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Trends in Diabetes Treatment and Control in U.S. Adults, 1999–2018

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Abstract

BACKGROUND—Documenting current trends in diabetes treatment and risk-factor control may inform public health policy and planning.

METHODS—We conducted a cross-sectional analysis of data from adults with diabetes in the United States participating in the National Health and Nutrition Examination Survey (NHANES) to assess national trends in diabetes treatment and risk-factor control from 1999 through 2018.

RESULTS—Diabetes control improved from 1999 to the early 2010s among the participants but subsequently stalled and declined. Between the 2007–2010 period and the 2015–2018 period, the percentage of adult NHANES participants with diabetes in whom glycemic control (glycated hemoglobin level, <7%) was achieved declined from 57.4% (95% confidence interval [CI], 52.9 to 61.8) to 50.5% (95% CI, 45.8 to 55.3). After major improvements in lipid control (non-high-density lipoprotein cholesterol level, <130 mg per deciliter) in the early 2000s, minimal improvement was seen from 2007–2010 (52.3%; 95% CI, 49.2 to 55.3) to 2015–2018 (55.7%; 95% CI, 50.8 to 60.5). From 2011–2014 to 2015–2018, the percentage of participants in whom blood-pressure control (<140/90 mm Hg) was achieved decreased from 74.2% (95% CI, 70.7 to 77.4) to 70.4% (95% CI, 66.7 to 73.8). The percentage of participants in whom all three targets were simultaneously achieved plateaued after 2010 and was 22.2% (95% CI, 17.9 to 27.3) in 2015–2018. The percentages of participants who used any glucose-lowering medication or any blood-pressure-lowering medication were unchanged after 2010, and the percentage who used statins plateaued after 2014. After 2010, the use of combination therapy declined in participants with uncontrolled blood pressure and plateaued for those with poor glycemic control.

CONCLUSIONS—After more than a decade of progress from 1999 to the early 2010s, glycemic and blood-pressure control declined in adult NHANES participants with diabetes, while lipid control leveled off. (Funded by the National Heart, Lung, and Blood Institute.)

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Type 2 diabetes affects more than 34 million U.S. adults and significantly increases the risk of cardiovascular events, microvascular disease, and premature death.¹ Tight glycemic, blood-pressure, and lipid control lowers the risk of diabetes-related illness and death, especially when attained concomitantly.²⁻⁶ Consequently, multifactorial risk-factor control forms the foundation of clinical care for patients with diabetes.⁷⁻⁹

Glycemic, blood-pressure, and lipid control improved from 1999 to 2010 in U.S. adults with diabetes,¹⁰ but recent analyses suggest that progress may have stalled or reversed in later periods.¹¹ However, most existing research has not considered trends in risk-factor control and diabetes treatment together. During the past two decades, the growing availability of different drug classes and agents,^{7-9,12} rising use of combination therapy,^{13,14} and evolving clinical guidance⁷⁻⁹ have fundamentally altered diabetes care and probably influenced population-level risk-factor control. Understanding trends in diabetes treatment is critical for our interpretation of risk-factor control.

The objectives of our study were to update national trends in risk-factor control in U.S. adults with diabetes, assess trends in treatment, and identify population subgroups most likely to have untreated risk factors. To accomplish these aims, we analyzed nearly two decades of data (1999 to 2018) from the National Health and Nutrition Examination Survey (NHANES).

METHODS

STUDY SAMPLE AND OVERSIGHT

The NHANES is a series of nationally representative, cross-sectional studies designed to monitor the health of the U.S. population. Participants are selected from the U.S. noninstitutionalized, civilian population with the use of a complex, stratified, multistage probability-cluster sampling design for in-home interviews and visits to a mobile examination center.¹⁵ Among persons selected for the NHANES from 1999 through 2018, the percentage who participated ranged from 52 to 84% for the household interview and 49 to 80% for the medical examination (Table S1 in the Supplementary Appendix, available with the full text of this article at [NEJM.org](https://www.nejm.org)). The National Center for Health Statistics (NCHS) institutional review board approved the study protocols, and all the participants provided written informed consent.

Our study included all participants in the NHANES from 1999 through 2018 who were nonpregnant and 20 years of age or older and who reported having ever received a diagnosis of diabetes from a physician (other than during pregnancy) (6653 participants). The first, third, and fourth authors designed the study, wrote the manuscript, and made the decision to submit the manuscript for publication. The first two authors analyzed the data and vouch for the completeness and accuracy of the data. The first author wrote the first draft of the manuscript. The National Heart, Blood, and Lung Institute, which provided grant funding to two authors, had no role in the design, analysis, interpretation, or writing of this study.

