bsc.gwu.edu/dpp/manuals.htmlvdoc) provides further guidelines for implementing the maintenance phase of the intervention.

Participants were encouraged to continue self-monitoring their intake for 1 week every month during maintenance. If participants were succeeding at weight loss maintenance, self-monitoring was encouraged but not as strongly emphasized. To simplify self-monitoring and encourage adherence to the calorie and fat goals, structured meal plans and meal-replacement products were provided as an option for participants. Participants also continued to self-monitor their activity using either the daily "Keeping Track" booklet or a monthly calendar.

Each clinical center was also required to offer three group courses (each lasting 4–8 weeks) per year during the maintenance phase. Participants were strongly encouraged but not required to attend these classes. The Lifestyle Resource Core developed materials for a variety of different courses, with at least one class per year focusing on a physical activity topic, one on a behavioral/motivational topic, and one on healthy eating/weight loss. Popular classes included resistance training, vegetarian cooking, and restart programs for those desiring to re-initiate intensive weight loss efforts.

Three to four motivational campaigns were also developed per year to assist with maintenance of the weight and physical activity goals. In several campaigns, local participant teams or DPP centers competed for the best attendance, self-monitoring, weight loss, minutes of physical activity, or steps as measured by pedometer (Accusplit Digi-Walker). Participants received supplemental materials reflecting the content and theme of the campaigns such as self-monitoring postcards, magnets, weight graphs, newsletters, T-shirts, and other small incentives.

Supervised activity sessions

The protocol required that each clinical center offer supervised physical activity sessions at least two times per week throughout the trial. Attendance was voluntary. The types of supervised activity sessions varied across centers and included neighborhood group walks, enrolling participants in the cardiac rehabilitation programs affiliated with the DPP clinical center, community aerobic classes (e.g., at the YMCA or Wellness Centers), and one-on-one personal training. All supervised activity sessions were led by a DPP staff member or someone trained by a DPP staff member as to the goals of the DPP lifestyle intervention. The session leaders documented attendance at all supervised activity sessions.

Individualization through "toolbox"

DPP participants encountered a variety of barriers to adherence over the course of the trial. Lifestyle coaches were encouraged to work with each participant individually to identify the specific barriers and possible solutions to these barriers. To help participants achieve and maintain the lifestyle goals, a "toolbox" of strategies that could be used with individual participants was developed. The toolbox was arranged in a hierarchy from less expensive to more expensive approaches (in terms of staff time as well as money) and contained problem-solving strategies and reinforcements for use with individual participants.

Approximately $100 per participant per year was available for implementing toolbox strategies. For example, participants having trouble achieving or maintaining the activity goal might be loaned or given an aerobic dance tape, enrolled in a community exercise class or a cardiac rehabilitation program, or seen individually by an exercise trainer to begin a tailored exercise regimen. Similarly, participants might be given a cookbook, grocery store vouchers, or portion-controlled foods (Slim-Fast or frozen en-

trees) to help them achieve the weight-loss goals. Toolbox funds were also used to provide small reinforcers for fulfilling behavioral contracts, which usually involved achieving specific weight or physical activity goals over a 4- to 6-week period.

Strategies to address the needs of an ethnically diverse population

Because type 2 diabetes disproportionately affects certain ethnic minorities (African Americans, Hispanic Americans, American Indians, and Asian Americans), the DPP recruited 45% of participants from these populations. Consequently, it was important that the intervention be designed to address the needs of this ethnically diverse population. This was accomplished through the use of case managers, often chosen from the same ethnic group as the participant, who could tailor the intervention to meet the needs of local participants. In addition, the core curriculum was available in Spanish and English and was designed to permit flexibility in the pace of presentation of new information, the amount of repetition of certain components of the program, and the complexity of self-monitoring forms that were used. Reference materials (e.g., fat and calories in commonly eaten foods) and lesson handouts included information about the types of foods and cooking methods used by various ethnic groups. The DPP provided several alternative approaches to self-monitoring for participants with limited reading or math skills, including a high- and low-fat food checklist called "Quick Track" and a caloric estimation tool based on the Food Guide Pyramid called "Count 100." Cooking classes and menus for calorie-controlled diets allowed flexibility to include familiar foods. During maintenance, centers selected topics for the group classes that were most appropriate for their participants, often specifically tailored to ethnic participants (e.g., Hip-Hop dancing was offered for physical activity). Lastly, the toolbox approach allowed coaches to address the individual needs of an ethnically diverse population.

Extensive network of centralized training, feedback, and support

In addition to local team support, a key feature of the DPP lifestyle intervention was an extensive centralized network of training, feedback, and support of the intervention staff. The Lifestyle Resource Core in collaboration with the Lifestyle Advisory Group, a centrally organized committee that included several lifestyle coaches, program coordinators, and study investigators, coordinated these aspects of the intervention.

