Are Adults Diagnosed with Diabetes achieving the American Diabetes Association Clinical Practice Recommendations?

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Abstract

Objective—This study assessed the proportion of adults with previously diagnosed diabetes mellitus (DM) who met selected preventive practices and treatment goals according to the American Diabetes Association (ADA) standards of medical care.

Methods—A secondary analysis of data collected for a previous epidemiologic study that used a probability cluster design to select 859 persons aged 21–79 years in the San Juan metropolitan area was undertaken. This study focused on 136 (15.8%) adults who self-reported DM. The Standards of Medical Care in Diabetes published by the ADA in 2011 were used to determine the proportion of adults achieving selected clinical practice recommendations.

Results—Less than half of adults achieved recommended treatment goals for LDL-cholesterol (47.8%), HDL-cholesterol (44.1%), blood pressure (41.2%) and HbA1c (28.7%). The percentage of adults achieving recommended levels of HbA1c, blood pressure and LDL-cholesterol simultaneously was 6.6%; the percentage achieving HbA1c, blood pressure, LDL-cholesterol, HDL-cholesterol, triglycerides and albumin-to-creatinine ratio target levels was only 2.2%. More than half (60.2%) reported daily self-monitoring of foot ulcers and HbA1c testing at least twice over the past year (52.3%). However, less than half reported annual dilated eye examination (49.2%), annual comprehensive foot examination (43.8%), daily self-monitoring blood glucose (37.5%), moderate or vigorous physical activity (33.8%), and self-management DM education (28.9%).

Conclusion—This study showed that a substantial proportion of adults with DM did not achieve ADA recommendations on selected preventive practices and treatment goals. Strategies to improve DM medical care and surveillance of preventive-care practices and treatment goals among affected individuals are essential for planning further initiatives that contribute to reduce the burden of DM complications.

Keywords

Diabetes; Treatment goals; Preventive care practices; Diabetes selfmanagement; Puerto Rico

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Diabetes mellitus (DM) disproportionately affects Hispanics in the United States (US), with rates two times higher than non-Hispanic Whites (1).Furthermore, Hispanics have more DM complications and worse outcomes than other ethnic groups (2–5). When the burden of DM is compared among Hispanic subgroups born in the US, foreign-born Puerto Ricans exhibit higher prevalence of hypertension (32%) and DM (15%) after adjusting for age, BMI, smoking, socioeconomic status and acculturation (6). In fact, the self-reported prevalence (12.4% in 2008) and annual-age adjusted incidence (12.8/1,000) of DM in Puerto Rico ranked among the top three states and territories of the US, which are higher than the figures estimated for the US general population (median prevalence of 8.3% in 2008 and age-adjusted incidence 9.1/1000 in 2005–2007) (7,8).

DM is accompanied by a high prevalence of macrovascular and microvascular complications, which contribute to premature mortality, disability, and significant economic burden to society (9,10). However, DM and its associated morbidity are largely preventable through primary prevention efforts and can be delayed by offering quality care and management as well as patient self-management education and support (9). Some of these measures include weight loss, regular physical activity, smoking cessation, effective management of blood glucose, lipids and blood pressure levels, self-monitoring blood glucose, self-management education, medical nutrition therapy, and aspirin therapy. Due to the substantial health and economic burden imposed by DM on society, increasing the rates of preventive health services among people with DM is one of the Healthy People 2020 objectives and one of the focuses of the American Diabetes Association (ADA) clinical practice recommendations (9,11). Analysis of the National Health and Nutrition Examination Survey (NHANES) data collected between 1999 and 2000 indicated that only 37.0% of adults with diagnosed DM in the US achieved a hemoglobin A1c (HbA1c) below 7%, 35.8% had a blood pressure below 130/80 mm Hg, and less than half (48.2%) had total cholesterol levels below 200 mg/dl (12). Most distressing was the observation that only 7.3% of people with DM achieved all three treatment goals (12). Latest NHANES data (1999–2002 and 2003–2006) showed that glycemic and low density lipoprotein cholesterol (LDL-C) targets increased from 43.1% to 57.1% and from 36.1% to 46.5%, respectively (13). However, the increase in the age-adjusted percentage achieving all three targets did not reach statistical significance (7.0% in 1999–2002 to 12.2% in 2003–2006), suggesting that achievement of ADA clinical practice recommendations is still far from optimal in the US.

