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Identifying Trends in Undiagnosed Diabetes in U.S. Adults by Using a Confirmatory Definition:

A Cross-Sectional Study

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Abstract

Background—A common belief is that one quarter to one third of all diabetes cases remain undiagnosed. However, such prevalence estimates may be overstated by epidemiologic studies that do not use confirmatory testing, as recommended by clinical diagnostic criteria.

Objective—To provide national estimates of undiagnosed diabetes by using a confirmatory testing strategy, in line with clinical practice guidelines.

Design—Cross-sectional study.

Setting—National Health and Nutrition Examination Survey results from 1988 to 1994 and 1999 to 2014.

Participants—U.S. adults aged 20 years and older.

Measurements—Confirmed undiagnosed diabetes was defined as elevated levels of fasting glucose (≥7.0 mmol/L [≥126 mg/dL]) and hemoglobin A_{1c} (≥6.5%) in persons without diagnosed diabetes.

Results—The prevalence of total (diagnosed plus confirmed undiagnosed) diabetes increased from 5.5% (9.7 million adults) in 1988 to 1994 to 10.8% (25.5 million adults) in 2011 to 2014.

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Confirmed undiagnosed diabetes increased during the past 2 decades (from 0.89% in 1988 to 1994 to 1.2% in 2011 to 2014) but has decreased over time as a proportion of total diabetes cases. In 1988 to 1994, the percentage of total diabetes cases that were undiagnosed was 16.3%; by 2011 to 2014, this estimate had decreased to 10.9%. Undiagnosed diabetes was more common in overweight or obese adults, older adults, racial/ethnic minorities (including Asian Americans), and persons lacking health insurance or access to health care.

Limitations—Cross-sectional design.

Conclusion—Establishing the burden of undiagnosed diabetes is critical to monitoring public health efforts related to screening and diagnosis. When a confirmatory definition is used, undiagnosed diabetes is a relatively small fraction of the total diabetes population; most U.S. adults with diabetes (~90%) have received a diagnosis of the condition.

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Understanding the burden of undiagnosed diabetes is critical to the evaluation and monitoring of public health efforts related to diabetes screening and diagnosis. A common belief is that one quarter to one third of diabetes cases in the United States are undiagnosed (1–3). However, previous estimates of the proportion of total diabetes cases that are undiagnosed may be overestimated by epidemiologic studies that do not use confirmatory testing, in line with clinical diagnostic criteria (4–6). National estimates of undiagnosed diabetes from large epidemiologic cohorts typically have relied on a single measurement of fasting glucose, hemoglobin A_{1c} (HbA_{1c}), or 2-hour glucose to identify cases of undiagnosed diabetes, potentially overstating its prevalence.

Guidelines from the American Diabetes Association explicitly state that in the absence of a clear clinical diagnosis (overt symptoms of diabetes or hyperglycemic crisis), a second test, in a new blood sample, is required to confirm the diagnosis of diabetes (7). However, 2 different tests frequently are done in the same sample, and the guidelines state that if the results of 2 different tests (for example, HbA_{1c} and fasting glucose levels) are above clinical thresholds, this also confirms the diagnosis (7). This confirmatory approach to diabetes diagnosis helps decrease false-positives (8, 9). However, previous national estimates of the prevalence of undiagnosed diabetes did not use a confirmatory testing strategy. This is of particular concern, because earlier studies demonstrated high variability among the biochemical tests used to define diabetes (8), which may substantially inflate prevalence estimates.

Thus, the objective of this study was to quantify the overall burden, trends, and risk factors of undiagnosed diabetes in the United States by using a combination of fasting glucose and HbA1c levels, a definition of undiagnosed diabetes consistent with clinical practice guidelines.

Methods

Study Population

The National Health and Nutrition Examination Survey (NHANES) studies are cross-sectional, complex samples of the U.S. civilian noninstitutionalized population conducted by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC). The present study included data from NHANES III (1988 to 1994) and the continuous NHANES (1999 to 2014), the results of which are released in 2-year cycles. The NCHS institutional review board approved protocols for the conduct of NHANES, and informed consent was obtained from all participants.

To evaluate trends over time, we used data from NHANES III (n = 7385) and 4-year survey cycles from 1999 to 2014 (n = 17 045). This study population was limited to nonpregnant adults aged 20 years and older who attended the fasting morning examination and excluded 54 eligible persons with missing fasting glucose or HbA_{1c} values. Persons who self-reported insulin use but did not report a diagnosis of diabetes also were excluded (n = 6).

Measurement of HbA_{1c} and Plasma Glucose Levels

Hemoglobin A_{1c} was measured in whole blood with instruments certified by the National Glycohemoglobin Standardization Program and standardized to the reference method used in the Diabetes Control and Complications Trial. Several changes were made to the HbA_{1c} measurement methods during the 26-year survey data collection from 1988 to 2014. Details regarding each HbA_{1c} measurement method are available from the NHANES documentation (10, 11). We calibrated HbA_{1c} values to account for changes in laboratory methods from 1988 to 2014 (5). Uncalibrated HbA_{1c} values have increased over successive NHANES surveys, even in young, healthy persons (12). These shifts have been attributed to changes in assay methods and have a substantial effect on population estimates. We used previously published methods to calibrate HbA_{1c} values to a stable, standard distribution to align them over time, as documented in the supplement to our 2014 report (5).

Plasma glucose concentrations were measured in specimens collected from participants who attended the morning fasting examination. Laboratory methods used to measure glucose levels also changed during the NHANES data collection period, and we applied regression equations recommended by the NCHS to align the plasma glucose values over time (5, 13, 14).

Definitions of Diagnosed and Confirmed Undiagnosed Diabetes

Diagnosed diabetes was defined as a self-reported physician diagnosis of diabetes (other than during pregnancy). Confirmed undiagnosed diabetes was defined as elevated levels of both fasting glucose (≥7.0 mmol/L [≥126 mg/dL]) and HbA_{1c} (≥6.5%) measured in the same blood sample in a person without a previous diagnosis of diabetes. The term *total diabetes* is used here to refer to the combination of diagnosed and confirmed undiagnosed diabetes cases. In the main analyses, persons defined as not having diabetes included those with a single elevated fasting glucose or HbA_{1c} value, but not both.

