

Trends in Age at Diagnosis of Type 2 Diabetes Among US Adults from 2001 to 2016

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<0.05 was considered significant. We used Stata/MP 14.2, accounting for the complex survey design of NHANES.

INTRODUCTION

The prevalence of diagnosed and undiagnosed diabetes reached 9.4% of US adults in 2015.¹ Obesity is a strong risk factor for diabetes and appears to be occurring at younger ages.¹ Consequently, diabetes may also occur earlier. The American Diabetes Association (ADA) recommends screening for diabetes at 45 years in asymptomatic patients and at any age in overweight or obese adults with risk factors.² Earlier screening might shift the age at diagnosis, but reports of this shift are largely anecdotal. We aimed to describe population-based trends in age at diagnosis of type 2 diabetes (T2D) among US adults.

METHODS

We conducted a cross-sectional, retrospective analysis using the 2001–2016 National Health and Nutrition Examination Survey (NHANES) data. We included people aged ≥ 18 years who had an HbA1C > 6.4%, fasting plasma glucose > 125 mg/dL, or who were previously told they had diabetes. Pregnant women, patients with probable type 1 diabetes (T1D) (aged < 20 years and receiving only insulin),³ and patients with missing data were excluded. Age at diagnosis was self-reported. For patients with previously undiagnosed diabetes, we assigned their age at the interview as age at diagnosis, but also conducted sensitivity analysis including only previously diagnosed patients. Duration of diabetes was the difference between age at interview and age at diagnosis. Mean age at diagnosis and duration were estimated for each 2-year period. Trends were assessed using linear regression and mid-points of survey cycles as independent variable. We also calculated the number of patients by age at diagnosis for 2001–2006, 2007–2012, and 2013–2016, respectively. A 2-sided *p* value

RESULTS

The sample included 7016 T2D patients (representing 26.2 million US adults), 5308 (75%) of whom were previously diagnosed. Mean age was 59 years, 52% were male, and mean BMI was 32.8 (Table 1). Mean age at diagnosis was 50.5 years. Mean duration was 8.4 years. There was no significant change in either mean age or duration from 2001 to 2016 (Fig. 1a). Results were the same when restricted to either previously diagnosed or undiagnosed patients. Compared with 2001–

Table 1 Patient Characteristics of US Adults with Type 2 Diabetes, NHANES 2001–2016

	No.	Percentage/mean	95% CI
Age (years), mean	7016	59.0	58.5–59.5
HbA1C (%), mean	6540	7.2	7.2–7.3
Sex			
Female	3390	48	47–50
Male	3626	52	50–53
Race			
Non-Hispanic White	2545	61	58–64
Non-Hispanic Black	1859	16	14–18
Hispanic	2045	15	13–18
Others	567	8	7–9
BMI			
< 25	932	13	11–14
25–29.9	1940	27	26–29
30–34.9	1796	28	26–29
≥ 35	1889	32	31–34
Ratio of family income to poverty			
< 1	1547	17	16–19
1–< 2	1958	26	24–27
2–< 4	1661	29	27–31
≥ 4	1166	27	25–30
Insurance			
No insurance	1011	12	11–13
Any private	3195	56	54–58
Public only	2757	32	30–33
Education			
< High school	2676	27	25–28
High school/GED	1624	25	23–26
Some college	1713	30	28–32
College graduate and above	986	19	17–21

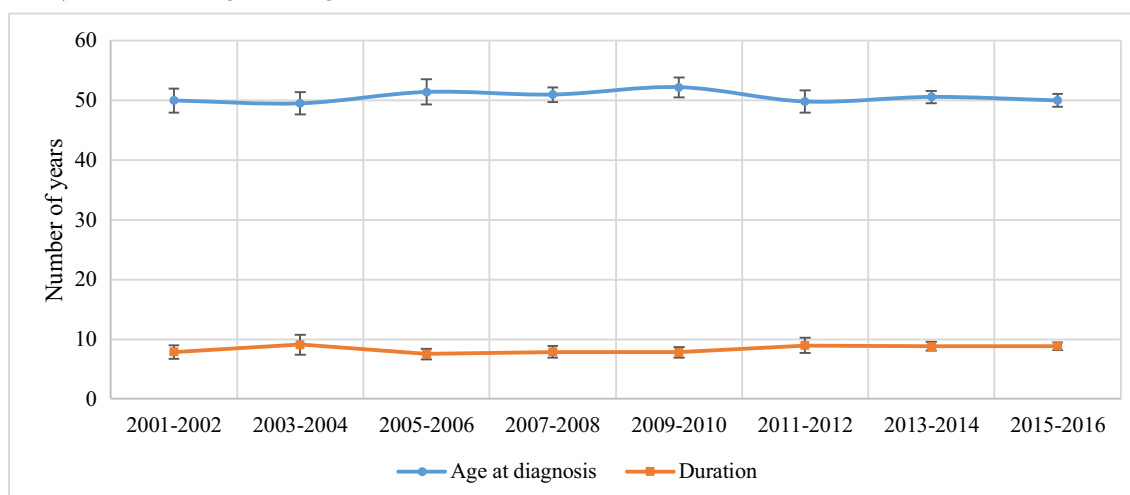
BMI, body mass index; CI, confidence interval; GED, general education diploma; NHANES, National Health and Nutrition Examination Survey

