Diabetes Prevention Strategies: Evidence, Experiences, and Outcomes

Richard Arakaki, M.D.

Professor Emeritus and Endocrinologist

University of Hawaii

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Disclosed no conflict of interest

Diabetes Prevention Strategies: Evidence, Experience, and Outcomes

Learning Outcomes/Objectives

As a result of participating in this activity, participants will be able to:

- Describe the burden of prediabetes and type 2 diabetes in the United States
- Identify modifiable risk factors for type 2 diabetes
- Implement effective strategies for reducing diabetes risk

National Diabetes Statistics Report, 2020

Among the U.S. population overall, crude estimates for 2018 were:

- 34.1 million adults aged 18 years or older—or 13.0% of all U.S. adults—had diabetes.
- 7.3 million adults aged 18 years or older who met laboratory criteria for diabetes were not aware of or did not report having diabetes (undiagnosed diabetes). This number represents 2.8% of all U.S. adults and 21.4% of all U.S. adults with diabetes.
- The percentage of adults with diabetes increased with age, reaching 26.8% among those aged 65 years or older.

Centers for Disease Control and Prevention. National Diabetes Statistics Report, 2020. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services; 2020.

National Diabetes Statistics Report, 2020 (con't)

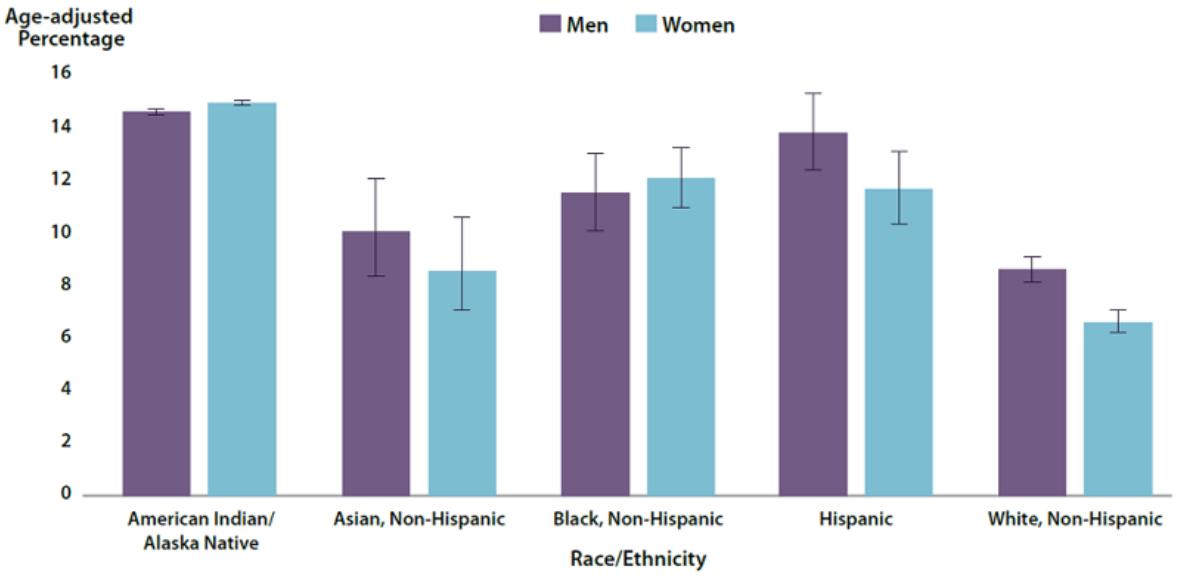
Mortality and complications among adults 18 years and older with diabetes in 2017:

- Seventh leading cause of death
- Leading cause of End Stage Renal Disease accounting for 38.6%
- Leading cause of blindness (among 18–64-year-olds)
- 7.8 million hospitalizations; admission for CVD – 1.7 million, for amputation – 130,000, for hyperglycemia – 209,000
- Nearly 16 million emergency room visits

Centers for Disease Control and Prevention. National Diabetes Statistics Report, 2020. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services; 2020.

National Diabetes Statistics Report, 2020 (more)

Figure 2. Age-adjusted estimated prevalence of diagnosed diabetes by race/ethnicity group and sex for adults aged 18 years or older, Unites States, 2017-2018

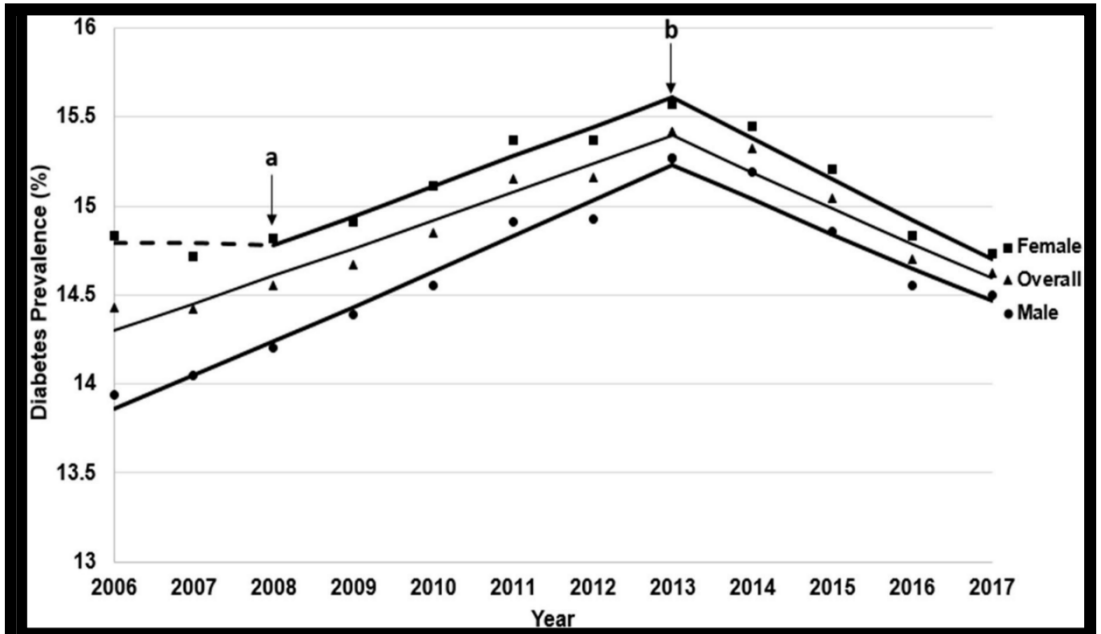


Note: Error bars represent upper and lower bounds of the 95% confidence interval. Data sources: 2017-2018 National Health Interview Survey; 2017 Indian Health Service National Data Warehouse (for American Indian/Alaska Native group only).