We conducted sensitivity analyses comparing the prevalence of confirmed undiagnosed diabetes, defined as elevated levels of both fasting glucose and HbA_{1c}, with three different definitions of unconfirmed undiagnosed diabetes: a) single elevated fasting glucose, b) single elevated HbA_{1c} value, c) either a single elevated fasting glucose or a single elevated HbA_{1c} value. We also conducted sensitivity analyses comparing risk factor prevalence and associations in persons with unconfirmed undiagnosed diabetes, defined as a single elevated HbA_{1c} or fasting glucose value (but not both); confirmed undiagnosed diabetes (elevation of both HbA_{1c} and fasting glucose levels); or diagnosed diabetes. In this sensitivity analysis, the no-diabetes group was made up of persons with levels of both fasting glucose and HbA_{1c} below clinical thresholds (that is, an HbA_{1c} concentration <6.5% and a fasting glucose level <7.0 mmol/L [<126 mg/dL]).

Assessment of Demographics and Other Risk Factors

All measurements were conducted by trained personnel using standardized protocols. Information on age, sex, race/ethnicity, family history of diabetes, smoking status, education, income, history of prediabetes, health insurance status, and access to care was self-reported. Hypertension was defined as systolic blood pressure of 140 mm Hg or greater, diastolic blood pressure of 90 mm Hg or greater, or current use of blood pressure–lowering medication. High cholesterol was defined as a total cholesterol level of 240 mg/dL (6.2 mmol/L) or greater or current use of cholesterol-lowering medication. Body mass index (BMI) was calculated as weight in kilograms divided by height in square meters. Albumin and creatinine levels were measured in urine, and albuminuria was defined as an albumin–creatinine ratio of 30 mg/g or greater. We also evaluated metformin use by using information from the prescription medication data files. Details on the interview questions are provided in Appendix Table 1 (available at Annals.org).

Statistical Analyses

To evaluate trends over time, we calculated prevalence estimates and SEs from the 6-year cycle from NHANES III (1988 to 1994) and 4-year cycles of the continuous NHANES (1999 to 2002, 2003 to 2006, 2007 to 2010, and 2011 to 2014). We also obtained prevalence estimates and SEs for the combined survey period from 1999 to 2014. The NCHS analytic guidelines recommend combining survey cycles to obtain more reliable estimates. Analyses were weighted to provide nationally representative estimates of the general noninstitutionalized civilian adult population of the United States. Survey weights of NHANES account for the complex survey design (including oversampling), nonresponse, and poststratification. We obtained SEs by using the Taylor series (linearization) method following analytic procedures recommended by the NCHS (15, 16). Prevalence estimates from the different survey cycles were applied to U.S. Census population numbers to obtain estimates of the number of persons with diagnosed and confirmed undiagnosed diabetes in the United States. We used predictive margins from logistic regression to calculate the age-, sex-, and race-adjusted prevalence ratios (PRs) for risk factors for confirmed undiagnosed diabetes, combining the most current data from 1999 to 2014. Persons with missing risk factor data were excluded from those respective analyses; covariate data were missing in less than 3% of the eligible study sample, except for the variable of family income to poverty ratio (8% missing).

We generated a weighted scatter plot and calculated the weighted Spearman and Pearson correlations, overall percentage agreement, and percentage positive agreement to show the concordance of fasting glucose and HbA_{1c} levels in the overall study sample of persons without a diabetes diagnosis. Statistical analyses were conducted by using Stata SE, version 14.2 (StataCorp). We used *svy* commands in Stata to account for the complex survey design of NHANES. Hemoglobin A_{1c} values were calibrated by using the *equate* package in R, version 2.15.1 (R Foundation for Statistical Computing) (5).

Role of the Funding Source

The funding source had no role in the design, conduct, or analysis of the study or the decision to submit the manuscript for publication.

Results

The prevalence of total diabetes in the United States for 1999 to 2014 was 9.3%. This estimate includes an 8.1% prevalence of diagnosed diabetes and a 1.2% prevalence of confirmed undiagnosed diabetes. The prevalence of total diabetes has increased substantially, from 5.5% in 1988 to 1994 (9.7 million adults) to 10.8% in 2011 to 2014 (25.5 million adults) (Table 1). Confirmed undiagnosed diabetes also has increased on an absolute scale (from 0.89% in 1988 to 1994 to 1.17% in 2011 to 2014) but has decreased as a proportion of total diabetes cases during this period. When a confirmatory definition is applied, the percentage of total diabetes cases in 1988 to 1994 that were undiagnosed was 16.3%; by 2011 to 2014, this estimate had decreased to 10.9% (Table 1).

The distribution of population characteristics differed substantially among persons with no diabetes, those with confirmed undiagnosed diabetes, and those with diagnosed diabetes (Table 2). More than 90% of persons with confirmed undiagnosed diabetes were overweight or obese (BMI, ≥25 kg/m^2). Age, sex, and race were major risk factors for confirmed undiagnosed diabetes, with higher prevalence estimates at older ages; in men versus women; and in blacks, Mexican Americans, and Asian Americans compared with non-Hispanic white adults (Table 3). After adjustment for age and sex, racial/ethnic minority populations were 2 to 3 times more likely than non-Hispanic white adults to have confirmed undiagnosed diabetes. One of the strongest risk factors for undiagnosed diabetes was BMI. The adjusted PR for having a BMI of 30 kg/m^2 or greater (vs. a BMI <25 kg/m^2) was 7.40 (95% CI, 3.39 to 11.40). Education, income, and family history of diabetes also were strongly associated with confirmed undiagnosed diabetes. Among persons with confirmed undiagnosed diabetes, 61.2% had a family history of diabetes, compared with only 39.5% of adults without diabetes (adjusted PR, 2.59 [CI, 1.90 to 3.29]). The prevalence of albuminuria was substantially greater in persons with confirmed undiagnosed diabetes than those without it (30.5% vs. 7.5%; adjusted PR, 3.80 [CI, 2.20 to 5.41]). Persons with confirmed undiagnosed diabetes also were much more likely to have a history of prediabetes (28.0% vs. 4.5%; adjusted PR, 5.97 [CI, 3.78 to 8.17]) or to be receiving metformin (6.0% vs. 0.43%; PR, 9.25 [CI, 4.41 to 14.09]). Not having had a recent health care visit (adjusted PR, 2.43 [CI, 1.61 to 3.26]) and lack of health insurance coverage (adjusted PR, 1.63 [CI, 1.02 to 2.25]) were both significant risk factors for having confirmed undiagnosed diabetes.

