

Exercise as Medicine

Commentary on issues related to medicine and sports

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Modest Lifestyle Changes Prevent Type 2 Diabetes in Persons at High Risk

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Diabetes is one of the most costly and burdensome chronic diseases of our time. The epidemic nature and debilitating consequences of diabetes stress the need for greater efforts to prevent or delay this disease.¹ According to the US Centers for Disease Control and Prevention, unless dangerous trends of diabetes are halted, the impact on our nation's health and medical care costs will be exorbitant.²

Type 2 diabetes, which accounts for 90%–95% of all cases, is highly related to modifiable lifestyle factors such as obesity and physical inactivity.¹ Moreover, escalating scientific evidence suggests that the prevention or delay of type 2 diabetes, even in persons at greatest risk, is an attainable goal through modest lifestyle changes. Such evidence is provided in two recent landmark research studies involving several thousand overweight or obese adults at high risk for type 2 diabetes.^{3,4} A summary of these studies and related practical implications for the prevention of diabetes is provided in the present commentary.

Growing Health Concern

There are an estimated 17 million Americans who have diabetes, including 5.9 million who are yet undiagnosed.^{2,5} The escalating prevalence of diabetes suggests we may be seeing just the tip of the iceberg. For instance, national survey data indicate that among US adults, diagnosed diabetes increased 49% from 1990 to 2000.⁵ Although more common in adults 45 years and older, type 2 diabetes is now being diagnosed with greater frequency among children and teens.⁶ Both a growing trend of type 2 diabetes in youth and an aging population (where diabetes is most prevalent) point to an even greater preponderance of adult diabetes and its clinical consequences in the future.

Modifiable Diabetes Risk Factors

The existence of a hyperglycemic state as evidenced by impaired fasting glucose (IFG) (i.e., 8-hour fasting blood glucose above 126 mg/dL) or impaired glucose tolerance (IGT) (i.e., 2-hour post-oral glucose tolerance test between 140–199 mg/dL) is the single greatest independent risk predictor for the future development of diabetes.⁷ An estimated 20 million Americans have IFG or IGT but are below threshold for diagnosis of diabetes.⁸ These individuals are considered to have “pre-diabetes” because of their elevated risk for the future development of this disease. A list of lifestyle risk factors associated with the development of type 2 diabetes is shown in Table I.

Obesity⁹ and sedentary lifestyle¹⁰ are independent and powerful risk factors for the development of impaired glucose homeostasis, i.e., impaired IFG, IGT, or diabetes. For example, adults with a body mass index (BMI) of 30 kg/m² or greater (or approximately 30 pounds over ideal weight) have a five-fold greater risk of developing diabetes compared with those with a normal BMI of 24.9 kg/m² or less.⁹ Overall, 80% of people with type 2 diabetes are overweight or obese.⁹ Excess adiposity, predominantly in the abdomen, significantly raises the risk of “metabolic syndrome” characterized by glucose intolerance, insulin resistance, type 2 diabetes, dyslipidemias, and hypertension.¹¹ Recent obesity guidelines from the National Institutes of Health¹² recommend the use of waist circumference measurements (at level of iliac crest) to evaluate a patient's abdominal fat, with measurements of >35 inches for women and >40 inches for men indicating elevated risk for cardiovascular disease and

Table I. Modifiable Independent but Often Confounding Risk Factors Associated With the Development of Type 2 Diabetes

Presence of hyperglycemic state (IFG or IGT)	Fasting blood glucose above 126 mg/dL (IFG) or 2-hour post-oral glucose tolerance test between 140–199 mg/dL (IGT). ⁷
Overweight/obese	Risk increases proportionally with increase in BMI above 24.9 kg/m ² . ⁹
Visceral obesity	Elevated risk of “metabolic obesity” for waist circumference >35 inches for women and >40 inches for men. ^{11,12}
Physical inactivity/low cardiovascular fitness level	Risk of diabetes is two- to four-fold higher in low fit compared with fit individuals. ¹⁴
Presence of other cardiovascular risk factors	Risk elevated when hypertension and dyslipidemia are also present. ⁷
IFG=impaired fasting glucose; IGT=impaired glucose tolerance; BMI=body mass index measured as weight in kilograms divided by height in meters squared	

metabolic syndrome, even in the presence of a normal BMI.