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a) Trends in age at diagnosis



b) Number of US adults with diabetes by age at diagnosis

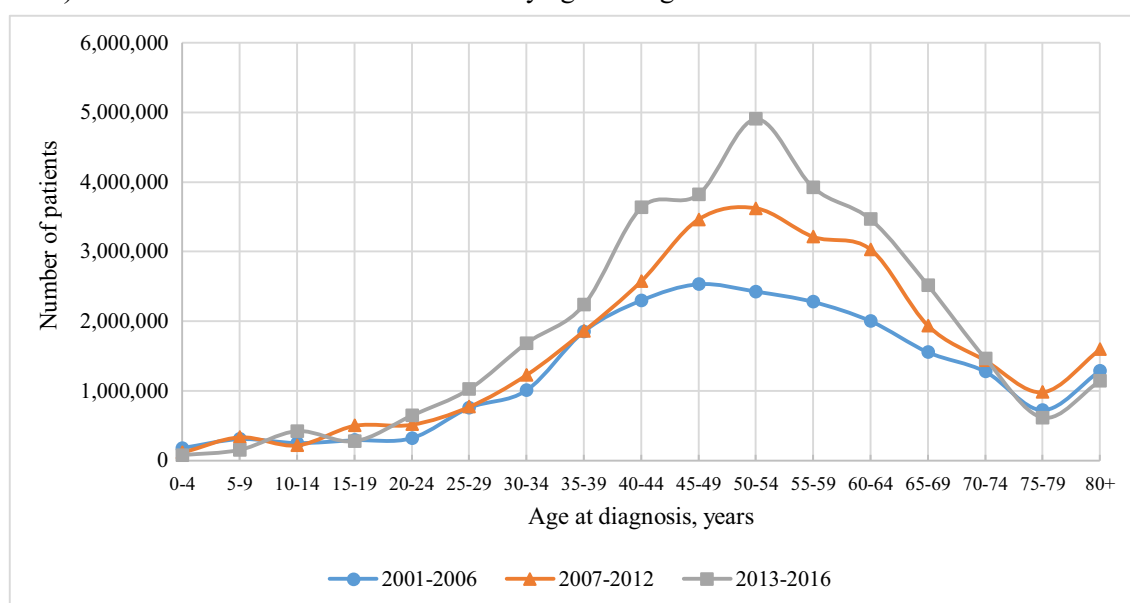


Figure 1 a Trends in mean age at diagnosis and duration of type 2 diabetes in US adults (p value for trends > 0.05), and b number of US adults with type 2 diabetes by age at diagnosis, 2001–2016. Error bars in a represent 95% confidence intervals.

2006, the number of patients diagnosed at ages 30–34, 50–54, 60–64, and 70–74 years in 2013–2016 was 1.7, 2.0, 1.7, and 1.1 times higher (p value < 0.001), respectively (Fig. 1b).

DISCUSSION

After decreasing throughout the 1990s,⁴ the mean age at diagnosis of T2D in the USA appears to have stabilized. Mean age of diagnosis and duration did not change from 2001 to 2016. Overall, there was an increase of 50% in prevalence of T2D. The number of younger patients—those diagnosed between 30 and 34 years—almost doubled, but so did the number of patients diagnosed between 50 and 54 years, with a much larger absolute increase occurring in the latter group.

Interestingly, there was almost no increase among patients aged ≥ 70 years. Therefore, although a casual observer might be struck by the increase in diabetes among younger adults, in fact, there were simply more patients with T2D at all ages. Given this finding, the ADA recommendation to begin screening at age 45 appears appropriate.

Our study has limitations. Because age at diagnosis was self-reported, findings were subject to recall bias. Also, since time from diabetes onset to diagnosis is unknown,⁵ we could not confirm when diabetes developed. The NHANES does not distinguish among diabetes types. Since $> 95\%$ of diabetics are type 2, and we excluded probable T1D patients, our estimates generally represent T2D.

In conclusion, we found that age at diagnosis of T2D among US adults did not change over 15 years. Instead, the doubling

of diabetes prevalence at all ages may have created the appearance of an age shift.

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Compliance with Ethical Standards:

Conflict of Interest: Dr. Herman serves on a Data Safety Monitoring Board for Merck Sharp & Dohme. Dr. Misra-Hebert receives funding from the Agency for Healthcare Research and Quality grant no. K08HS024128 and has received research funding from Novo Nordisk and Merck. All other authors have no conflict of interest.

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