Center for Disease Control and Prevention. National Diabetes Statistics Report, 2020

AI/AN Diabetes Prevalence Trends

Trends in age-adjusted prevalence of diagnosed diabetes among American Indian and Alaska Native adults aged 18 years and older in the Indian Health Service active clinical population, overall and by sex, 2006–2017.



Ann Bullock et al. BMJ Open Diab Res Care 2020;8:e001218

SDPI 2020 Report to Congress

Diabetes Prevalence

For the first time, diabetes prevalence in AI/AN adults has decreased – and has done so consistently for 4 years, dropping from 15.4 percent in 2013 to 14.6 percent in 2017 (Figure 2).[2] Neither the general United States (U.S.) population, nor any other U.S. racial/ethnic group has shown a decrease in prevalence.[3] Given that diabetes-related mortality has also decreased,[4] this improvement in prevalence appears to be driven by a reduction in new cases of diabetes in AI/AN adults.

Best Strategy

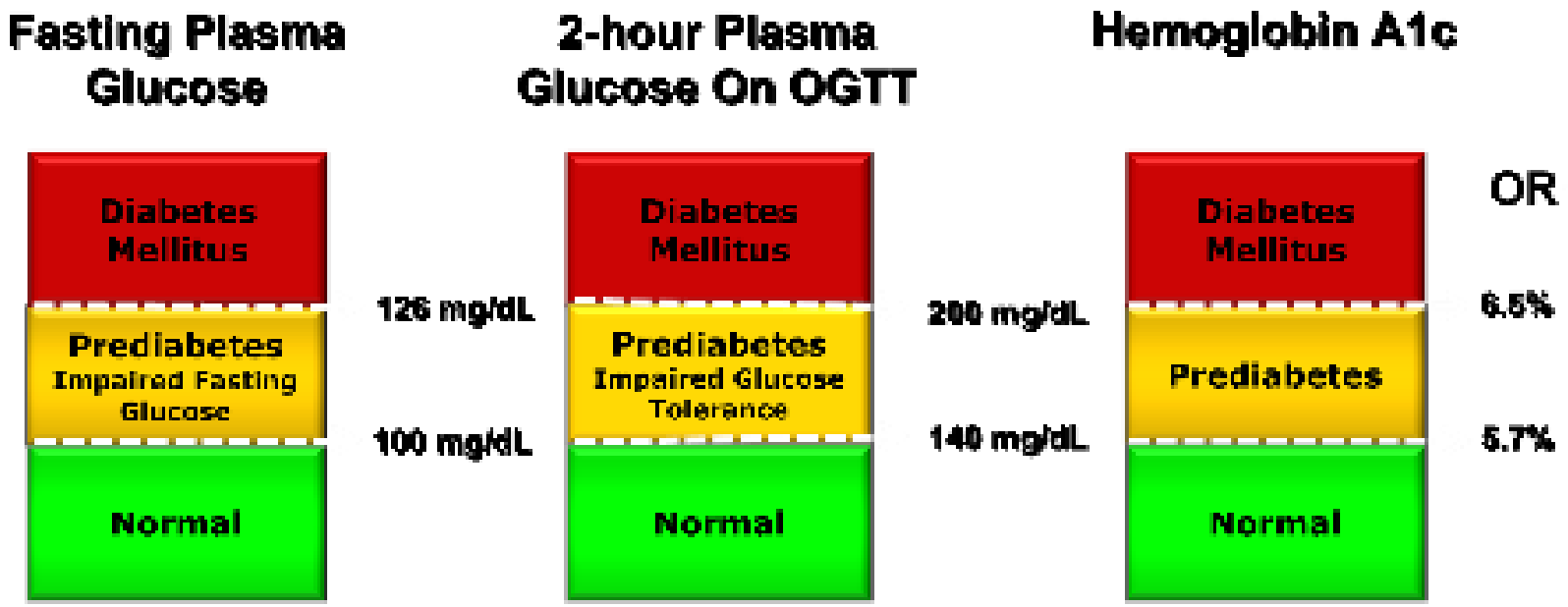
The best strategy to reduce new cases (incidence) of diabetes requires identifying people at risk and offering interventions that prevent or delay diabetes development.

Criteria for Testing for Diabetes or Prediabetes in Asymptomatic Adults

- Overweight or obese individuals (BMI ≥ 25) who have one or more of the following risk factors:
  - First-degree relative with diabetes (Family History)
  - High Risk race/ethnicity
  - History of CVD or have HTN or abnormal blood lipid levels
  - Women with polycystic ovary syndrome (PCOS)
  - Physical inactivity (sedentary lifestyle)
  - Other conditions associated with insulin resistance
- Patients with prediabetes (A1C ≥ 5.7%, IFG, IGT) should be tested annually
- Women with GDM history, should have lifelong testing every three years

Table 2.3 from American Diabetes Association. *Diabetes Care.* 2021;44:S15-S33. https://doi.org/10.2337/dc21-S002

Diagnostic Criteria for Glucose Intolerance



The diagnosis of diabetes can also be made based on unequivocal symptoms and a random glucose >200 mg/dL.

In the absence of unequivocal hyperglycemia, diagnosis requires two abnormal test results from the same sample or in two separate test samples.

American Diabetes Association. *Diabetes Care.* 2021;44:S15-S33. https://doi.org/10.2337/dc21-S002

National Diabetes Statistics Report, 2020
Prevalence of Prediabetes

- An estimated 88 million adults aged 18 years or older had prediabetes in 2018.
- Among U.S. adults aged 18 years or older, crude estimates for 2013–2016 were:
  - 34.5% had prediabetes based on their fasting glucose or A1C level.
  - 10.5% had prediabetes based on both elevated fasting plasma glucose and A1C levels.
  - 15.3% with prediabetes reported being told by a health professional that they had this condition.
  - A higher percentage of men (37.4%) than women (29.2%) had prediabetes.
  - Prevalence of prediabetes was similar among all racial/ethnic groups and education levels.