RISK-FACTOR CONTROL

Glycated hemoglobin was measured with the use of high-performance liquid chromatography methods. To account for changes in laboratory methods over time, we calibrated glycated hemoglobin levels using a previously documented equipercenile equating approach.¹⁶ This approach uses a statistical correction to account for shifts in both the mean and standard deviation of the glycated hemoglobin distribution resulting from changes in laboratory methods. For this analysis, we used the latest NHANES survey years (2015 through 2018) as the reference. We defined glycemic control as a glycated hemoglobin level of less than 7.0%.^{7,8} In sensitivity analyses, we examined glycemic control using individualized targets based on participants' age and health status.¹⁰ After the participant rested in a seated position for 5 minutes, blood pressure was measured three consecutive times on the same arm with a mercury sphygmomanometer. We calculated mean systolic and diastolic blood pressure using all available readings. We defined blood-pressure control as mean systolic and diastolic blood pressures of less than 140/90 mm Hg^{7,8} and also considered a more stringent target of less than 130/80 mm Hg. Serum cholesterol was measured enzymatically. We calculated non-high-density lipoprotein (non-HDL) cholesterol as total measured cholesterol minus HDL cholesterol. We defined lipid control as a non-HDL cholesterol level of less than 130 mg per deciliter (3.4 mmol per liter)¹ and examined a low-density lipoprotein (LDL) cholesterol level of less than 100 mg per deciliter (2.6 mmol per liter) in sensitivity analyses.¹⁷

MEDICATION USE

Respondents were asked if they had taken any prescription medications in the past 30 days. Those who answered "yes" were asked to show interviewers the containers for all medications. When containers were unavailable, respondents reported medication names to researchers. All medications were converted to a standard generic drug name and then categorized into therapeutic classes on the basis of the Multum MediSource Lexicon classification system.¹⁸ Using drug-classification codes, we created measures for the use of any type and specific types of glucose-lowering, blood-pressure-lowering, and lipid-lowering medications (see the Methods section in the Supplementary Appendix).

SOCIODEMOGRAPHIC CHARACTERISTICS AND WEIGHT STATUS

Participants reported age, sex (male or female), race and ethnic group (non-Hispanic White, non-Hispanic Black, Asian American, Mexican American, or other), education (high school or less, some college, or college graduate), family income (<130%, 130 to 349%, or 350% of the federal poverty level), health-insurance status (uninsured or any health insurance), smoking status (current smoker, former smoker, or never smoked), and age at diagnosis of diabetes. We calculated body-mass index (BMI; the weight in kilograms divided by the square of the height in meters) and classified participants into three weight-status groups: normal (BMI of <25), over-weight (BMI of 25 to <30), or obese (BMI of 30).

STATISTICAL ANALYSIS

We examined participant characteristics over time and estimated the prevalence of risk-factor control and medication use. Temporal trends were assessed with the use of two-piece

linear spline models, with one knot at inflection points. Time was modeled as the midpoint of each 2-year survey period. To minimize the effects of small sample size and improve the precision of estimates, we pooled survey years into 4-year intervals (1999 through 2002, 2003 through 2006, 2007 through 2010, 2011 through 2014, and 2015 through 2018).¹⁹ We assessed the number of glucose-lowering, blood-pressure-lowering, and lipid-lowering medications used overall and across levels of risk-factor control. For this analysis, each ingredient in a combination drug was counted as a separate medication. We examined factors that were associated with treatment in participants in whom targets for glycemic, blood-pressure, and lipid control were not achieved using logistic and multinomial logistic-regression models. In sensitivity analyses, we examined trends in risk-factor control after adjusting for sociodemographic characteristics (age, sex, and race or ethnic group), using 2-year survey cycles, using a definition of glycemic control based on individualized targets,¹⁰ and using an LDL cholesterol level of less than 100 mg per deciliter to define lipid control.

All analyses were conducted with the use of Stata software, version 16.0 (StataCorp), and used recommended sample weights¹⁵ that account for oversampling of certain populations and survey nonresponse. The calculated estimates are designed to be representative of the U.S. civilian noninstitutionalized population with diagnosed diabetes. The width of the confidence intervals has not been adjusted for multiplicity of testing. Inferences that are drawn from these intervals may not be reproducible.

RESULTS

TRENDS IN DIABETES RISK-FACTOR CONTROL

From 1999 through 2018, the age and racial or ethnic distribution of adult NHANES participants with diagnosed diabetes remained stable, whereas the percentage of participants who had a college degree, higher income, health insurance, obesity, or long-standing diabetes increased. Details on the characteristics of the participants are provided in Table 1 and Table S2.