Among persons with confirmed undiagnosed diabetes, 37.4% had an HbA_{1c} value lower than 7% overall (Table 4). Hemoglobin A_{1c} levels varied substantially by age in persons with confirmed undiagnosed diabetes; only 21.0% of those aged 20 to 45 years had an HbA_{1c} value lower than 7%, compared with 40.4% of those aged 45 to 64 years. Approximately 65% of persons with confirmed undiagnosed diabetes aged 20 to 44 years had an HbA_{1c} level of 8% or higher, compared with 40.7% of those in all age groups. By contrast, among adults with diagnosed diabetes, only 24.7% (and only 36.4% of those aged 20 to 44 years) had an HbA_{1c} level of 8% or higher.

The weighted Pearson and Spearman correlations of fasting glucose and HbA_{1c} levels in this nationally representative sample of U.S. adults were 0.75 and 0.45, respectively (correlations were similar in unweighted analyses) (Appendix Figure, available at Annals.org). The positive percentage agreement for diagnostic thresholds of fasting glucose and HbA_{1c} levels based on single measurements was 40.6% (overall agreement, 98.1%). Among persons with a single fasting glucose value of 7.0 mmol/L (126 mg/dL) or greater, 45% had an HbA_{1c} value of 6.5% or higher, whereas among persons with an HbA_{1c} value of 6.5% or greater, 78% had a fasting glucose level of 7.0 mmol/L (126 mg/dL) or higher.

Prevalence estimates based on definitions of unconfirmed undiagnosed diabetes (such as a single elevated fasting glucose or HbA_{1c} value) were substantially higher than those for confirmed undiagnosed diabetes (Appendix Table 2, available at Annals.org). For example, the prevalence of undiagnosed diabetes defined by a single HbA_{1c} measurement of 6.5% or greater was 29% higher than that defined by the confirmatory criteria (1.48% vs. 1.15%). The prevalence of undiagnosed diabetes defined by a single fasting glucose measurement of 7.0 mmol/L (126 mg/dL) or greater was 123% higher than that defined by the confirmatory criteria (2.56% vs. 1.15%). Using a definition of either an elevated fasting glucose or an elevated HbA_{1c} value resulted in the highest prevalence, with a prevalence estimate approximately 151% higher than that resulting from the confirmed definition (2.89% vs. 1.15%). The discordance across definitions substantially increased with age, exceeding a difference of more than 200% in older adults.

The prevalence of diabetes risk factors tended to be higher among persons with confirmed undiagnosed diabetes than those meeting the unconfirmed definition (only 1 elevated hyperglycemia measurement) (Appendix Table 3, available at Annals.org). For example, persons with confirmed undiagnosed diabetes were more likely than those with unconfirmed diabetes to be Mexican American (15% vs. 6%), to be obese (65% vs. 53%), to have no health insurance (24% vs. 12.5%), and to not have had a recent health care visit (28% vs. 7.8%). Age-, sex-, and race-adjusted risk factor associations for confirmed undiagnosed diabetes tended to be stronger than those for unconfirmed undiagnosed diabetes (Appendix Table 4, available at Annals.org). One exception to this pattern was age; persons with confirmed undiagnosed diabetes tended to be somewhat younger than those with unconfirmed or diagnosed diabetes.

Discussion

Defining undiagnosed diabetes on the basis of clinical practice guidelines suggests that the total number of U.S. adults with diabetes in 2015 was approximately 25.5 million, up from 21.4 million in 2010, with the vast majority of diabetes cases being diagnosed. The prevalence of confirmed undiagnosed diabetes in 2011 to 2014 was 1.17%, or 2.77 million adults in 2015.

Currently, CDC estimates, which do not use confirmatory testing, are that 30.1 million U.S. adults have diabetes, 23.8% (7.2 million) of whom have undiagnosed disease (2). These data also are derived by applying NHANES estimates from 2011 to 2014 to the 2015 U.S. Census population. Using the most recent national data but requiring confirmatory testing, we found that 25.5 million U.S. adults had diabetes and that only about 11% of this population had undiagnosed disease. This difference reflects our use of a definition of undiagnosed diabetes that is in line with clinical guidelines to most accurately estimate the proportion of persons with undiagnosed diabetes in the United States. When confirmation is used, we see that undiagnosed diabetes is only a small fraction of total diabetes cases; this is particularly true in older adults, in whom most diabetes cases are diagnosed (only 6.7% of total diabetes cases in adults aged 65 and older were undiagnosed in 2011 to 2014).

Our findings are in stark contrast to previously published national estimates and statements in current clinical practice guidelines, which suggest that one quarter to one third of diabetes cases are undiagnosed (1, 2, 6, 7). Our analysis demonstrates that we are doing a better job with diabetes screening and diagnosis than might be inferred from previous estimates; overall, only a relatively small portion of the U.S. population who would be identified clinically as having diabetes has undiagnosed disease. Further, we found that the percentage of diabetes cases that are undiagnosed has decreased over time (from 16.3% in 1988 to 1994 to 10.9% currently). This finding is consistent with increased diabetes screening and diagnosis in the United States during the past 2 decades (17). Our results may suggest that in the current stage of the U.S. diabetes epidemic, the greatest gains will be made from emphasizing highly targeted screening programs and improving management of diagnosed diabetes.

Age and BMI are by far the most important risk factors for diabetes. Current guidelines state that routine screening for diabetes should begin at age 45 years, although screening is recommended in adults of any age who are overweight or obese (7). Our results support current screening recommendations for targeting middle-aged and older adults, those who are overweight or obese, high-risk racial/ethnic groups (including Asian Americans), and persons with a family history of diabetes. We also found that men were more likely than women to have confirmed undiagnosed diabetes. Persons with health insurance were less likely to have confirmed undiagnosed diabetes, suggesting that expanding coverage may help ensure that diabetes does not go undiagnosed. The stronger risk factor associations for the confirmed definition of undiagnosed diabetes (compared with a single elevated hyperglycemia measurement) and evidence for low health care access and use help demonstrate the construct validity of this definition. Our findings suggest that persons with confirmed undiagnosed diabetes are a high-risk population that is being missed by our

current screening programs. Of concern, more than 60% of persons with confirmed undiagnosed diabetes had an HbA_{1c} value greater than 7%, the "usual target" for glycemic control in adults with type 2 diabetes. We also observed that a substantial portion of younger adults (aged 20 to 45 years) with confirmed undiagnosed diabetes had very high HbA_{1c} levels (~65% had an HbA_{1c} value ≥8%), suggesting the presence of a subgroup of overweight and obese adults who lack access to care and are being missed by current screening practices.