Centers for Disease Control and Prevention. National Diabetes Statistics Report, 2020. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services; 2020.

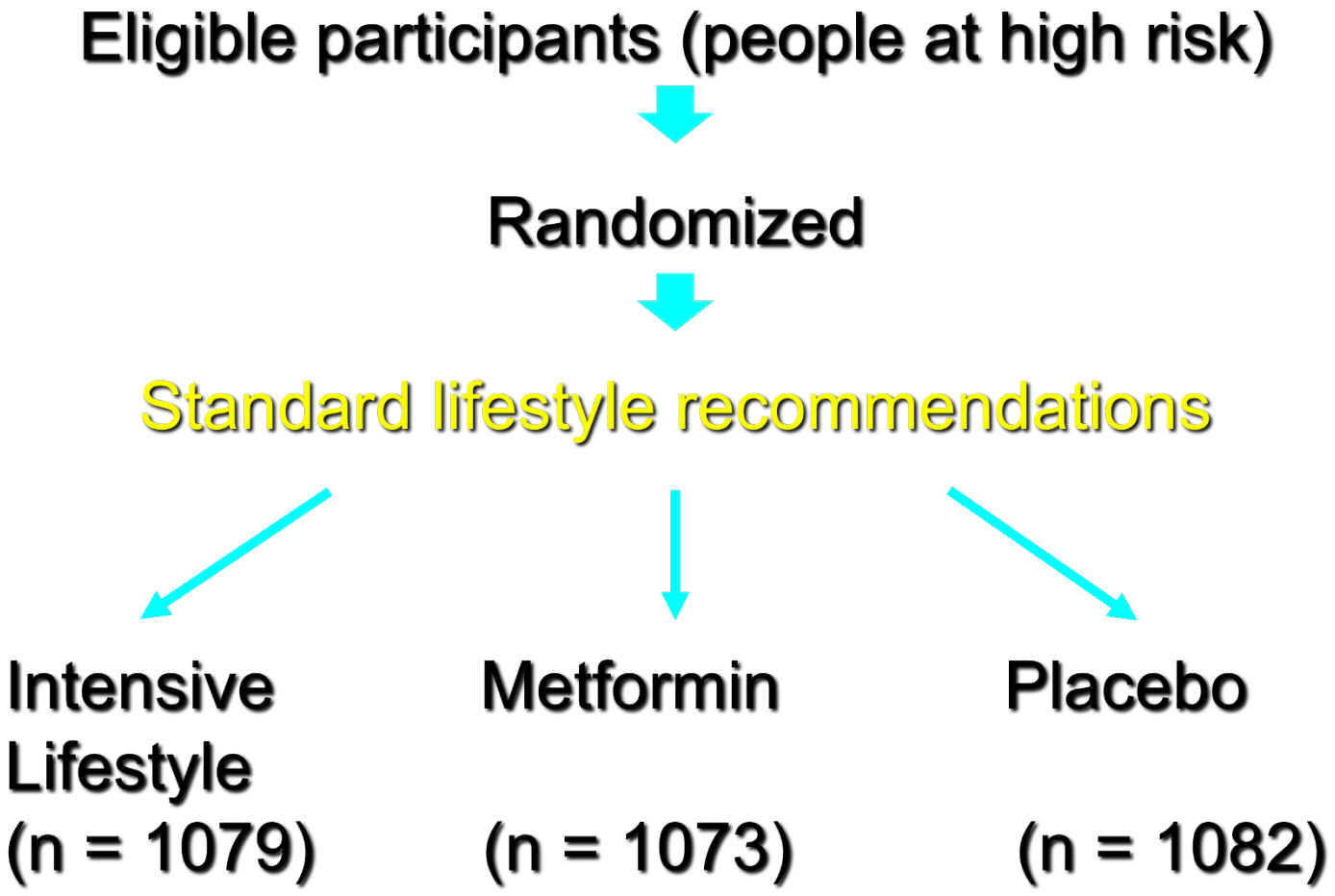
Diabetes can be prevented or delayed in people with prediabetes!

Current interventions are modeled after the Diabetes Prevention Program (DPP)

A Randomized Clinical Trial to Prevent Type 2 Diabetes in Persons at High Risk

Knowler W, et al. N Engl J Med. 2002;346:393-403

DPP Interventions



DPP Lifestyle Intervention

An intensive program with the following specific goals:

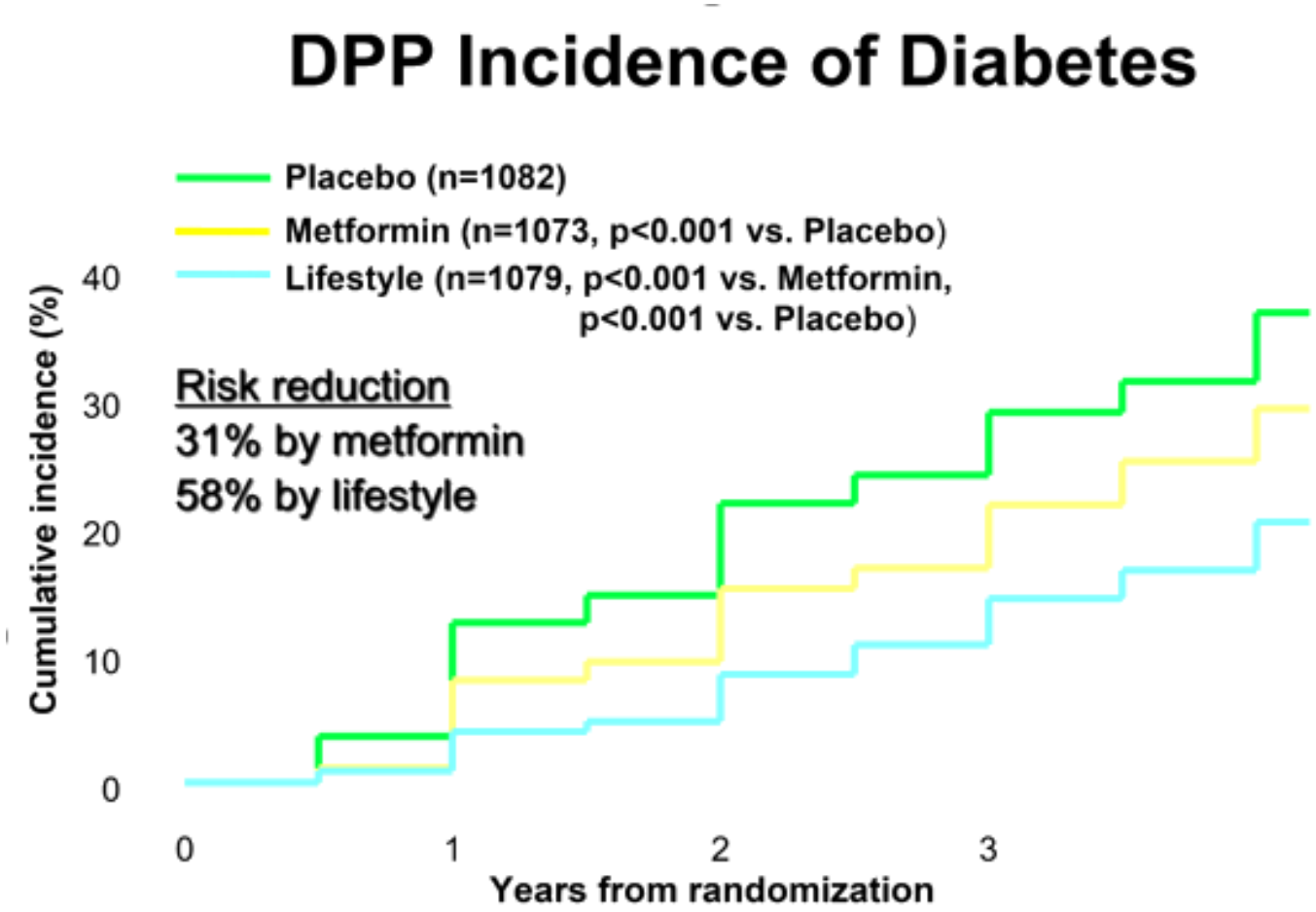
- ≥ 7% loss of body weight and maintenance of weight loss
  - Dietary fat goal -- <25% of calories from fat
  - Calorie intake goal -- 1200-1800 kcal/day
- ≥ 150 minutes per week of physical activity

A structured lifestyle program:

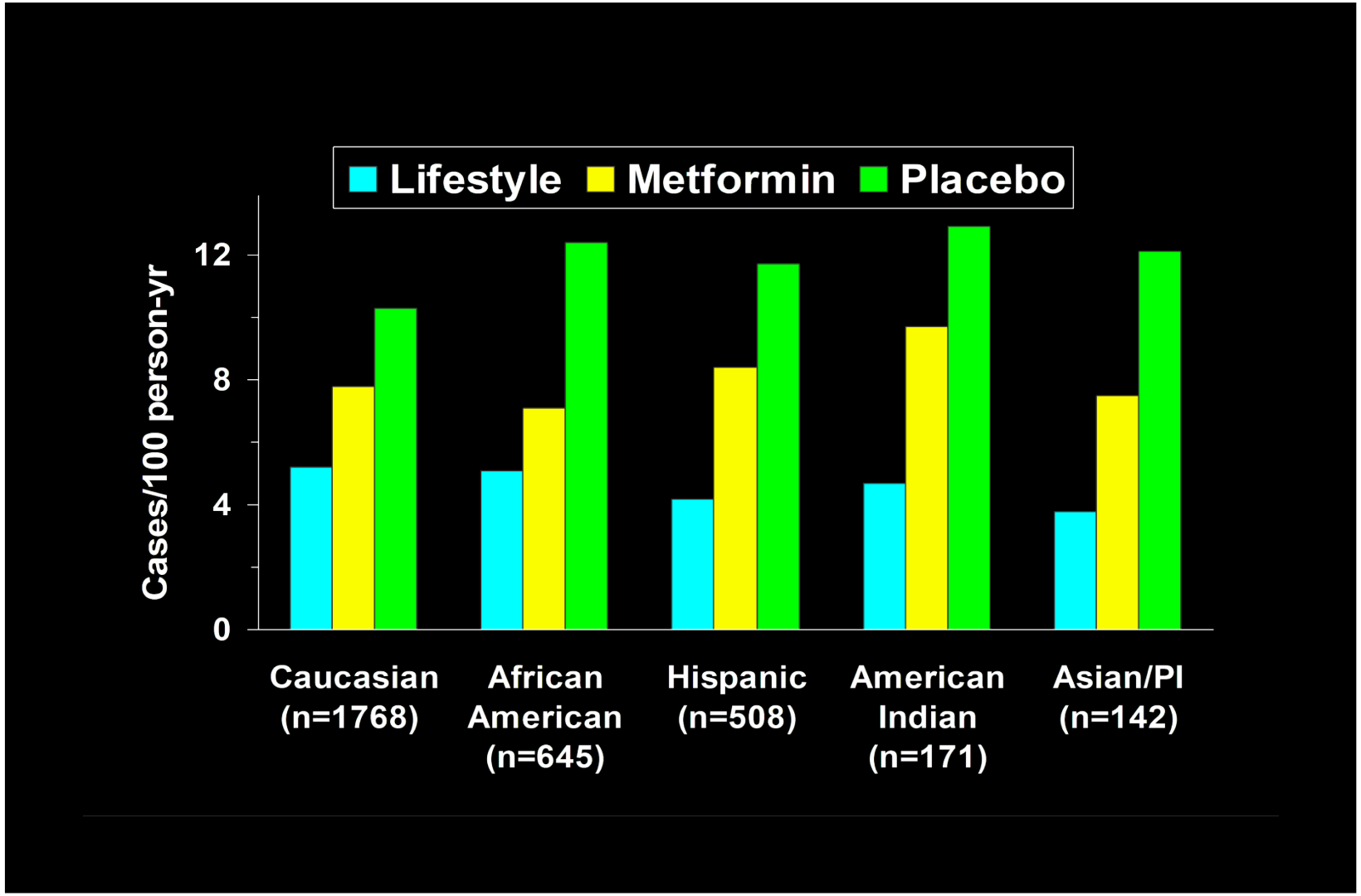
- 16 session core curriculum (over 24 weeks)
- Long-term maintenance program
- Supervised by a case manager; assisted by support staff