Trends for glycemic, blood-pressure, and lipid control were nonlinear, with an inflection point around 2010 (Fig. 1). The percentage of participants in whom glycemic control (glycated hemoglobin level, <7%) was achieved increased from 44.0% (95% confidence interval [CI], 38.9 to 49.3) to 57.4% (95% CI, 52.9 to 61.8) from 1999–2002 to 2007–2010 but then declined to 50.5% (95% CI, 45.8 to 55.3) in 2015–2018. The percentage of participants in whom blood-pressure control (<140/90 mm Hg) was achieved rose from 64.0% (95% CI, 59.2 to 68.5) in 1999–2002 to 74.2% (95% CI, 70.7 to 77.4) in 2011–2014 but then declined to 70.4% (95% CI, 66.7 to 73.8) in 2015–2018. Similar trends were observed for blood pressure controlled to less than 130/80 mm Hg. The percentage of participants in whom lipid control (non-HDL cholesterol level, <130 mg per deciliter) was achieved increased from 25.3% (95% CI, 20.8 to 30.4) in 1999–2002 to 52.3% (95% CI, 49.2 to 55.3) in 2007–2010 and subsequently leveled off (55.7% in 2015–2018; 95% CI, 50.8 to 60.5). The percentage of participants in whom glycemic, blood-pressure, and lipid control were simultaneously achieved rose from 9.0% (95% CI, 6.7 to 11.9) in 1999–2002 to 24.9% (95% CI, 21.1 to 29.0) in 2007–2010 and then plateaued (22.2% in 2015–2018; 95%

CI, 17.9 to 27.3). When all years were modeled, the annual rate of change in diabetes control decreased for all outcomes (Table S3).

Trends in mean levels of glycosylated hemoglobin, systolic and diastolic blood pressures, and non-HDL cholesterol were nonlinear, reaching an inflection point in 2007–2010 before plateauing or increasing thereafter (Fig. S1). Trends in risk-factor control were similar after adjustment for age, sex, and race or ethnic group (Fig. S2) and when 2-year survey cycles were used (Fig. S3). Glycemic control (defined on the basis of individualized targets) and lipid control (defined as an LDL cholesterol level of <100 mg per deciliter) increased from 1999 to 2010 but were unchanged thereafter (Figs. S4 and S5).

TRENDS IN DIABETES TREATMENT

The use of any glucose-lowering medication increased by 8.6 percentage points (95% CI, 3.2 to 13.8) from 1999–2002 to 2007–2010 and then leveled off (Fig. 2 and Table S3). From 1999 to 2018, there was an increase in the use of metformin, insulin, and newer agents (e.g., sodium–glucose cotransporter 2 inhibitors) and a decrease in the use of sulfonylureas and thiazolidinediones. The use of any blood-pressure–lowering medication rose 15.9 percentage points (95% CI, 10.1 to 21.8) from 1999–2002 to 2007–2010 and then stabilized. The use of diuretics and calcium-channel blockers remained stable from 1999 to 2018, whereas the use of beta-blockers and angiotensin-converting–enzyme (ACE) inhibitors or angiotensin-receptor blockers (ARBs) rose. Statin use increased by 27.6 percentage points (95% CI, 21.5 to 33.6) from 1999–2002 to 2011–2014 before leveling off.

The percentage of adult NHANES participants with diagnosed diabetes who used combination glucose-lowering therapy increased until 2007–2010, overall and in those with poor glycemic control (Fig. 3). The percentage of participants who received combination blood-pressure–lowering therapy declined after 2007–2010 in the overall population and for those with a blood pressure of 140/90 mm Hg or higher. The total number of prescription drugs that were used by participants peaked in 2011–2014 before leveling off (Fig. S6).

Younger adults, Mexican Americans, and those without health insurance were generally less likely to receive treatment (monotherapy or combination therapy) when targets for glycemic, blood-pressure, or lipid control were not achieved (Table 2). Non-Hispanic Blacks were less likely than non-Hispanic Whites to receive combination therapy when glycemic targets were not achieved but were more likely to receive combination therapy when blood-pressure targets were not met.

DISCUSSION

After large improvements from 1999 to 2010, diabetes control stalled and worsened in the United States. In line with recent research,¹¹ updated estimates in our study showed that glycemic control declined after 2010, while lipid control leveled off. In addition, our study showed a decrease in blood-pressure control that emerged after 2014, paralleling a recent decline in blood-pressure control in the general U.S. population.²⁰ Suboptimal treatment probably contributed to worsening diabetes control in our study participants. Furthermore, after large increases, use of any glucose-lowering, blood-pressure–lowering, and statin

medication plateaued after 2010. Similarly, the use of combination therapy declined among participants with diagnosed diabetes with uncontrolled blood pressure and leveled off after 2010 among those with poor glycemic control.