Earlier prevalence studies relied on conventional definitions of undiagnosed diabetes based on a single measure, thus overstating prevalence. In the presence of random error, a single biochemical measurement will always overestimate the prevalence of a condition defined above or below a cut point of that measurement in the population. We almost never conduct confirmatory testing in persons with abnormal values in large population-based studies. Thus, an inherent incongruity exists between how diabetes is diagnosed in clinical practice and how diabetes cases are identified in epidemiologic studies. Our study demonstrates that using a confirmatory definition based on a combination of fasting glucose and HbA_{1c} levels can help address this issue. When we directly contrasted our confirmatory definition of undiagnosed diabetes to unconfirmed definitions used widely in the literature, we observed substantial differences in prevalence. Indeed, unconfirmed definitions resulted in prevalence estimates that were 22% to more than 200% higher. The discordance increased with older age, suggesting a high rate of false-positives in older adults and thus an even greater need to use confirmatory testing in this population.

This study had several limitations that should be considered in interpreting our results. First, we had information only on fasting glucose and HbA_{1c} levels measured in a single blood sample at one point in time. Our results likely would differ somewhat if a second blood sample were obtained to confirm the elevations in either the fasting glucose level or HbA_{1c} value. Indeed, our previous work examining repeated fasting glucose measurements in different blood samples collected approximately 2 weeks apart demonstrated that the prevalence of undiagnosed diabetes is overestimated by as much as 24% if only a single fasting glucose measurement is used versus confirmation with a second measurement in a new blood sample (8). Second, we relied on self-report to identify persons with diagnosed diabetes, which may have resulted in some misclassification. Third, fasting glucose measurements were available only in the morning subsample of each NHANES survey, resulting in less precise estimates, particularly for subgroup analyses. Finally, NHANES sampled only noninstitutionalized adults; therefore, some segments of the population likely were underrepresented in our analyses.

Since 2010, the American Diabetes Association has recommended measuring HbA_{1c} for diagnosing diabetes. Adding the HbA_{1c} test at a cut point of 6.5% or higher to the diabetes diagnostic criteria was justified by its high specificity (18). Using a combination of glucose and HbA_{1c} values from a single fasting blood sample leverages the advantages of both tests; may eliminate the need for a return patient visit for a second blood draw; and, because HbA_{1c} values are used to guide treatment, allows providers to make treatment decisions based on the HbA_{1c} test result. In our data and those from other population-based studies, HbA_{1c} and fasting glucose levels are strongly correlated (19–21), but classification may be

discordant when single measurements are used to classify diabetes. If the 2 different tests are used for diagnosis, attention should be paid to any substantial discordance, because it may indicate a sample processing problem (common for glucose measurement), the presence of anemia (which may affect the interpretation of HbA_{1c} values), a coexisting medical condition that may be interfering with the interpretation of the test result, or physiologic random variation.

The percentage of total diabetes cases that are undiagnosed is a critical public health indicator. Our study demonstrates the importance of using a definition of undiagnosed diabetes in epidemiologic studies that is more consistent with clinical practice to derive accurate population estimates of the burden of undiagnosed diabetes. Our results also suggest that, overall, most diabetes cases are being captured by current screening and diagnostic practices. Persons with undiagnosed diabetes are only a small fraction of the total diabetes population; most adults (~90%) with diabetes in the United States have received a diagnosis of the condition. Further, most U.S. adults with undiagnosed diabetes are overweight or obese, suggesting the importance of regular screening in this population; particular attention should be paid to obese adults, regardless of age. Ultimately, our results should help inform the allocation of public health resources and suggest the importance of targeted screening efforts.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Appendix

Appendix Table 1

NHANES 1999–2014 Questions*

Question	Data Availability by Survey Year
Diagnosed diabetes	
"Other than during pregnancy, have you ever been told by a doctor or other health professional that you have diabetes or sugar diabetes?"	1999–2014
History of prediabetes	
Answered "Borderline diabetes" to the question "Other than during pregnancy, have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?"	1999–2014
Or positive response to: "Have you ever been told by a doctor or other health professional that you any of the following: prediabetes, impaired fasting glucose, impaired glucose tolerance, borderline	2005–2014

Question	Data Availability by Survey Year
diabetes or that your blood sugar is higher than normal but not high enough to be called diabetes or sugar diabetes?"	
Family history of diabetes	
"Including living and deceased, were any of your biological that is, blood relatives including grandparents, parents, brothers, sisters ever told by a health professional that they had diabetes?"	1999–2014
Health insurance coverage	
"Are you covered by health insurance or some other kind of health care plan? [Include health insurance obtained through employment or purchased directly as well as government programs like Medicare and Medicaid that provide medical care or help pay medical bills.]"	1999–2014
Usual source of care	
"Is there a place that you usually go when you are sick or you need advice about your health?"	1999–2014
Last health care visit	
"About how long has it been since you last saw or talked to a doctor or other health care professional about your health? Include doctors seen while you were a patient in a hospital. Has it been … "	1999–2014

NHANES = National Health and Nutrition Examination Survey.

*Source: wwwn.cdc.gov/nchs/nhanes/search/datapage.aspx?Component=Questionnaire.

Appendix Table 2

Prevalence of Confirmed and Unconfirmed Definitions of Undiagnosed Diabetes in the Overall Population and by Age Group in U.S. Adults Aged 20 Years and Older, NHANES 1999–2014*

Variable	Overall	Age Group			
		20–44 Years	45–64 Years	65–79 Years	≥80 Years
Prevalence (±SE), %					
Confirmed undiagnosed diabetes	1.15 ± 0.10	0.52 ± 0.08	1.57 ± 0.18	2.20 ± 0.33	1.52 ± 0.36
Single elevated HbA_{1c} level	1.48 ± 0.11	0.68 ± 0.09	1.91 ± 0.19	2.95 ± 0.37	2.28 ± 0.43
Single elevated fasting glucose level	2.56 ± 0.14	0.97 ± 0.12	3.25 ± 0.29	5.69 ± 0.55	4.85 ± 0.66
Single elevated HbA_{1c} or fasting glucose level	2.89 ± 0.15	1.13 ± 0.13	3.59 ± 0.29	6.44 ± 0.58	5.61 ± 0.67
Percent Difference of Unconfirmed from Confirmed, %					
Single elevated HbA_{1c} level	+29	+31	+22	+34	+50
Single elevated fasting glucose level	+123	+87	+107	+159	+219
Single elevated HbA_{1c} or fasting glucose level	+151	+117	+129	+193	+269

HbA_{1C} = hemoglobin A_{1C}; NHANES = National Health and Nutrition Examination Survey.