DPP: Description of lifestyle intervention. Diabetes Care 25:2165-71, 2002

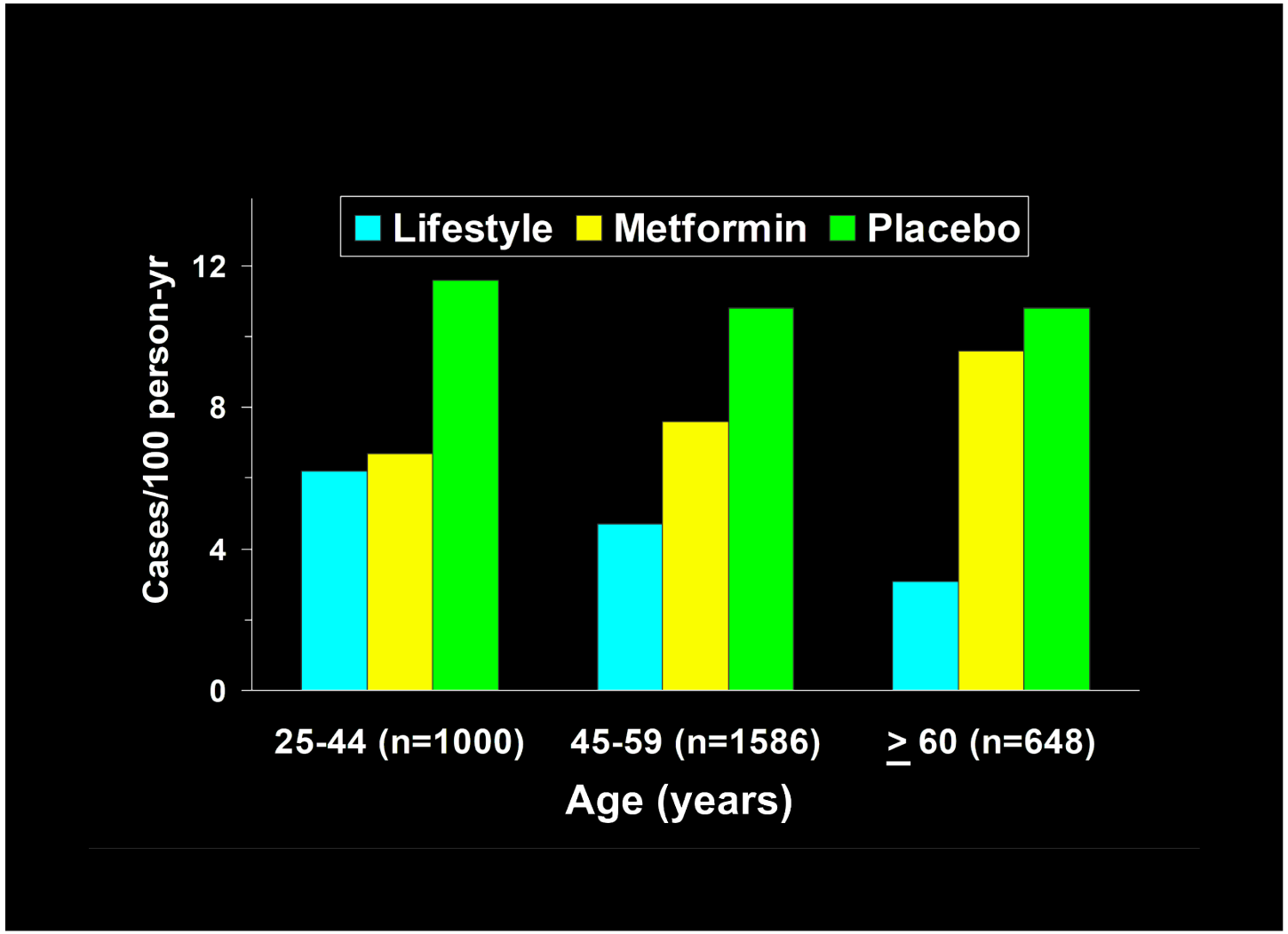
DPP Incidence of Diabetes



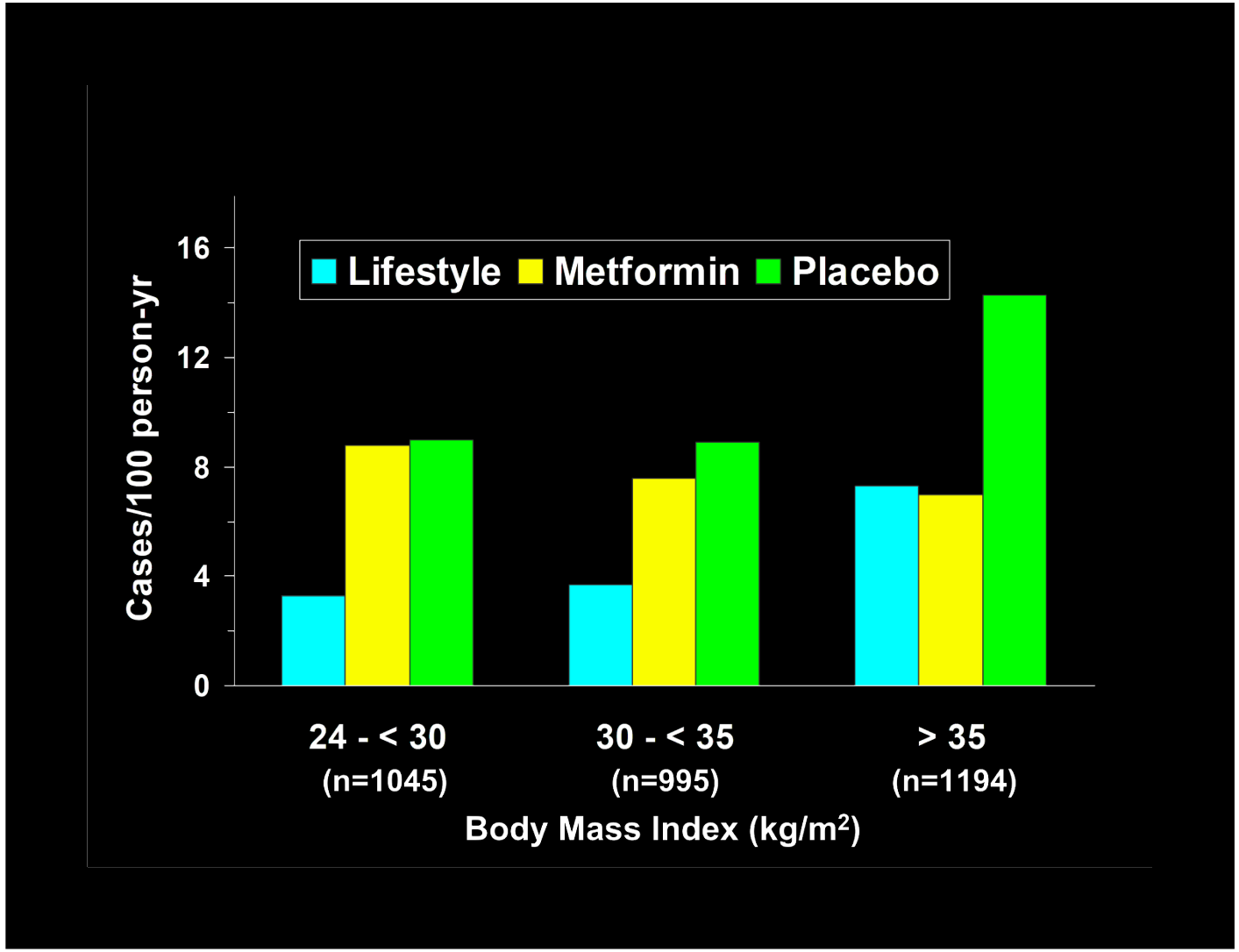
Diabetes Incidence Rates by Ethnicity



Diabetes Incidence Rates by Age



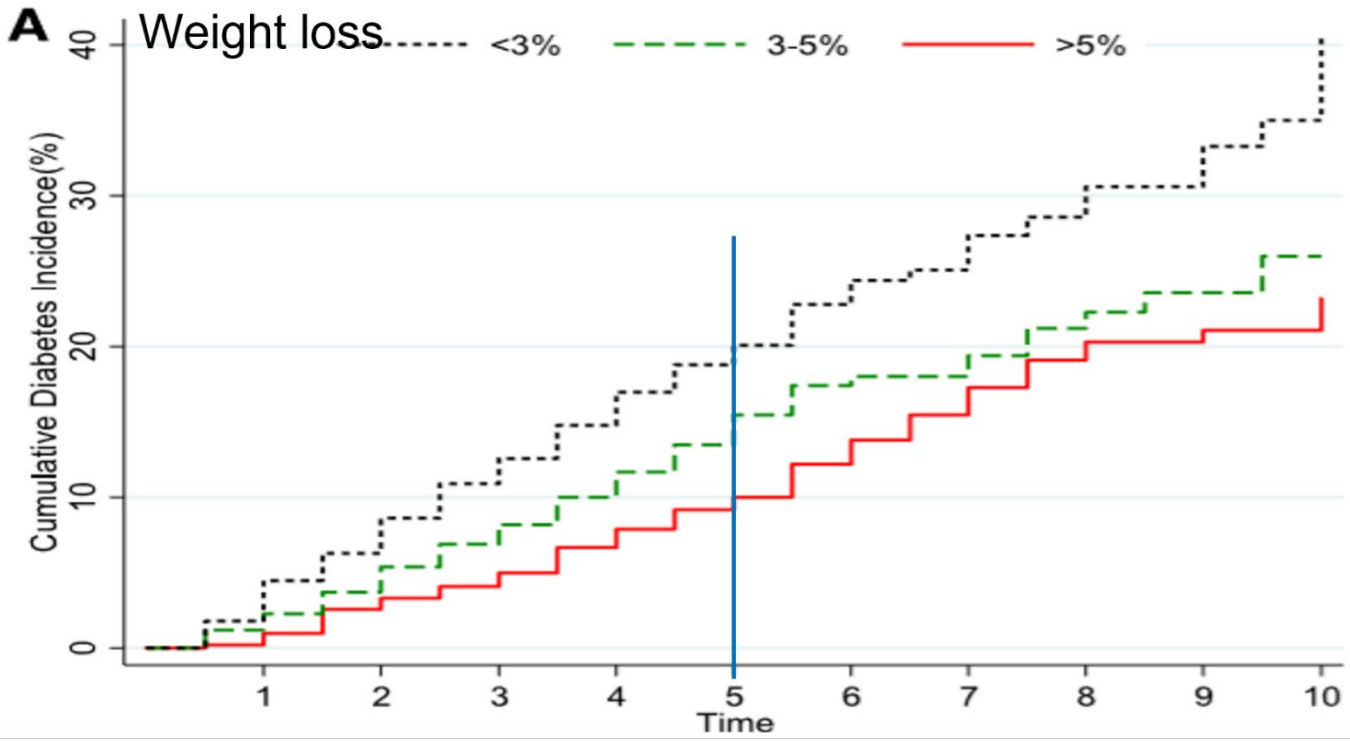
Diabetes Incidence Rates by BMI



Keys to DPP Lifestyle Success

- Weight loss was the key to diabetes prevention
  - Each kg (2.2 lbs.) of weight loss was associated with a 16% reduction in risk for developing diabetes
- Reduction of total calories, especially fat calories
- Achieving 150 minutes of activity each week

Long-term Outcomes of Lifestyle Intervention to Prevention Diabetes in American Indian and Alaska Native Communities: The Special Diabetes Program for Indians (SDPI) DPP



CONCLUSIONS

Moderate to small weight loss was associated with substantially reduced long-term risk of diabetes in diverse AI/AN communities. High participant attrition rates and nonoptimal postcurriculum weight loss are important challenges found in this translational effort implemented in an underserved population.