Evolving evidence about the risks and benefits of intensive treatment may have contributed to worsening glycemic and blood-pressure control. Three major trials that were published in 2008 or 2009^{21–23} showed that intensive glycemic control (glycated hemoglobin level, <6.0% or <6.5%) had no cardiovascular benefit and increased the risk of hypoglycemia, findings that renewed support for individualized glycemic targets.²⁴ In the period after those three trials (2011–2014), glycemic control declined sharply and the use of multiple glucose-lowering medications leveled off in the present long-term study, findings that suggest a shift toward more conservative treatment in the community. Similarly, results from the 2010 Action to Control Cardiovascular Risk in Diabetes trial showed that intensive blood-pressure control (systolic blood pressure, <120 mm Hg vs. <140 mm Hg) in adults with diabetes offered no cardiovascular benefit and increased the risk of serious adverse events²⁵; these findings prompted expert groups to relax their target recommendation for systolic blood pressure from less than 130 mm Hg to less than 140 mm Hg.^{26,27} Blood-pressure control, whether defined as less than 130/80 mm Hg or less than 140/90 mm Hg, subsequently declined, as did the use of combination treatment for those with uncontrolled blood pressure (<140/90 mm Hg). These findings suggest a general shift toward less intensive treatment of hypertension.

The national declines in glycemic and blood-pressure control and the plateauing of lipid control after 2010 have major public health implications. Uncontrolled risk factors confer significant risk of microvascular disease, cardiovascular events, and death among adults with type 2 diabetes.^{2–6} Our findings may portend a possible population-level increase in diabetes-related illness moving forward. Indeed, recent evidence suggests that a “resurgence” in diabetic complications may already be under way.²⁸ After steady declines from 1995 to 2010, rates of hyperglycemic emergencies and amputations of the feet or legs began increasing among U.S. adults with diabetes, while rates of end-stage renal disease, stroke, and acute myocardial infarction plateaued after 2010.²⁸ These trends highlight the urgent need for interventions and strategies that safely resume progress in diabetes risk-factor control.

We believe that increasing the use of first-line therapies is an important, practical first step. In 2015–2018, only 56.3% of adults with diabetes were using statins, 59.5% were using metformin, and 60.3% were using an ACE inhibitor or ARB. Our results are consistent with those of previous studies and suggest that first-line treatments remain substantially underused.^{13,14,29} Clinical guidelines note that achieving glycemic and blood-pressure control often entails the use of multiple agents.^{7,8} However, we found that only 60.6% of participants with a glycated hemoglobin level of 7% or higher and 52.8% of those with a blood pressure of 140/90 mm Hg or higher were treated with more than one glucose-lowering or blood-pressure-lowering medication, respectively. Although treatment intensification requires a careful consideration of the risk–benefit trade-off, our results suggest that a considerable percentage of patients with uncontrolled risk factors may benefit from more aggressive treatment.

In line with previous research,^{14,30} we observed that the use of newer second-line glucose-lowering medications rose, whereas the use of older classes such as sulfonylureas declined; these findings reflect an encouraging shift toward safer treatment. Nonetheless, use of these newer medications remained low overall, probably because they continue to be expensive. Many of these drugs will become generic during the next several years,³¹ which could translate into expanded access and population-level changes in glycemic control.

Younger persons and other high-risk patients with diabetes may especially benefit from enhanced medication access and uptake. We found that younger adults, Mexican Americans, and persons without health insurance were more likely to be untreated when risk-factor targets were not achieved. These gaps are especially troubling given that rates of diabetes-related complications are higher in racial or ethnic minorities and uninsured populations^{32,33} and that type 2 diabetes that develops during young adulthood has a more aggressive clinical course than diabetes that occurs in later life.³⁴

Our study had several strengths. We analyzed the most recent national data available in a large sample of adults with diagnosed diabetes. Almost 20 years of data were available, all of which were collected in a rigorous and systematic manner by trained personnel who used standardized protocols. We used calibrated glycated hemoglobin levels to account for changes in laboratory methods during the nearly two-decade study period.

There are also several limitations that should be considered in the interpretation of our results. First, because of the relatively small sample size, we may have lacked the power to adequately detect small changes in diabetes control or treatment. Second, response rates have declined in the NHANES over time. Sampling weights that were developed by the NCHS to minimize nonresponse bias were used in our analyses,¹⁵ although the effect of any nonresponse bias cannot be known with certainty. Third, we defined risk-factor control using targets from the most recent clinical guidelines and research, but recommendations have changed during the study period. However, we observed similar trends when using alternative targets and when examining trends in mean levels of glycated hemoglobin, blood pressure, and non-HDL cholesterol. Fourth, because medication use was ascertained in part from participant report, data on medication use may be subject to recall bias. Fifth, we could not reliably distinguish between type 1 and type 2 diabetes. However, type 2 diabetes makes up more than 90% of diagnosed diabetes cases in the United States.³⁵ Thus, our findings largely reflect risk-factor treatment and control in those with type 2 diabetes.

