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Intensive glycemic control in younger and older U.S. adults with type 2 diabetes

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ABSTRACT

Aims: To determine the extent to which older vs. younger adults with diabetes intensively control glycemia.
Methods: Participants were age ≥ 40 years who self-reported a physician diagnosis of diabetes in the 2009–2014 National Health and Nutrition Examination Surveys (N = 1554). Intensive glycemic control was defined as A1c < 7.0% and taking insulin, sulfonylureas, or ≥2 glycemic medications. Logistic regression was used to determine the adjusted odds of intensive control in older (≥65 years) vs. younger adults (age 40–64 years).
Results: The prevalence of intensive control was greater for older (33.4%) vs. younger (21.3%) adults (p < 0.001). In logistic regression, intensive control was significantly higher in older vs. younger adults after fully adjusting for sociodemographics, diabetes duration, comorbidities, disability, use of multiple medications, and depression (OR = 1.72, 1.09–2.69). The multivariable adjusted prevalence of intensive control was 40% higher in adults ≥75 years (35.6%) compared to adults 40–49 years (21.7%).
Conclusions: Older adults are being treated more aggressively than younger adults to achieve A1c < 7.0% despite the presence of comorbidities, duration of diabetes, disability, and depression. Glycemic guidelines for individualized therapy are not being widely followed.

1. Introduction

An estimated 28.9 million U.S. adults have diabetes, yielding a large public health burden of morbidity, mortality and economic costs due mainly to diabetes-related complications.[1] The Diabetes Control and Complications Trial (DCCT) and the United Kingdom Prospective Diabetes Study (UKPDS) established that intensive glycemic control with a reduction in A1c levels to an average of 7.0% significantly reduced microvascular disease in persons with type 1 and type 2 diabetes.[2,3] Clinical practice guidelines developed on the basis of these findings recommended an A1c < 7.0% to decrease the risk of diabetes complications. After the trials ended, significant long term reductions in cardiovascular disease (CVD) in those randomized to intensive treatment emerged during participant follow-up.[4] However, three subsequent studies, in older adults with longer duration type 2 diabetes and CVD or risk factors for CVD, found that more intensive therapy targeting even lower A1c levels did not reduce CVD.[5–7] Moreover, the Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial, which targeted A1c < 6.0%, increased mortality compared to the standard (A1c < 7.5%) treatment group.[6]

On the basis of these studies, the ADA revised their guidelines in 2008 to recommend an A1c goal of <7.0% for adults who can benefit the most from a reduction in A1c to prevent diabetes-related complications, such as those with longer life expectancy and little comorbidity, but less stringent goals (e.g., A1c <8.0%) for patients with a history of hypoglycemia, advanced complications, several comorbid conditions, and shorter life expectancy.[8] Similarly, the American Geriatrics Society (AGS) first recommended in 2003 that individualized therapy take into account diabetes severity and life expectancy and recommended less stringent targets (e.g., A1c

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Table 1
Characteristics of adults with type 2 diabetes age ≥ 40 years, NHANES 2009–2014.

	Percent (standard error)			
	Total (N = 1554)	Age 40–64 years (n = 793)	Age ≥ 65 years (n = 761)	ANOVA p-value
Age	100.0	55.2 (1.51)	44.8 (1.51)	0.005
Sex, % women	48.8 (1.67)	49.2 (2.28)	48.2 (2.61)	0.778
Race/Ethnicity				<0.001
Non-Hispanic white	61.4 (2.31)	57.1 (2.87)	66.8 (2.49)	
Non-Hispanic black	15.8 (1.67)	17.8 (2.07)	13.3 (1.49)	
Mexican American	8.6 (1.55)	11.0 (1.88)	5.6 (1.37)	
Other Hispanic	5.0 (0.77)	5.5 (0.93)	4.4 (0.82)	
Non-Hispanic other	9.2 (1.27)	8.6 (1.30)	10.0 (1.67)	
Education, % high school graduate or higher	73.4 (1.89)	75.7 (2.14)	70.6 (2.30)	0.029
Health insurance, % yes	90.9 (0.97)	85.1 (1.67)	98.1 (0.63)	<0.001
Current smoking	14.0 (0.92)	20.6 (1.52)	5.8 (0.84)	<0.001
Duration of diabetes (years)				<0.001
<5	27.9 (1.42)	34.9 (2.05)	19.3 (1.88)	
5–9	23.0 (1.19)	24.6 (1.91)	20.9 (1.44)	
10–19	31.2 (1.91)	30.0 (2.48)	32.7 (2.06)	
≥20	17.9 (1.18)	10.5 (1.40)	27.1 (1.88)	
Comorbidities, ≥1[*]	60.4 (1.71)	47.5 (2.20)	76.7 (1.73)	<0.001
Disability[†]	67.4 (2.25)	63.2 (2.95)	72.3 (2.48)	0.006
Multiple medication use, % ≥6 medications	56.6 (1.97)	49.0 (2.65)	66.0 (2.04)	<0.001
Depression[‡]	12.4 (1.18)	16.2 (1.72)	7.8 (1.34)	<0.001

[*] Comorbidities include cancer (excluding skin cancer except melanoma), lung disease (asthma, bronchitis, or emphysema), cardiovascular disease (stroke or CVD), and chronic kidney disease.
[†] Disability includes work disability, mobility disability, or pain ≥3 days in past month that makes daily activities difficult.
[‡] Depression defined as a PHQ9 score ≥ 10.