Jiang L, et al. Diabetes Care. 2017; https://doi.org/10.2337/dc17-2685

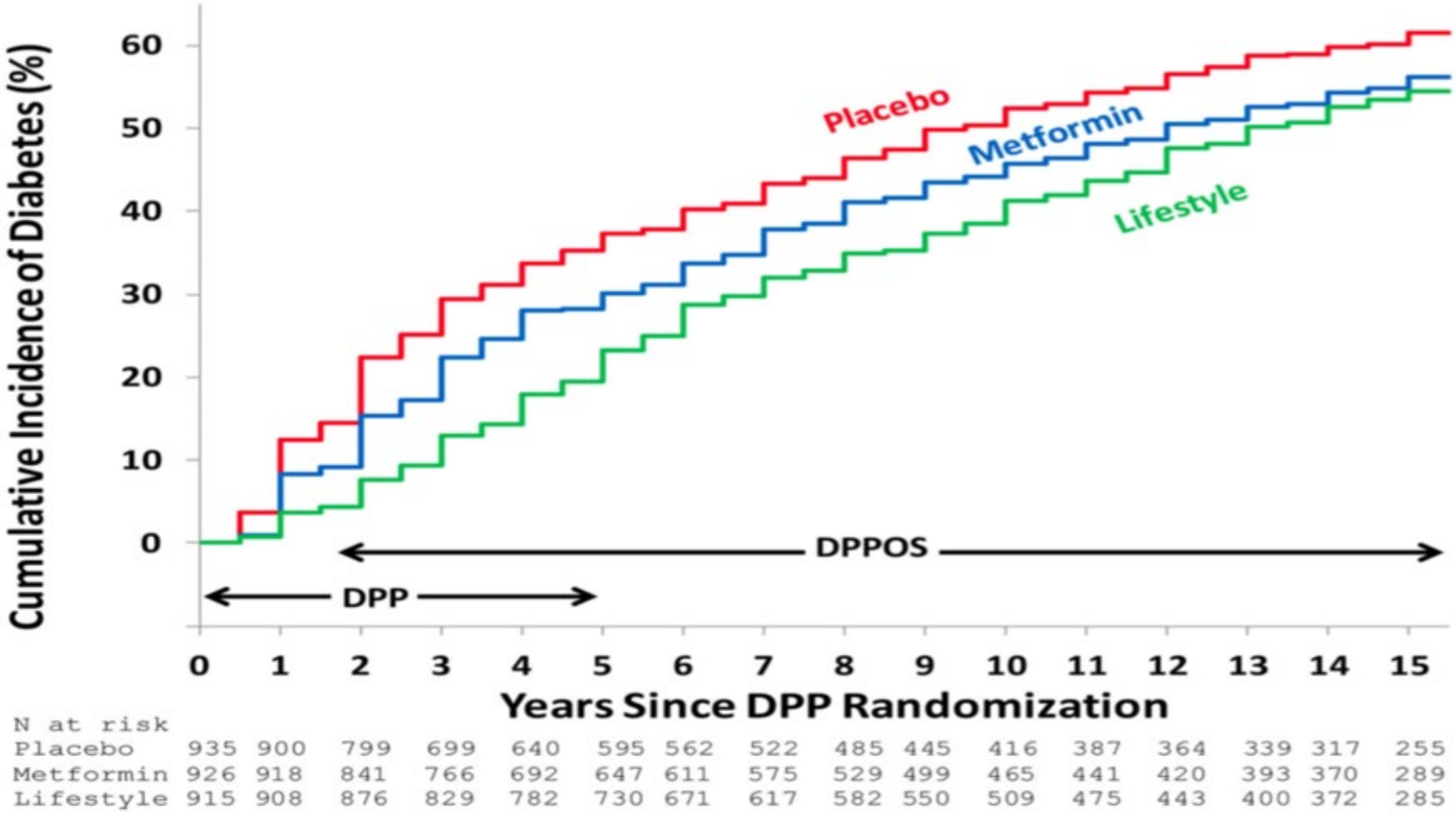
Factors That Impact Lifestyle Intervention Success

- Attending more classes during the SDPI-DP core curriculum period
- Less psychological distress
- Greater family support

Jiang L, et al. Translating the Diabetes Prevention Program into American Indian and Alaska Native Communities. Diabetes Care. 2013;36:2027-2034. DOI:10.2337/dc12-1250.

Dill EJ, et al. Psychosocial Predictors of Weight Loss among American Indian and Alaska Native Participants in a Diabetes Prevention Translational Program. J DiabetesResearch. 2016; https://dx.doi.org/10.1155/2016/154693.

Long-term Effects of Lifestyle Intervention or Metformin on Diabetes Development and Microvascular Complications: the DPP Outcomes Study (DPPOS)



Diabetes Prevention Group. *Lancet Diabetes Endocrinol*. 2015;3(11):866-875. doi:10.1016/S2213-8587(15)00291-0.

DPPOS Summary

- Original interventions continue to have an effect on diabetes development—16 years later.
- Diabetes prevention/delay reduced development of complications (kidney, nerve, eye).
- Individual interventions (Lifestyle and Metformin compared to Placebo) did not have significant effects on complications.
- Lifestyle, in particular, reduced the use of medications to treat diabetes, high blood pressure, and abnormal lipid (cholesterol) levels; and in women reduced microvascular complications.
- Metformin is cost saving and both Lifestyle and Metformin represent good health care investments.

Prevention or Delay of Type 2 Diabetes: Standards of Medical Care in Diabetes — 2021

- 3.1 At least annual monitoring for the development of type 2 diabetes in those with prediabetes is suggested. E
- 3.2 Refer patients with prediabetes to an intensive lifestyle behavior change program modeled on the Diabetes Prevention Program to achieve and maintain 7% loss of initial body weight and increase(such as brisk walking) to at least 150 min/week. A
- 3.6 Metformin therapy for prevention of type 2 diabetes should be considered in those with prediabetes, especially for those with BMI $\geq$ 35kg/m^2, those aged <60 years, and women with prior gestational diabetes mellitus. A
- 3.7 Long-term use of metformin may be associated with biochemical vitamin B12 deficiency; consider periodic measurement of vitamin B12 levels in metformin treated patients, especially those with anemia or peripheral neuropathy. B