After more than a decade of progress, glycemic and blood-pressure control declined in adult NHANES participants with diagnosed diabetes, while lipid control leveled off.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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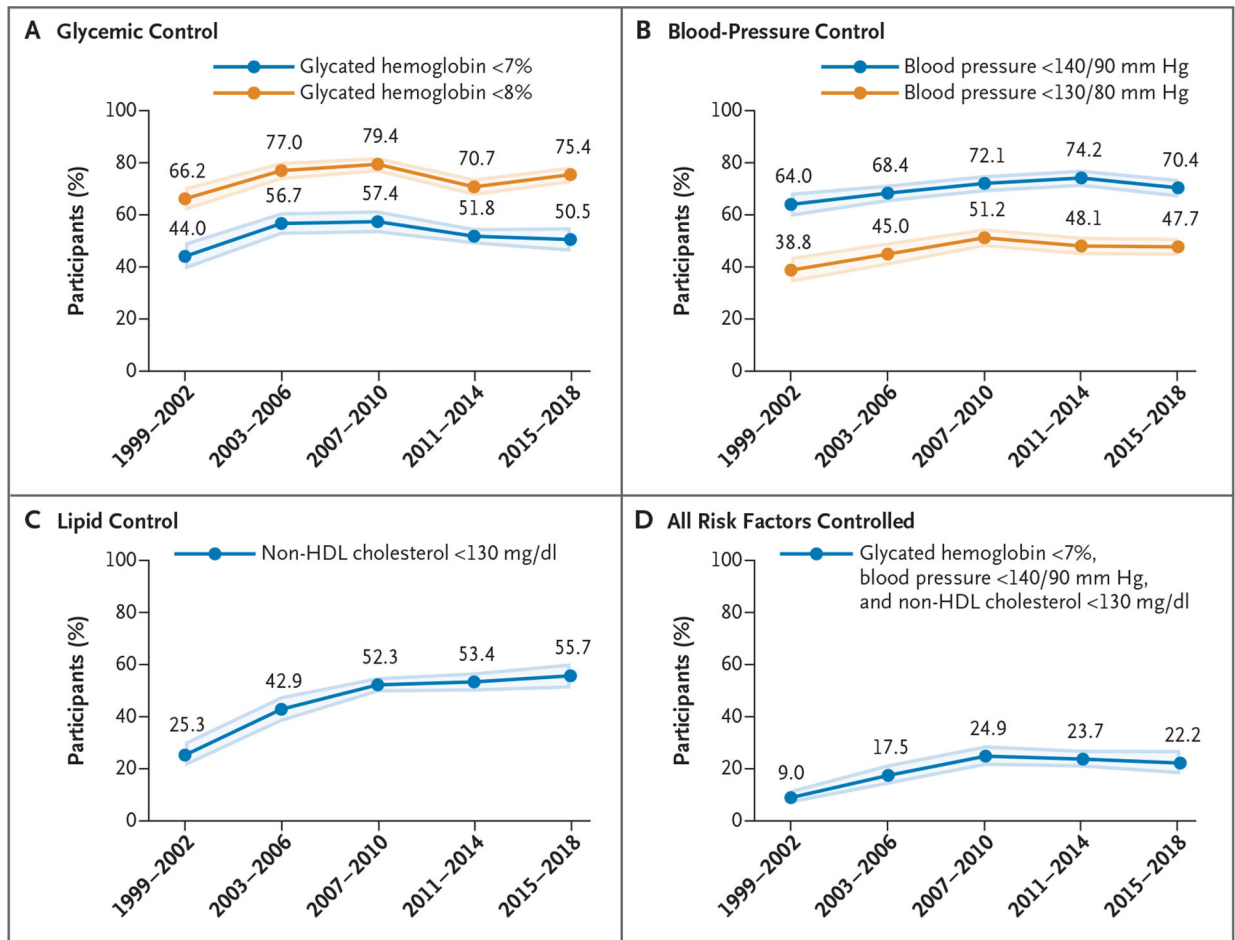


Figure 1. Prevalence of Glycemic, Blood-Pressure, and Lipid Control among Adult NHANES Participants with Diagnosed Diabetes, 1999–2002 to 2015–2018.

Shaded areas indicate 95% confidence intervals. To convert the value for non-high-density lipoprotein (non-HDL) cholesterol to millimoles per liter, multiply by 0.02586. NHANES denotes the National Health and Nutrition Examination Survey.