Epidemiologic data regarding whether ADA clinical practice recommendations are being achieved in Puerto Rico is limited. Behavioral Risk Factor Surveillance System (BRFSS) data collected in Puerto Rico between 2000 and 2002 indicated that the percentage of adults with DM who engaged in preventive care practices was lower than the US national health targets for 2010 (14). However, the percentage of patients meeting ADA treatment goals remains to be determined. Considering the high burden of DM among adults living in Puerto Rico, we assessed the proportion of adults with previously diagnosed DM who met selected ADA clinical practice recommendations. Assessment of whether clinical practices are being achieved will determine the need for implementing effective actions to improve DM treatment to prevent associated macrovascular and microvascular complications.

Methods

Study design and Sample Selection

The methods used in this study have been reported in greater detail in separate publications (15–17). Briefly, the parent study, *Prevalence of the metabolic syndrome in San Juan, Puerto Rico*, was a cross-sectional survey of the non-institutionalized population aged 21 to 79 years residing in the San Juan metropolitan area. A three-stage, cluster sampling design was used to select households between August 2005 and May 2007. Sample selection included

random selection of census groups of blocks using a systematic design, followed by the random selection of a single block from each group, and finally the random selection of an area segment within each block. All adults within each household within the selected segment who were aged 21 to 79 years were eligible to participate in the study. The survey included a face-to-face interview, and anthropometric, blood pressure and laboratory measurements. Of the 1,200 eligible participants, 859 completed all study procedures for an overall response rate of 71.5%. All study procedures were approved by the Institutional Review Board of the University of Puerto Rico Medical Sciences Campus. Informed consent was obtained from all subjects prior to their participation in the study. This study focuses on 136 (15.8%) adults who self-reported DM. Adults were considered to have DM if they answered "Yes" to the following BRFSS question: "Has a doctor ever told you that you have diabetes?" (18). Women who were told they had DM only during pregnancy were classified as not having DM.

Data collection

The face-to-face interview collected information on family history of DM, age at diagnosis, type of treatment and history of selected comorbidities. Subjects were classified as never smokers if they had smoked less than 100 cigarettes in their lifetime; as ex-smokers if they had smoked at least 100 cigarettes in their lifetime but had quit; and as current smokers if they had smoked at least 100 cigarettes during their lifetime and were still smoking. Alcohol intake was assessed by asking participants to quantify the number of drinks consumed in the past month before the survey. Lifetime abstainers included subjects that had never consumed alcohol in their entire lifetime; non-current drinkers were those who had consumed alcohol in their lifetime but did not drink alcohol in the past month; and current drinkers were subjects who reported intake of at least one drink of any type of alcohol in the past month. Respondents were classified as meeting national guidelines on physical activity if they reported participation in moderate-intensity activities for a minimum of 30 minutes on five days per week or vigorous-intensity activity for a minimum of 20 minutes on three days per week. Waist circumference was determined with a measuring tape at the high point of the iliac crest at minimal respiration. A Cardinal Detecto digital scale (Cardinal/Detecto, Webb City, MO) was used to measure current body weight in kilograms, and a portable Seca stadiometer (Seca Corporation, Hanover, MD) was used to determine height in meters. Body mass index (BMI) categories were defined as underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (30.0 kg/m^2). Three blood pressure measurements were taken 10 minutes apart using an appropriate cuff size and a standard aneroid sphygmomanometer. Blood pressure status was based on the average of the three measurements.

Definition of treatment goals and preventive care practices for DM—The Standards of Medical Care in Diabetes published by the ADA in 2011 (9) were used to determine the proportion of adults achieving clinical practice recommendations. Primary treatment goals were defined as lowering HbA1c to below 7%, blood pressure below 130/80 mm Hg, and LDL-C below 100 mg/dL. Secondary treatment goals included triglycerides below 150 mg/dL, high density lipoprotein cholesterol (HDL-C) above 40 mg/dL in men and above 50 mg/dL in women, and albumin-to-creatinine ratio below 30 μg/g. We also assessed the frequency of six selected preventive practices with the following BRFSS questions (18): 1) About how often do you check your blood for glucose or sugar?, 2) About how often do you check your feet for any sores or irritations?, 3) About how many times in the past 12 months has a doctor, nurse or other health professional checked you for "A one C" (hemoglobin A1c)?, 4) About how many times in the past 12 months has a health professional checked your feet for any sores or irritations?, 5) When was the last time you

had an eye exam in which the pupils were dilated?, 6) Have you ever taken a course or class in how to manage your diabetes yourself?