Along with an upsurge in obesity, a sedentary lifestyle is another influential ingredient in the growing prevalence of type 2 diabetes.¹⁰ Unfortunately, lack of regular exercise characterizes most Americans; nearly seven of every 10 US adults recently reported no regular leisure-time physical activity.^{5,13} The compelling impact of low physical fitness, an objective measure of physical inactivity, on the risk of type 2 diabetes was demonstrated in a study of over 8000 men who were nondiabetic at baseline.¹⁴ Results of this study showed those with low cardiorespiratory fitness (the least fit 20% of the cohort) on an initial routine maximal treadmill test had double the risk for IFG and a four-fold risk for diabetes compared with those in the high-fitness group (the most fit 40% of the cohort). In the Nurse's Health Study,¹⁵ women who reported routine walking had a substantial reduction in risk of type 2 diabetes, even after controlling for BMI and other confounding variables.

Interventional Studies

An accumulating body of scientific evidence from randomized controlled studies shows that modest weight loss (e.g., 5%–10% of body mass) and routine physical activity (e.g., accumulation of ≥ 150 min/wk), particularly when combined with behavioral approaches, effectively improve glucose homeostasis and promote overall health and well being in persons with either diabetes or prediabetes.¹ Moreover, an expert panel from the American Diabetes Association (ADA) and National Institute of Diabetes, Digestive and Kidney Disorders (NIDDK) concluded in a recent position paper¹ that diabetes can be prevented or delayed through lifestyle changes and that diabetes prevention efforts that focus

on modest weight loss and increased physical activity are also likely to have additional health benefits. The panel further concluded that lifestyle efforts are more effective than medications to lower diabetes risk in persons with IGT. Based on current evidence, the panel did not recommend the routine use of medications to prevent diabetes, at least until there are studies showing that drugs will delay or prevent the complications of diabetes or until the cost effectiveness of using pharmacologic agents has been established. Whether successful lifestyle or pharmacologic interventions that prevent diabetes in patients predisposed to this disease also prevent morbidity and mortality associated with diabetes is not yet known.

The conclusions stated in the ADA/NIDDK position stand on the efficacy of lifestyle interventions to prevent diabetes were in large part based on two recent landmark research trials^{3,4} that convincingly demonstrated reduced diabetes incidence in men and women with IGT or IFG. A synopsis of these two research studies is described here.

DIABETES PREVENTION PROGRAM (DPP) TRIAL. The primary goal of the DPP trial,³ a multicenter study conducted in the United States, was to prevent or delay the development of type 2 diabetes in 3234 adults (mean age, 50 \pm 10 years; BMI, 34 \pm 6 kg/m²; 68% women; 45% non-Caucasian) with IGT. Subjects were randomized to one of three intervention groups, which included an intensive nutrition and exercise counseling (“lifestyle”) group or either a medication treatment group (metformin 850 mg/day for 4 weeks then titrated upward to 1700 mg/day) or a placebo group. The latter interventions were combined with standard diet and exercise recommendations. The intensive lifestyle intervention group consisted of a behavioral weight management program intended to reduce body weight ($\geq 7\%$), total energy intake, and