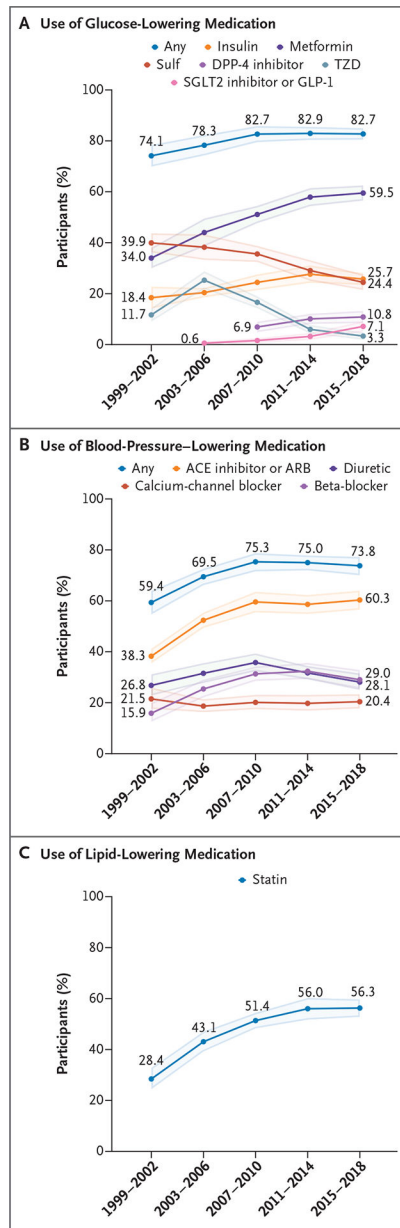


Figure 2. Medication Use in Adult NHANES Participants with Diabetes, 1999–2002 to 2015–2018.

Shaded areas indicate 95% confidence intervals. ACE denotes angiotensin-converting enzyme, ARB angiotensin-receptor blocker, DPP-4 dipeptidyl peptidase 4, GLP-1 glucagon-like peptide 1, SGLT2 sodium–glucose cotransporter 2, Sulf sulfonylurea, and TZD thiazolidinedione.

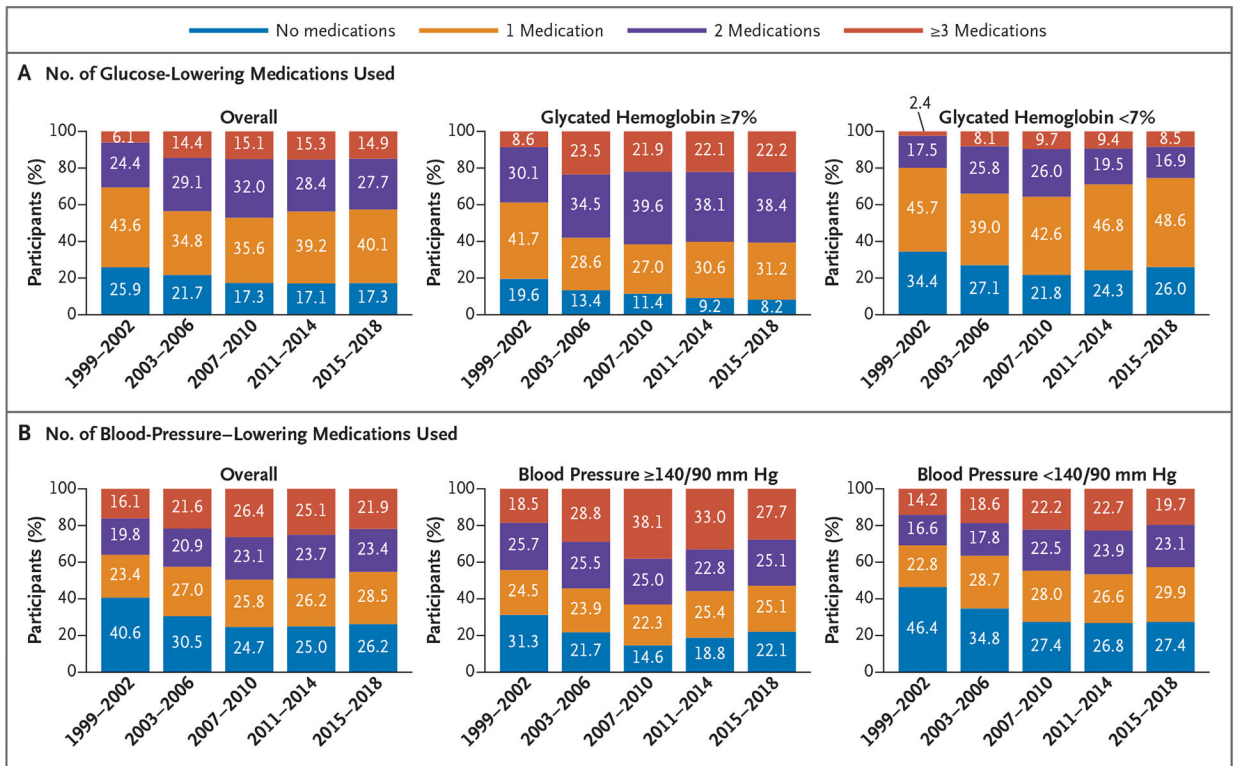


Figure 3. Distribution of the Number of Glucose-Lowering and Blood-Pressure-Lowering Medications Used in Adult NHANES Participants with Diagnosed Diabetes, 1999–2002 to 2015–2018.

