Number and Characteristics of US Adults Meeting Prediabetes Criteria for Diabetes Prevention Programs: NHANES 2007–2016

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INTRODUCTION

Type 2 diabetes is a major public health challenge but can be prevented. The landmark Diabetes Prevention Program (DPP) Trial demonstrated a 58% reduction in 3-year diabetes incidence with an intensive lifestyle intervention in high-risk persons with prediabetes.[1] There is substantial interest in translating this program to community settings. In 2010, the Centers for Disease Control and Prevention created a partnership called the National Diabetes Prevention Program (National DPP) and developed a set of guidance documents and steps for national certification of local lifestyle change programs.[2] In 2018, the Centers for Medicare and Medicaid Services began providing insurance coverage for Medicare beneficiaries meeting Medicare DPP criteria to attend recognized DPPs.[3] As is typical for research translation, community-based programs that are part of the National DPP use less restrictive eligibility criteria than the original DPP Trial. The Medicare DPP model was certified based on expected Medicare savings.[4] Differences in eligibility criteria may influence the effectiveness of the intervention and the potential influence on the diabetes epidemic. Currently, it is unknown how many adults in the USA are eligible for these programs. By each set of criteria, we sought to quantify (1) the proportion and number of US adults who would be eligible and (2) the differences in characteristics of adults identified.

METHODS

We conducted a cross-sectional descriptive analysis of adults aged 20 years or older who participated in the 2007–2016 National Health and Nutrition Examination Survey (NHANES) ($n = 8792$). We determined the proportion of the non-diabetic US population eligible for each program and compared clinical characteristics. Analyses were conducted in 2018, accounted for the complex survey design, and were weighted to the 2016 US adult population. National DPP eligibility criteria

are age ≥ 18 years, BMI ≥ 25 kg/m^2 (Asian ≥ 23 kg/m^2), and any one of the following: HbA1c 5.7–6.4%, fasting glucose 100–125 mg/dL, 2-h glucose 140–199 mg/dL, history of gestational diabetes, or CDC Prediabetes Risk Score ≥ 9.[3] Medicare DPP eligibility criteria are age ≥ 65 years, BMI ≥ 25 kg/m^2 (Asian ≥ 23 kg/m^2), and any one of the following: HbA1c 5.7–6.4%, fasting glucose 110–125 mg/dL, or 2-h glucose 140–199 mg/dL.[2] DPP Trial eligibility criteria are age ≥ 25 years, BMI ≥ 24 kg/m^2 (Asian ≥ 22 kg/m^2), fasting glucose 95–125 mg/dL, and 2-h glucose 140–199 mg/dL.[1]

RESULTS

Overall, 101.2 million US adults (47.7%) were eligible for National DPP in 2016, corresponding to 43.5% of adults aged 20–64 and 69.4% of adults aged ≥ 65 years (Fig. 1). Among adults ≥ 65 years, 41.9% (15.3 million) were eligible for Medicare DPP. In contrast, 11.0% of adults aged 20–64 (19.1 million) and 30.2% of older adults (11.1 million) met eligibility criteria for the original DPP Trial.

Adults eligible for National DPP had more favorable risk factor profiles than those who would be eligible for the DPP Trial, as assessed by body mass index, lipids, blood pressure,
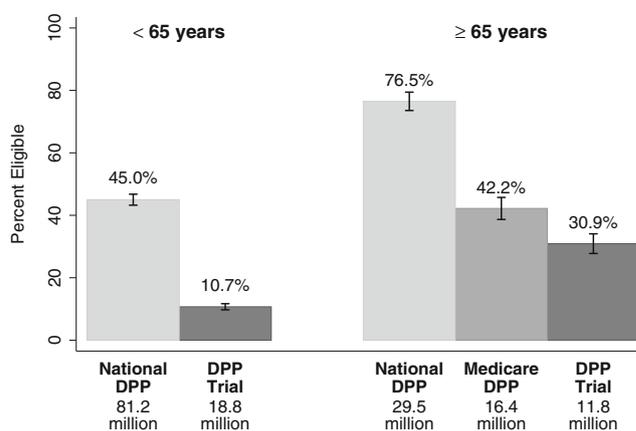

Fig. 1 Proportion and number of US adults aged ≥ 20 years meeting eligibility criteria for Diabetes Prevention Programs, stratified by age < 65 years and ≥ 65 years, NHANES 2007–2016. Standardized to the 2016 US adult population using the American Community Survey.

Table 1 Percent, Number, and Characteristics of US Adults by Diabetes Prevention Program Eligibility, Stratified by Age < 65 Years and ≥ 65 Years, NHANES 2007–2016