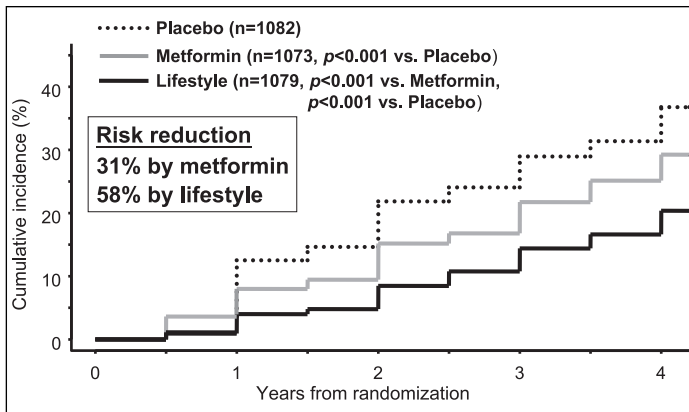


Figure 1. Incidence of diabetes in placebo, metformin, and lifestyle intervention groups: the Diabetes Prevention Program.¹ From the Diabetes Prevention Research Group. Reduction in the evidence of type 2 diabetes with life-style intervention or metformin. *N Engl J Med.* 2002;346:393–403.³ Available at www.bsc.gwu.edu/dpp/slides.htmlvdoc.

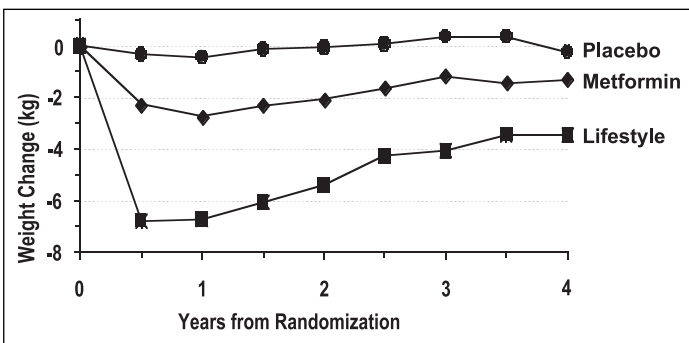


Figure 2. Mean weight change in the Diabetes Prevention Program;¹ $p < 0.001$ between the treatment groups. From the Diabetes Prevention Research Group. Reduction in the evidence of type 2 diabetes with life-style intervention or metformin. *N Engl J Med.* 2002;346:393–403.³ Available at www.bsc.gwu.edu/dpp/slides.htmlvdoc.

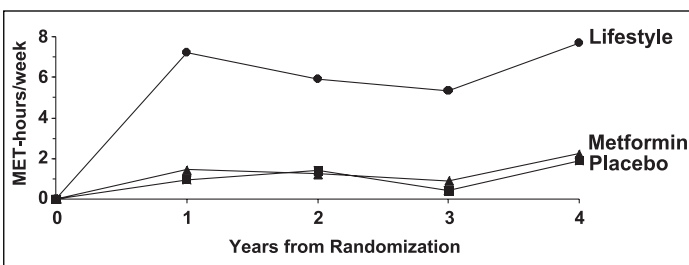


Figure 3. Mean change in leisure physical activity in the diabetes prevention program;¹ $p < 0.001$ between the treatment groups. From the Diabetes Prevention Research Group. Reduction in the evidence of type 2 diabetes with life-style intervention or metformin. *N Engl J Med.* 2002;346:393–403.³ Available at www.bsc.gwu.edu/dpp/slides.htmlvdoc.

calories from fat, while concurrently increasing regular leisure-time physical activity (>150 min/wk). The program was implemented through a supervised format of 16 instructor-led sessions over 24 weeks with a longer maintenance program. After an average follow-up of 2.8 years, a 58% relative reduction in the progression to diabetes was observed in the lifestyle group (absolute incidence, 4.8%), and a 31% relative reduction in the progression to diabetes was observed in the metformin group (absolute incidence, 7.8%) compared with control subjects (absolute incidence, 11.0%) (Figure 1). The mean weight loss for the study duration in the lifestyle group was approximately 12 lb or 6% of initial body weight. On average, 50% of the lifestyle group achieved the goal of $\geq 7\%$ weight reduction and 74% maintained at least 150 min/wk of moderately intense activity (Figures 2 and 3). No serious side effects were seen in any group. It was concluded that lifestyle changes and treatment with metformin both reduced the incidence of diabetes in persons at high risk but that lifestyle was more effective.