Panel A shows the distribution of the number of glucose-lowering medications used by adults with diabetes, overall and according to status with respect to glycemic control. Panel B shows the distribution of the number of blood-pressure-lowering medications used by adults with diabetes, overall and according to status with respect to blood-pressure control.

Table 1. Characteristics of Adult NHANES Participants with Diagnosed Diabetes, 1999–2002 to 2015–2018. *

Characteristic	1999–2002 (N = 983)	2003–2006 (N = 1047)	2007–2010 (N = 1481)	2011–2014 (N = 1424)	2015–2018 (N = 1718)
Age					
Distribution — % (95% CI)					
20–44 yr	17.5 (14.0–21.6)	15.9 (12.6–19.9)	12.6 (10.5–15.0)	13.3 (11.4–15.5)	12.3 (10.9–14.0)
45–64 yr	43.9 (39.5–48.4)	44.8 (41.4–48.3)	46.4 (43.6–49.3)	47.9 (44.1–51.7)	44.6 (41.2–48.1)
65 yr	38.7 (34.5–43.0)	39.3 (34.7–44.1)	41.0 (38.0–44.0)	38.8 (35.5–42.2)	43.0 (39.3–46.8)
Mean (95% CI) — yr	59.0 (57.6–60.5)	59.2 (57.8–60.7)	60.0 (59.0–61.0)	60.1 (59.3–60.9)	60.8 (59.8–61.8)
Race or ethnic group — % (95% CI) †					
Non-Hispanic White	61.1 (53.9–67.8)	63.9 (57.4–70.0)	61.5 (54.0–68.5)	60.7 (54.9–66.3)	59.8 (54.3–65.0)
Mexican American	6.8 (4.7–9.6)	8.0 (5.4–11.6)	8.3 (5.3–12.9)	9.2 (6.2–13.5)	10.2 (7.0–14.7)
Non-Hispanic Black	16.2 (11.8–21.8)	17.0 (13.2–21.7)	18.0 (14.2–22.7)	15.8 (11.9–20.7)	12.9 (10.0–16.6)
Other	15.9 (9.8–24.9)	11.1 (8.8–14.0)	12.2 (9.1–16.0)	9.0 (6.5–12.3)	11.1 (9.5–13.0)
Asian American‡	—	—	—	5.3 (4.0–7.0)	5.9 (4.4–8.0)
Sex — % (95% CI)					
Female	50.5 (46.5–54.5)	54.0 (50.5–57.6)	50.9 (46.8–55.0)	51.2 (48.1–54.3)	45.1 (40.7–49.5)
Male	49.5 (45.5–53.5)	46.0 (42.4–49.5)	49.1 (45.0–53.2)	48.8 (45.7–51.9)	54.9 (50.5–59.3)
Educational level — % (95% CI)					
High school or less	62.0 (57.1–66.7)	55.2 (50.0–60.3)	54.8 (50.4–59.1)	49.4 (44.4–54.5)	44.1 (40.7–47.6)
Some college	25.3 (20.6–30.7)	28.0 (24.1–32.2)	28.6 (24.7–32.7)	31.3 (27.8–35.1)	33.1 (29.6–36.7)
College graduate	12.6 (9.8–16.2)	16.8 (13.3–21.0)	16.6 (14.1–19.5)	19.2 (15.8–23.3)	22.8 (19.2–26.9)
Weight status — % (95% CI)					
Normal: BMI of <25	16.9 (13.3–21.2)	15.4 (12.2–19.3)	12.9 (11.2–14.8)	12.5 (10.3–15.0)	10.3 (8.2–12.8)
Overweight: BMI of 25 to <30	31.5 (27.2–36.1)	28.3 (24.3–32.6)	23.8 (20.9–27.0)	26.1 (23.2–29.2)	27.7 (24.8–30.8)
Obese: BMI of ≥ 30	51.6 (46.1–57.2)	56.3 (51.5–61.1)	63.3 (59.5–67.0)	61.4 (57.5–65.2)	62.0 (57.7–66.1)
Smoking status — % (95% CI)					
Never smoked	48.1 (43.0–53.3)	48.9 (44.7–53.2)	48.8 (46.3–51.4)	49.3 (46.1–52.4)	49.2 (46.1–52.3)
Former smoker	32.8 (28.8–37.1)	32.9 (29.7–36.2)	33.9 (31.5–36.4)	34.8 (32.0–37.6)	36.7 (33.2–40.4)
Current smoker	19.1 (16.3–22.3)	18.2 (15.0–21.8)	17.2 (15.2–19.4)	16.0 (13.9–18.2)	14.1 (11.5–17.1)

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* The sample size for each 4-year interval is unweighted, but all other numbers in the table are weighted percentages or means (with 95% confidence intervals). BMI denotes body-mass index, and NHANES the National Health and Nutrition Examination Survey.