*Confirmed undiagnosed diabetes was defined as diagnostic levels of both HbA_{1C} (≥6.5%) and fasting plasma glucose (≥7.0 mmol/L [≥126 mg/dL]). Unconfirmed definitions of undiagnosed diabetes were based on a single elevated HbA_{1C}

level (≥6.5%) or single elevated fasting plasma glucose level (≥7.0 mmol/L [≥126 mg/dL]) or either an elevated HbA_{1c} or an elevated fasting plasma glucose level.

Appendix Table 3

Characteristics of Persons With No Diabetes, Unconfirmed Undiagnosed Diabetes, Confirmed Undiagnosed Diabetes, and Diagnosed Diabetes in U.S. Adults Aged 20 Years and Older, NHANES 1999–2014 *

Characteristic	No Diabetes (*n* = 14,522) †‡	Unconfirmed Undiagnosed Diabetes (*n* = 400) †§	Confirmed Undiagnosed Diabetes (*n* = 287) †‖	Diagnosed Diabetes (*n* = 1,836) †
Age group				
20–44 years	51.08 ± 0.81	16.78 ± 2.31	21.20 ± 2.90	15.30 ± 1.17
45–64 years	34.25 ± 0.68	41.36 ± 3.60	48.39 ± 3.16	46.37 ± 1.54
65–79 years	11.09 ± 0.33	32.23 ± 3.18	25.06 ± 3.06	30.19 ± 1.33
≥80 years	3.58 ± 0.19	9.63 ± 1.48	5.35 ± 1.27	8.14 ± 0.67
Sex				
Female	51.55 ± 0.38	39.42 ± 3.10	37.55 ± 3.74	50.57 ± 1.42
Male	48.45 ± 0.38	60.58 ± 3.10	62.45 ± 3.74	49.43 ± 1.42
Race				
Non-Hispanic white	70.90 ± 1.13	71.08 ± 2.71	54.57 ± 3.99	61.55 ± 2.10
Non-Hispanic black	10.50 ± 0.60	14.35 ± 1.81	14.74 ± 2.33	15.18 ± 1.27
Mexican American	7.74 ± 0.55	5.88 ± 1.09	14.77 ± 2.16	8.78 ± 0.96
Asian American ¶	1.36 ± 0.16	2.16 ± 0.60	3.05 ± 1.09	1.64 ± 0.23
Other	9.50 ± 0.66	6.54 ± 1.46	12.87 ± 2.71	12.85 ± 1.39
BMI category				
<25 kg/m^2	34.82 ± 0.56	14.85 ± 2.01	9.19 ± 2.18	14.35 ± 1.15
25–29.9 kg/m^2	34.29 ± 0.56	31.66 ± 3.02	26.08 ± 3.36	27.05 ± 1.41
≥30 kg/m^2	30.89 ± 0.52	53.49 ± 3.01	64.74 ± 3.99	58.60 ± 1.62
Education				
College or more	28.05 ± 0.88	17.39 ± 3.36	14.56 ± 3.03	16.39 ± 1.24
Some college	30.92 ± 0.54	25.24 ± 3.00	27.29 ± 3.85	29.85 ± 1.59
High school or less	41.03 ± 0.90	57.37 ± 3.39	58.14 ± 4.35	53.76 ± 1.78
Income–poverty ratio				
≥350%	43.86 ± 1.04	31.51 ± 3.62	31.16 ± 3.96	29.40 ± 1.82
130%–349%	35.67 ± 0.73	45.06 ± 3.34	41.41 ± 4.41	44.04 ± 1.82

Characteristic	No Diabetes (*n* = 14,522)[†‡]	Unconfirmed Undiagnosed Diabetes (*n* = 400)[†§]	Confirmed Undiagnosed Diabetes (*n* = 287)[†‖]	Diagnosed Diabetes (*n* = 1,836)[†]
<130%	20.47 ± 0.75	23.43 ± 2.54	27.42 ± 2.97	26.56 ± 1.69
Family history of diabetes	39.29 ± 0.67	52.33 ± 2.95	61.21 ± 3.29	71.06 ± 1.43
Hypertension	29.02 ± 0.60	66.78 ± 3.10	61.17 ± 4.34	69.40 ± 1.55
High cholesterol	24.43 ± 0.55	42.59 ± 2.90	43.90 ± 4.09	53.68 ± 1.66
Albuminuria (ACR ≥30 mg/g)	7.22 ± 0.27	21.09 ± 2.49	30.52 ± 3.95	29.71 ± 1.29
Smoking status				
Never-smoker	53.20 ± 0.74	46.43 ± 3.04	44.81 ± 3.87	49.96 ± 1.44
Former smoker	24.05 ± 0.58	39.39 ± 2.99	36.15 ± 3.77	32.68 ± 1.44
Current smoker	22.75 ± 0.65	14.18 ± 2.21	19.04 ± 3.09	17.36 ± 1.08
History of prediabetes	4.07 ± 0.23	25.77 ± 2.86	28.04 ± 3.59	–
Metformin use	0.36 ± 0.06	3.87 ± 1.10	6.02 ± 1.64	51.44 ± 1.66
Last health care visit was >1 year ago	15.81 ± 0.46	7.84 ± 1.40	28.07 ± 3.34	2.81 ± 0.51
No health insurance coverage	19.50 ± 0.58	12.53 ± 1.74	24.07 ± 3.16	10.52 ± 0.93
No usual source of care	15.91 ± 0.44	6.73 ± 1.34	19.87 ± 2.88	3.26 ± 0.50

ACR = urinary albumin–creatinine ratio; BMI = body mass index; HbA_{1C} = hemoglobin A_{1C}; NHANES = National Health and Nutrition Examination Survey.

[*] Values are percentages (±SEs).

[†] Unweighted.

[‡] Defined as diagnostic levels of both HbA_{1C} (<6.5%) and fasting glucose (<7.0 mmol/L [<126 mg/dL]) among persons without diagnosed diabetes.

[§] Defined as diagnostic levels of either HbA_{1C} (≥6.5%) or fasting glucose (≥7.0 mmol/L [≥126 mg/dL]) but not elevated levels of both HbA_{1C} and fasting glucose among persons without diagnosed diabetes.