	20 to < 65 years		≥ 65 years		
	Eligible for National DPP	**Eligible for DPP Trial**	**Eligible for National DPP**	**Eligible for Medicare DPP**	**Eligible for DPP Trial**
	n = 3233	*n* = 887	*n* = 1289	*n* = 828	*n* = 609
Age (years)	46.5 (0.3)	48.7 (0.5)	72.3 (0.2)	72.9 (0.3)	73.2 (0.3)
Female (%)	47.4 (1.0)	46.8 (2.3)	55.1 (1.5)	56.3 (1.7)	52.5 (2.4)
Race (%)					
Non-Hispanic					
White	65.2 (1.9)	63.4 (2.5)	81.5 (1.6)	79.5 (2.0)	80.7 (2.1)
Black	12.1 (1.0)	9.8 (1.1)	7.0 (0.9)	7.5 (1.1)	6.4 (1.2)
Asian[a]	4.3 (0.6)	6.6 (1.0)	3.2 (0.6)	3.7 (0.9)	4.5 (1.1)
All Hispanic	17.0 (1.5)	19.7 (2.0)	7.2 (1.0)	8.2 (1.2)	8.6 (1.4)
Mexican American	10.8 (1.2)	13.1 (1.5)	3.7 (0.7)	4.5 (0.9)	4.9 (1.0)
Education[b] (%)					
More than high school	59.2 (1.5)	56.0 (2.3)	54.0 (2.1)	48.1 (2.6)	46.8 (2.9)
High school	23.4 (1.1)	23.2 (1.8)	25.9 (1.6)	29.7 (1.9)	29.3 (2.2)
Less than high school	17.4 (1.0)	20.7 (1.5)	20.1 (1.5)	22.2 (1.7)	23.9 (1.9)
Body mass index (kg/m^2)	32.6 (0.2)	33.2 (0.3)	30.7 (0.2)	31.2 (0.3)	31.2 (0.3)
Waist circumference (cm)[c]	107.5 (0.3)	109.8 (0.7)	106.5 (0.4)	107.6 (0.5)	108.3 (0.6)
HbA1c (%)	5.4 (0.01)	5.8 (0.04)	5.6 (0.02)	5.7 (0.02)	5.8 (0.03)
Fasting glucose (mg/dL)	103. (0.4)	116 (1.0)	104 (0.6)	110 (0.8)	114 (0.9)
2-h glucose (mg/dL)	128 (1.1)	190 (2.4)	146 (1.9)	172 (2.2)	193 (2.3)
Systolic blood pressure (mmHg)[d]	123 (0.3)	126 (0.7)	130 (0.7)	131 (0.8)	132 (1.1)
Diastolic blood pressure (mmHg)[d]	73 (0.3)	74 (0.4)	64 (0.5)	63 (0.6)	63 (0.7)
Total cholesterol (mg/dL)[e]	202 (1.0)	203 (2.0)	197 (1.6)	197 (1.9)	194 (2.0)
LDL-cholesterol (mg/dL)[f]	124 (0.8)	120 (1.7)	115 (1.7)	116 (2.0)	114 (2.0)
HDL-cholesterol (mg/dL)[g]	50 (0.4)	47 (0.7)	57 (0.8)	54 (0.7)	53 (0.7)
Triglycerides (mg/dL)[h]	150 (3.1)	183 (9.1)	133 (3.1)	142 (3.6)	144 (3.6)
History of cardiovascular disease[i], %	4.1 (0.4)	5.3 (0.9)	19.8 (1.3)	21.2 (1.6)	22.5 (2.0)
Prediabetes by fasting glucose 100–125 mg/dL, HbA1c 5.7–6.4%, or 2-h glucose 140–199 mg/dL (%)	71.9 (1.2)	(100)	73.1 (1.7)	(100)	(100)
History of gestational diabetes[j] (%)	9.9 (1.1)	12.5 (2.0)	1.0 (0.6)	1.2 (0.8)	1.7 (1.2)
Needs special equipment to walk (%)	5.3 (0.5)	7.6 (1.1)	15.1 (1.3)	15.4 (1.6)	15.6 (2.0)

Mean (standard error) unless noted as %. Columns are not mutually exclusive. Standardized to the 2016 US adult population using the American Community Survey
[a]*Proportions are from the 2011–2016 NHANES survey years during which Asians were oversampled and sample sizes are sufficient for subgroup analysis*
[b]*2 individuals missing information on education*
[c]*75 individuals missing waist circumference measurements*
[d]*130 individuals do not have at least 2 systolic/diastolic blood pressure measurements*
[e]*16 individuals missing total cholesterol measurements*
[f]*103 individuals missing LDL measurements from 2007 to 2014; data not yet available for 2015–2016*
[g]*16 individuals missing HDL measurements*
[h]*15 individuals missing measurements for triglycerides from 2007 to 2014; data not yet available for 2015–2016*
[i]*21 individuals missing information on history of cardiovascular disease, defined as self-report of stroke, coronary heart disease, heart attack/ myocardial infarction*
[j]*Females only*
HbA1c, hemoglobin A1c, DPP, Diabetes Prevention Program

HbA1c, fasting glucose, and 2-h glucose (Table 1). Older adults eligible for National DPP but not Medicare DPP had a mean HbA1c of 5.3% and fasting glucose of 95 mg/dL (33% with prediabetes by ADA definition), whereas those eligible for Medicare DPP had a mean HbA1c of 5.7% and fasting glucose of 110 mg/dL (100% with prediabetes).

DISCUSSION

Almost half of US adults met eligibility criteria for National or Medicare DPP. Adults eligible for these community-based programs represent very different populations—with more favorable cardiometabolic profiles—compared to the original participants of the DPP Trial. Our estimates provide useful information on the number of US adults eligible for these established programs but do not reflect program enrollment or account for eligibility restrictions such as life-limiting diseases or disability.

Older adults meeting National DPP but not Medicare DPP eligibility criteria were a lower-risk population, only 1/3 of whom had prediabetes. While weight loss interventions have multiple benefits, including improving blood pressure, cholesterol, mobility, and quality of life,[5] DPP participation by high-risk, young and middle-aged adults may pay the greatest dividends for reducing long-term diabetes complications in the USA. Creating sustainable community-based programs will be challenging; there is growing interest in digital platforms to deliver these interventions.[6] Ensuring access to

recognized DPPs for high-risk individuals while simultaneously pursuing population-based prevention policies will be critical for reducing the burden of diabetes in the USA.

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