[†] Race and ethnic group were reported by the participants.

[‡] Representative information for non-Hispanic Asian Americans was available in the NHANES only from 2011 through 2018.

Table 2.

Adjusted Odds Ratios for Glucose-Lowering, Blood-Pressure-Lowering, and Statin Treatment in Adult NHANES Participants with Diagnosed Diabetes, 1999–2018. *

Variable	Use of Glucose-Lowering Medication in Persons with Glycated Hemoglobin Level of 7%		Use of Blood-Pressure-Lowering Medication in Persons with Blood Pressure of 140/90 mm Hg		Use of Statin Medication in Persons with Non-HDL Cholesterol Level of 130 mg/dl	
	1 Medication (vs. No Treatment)	2 Medications (vs. No Treatment)	1 Medication (vs. No Treatment)	2 Medications (vs. No Treatment)	1 Medication (vs. No Statin)	2 Medications (vs. No Statin)
Age						
20–44 yr	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
45–64 yr	1.59 (1.00–2.55)	2.59 (1.62–4.14)	3.31 (1.50–7.34)	3.21 (1.69–6.08)	2.31 (1.58–3.36)	2.31 (1.58–3.36)
65 yr	1.85 (1.16–2.93)	2.21 (1.38–3.53)	5.60 (2.55–12.30)	7.41 (3.89–14.11)	2.14 (1.48–3.10)	2.14 (1.48–3.10)
Race or ethnic group						
Non-Hispanic White	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Mexican American	0.69 (0.46–1.03)	0.53 (0.35–0.79)	0.92 (0.58–1.49)	0.65 (0.43–0.98)	0.68 (0.51–0.89)	0.68 (0.51–0.89)
Non-Hispanic Black	1.02 (0.69–1.51)	0.64 (0.43–0.96)	1.23 (0.75–2.02)	1.74 (1.15–2.63)	0.80 (0.61–1.04)	0.80 (0.61–1.04)
Asian American [†]	2.18 (0.98–4.84)	1.89 (0.81–4.36)	0.90 (0.43–1.89)	0.68 (0.36–1.27)	0.93 (0.60–1.43)	0.93 (0.60–1.43)
Sex						
Female	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Male	0.92 (0.65–1.31)	0.88 (0.64–1.19)	0.93 (0.65–1.33)	0.89 (0.65–1.22)	1.13 (0.90–1.41)	1.13 (0.90–1.41)
Education						
High school or less	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Some college	1.12 (0.73–1.72)	1.12 (0.76–1.65)	1.21 (0.76–1.94)	1.34 (0.90–2.01)	0.91 (0.69–1.20)	0.91 (0.69–1.20)
College graduate	1.99 (1.16–3.41)	1.81 (1.11–2.94)	0.99 (0.57–1.73)	0.61 (0.36–1.04)	1.00 (0.73–1.39)	1.00 (0.73–1.39)
Family income						
<130% of FPL	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
130–349% of FPL	1.29 (0.86–1.95)	1.35 (0.93–1.96)	1.56 (1.04–2.33)	1.86 (1.32–2.62)	1.03 (0.79–1.34)	1.03 (0.79–1.34)
350% of FPL	1.32 (0.72–2.42)	1.58 (1.00–2.49)	1.30 (0.71–2.38)	1.38 (0.83–2.30)	1.19 (0.86–1.65)	1.19 (0.86–1.65)
Insurance						
Uninsured	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Any insurance	2.96 (1.99–4.40)	3.80 (2.63–5.50)	2.62 (1.53–4.49)	4.77 (2.72–8.38)	2.78 (1.92–4.03)	2.78 (1.92–4.03)
Weight status						

Variable	Use of Glucose-Lowering Medication in Persons with Glycated Hemoglobin Level of 7% 1 Medication (vs. No Treatment)	Use of Blood-Pressure-Lowering Medication in Persons with Blood Pressure of 140/90 mm Hg 1 Medication (vs. No Treatment)	Use of Statin Medication in Persons with Non-HDL Cholesterol Level of 130 mg/dl Statin (vs. No Statin)
Normal: BMI of <25	1 (reference)	1 (reference)	1 (reference)
Overweight: BMI of 25 to <30	1.21 (0.68–2.16)	1.24 (0.67–2.29)	1.56 (1.09–2.25)
Obese: BMI of ≥30	1.18 (0.67–2.09)	2.31 (1.26–4.24)	1.59 (1.12–2.24)

* Odds ratio with 95% confidence intervals were adjusted for age, sex, and race or ethnic group. To convert the value for non-high-density lipoprotein (non-HDL) cholesterol to millimoles per liter, multiply by 0.02586. FPL denotes federal poverty level.

[†] Data for Asian Americans were available only from 2011 through 2018.