Laboratory measurements—Blood was drawn from an antecubital vein in the morning after a 12-hour overnight fasting and was sent for analysis within four hours of blood collection. Concentrations of total cholesterol, triglycerides, HDL-C, fasting plasma glucose and HbA1c were determined using commercial enzymatic colorimetric kits (Bayer Diagnostics, Tarrytown, NY). Levels of LDL-C were estimated indirectly using the Friedewald equation. A random untimed urine sample was also obtained from all participants to measure albumin and creatinine with a Bayer ADVIA® 1650 Chemistry analyzer (Bayer HealthCare, Tarrytown, NY).

Statistical analysis—Frequency distributions were computed to describe the characteristics of the study group and clinical practice recommendations. Analyses were performed using Stata version 11 (StataCorp LP, College Station, TX).

Results

Characteristics of participants with diagnosed DM are shown in Table 1. The mean age of adults was 61.6±11.5 years, whereas the mean age at DM diagnosis was 51.8±12.8 years. More than half were females (59.6%), had an education level of high school or higher (59.6%) and had an annual family income below $20,000 (66.2%). A significant number of subjects were covered by either a private or public health insurance (66.2% and 27.2%, respectively). As expected, the vast majority (94.1%) was either overweight or obese and had an elevated waist circumference (64.7%) or increased waist to hip ratio (84.6%).

Of all the subjects with DM, 64.7% reported the use of oral hypoglycemic agents without insulin, 8.1% insulin only, and 13.2% combination therapy. Assessment of medical history showed that 74.3% had hypertension, 67.7% dyslipidemia, 15.4% coronary heart disease, and 80.9% met the 2005 American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI) updated National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) criteria for metabolic syndrome (19). Assessment of lipids, glucose and blood pressure measurements showed that the average levels of LDL-C (107.8±40.4 mg/dL), triglycerides (153.3±86.0 mg/dL), fasting glucose (175.8±79.9 mg/dL), and HbA1c (8.6±2.3%) were elevated.

The percentages of adults meeting selected ADA clinical practice recommendations are shown in Table 2. Less than half of adults achieved recommended LDL-C (47.8%), HDL-C (44.1%), blood pressure (41.2%) and HbA1c (28.7%) recommendations. However, nearly 58% had triglycerides' levels below 150 mg/dL. Although albumin-to-creatinine ratio was normal (albumin-to-creatinine ratio <30 μg/g) for over half of participants (60.3%), microalbuminuria was present in 36% of adults, and 3.7% had macroalbuminuria. The percentage of adults achieving HbA1c, blood pressure and LDL-C simultaneously was only 6.6%, whereas the percentage achieving HbA1c, blood pressure, LDL-C, HDL-C, triglycerides and albumin-to-creatinine ratio target levels was only 2.2%.

In terms of DM preventive practices, the vast majority (90.4%) were non-smokers at the time of the interview, and more than half (60.2%) reported daily self-monitoring of foot ulcers and HbA1c testing at least twice over the past year (52.3%). However, less than half reported annual dilated eye examination (49.2%), annual comprehensive foot examination (43.8%), daily self-monitoring blood glucose (37.5%), moderate or vigorous physical activity (33.8%), and DM self-management education (28.9%).

Discussion

This study showed that the percentage of adults with diagnosed DM that achieved HbA1c, blood pressure and LDL-C target goals simultaneously was very low (6.6%). When other lipids and albumin-to-creatinine ratio target levels were examined, this percentage was even further reduced (2.2%). Achievement of recommended goals of HbA1c, blood pressure, and total serum cholesterol levels in this study was lower than the age-adjusted percentage of adults diagnosed with DM in the US achieving all three treatment goals (12.2% in 2003–2006) (13); however, the results are consistent with previous studies in the US that indicate that achievement of ADA clinical practice recommendations is far from optimal (4,12,13,20,21).