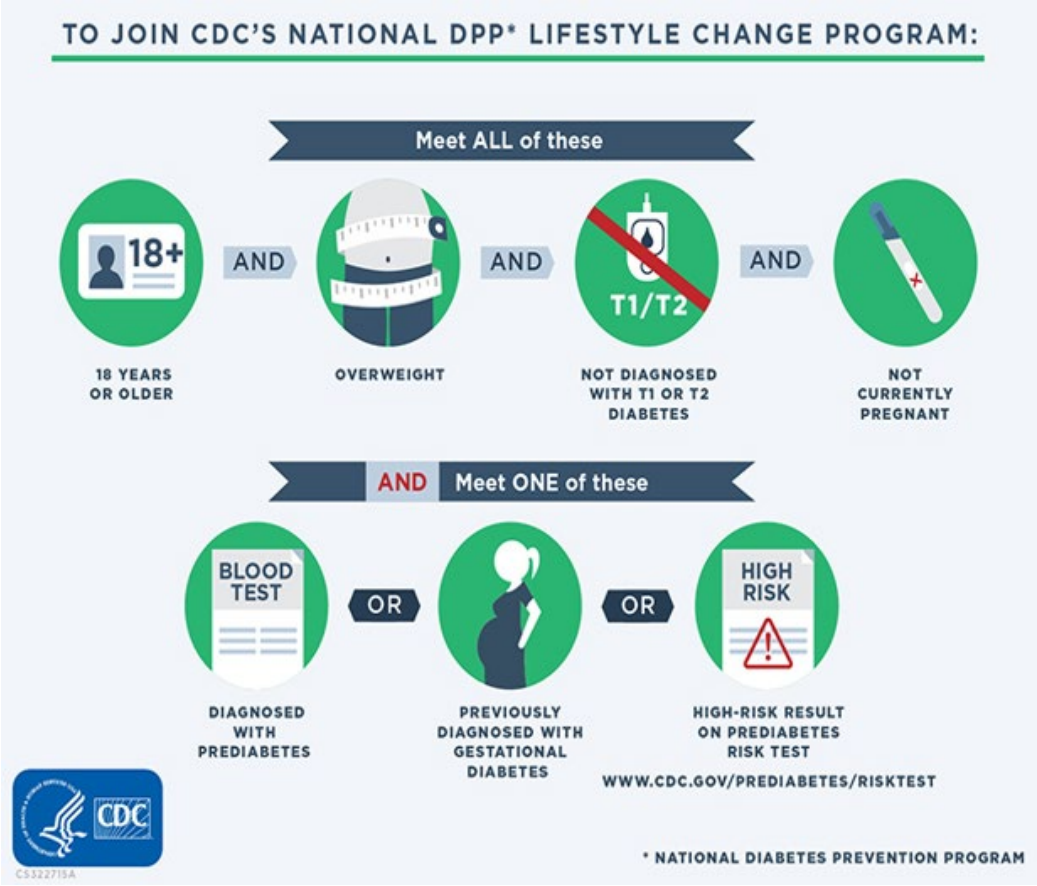
ADA. Diabetes Care 2021;44:S34-39. *doi 10.2337/dc21-S003*

Factors That Increase Risk for Diabetes

- Prediabetes individuals at greater risk for diabetes
  - Higher glucose levels
  - Older
  - Higher BMI
- Other diseases and medications, smoking, and sedentary lifestyle

Translation of DPP Lifestyle Intervention

CDC National DPP LS Change



Medicare DPP

- Enrollment in Medicare Part B through original Medicare (fee-for-service) or a Medicare Advantage (MA) plan.
- Body mass index (BMI) of 25 or higher (23 or higher if you self-identify as Asian).
- Results from any one of these three blood tests within a year of starting the program:
  - Fasting plasma glucose test result of 110–125 mg/dL.
  - Oral glucose tolerance test result of 140–199 mg/dL.
  - HbA1c test result of 5.7% – 6.4%.
- No history of type 1 or type 2 diabetes (gestational diabetes is acceptable).
- No current end-stage kidney disease.

Medications for Diabetes Prevention

Note: There are no U.S. Food and Drug Administration-approved medications for the prevention of diabetes.

Metformin

- Metformin, an anti-hyperglycemic agent.
- Reduced diabetes incidence by 31% in the DPP trial.
- Metformin is most effective for diabetes prevention in adults with prediabetes and any of the following characteristics:
  - Body mass index of at least 35 kg/m^2
  - Age less than 60 years
  - History of gestational diabetes mellitus

Pharmacologic and Surgical Treatments to Prevent Diabetes

Intervention	Follow-up Period, y	RRR, % (*P* Value vs Placebo)	Pregnancy Risk Category[a]	Adverse Effects
Antihyperglycemic Agents				
Metformin[9]	2.8	31 (<.001)	B	GI distress, infection, lactic acidosis, Nausea, Vomiting, diarrhea
Acarbose[14]	3.3	25 (.0015)	B	GI distress/pain, diarrhea, high LFT results
Pioglitazone[15]	2.4	72 (<.001)	C	HF, weight gain, HLD, edema, hepatotoxicity, bladder cancer
Rosiglitazone[16]	3.0	60 (<.0001)	C	HF, weight gain, HLD, edema, hepatotoxicity
Weight-Loss Interventions				
Orlistat[17]	4	37 (.0032)	X	Headache, GI distress or pain, URTI, hepatotoxicity
Phentermine plus topiramate[18]	2	79 (<.05)	Phentermine: X; topiramate: D	Phentermine: hypertension, palpitations, GI distress, dysphoria, restlessness; topiramate: paresthesias, diarrhea, URTI, drowsiness, dizziness
Bariatric surgery[19]	10	75 (<.001)	...	Dumping syndrome, malabsorption, infection, stenosis

Shubrook JH, et al. Evidence for the Prevention of Type 2 Diabetes. J Am Osteopath Assoc. 2018;118(11):730-737.

Long Term Sustainability of Diabetes Prevention Approaches

JAMA Internal Medicine | Original Investigation

Long-term Sustainability of Diabetes Prevention Approaches
A Systematic Review and Meta-analysis of Randomized Clinical Trials

Key Points

Questions How much do primary prevention strategies reduce the risk of conversion from prediabetes to diabetes, and are initial effects sustained over the long term?

Findings In this meta-analysis of randomized clinical trials including 49 029 participants, lifestyle modification and medications promoting weight loss or insulin sensitization were associated with reduced diabetes risk by 36% to 39%. Effects of medications were not sustained after they were discontinued; effects of lifestyle modification, however, were sustained after intervention was stopped, although the effects waned over time.

Meaning For individuals at risk for diabetes, healthy lifestyle changes, weight loss, or use of insulin-sensitizing medications slow the progression to diabetes similarly; lifestyle modification strategies are better in the long term, although strategies to maintain their effects are needed.

Haw JS et al. JAMA Intern Med. 2017;177(12):1808-17. *doi.1001/jamainternmed.2017.6040*

Thank You for Your Attention

Any Questions?