<8.0%) when the risks of intensive glycemic control outweighed the benefits.[9]

A previous study using national data from 2001 to 2010 found that among older adults with A1c < 7.0% and significant health problems, 60% were treated with insulin or sulfonylureas; these results indicate possible overtreatment.[10] However, the practice patterns in younger adults with longer life expectancy, versus older adults, are relatively unknown. We used data from the National Health and Nutrition Examination Survey to determine the extent to which younger versus older adults are being treated more intensively to lower A1c levels while accounting for factors related to treatment, including duration of disease, comorbidities, disability, use of prescription medications, and depression.

2. Subjects, materials, and methods

2.1. Study design and participants

The National Health and Nutrition Examination Survey (NHANES) is a stratified multistage probability cluster survey conducted in the non-institutionalized civilian U.S. population.[11] Participants are interviewed in their home for demographic and health information and are then scheduled to visit a mobile examination center for physical examinations and laboratory measures.[12,13] Written informed consent was obtained from all participants and was approved by the National Center for Health Statistics Institutional Review Board. Our analyses included adults age ≥ 40 years who answered "yes" when asked whether a physician or other health care professional ever told them they had diabetes (N = 1554). We excluded adults with probable type 1 diabetes defined as having a diagnosis at age < 30 years, starting insulin treatment within one year of diagnosis, and currently taking insulin (n = 21). Participants self-reported age, race/ethnicity, education, health insurance status, smoking status, duration of diabetes, and use of insulin.

2.2. Health status

Self-reported comorbidities included a history of cancer (excluding skin cancer, except Melanoma), lung disease (asthma, bronchitis, or emphysema), cardiovascular disease (stroke, congestive heart failure, coronary heart disease, angina, or heart attack). Chronic kidney disease (CKD) was determined using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation which estimates glomerular filtration rate (eGFR) from serum creatinine based on age, sex, and race and defined as eGFR < 60 mL/min per $1.73m^2$.[14] Participants with ≥1 of these conditions were considered to have comorbidities.

Disability was defined as having mobility disability, work disability, or general pain. Participants who reported needing special equipment to walk or much difficulty/inability to do any of the following activities were considered to have a mobility disability: (1) walking a quarter mile, (2) walking up ten steps, (3) stooping, crouching, or kneeling, (4) walking between rooms, (5) standing up from an armless chair, (6) getting in and out of bed. A work disability was determined if participants responded "yes" when asked if limitations kept them from working. Participants who reported ≥3 days in the past month where pain made it hard for usual activities were considered to have disability related to general pain.

Participants self-reported use of prescription medications in the past 30 days and were asked to show the interviewer their medication containers. Use of ≥6 prescription medications was considered multiple medication use.

The Patient Health Questionnaire (PHQ9) was used to determine depression.[15] Participants answered 9 questionnaire items with "not at all" (value of 0), "several days" (value of 1), "more than half the days" (value of 2), or "nearly every day" (value of 3) in the past two weeks." Symptoms included (1) little interest in doing things, (2) feeling down, depressed, or hopeless, (3) trouble sleeping or sleeping too much, (4) feeling tired or having little energy, (5) poor appetite or overeating, (6) feeling bad about yourself, (7) trouble concentrating on things, (8) moving or speaking slowly or too fast, (9) would be better off dead. Depression was defined as having a PHQ9 score ≥ 10.

2.3. Intensive control of diabetes

Intensive control of diabetes was defined as A1c < 7.0% and use of sulfonylureas, insulin, or ≥2 glycemic medications. The DCCT used insulin and the UKPDS used insulin and sulfonylureas as intensive therapy to achieve A1c control[2,3] and taking 2 or more glycemic medications indicates that diabetes cannot be controlled with lifestyle or first line medications. This definition of intensive control is not based on A1c alone but in the context of pharmacological therapy (and potential detriment) required to achieve near normal A1c. The comparison in older and younger adults is the use of this potentially harmful pharmacological therapy to achieve A1c < 7.0%. Hemoglobin A1c was measured in all adults from a standard blood draw and standardized to the Diabetes Control and Complications Trial method.[16] A1c was measured with the A1c G7 HPLC Glycohemoglobin Analyzer (Tosoh Medics, Inc., San Francisco, CA) which had a coefficient of variation of 0.7–1.5%. Sulfonylurea use was determined during the prescription medication interview; insulin

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