Despite that previous trials have demonstrated that improved glycemic control is associated with decreased risk of retinopathy, nephropathy and neuropathic complications (9), only 28.7% of adults achieved recommended HbA1c levels. This figure is lower than the percentage reported among adults diagnosed with DM in the US (57.1% in 2003–2006) (13) and among patients with DM enrolled in commercial health maintenance organizations (HMO) (43.1%), Medicare HMO (46.2%) and Medicaid HMO (31.4%) during 2007 (20). Mean HbA1c of adults in this study was 8.6%, which is slightly higher than the average reported for US adults (7.2%) (13,21). This finding is consistent with previous observations that Hispanics have higher average levels of HbA1c when compared to non-Hispanic Whites and non-Hispanic Blacks in the US (13,21,22). There are several possible reasons for the poor glycemic control observed in this study. Despite the vast majority of adults with DM were either overweight or obese, more than two-thirds did not meet recommended levels of physical activity. In addition, nearly two-thirds did not comply with ADA clinical recommendation of daily self-monitoring of blood glucose. The vast majority of adults with DM were managed pharmacologically, and more than two-thirds also reported hypertension and dyslipidemia, so the possibility of poor medication adherence rates due to potential drug interactions cannot be excluded (23,24).

Since individuals with DM are at high risk for future cardiovascular events, control of both blood pressure and lipids is of utmost importance (25). Less than half of adults in our study had blood pressure and LDL-C at target levels (41.2% and 47.8%, respectively). These findings are consistent with the latest overall blood pressure and LDL-C control rates in the US general population (45.5% and 46.5%, respectively) (13) and with rates observed in adults with DM enrolled in both commercial and Medicare HMO (20). In contrast, HDL-C control rates, met by less than half of adults in our study (44.1%), was lower than the percentage achieved in the US general population (58%) (13). Findings were more encouraging for triglycerides, where 58% of adults in this study achieved target goals, a higher percentage than that observed in the US (46.6%) (13). Differences in control rates might be due to variations in care-seeking or health behaviors or socioeconomic status and thus warrant further investigation. More aggressive interventions to control blood pressure and lipids must be encouraged to reduce microvascular and macrovascular complications in DM (4,9,12,13,20,25). Nearly 40% of adults in this study had a urinary albumin-to-creatinine ratio at or above 30 μg/mg. This figure is slightly higher than the percentage of adults in the US presenting this renal finding (30.5%), a finding that is in line with previous reports that suggest that diabetic nephropathy occurs more frequently among minority groups in the US (3–5). Since persistent albuminuria in the range of 30–299 μg/mg is a marker for development of diabetic nephropathy (9), increased efforts to prevent or delay the onset of microalbuminuria in patients with DM and normoalbuminuria are needed (9).

The percentage of adults with diagnosed DM who engaged in preventive-care practices was lower than the following US national health targets for 2011: 65% for HbA1c testing, 76%

for annual dilated eye examination, 91% for annual foot examination, 60% for DM self-management education and 61% for self-monitoring of blood glucose at least once daily (26,27). However, these results are consistent with BRFSS data collected between 2000 and 2002 in Puerto Rico that indicated that, with the exception of HbA1c testing, the percentages of adults with DM engaging in eye and foot examinations, DMeducation, and blood glucose self-monitoring were lower than the US national health objectives target percentages for 2010 (14,26,27). Mukhtar and colleagues evaluated progress toward national diabetes objectives and found that among all US states and jurisdictions, Puerto Rico had the lowest age-adjusted prevalence of annual foot (47%) and dilated eye (50.6%) examinations (28). These data reinforce the need for continual efforts to improve preventive practice measures that have proven to prevent or delay DM complications.

Several limitations are noteworthy in the interpretation of our study results. The study was not designed to formally examine the proportion of adults diagnosed with DM achieving ADA clinical practice recommendations. Self-reported data are subject to recall and social desirability bias. However, self-reported DM data have been shown to be sufficiently accurate for use in epidemiologic studies (29). Moreover, type 1 and type 2 were not distinguishable; however, type 2 DM accounts for the majority of the total cases of DM. Detailed history of diet and exercise were not measured in this study, variables that may affect glycemic, blood pressure and lipids' control. Due to the small number of adults who achieved simultaneously all treatment goals, we were unable to assess the independent effect of sociodemographic and clinical characteristics on the control of blood glucose, blood pressure and LDL-C. Additional research in a larger sample is needed to extend these findings to the adult population of Puerto Rico and determine the factors that might influence achievement of ADA treatment goals.

These data show that a substantial proportion of adults diagnosed with DM did not achieve ADA clinical practice recommendations. Strategies to improve the level of DM care and reduce the burden of related complications are urgently needed, as this will reduce society's health and economic burden exerted by DM. Partnerships that include public health agencies, physician-coordinated teams, and patients should work together to improve DM management (9,30,31). Moreover, ongoing surveillance of DM-related preventive-care practices and percentage of adults achieving treatment goals are essential for planning further initiatives.