FINNISH STUDY. In the Finnish Study,⁴ 522 middle-aged (mean age, 55 years), obese (mean BMI, 31 kg/m²) men and women with IGT were randomized to receive either limited diet and exercise counseling (control group) or intensive individualized instruction on weight reduction, food intake, and increasing physical activity (intervention group). After an average follow-up of 3.2 years, there was a 58% relative reduction in the incidence of diabetes in the intervention group compared with the control subjects. Remarkably, this magnitude of risk reduction was identical to that observed in the DPP trial. Regarding the positive effects of lifestyle changes, a strong correlation was observed between the ability to stop the progression to diabetes and the degree to which subjects were able to achieve one or more of the following: 1) lose weight (goal of 5.0% weight reduction); 2) reduce fat intake (goal of <30% of calories); 3) reduce saturated fat intake (goal of <10% of calories); 4) increase fiber intake (goal of >15 g/1000 kcal); and 5) exercise (goal of >150 min/wk). The researchers concluded that type 2 diabetes could be prevented or delayed with modest lifestyle changes involving becoming more physically active and adopting healthy eating habits in men and women with IGT.

Practical Implications for Diabetes Prevention

The benefit of weight loss and physical activity to delay or prevent type 2 diabetes strongly suggests that lifestyle modification should be the first-line approach in persons at risk for diabetes. Because this intervention not only has been shown to prevent or

Table II. Synopsis of Recommendations to Prevent or Delay Type 2 Diabetes

Individuals at high risk for developing diabetes need to become aware of the benefits of modest weight loss and participating in regular physical activity.

Screening

Based on current screening guidelines for diabetes men and women ≥ 45 years of age are candidates for screening to detect IFG or IGT, particularly those with a BMI ≥ 25 kg/m².

Screening should be considered in younger individuals with a BMI ≥ 25 kg/m² who have one of the following risk factors: a family history of diabetes, have had gestational diabetes or a baby weighing >9 lb, are not Caucasian, have dyslipidemia, or who have hypertension. In individuals with normoglycemia, rescreening at 3-year intervals is reasonable.

How to Screen

Screening should be carried out only as part of a health care office visit. Either an FPG test or 2-hour OGTT (75-g glucose load) is appropriate, and positive test results should be confirmed on another day.

Intervention Strategy

Patients with IFG or IGT should be given counseling on weight loss as well as instruction for increasing physical activity. Follow-up counseling appears important for success. Monitoring for the development of diabetes should be performed every 1–2 years. Close attention should be given to, and appropriate treatment given for, other cardiovascular disease risk factors (e.g., tobacco use, hypertension, dyslipidemia). Drug therapy should not be routinely used to prevent diabetes until more information is known about its cost effectiveness.

IFG=impaired fasting glucose; IGT=impaired glucose tolerance; BMI=body mass index measured as weight in kilograms divided by height in meters squared; OGTT=oral glucose tolerance test; FPG=fasting plasma glucose. Adapted with permission from the American Diabetes Association and National Institute of Diabetes, Digestive and Kidney Disease. *Diabetes Care*. 2002;25:742–749.¹

delay diabetes, but also has a variety of other benefits, primary care physicians should urge all overweight or sedentary individuals to adopt these changes, and such recommendations should be made at every opportunity.¹ Modest weight loss (5%–10% of body weight) and moderate intensity physical activity (30 minutes daily) are the recommended goals. A synopsis of recommendations to prevent or delay diabetes as adopted from the ADA/NIDDK position stand is shown in Table II.

FUTURE DIRECTIONS. The concept of preventing or delaying diabetes before it reaches diagnostic criteria or further exacerbates clinical consequences in patients with either IGT or IFG remains an important public health objective. Recent studies show diabetes can be delayed or prevented with only modest changes in body weight and physical activity, but in these trials considerable effort from well-trained staff was needed to achieve these behavioral changes. Thus, low-cost ways to reinforce lifestyle goals are greatly encouraged, and low-cost community-based programs to increase physical activity and avoid unhealthful lifestyle choices offer potential benefits for people who are at risk for diabetes.¹ Increased support from primary care physicians, nurses, and allied health specialists to help people lose weight and keep it off and to exercise more often remains a cornerstone strategy, not just for preventing diabetes, but also for improving cardiovascular health and quality of life. ■

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