[‖] Defined as diagnostic levels of both HbA_{1C} (≥6.5%) and fasting glucose (≥7.0 mmol/L [≥126 mg/dL]) among persons without diagnosed diabetes.

[¶] Data from NHANES 2011–2014.

Appendix Table 4

Age-, Sex-, and Race-Adjusted Prevalence Ratios for Unconfirmed Undiagnosed, Confirmed Undiagnosed, and Diagnosed Diabetes in U.S. Adults Aged 20 Years and Older, NHANES 1999–2014

Characteristic	Age-, Sex-, and Race-Adjusted PR (95% CI)			
	Unconfirmed Undiagnosed Diabetes*	Confirmed Undiagnosed Diabetes†	DiagnosedDiabetes	Confirmed Undiagnosed Diabetes† Within the Total Group With Undiagnosed Diabetes
Age group				
20–44 years	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
45–64 years	3.81 (2.40–5.21)	4.06 (2.71–5.40)	4.50 (3.66–5.34)	1.11 (0.80–1.42)
65–79 years	9.24 (5.79–12.70)	7.05 (4.08–10.03)	8.50 (6.89–10.11)	0.92 (0.62–1.21)
≥80 years	9.16 (5.36–12.96)	5.47 (2.31–8.64)	7.88 (6.24–9.52)	0.78 (0.42–1.14)
Sex				
Female	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Male	1.80 (1.36–2.24)	1.88 (1.30–2.45)	1.14 (1.02–1.26)	1.04 (0.81–1.27)
Race				
Non-Hispanic white	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Non-Hispanic black	1.79 (1.28–2.29)	2.27 (1.43–3.12)	1.95 (1.67–2.22)	1.17 (0.79–1.56)
Mexican American	1.25 (0.82–1.68)	3.66 (2.37–4.95)	1.95 (1.66–2.24)	1.81 (1.32–2.30)
Asian American‡	2.03 (0.95–3.11)	3.60 (1.25–5.96)	1.64 (1.27–2.01)	1.37 (0.69–2.05)
Other	0.94 (0.52–1.36)	2.24 (1.19–3.28)	1.88 (1.54–2.22)	1.64 (1.13–2.14)
BMI category				
<25 kg/m^2	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
25–29.9 kg/m^2	1.80 (1.14–2.46)	2.45 (1.10–3.79)	1.63 (1.31–1.95)	1.17 (0.65–1.68)
≥30 kg/m^2	3.87 (2.68–5.07)	7.65 (3.51–11.79)	3.81 (3.14–4.47)	1.50 (0.88–2.13)
Education				
College or more	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Some college	1.43 (0.70–2.17)	1.80 (0.81–2.80)	1.61 (1.29–1.92)	1.14 (0.56–1.72)
High school or less	1.96 (1.06–2.85)	2.15 (1.06–3.24)	1.66 (1.38–1.94)	1.06 (0.56–1.55)
Income–poverty ratio				

Characteristic	Age-, Sex-, and Race-Adjusted PR (95% CI)			
	Unconfirmed Undiagnosed Diabetes*	Confirmed Undiagnosed Diabetes†	DiagnosedDiabetes	Confirmed Undiagnosed Diabetes† Within the Total Group With Undiagnosed Diabetes
≥350%	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
130%–349%	1.60 (1.09–2.12)	1.42 (0.80–2.05)	1.50 (1.25–1.76)	0.95 (0.63–1.27)
<130%	1.74 (1.11–2.37)	1.67 (1.00–2.33)	1.66 (1.34–1.98)	0.98 (0.66–1.30)
Family history of diabetes				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	1.92 (1.47–2.37)	2.64 (1.93–3.34)	3.47 (3.04–3.89)	1.17 (0.90–1.44)
Hypertension				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	2.49 (1.65–3.33)	2.63 (1.40–3.86)	2.77 (2.33–3.22)	1.04 (0.74–1.34)
High cholesterol				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	1.37 (1.04–1.71)	1.75 (1.16–2.34)	2.08 (1.81–2.35)	1.12 (0.85–1.38)
Albuminuria (ACR ≥30 mg/g)				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	2.09 (1.44–2.73)	3.93 (2.26–5.59)	2.83 (2.49–3.17)	1.27 (0.95–1.59)
Smoking				
Never-smoker	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Former smoker	1.19 (0.86–1.53)	1.31 (0.85–1.77)	1.04 (0.90–1.17)	1.09 (0.80–1.38)
Current smoker	0.84 (0.51–1.17)	1.12 (0.64–1.61)	1.04 (0.88–1.19)	1.11 (0.75–1.47)
History of prediabetes				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	5.35 (3.84–6.87)	6.68 (4.30–9.06)	–	1.12 (0.80–1.45)
Metformin use				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	6.84 (3.04–10.64)	11.20 (5.84–16.57)	19.82 (17.96–21.69)	1.22 (0.70–1.74)
Last healthcare visit >1 year ago				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)

Characteristic	Age-, Sex-, and Race-Adjusted PR (95% CI)			
	Unconfirmed Undiagnosed Diabetes*	Confirmed Undiagnosed Diabetes†	DiagnosedDiabetes	Confirmed Undiagnosed Diabetes† Within the Total Group With Undiagnosed Diabetes
Yes	0.64 (0.39–0.89)	2.41 (1.59–3.22)	0.23 (0.15–0.32)	1.88 (1.46–2.30)
Has health insurance coverage				
Yes	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
No	1.07 (0.71–1.42)	1.63 (1.02–2.24)	0.75 (0.60–0.89)	1.23 (0.86–1.60)
Has usual source of care				
Yes	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
No	0.62 (0.36–0.88)	1.59 (0.99–2.19)	0.29 (0.21–0.38)	1.55 (1.13–1.97)

ACR = urinary albumin–creatinine ratio; BMI = body mass index; HbA_{1c} = hemoglobin A_{1c}; NHANES = National Health and Nutrition Examination Survey; PR = prevalence ratio.

*Defined as diagnostic levels of either HbA_{1c} (≥6.5%) or fasting glucose (≥7.0 mmol/L [≥126 mg/dL]) but notelevated levels of both HbA_{1c} and fasting glucose among persons without diagnosed diabetes.

†Defined as diagnostic levels of both HbA_{1c} (≥6.5%) and fasting glucose (≥7.0 mmol/L [≥126 mg/dL]) among persons without diagnosed diabetes.