Training. All lifestyle coaches were required to attend annual, 2-day national training sessions conducted by the Lifestyle Resource Core. In the latter 2 years of the intervention, additional training was offered for newly hired lifestyle coaches so that they could assume all lifestyle case management functions quickly and reliably. There was no formal certification procedure for lifestyle coaches. In addition to attending the training sessions, coaches were instructed to be conversant with the DPP protocol and all lifestyle intervention manuals and to submit an audiotape of at least two individual participant sessions for review by the Lifestyle Resource Core. New coaches who were unable to attend central training were required to view videotapes from the central trainings and directly observe or listen to audiotapes of at least two sessions with a centrally trained lifestyle coach.

The annual training sessions included didactic presentations on the key principles and strategies of the core and maintenance curricula, updates on lifestyle intervention research, review of lifestyle intervention data, and discussion of new participant materials, group classes, or motivational campaigns. There was extensive use of case presentations, role-playing, and clinical practice skills, such as reflective listening, motivational interviewing, and empowerment strategies. Training sessions were videotaped and available for review at each site.

Lifestyle coaches also received support and training at the local level through regular team meetings and case conferences with local consultants with expertise in behavioral science, nutrition, and exercise physiology. Staff at most centers included a part-time behavioral consultant who could address chronic behavioral barriers to diet and exercise adherence and, on occasion, see individual participants for a brief period (no more than two to four sessions) of counseling. In addition, local experts in nutrition and exercise were available to assist lifestyle coaches with individualization of the intervention for specific participants. Lifestyle coaches also received support from regularly scheduled conference calls with the Lifestyle Resource Core and the Lifestyle Advisory Group.

During the first year of the DPP, individual lifestyle coaches were called monthly by a member of the Lifestyle Resource Core to review and discuss nonadherent participants. After the first year, the Lifestyle Resource Core conducted monthly regional conference calls with the lifestyle staff from four or five centers and was available for guidance and consultation whenever requested by local clinics. Additionally, each clinic was assigned a representative from the Lifestyle Advisory Group who contacted the center monthly to provide additional discussion and problem solving of issues related to implementation of the protocol, new maintenance campaigns, and clinic performance. This network of phone calls reinforced the participant learning objectives and lifestyle coaching skills taught at the annual trainings. The phone calls also provided an opportunity for coaches to identify a variety of obstacles to lifestyle change for their participants and to discuss behavioral approaches to improve specific problems.

Monitoring of adherence to the lifestyle goals. The remote data entry system of the DPP made it possible for local centers to have daily access to a variety of lifestyle progress reports for their individual participants as well as summary data of their center's overall goal performance. National data were sent monthly showing how each center's data compared with those of other sites. Centers were required to hold team meetings at least once per month to review their progress. Five summary variables were examined: mean weight loss, mean percent weight loss, mean exercise minutes, percent of participants at weight goal, and percent of participants at exercise goal. The Lifestyle Advisory Group also monitored these data, and clinics that were not performing well were given extra support from their specified representative. When appropriate, conference calls were held with the principal investigator and other staff at the local center or site visits were made to provide more extensive oversight.

CONCLUSIONS — The DPP lifestyle intervention was based on empirical literature in nutrition, exercise, and behavioral weight control, especially as it applied to the prevention of type 2 diabe-

tes in diverse ethnic groups. The intervention was designed to achieve and maintain at least a 7% weight loss and 700 calories/week of physical activity in all lifestyle participants. To achieve these goals, the intervention was designed to be intensive and included features such as individual case management, frequent contact over the entire trial, a structured 16-session initial core curriculum and more individualized maintenance programming, and a "toolbox" of strategies for dealing with nonadherent participants. Extensive centralized feedback, training, and support were provided to all DPP centers. These strategies proved to be very successful, as the lifestyle intervention resulted in a 58% reduction in the incidence rate of diabetes (2).

Acknowledgments— This study was supported by the National Institutes of Health through the National Institute of Diabetes and Digestive and Kidney Diseases, the National Institute of Child Health and Human Development, the National Institute on Aging, the National Center on Minority Health and Health Disparities (NCMHD), the National Center for Research Resources General Clinical Research Center Program, the Office of Research on Women's Health, the Indian Health Service, the Centers for Disease Control and Prevention, the American Diabetes Association, Bristol-Myers Squibb, Lipha Pharmaceuticals, and Parke-Davis. Accusplit, LifeScan, Health O Meter, Hoechst Marion Roussel, Merck-Medco Managed Care, Merck and Co., Nike Sports Marketing, Slim Fast Foods, and Quaker Oats donated materials, equipment, or medicines for concomitant conditions. McKesson BioServices, the Matthews Media Group, and the Henry M. Jackson Foundation provided support services under subcontract with the Coordinating Center.

We thank the thousands of volunteers in this program for their devotion to the goal of diabetes prevention.

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