Acknowledgments

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Table 1

Characteristics of adult participants with self-reported diabetes mellitus (n=136)

Variable	Number (percentage) or mean±SD
Age (years)	61.6±11.5
Age distribution (%)	
21–39	6 (4.4)
40–59	46 (33.8)
60–79	84 (61.8)
Women (%)	81 (59.6)
High school education or more (%)	81 (59.6)
Annual household income < $20,000 (%)	90 (66.2)
Health insurance (%)	
Private	90 (66.2)
Public	37 (27.2)
None	9 (6.6)
BMI (kg/m^2)	31.8±6.4
BMI distribution (%)	
<25.0	8 (5.9)
25.0–29.9	60 (44.1)
30.0	68 (50.0)
Waist circumference (inches)	39.7±5.2
Waist circumference distribution (%)	
40 inches in men and 35 inches in women	88 (64.7)
<40 inches in men and <35 inches in women	48 (35.3)
Waist-to-hip ratio	0.9±0.1
Waist-to-hip ratio distribution (%)	
>0.85 in men and >0.90 in women	115 (84.6)
0.85 in men and 0.90 in women	21 (15.4)
Current drinking	29 (21.3)
Age at DM diagnosis (years)	51.8±12.8
Type of DM treatment	
Insulin only	11 (8.1)
Oral hypoglycemic agents only	88 (64.7)
Insulin and oral hypoglycemic agents	18 (13.2)
Dietary lifestyles	19 (14.0)
History of hypertension (%)	101 (74.3)
History of dyslipidemia (%)	92 (67.7)
History of coronary heart disease (%)	21 (15.4)
Metabolic syndrome (%)	110 (80.9)

Variable	Number (percentage) or mean±SD
Family history of DM (%)	103 (75.7)
Fasting total cholesterol, md/dL	183.6±41.8
Fasting LDL-C, mg/dL	107.8±40.4
Fasting HDL-C, mg/dL Women Men	48.8±9.6 45.0±14.0
Fasting triglycerides, mg/dL	153.3±86.0
Fasting glucose, mg/dL	175.8±79.9
Fasting HbA1c A1C, %	8.6±2.3
Systolic blood pressure, mm Hg	129.2±20.8
Diastolic blood pressure, mm Hg	74.4±10.9
Urinary albumin excretion, μg/g [*]	17.3 (9.0, 53.3)
Overall health status fair or poor (%)	85 (62.5)

[*] Median and 25th and 75th percentiles; BMI: body mass index; DM: diabetes mellitus; LDL-C: low density lipoprotein cholesterol; HDL-C: high density lipoprotein cholesterol; HbA1c: hemoglobin A1c

Table 2

Proportion of adults diagnosed with diabetes mellitus achieving selected American Diabetes Association clinical practice recommendations (n=136)

Recommendation	Number	Percent
Treatment Goals		
Albumin-to-creatinine ratio <30 μg/g	82	60.3
Triglycerides <150 mg/dL	78	57.4
LDL-C <100 mg/dL	65	47.8
HDL-C 40 mg/dL in men and 50 mg/dL in women	60	44.1
Blood pressure <130/80 mm Hg	56	41.2
HbA1C 7%	39	28.7
HbA1c + Blood pressure + LDL-cholesterol target goals	9	6.6
HbA1c + Blood pressure + LDL-cholesterol + HDL-cholesterol + Triglycerides + Albumin-to-creatinine ratio target goals	3	2.2
Preventive Practices		
No smoking	123	90.4
Daily self-monitoring of foot ulcers [*]	77	60.2
Hemoglobin A1C testing at least twice a year [*]	67	52.3
Annual dilated eye examination [*]	63	49.2
Annual comprehensive foot examination [*]	56	43.8
Daily self-monitoring of blood glucose [*]	48	37.5
Moderate or vigorous physical activity	46	33.8
Self-management education at time of DM diagnosis and as needed thereafter [*]	37	28.9
Physician's office visits due to DM [*] 0 1–2 3	19 14 95	14.8 11.0 74.2

[*] Based on 128 participants who completed this module; LDL-C: low density lipoprotein cholesterol; HDL-C: high density lipoprotein cholesterol; DM: diabetes mellitus; HbA1c: hemoglobin A1c