‡Data from NHANES 2011–2014.

Appendix Figure. Weighted scatter plot of HbA_{1c} and fasting glucose in U.S. adults aged 20 and older without a history of diagnosed diabetes. Circles are proportional to the weight of the observation in the analysis (i.e., number of U.S. adults). The figure is divided into 4 quadrants (a, b, c, and d) according to diagnostic cut points for fasting glucose and HbA_{1c}. On the basis of the weighted number of persons who fall into these quadrants, overall percentage agreement is 98.1%, defined as 100% × [(b + c)/(a + b + c + d)]. Positive percentage agreement is 40.6%, defined as 100% × [b/(a + b + d)]. Weighted Pearson correlation is 0.75; weighted Spearman correlation is 0.45. HbA_{1c} = hemoglobin A_{1c}. * To convert to millimoles per liter (mmol/L), multiply by 0.0555.

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Table 1

Trends in Diagnosed and Confirmed Undiagnosed Diabetes in U.S. Adults Aged 20 Years and Older

Variable	NHANES 1988–1994 (*n* = 7385)*	NHANES 1999–2002 (*n* = 3807)*	NHANES 2003–2006 (*n* = 3689)*	NHANES 2007–2010 (*n* = 4898)*	NHANES 2011–2014 (*n* = 4651)*
Prevalence (±SE), %					
Total confirmed diabetes†	5.46 ± 0.40	7.72 ± 0.65	8.70 ± 0.60	9.49 ± 0.51	10.77 ± 0.76
Diagnosed diabetes	4.57 ± 0.41	6.35 ± 0.53	7.57 ± 0.52	8.52 ± 0.53	9.60 ± 0.69
Confirmed undiagnosed diabetes‡	0.89 ± 0.12	1.37 ± 0.23	1.13 ± 0.20	0.97 ± 0.16	1.17 ± 0.20
Confirmed undiagnosed diabetes, *% of total confirmed diabetes*	16.3	17.7	13.0	10.2	10.9
	1990 Census	**2000 Census**	**2005 Census**	**2010 Census**	**2015 Census**
Total confirmed diabetes, *n (million)*	9.70	15.51	18.11	21.40	25.50
Diagnosed diabetes, *n (million)*	8.12	12.76	15.76	19.21	22.73
Confirmed undiagnosed diabetes, *n (million)*	1.58	2.75	2.35	2.19	2.77

HbA_{1C} = hemoglobin A_{1C}; NHANES = National Health and Nutrition Examination Survey.

*Unweighted.

†Population of persons with diagnosed diabetes plus confirmed undiagnosed diabetes (diagnostic levels of both HbA_{1C} [≥6.5%] and fasting plasma glucose [≥7.0 mmol/L (≥126 mg/dL)]).

‡Defined as diagnostic levels of both HbA_{1C} (≥6.5%) and fasting plasma glucose (≥7.0 mmol/L [≥126 mg/dL]) among persons without diagnosed diabetes.

Table 2

Characteristics of Persons With and Without Confirmed Undiagnosed Diabetes and With Diagnosed Diabetes in U.S. Adults Aged 20 Years and Older, NHANES 1999–2014 *

Characteristic	No Diabetes (*n* = 14 922)†	Confirmed Undiagnosed Diabetes (*n* = 287)†	Diagnosed Diabetes (*n* = 1836)†
Age group			
20–44 y	50.42 ± 0.80	21.20 ± 2.90	15.30 ± 1.17
45–64 y	34.38 ± 0.66	48.39 ± 3.16	46.37 ± 1.54
65–79 y	11.49 ± 0.32	25.06 ± 3.06	30.19 ± 1.33
≥80 y	3.70 ± 0.19	5.35 ± 1.27	8.14 ± 0.67
Sex			
Female	51.31 ± 0.38	37.55 ± 3.74	50.57 ± 1.42
Male	48.69 ± 0.38	62.45 ± 3.74	49.43 ± 1.42
Race			
Non-Hispanic white	70.91 ± 1.14	54.57 ± 3.99	61.55 ± 2.10
Non-Hispanic black	10.57 ± 0.60	14.74 ± 2.33	15.18 ± 1.27
Mexican American	7.71 ± 0.55	14.77 ± 2.16	8.78 ± 0.96
Asian American‡	1.37 ± 0.16	3.05 ± 1.09	1.64 ± 0.23
Other	9.44 ± 0.66	12.87 ± 2.71	12.85 ± 1.39
BMI category			
<25.0 kg/m^2	34.45 ± 0.55	9.19 ± 2.18	14.35 ± 1.15
25.0–29.9 kg/m^2	34.24 ± 0.56	26.08 ± 3.36	27.05 ± 1.41
≥30.0 kg/m^2	31.32 ± 0.51	64.74 ± 3.99	58.60 ± 1.62
Education			
College or more	27.85 ± 0.87	14.56 ± 3.03	16.39 ± 1.24
Some college	30.81 ± 0.54	27.29 ± 3.85	29.85 ± 1.59
High school or less	41.34 ± 0.89	58.14 ± 4.35	53.76 ± 1.78
Income–poverty ratio			
≥350%	43.62 ± 1.03	31.16 ± 3.96	29.40 ± 1.82
130%–349% T32 HL007024	35.85 ± 0.73	41.41 ± 4.41	44.04 ± 1.82
<130%	20.53 ± 0.75	27.42 ± 2.97	26.56 ± 1.69
Family history of diabetes	39.53 ± 0.66	61.21 ± 3.29	71.06 ± 1.43

Characteristic	No Diabetes (*n* = 14 922)†	Confirmed Undiagnosed Diabetes (*n* = 287)†	Diagnosed Diabetes (*n* = 1836)†
Hypertension	29.74 ± 0.59	61.17 ± 4.34	69.40 ± 1.55
High cholesterol	24.77 ± 0.53	43.90 ± 4.09	53.68 ± 1.66
Albuminuria (ACR ≥30 mg/g)	7.48 ± 0.27	30.52 ± 3.95	29.71 ± 1.29
Smoking status			
Never-smoker	53.07 ± 0.74	44.81 ± 3.87	49.96 ± 1.44
Former smoker	24.34 ± 0.57	36.15 ± 3.77	32.68 ± 1.44
Current smoker	22.59 ± 0.64	19.04 ± 3.09	17.36 ± 1.08
History of prediabetes	4.48 ± 0.24	28.04 ± 3.59	–
Metformin use	0.43 ± 0.07	6.02 ± 1.64	51.44 ± 1.66
Last health care visit >1 y ago	15.66 ± 0.45	28.07 ± 3.34	2.81 ± 0.51
No health insurance coverage	19.36 ± 0.58	24.07 ± 3.16	10.52 ± 0.93
No usual source of care	15.74 ± 0.44	19.87 ± 2.88	3.26 ± 0.50

ACR = urinary albumin–creatinine ratio; BMI = body mass index; NHANES = National Health and Nutrition Examination Survey.

*Values are percentages (±SEs).

†Unweighted.

‡Data from NHANES 2011–2014.

Table 3

Crude Prevalence of Confirmed Undiagnosed Diabetes by Population Characteristics and Prevalence Ratios in U.S. Adults Aged 20 Years and Older Without Diagnosed Diabetes, NHANES 1999–2014

Characteristic	Crude Prevalence (±SE), %	PR (95% CI)*
Age group		
20–44 y	0.53 ± 0.08	1.00 (reference)
45–64 y	1.76 ± 0.21	3.97 (2.66–5.29)
65–79 y	2.70 ± 0.40	6.69 (3.87–9.51)
≥80 y	1.81 ± 0.42	5.22 (2.20–8.24)
Sex		
Female	0.92 ± 0.11	1.00 (reference)
Male	1.61 ± 0.18	1.85 (1.29–2.42)
Race		
Non-Hispanic white	0.97 ± 0.13	1.00 (reference)
Non-Hispanic black	1.74 ± 0.24	2.24 (1.40–3.07)
Mexican American	2.38 ± 0.33	3.66 (2.37–4.95)
Asian American†	2.75 ± 0.90	3.49 (1.20–5.78)
Other	1.70 ± 0.36	2.25 (1.21–3.29)
BMI category		
<25.0 kg/m^2	0.33 ± 0.08	1.00 (reference)
25.0–29.9 kg/m^2	0.94 ± 0.13	2.41 (1.09–3.73)
≥30.0 kg/m^2	2.51 ± 0.28	7.40 (3.39–11.40)
Education		
College or more	0.66 ± 0.15	1.00 (reference)
Some college	1.11 ± 0.19	1.79 (0.80–2.78)
High school or less	1.76 ± 0.19	2.11 (1.04–3.18)
Income–poverty ratio		
≥350%	0.89 ± 0.15	1.00 (reference)
130%–349%	1.43 ± 0.20	1.40 (0.79–2.01)
<130%	1.65 ± 0.22	1.64 (0.98–2.30)
Family history of diabetes		

Characteristic	Crude Prevalence (±SE), %	PR (95% CI)*
No	0.80 ± 0.09	1.00 (reference)
Yes	1.92 ± 0.21	2.59 (1.90–3.29)
Hypertension		
No	0.69 ± 0.09	1.00 (reference)
Yes	2.53 ± 0.30	2.57 (1.36–3.78)
High cholesterol		
No	0.94 ± 0.11	1.00 (reference)
Yes	2.19 ± 0.26	1.74 (1.15–2.32)
Albuminuria (ACR ≥30 mg/g)		
No	0.94 ± 0.10	1.00 (reference)
Yes	4.88 ± 0.76	3.80 (2.20–5.41)
Smoking status		
Never-smoker	1.06 ± 0.13	1.00 (reference)
Former smoker	1.85 ± 0.25	1.30 (0.85–1.76)
Current smoker	1.06 ± 0.18	1.13 (0.64–1.61)
History of prediabetes		
No	0.95 ± 0.10	1.00 (reference)
Yes	7.37 ± 1.09	5.97 (3.78–8.17)
Metformin use		
No	1.19 ± 0.11	1.00 (reference)
Yes	15.22 ± 3.56	9.25 (4.41–14.09)
Last health care visit >1 y ago		
No	1.07 ± 0.10	1.00 (reference)
Yes	2.23 ± 0.33	2.43 (1.61–3.26)
Has health insurance coverage		
Yes	1.18 ± 0.12	1.00 (reference)
No	1.55 ± 0.22	1.63 (1.02–2.25)
Has usual source of care		
Yes	1.19 ± 0.12	1.00 (reference)
No	1.58 ± 0.24	1.60 (0.99–2.21)

ACR = urinary albumin–creatinine ratio; BMI = body mass index; NHANES = National Health and Nutrition Examination Survey; PR = prevalence ratio.

*Adjusted for age, sex, and race.

†Data from NHANES 2011–2014.

Table 4

Glycemic Control Categories in Persons With Confirmed Undiagnosed or Diagnosed Diabetes in U.S. Adults Aged 20 Years and Older, NHANES 1999–2014*

Variable	Overall (*n* = 287)†	Age Group			
		20–44 Years (*n* = 55)†	45–64 Years (*n* = 126)†	65–79 Years (*n* = 82)†	≥80 Years (*n* = 24)†
Confirmed undiagnosed diabetes					
Calibrated HbA_{1c} level					
<7.0%	37.37 ± 3.65	21.04 ± 6.33	40.36 ± 6.15	44.31 ± 6.52	43.61 ± 10.77
7.0%–7.9%	21.94 ± 2.90	13.85 ± 3.85	20.41 ± 4.53	26.69 ± 6.23	45.48 ± 11.20
≥8.0%	40.69 ± 3.65	65.11 ± 7.12	39.23 ± 5.93	29.00 ± 7.38	11.91 ± 6.83
	Overall (*n* = 1836)†	**20–44 Years (*n* = 200)†**	**45–64 Years (*n* = 807)†**	**65–79 Years (*n* = 640)†**	**≥80 Years (*n* = 189)†**
Diagnosed diabetes					
Calibrated HbA_{1c} level					
<7.0%	55.35 ± 1.56	44.77 ± 3.86	51.64 ± 2.56	63.02 ± 2.60	67.96 ± 3.49
7.0%–7.9%	19.95 ± 1.27	18.79 ± 3.55	19.77 ± 1.95	20.09 ± 2.11	22.58 ± 3.52
≥8.0%	24.70 ± 1.35	36.44 ± 4.23	28.59 ± 2.34	16.89 ± 1.75	9.46 ± 1.96

HbA_{1C} = hemoglobin A_{1C}; NHANES = National Health and Nutrition Examination Survey.

*Values are percentages (±SEs).

†Unweighted.