



Burden of Complications in U.S. Adults With Young-Onset Type 2 or Type 1 Diabetes

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Young-onset type 2 diabetes has a more aggressive clinical course than type 2 diabetes that occurs at an older age (1). Accumulating evidence suggests that young adults with type 2 diabetes have complication rates exceeding those of individuals of similar age with type 1 diabetes (1–3). However, prior studies have focused on select populations and the generalizability of their findings is not clear. To address this gap in the literature, we analyzed recent national data to characterize the prevalence of complications among U.S. adults with young-onset type 1 and type 2 diabetes.

We pooled data from the 2016 and 2017 National Health Interview Survey (NHIS). The NHIS is the only representative U.S. study that collects self-reported information on types of diabetes. Participants reported whether they had ever been diagnosed with diabetes other than during pregnancy. Those with diagnosed diabetes reported the type of diabetes (type 1, type 2, other), age of diagnosis, and use of antidiabetes medication.

Following past research, we defined young-onset type 2 diabetes as being diagnosed before age 40 (1). We defined young-onset type 1 diabetes using this same cut point for comparability. We classified participants as having young-onset type 1 diabetes if they reported having type 1 diabetes diagnosed before

age 40 and were currently using insulin ($n = 232$). We classified all remaining participants with diabetes diagnosed by age 40, except those with “other” types of diabetes, as having young-onset type 2 diabetes ($n = 1,207$) (4).

Participants reported history of cardiovascular events (coronary heart disease, angina, heart attack, other heart condition, stroke). We defined cardiovascular disease (CVD) as having at least one of these conditions. We also examined each cardiovascular condition separately. Participants reported whether they had ever been diagnosed with diabetic retinopathy and whether they had been diagnosed with “weak or failing kidneys” during the past year.

We conducted analyses using recommended sample weights to generate estimates representative of the U.S. civilian noninstitutionalized population. We examined participant characteristics and the prevalence of complications according to diabetes type and used χ^2 tests to assess group differences.

U.S. adults with young-onset type 1 diabetes were younger (42.6 vs. 50.5 years of age, $P < 0.001$) and diagnosed at an earlier age than those with young-onset type 2 diabetes (19.0 vs. 27.2 years of age, $P < 0.001$), but disease duration between the two groups was similar (23.6 vs. 23.3 years, $P = 0.84$) (Table 1). Adults with

type 1 diabetes generally had fewer clinical and lifestyle risk factors than those with young-onset type 2 diabetes.

The prevalence of any CVD was high but did not differ between those with young-onset type 1 versus young-onset type 2 diabetes (23.1% vs. 28.3%, $P = 0.18$) (Table 1). Results were similar when considering each CVD outcome separately. One exception was the prevalence of angina; however, the estimate for adults with type 1 diabetes was imprecise and should be interpreted with caution. The prevalence of recently diagnosed kidney disease (“weak or failing kidneys”) did not differ significantly between the two groups (10.4% vs. 8.5%, $P = 0.49$). The prevalence of diabetic retinopathy was higher among those with young-onset type 1 diabetes versus young-onset type 2 diabetes (24.7% vs. 11.4%, $P < 0.001$). Results were similar after adjustment for socio-demographic characteristics (results not shown).

Our findings differ from previous research. Prior studies have reported a higher prevalence of CVD, kidney disease, and, to a lesser extent, retinopathy among those with young-onset type 2 diabetes compared with similarly aged adults with type 1 diabetes (1–3). We suspect these differences may be due to differences in data collection and study

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Table 1—Characteristics and prevalence of complications among U.S. adults with young-onset type 2 and type 1 diabetes, NHIS, 2016–2017

	Type 1 diabetes† (n = 232)	Type 2 diabetes (n = 1,207)	P value#
Sociodemographic characteristics			
Age, mean, years	42.6 (40.0–45.2)	50.5 (49.4–51.7)	<0.001
Age of diagnosis, mean, years	19.0 (17.3–20.7)	27.2 (26.5–27.9)	<0.001
Duration of diabetes, mean, years	23.6 (21.3–25.9)	23.3 (21.9–24.7)	0.84
Sex, %			
Female	47.9 (39.6–56.3)	53.4 (49.6–57.3)	0.24
Male	52.1 (43.7–60.4)	46.6 (42.7–50.4)	
Race/ethnicity, %			
Non-Hispanic white	79.1 (71.5–85.1)	48.0 (43.8–52.3)	<0.001
Non-Hispanic black	7.4 (4.3–12.7)	19.5 (16.8–22.6)	
Hispanic	10.6 (6.0–17.8)	23.3 (19.4–27.6)	
Other	2.9 (1.3–6.5)	9.2 (7.0–12.0)	
Family income level, %			
Income-poverty ratio <200%	29.3 (23.1–36.3)	49.9 (46.0–53.9)	<0.001
Income-poverty ratio ≥200%	70.7 (63.7–76.9)	50.1 (46.1–54.0)	
Education, %			
<High school	28.9 (22.3–36.6)	51.6 (47.5–55.7)	<0.001
≥High school	71.1 (63.4–77.7)	48.4 (44.3–52.5)	
Health insurance status, %			
Insured	94.7 (90.7–97.0)	89.7 (87.1–91.9)	0.03
Uninsured	5.3 (3.0–9.3)	10.3 (8.1–12.9)	
Health status characteristics			
Ever diagnosed with hypertension, %	36.4 (29.1–44.4)	62.4 (58.5–66.1)	<0.001
Ever diagnosed with high cholesterol, %	46.6 (38.3–55.0)	55.3 (51.5–59.0)	0.07
Family history of diabetes, %	51.2 (43.2–59.1)	79.7 (76.6–82.4)	<0.001
Body-mass index, mean, kg/m ²	29.3 (25.7–31.1)	34.5 (33.7–35.4)	<0.001
Obese‡, %	26.2 (20.0–33.5)	60.8 (56.9–64.5)	<0.001
Current smoking, %	15.7 (11.0–21.7)	18.8 (16.2–21.7)	0.33
Physically inactive§, %	35.3 (28.4–42.9)	45.2 (41.6–48.9)	0.02
Current treatment, %			
Oral antidiabetes drugs only	0.0	50.1 (46.5–53.6)	<0.001
Insulin only	89.7 (84.0–93.4)	10.2 (8.3–12.5)	
Both insulin and oral antidiabetes drugs	10.3 (6.6–16.0)	21.0 (18.1–24.2)	
Neither insulin nor oral antidiabetes drugs	0.0	18.8 (16.0–22.0)	
Complications			
Any CVD, %	23.1 (16.5–29.7)	28.3 (25.1–31.5)	0.18
Coronary heart disease	10.7 (5.3–16.1)	11.2 (8.8–13.5)	0.87
Angina	2.2¶ (0.6–3.7)	5.7 (4.0–7.5)	0.01
Heart attack	8.8 (3.7–13.8)	7.8 (5.9–9.7)	0.71
Other heart condition	15.7 (9.5–21.9)	13.8 (11.2–16.3)	0.56
Stroke	6.0 (2.8–9.2)	8.7 (6.6–10.7)	0.21
Kidney disease, %	10.4 (5.1–15.6)	8.5 (6.6–10.4)	0.49
Retinopathy, %	24.7 (17.1–32.2)	11.4 (8.9–13.9)	<0.001

Data are presented as mean or percentage with 95% CI in parentheses. Estimates were weighted and based on pooled data from the 2016 and 2017 waves of the NHIS. Young-onset diabetes was defined as a self-reported diagnosis of diabetes by a health care provider before the age of 40 years.

†Type 1 diabetes was defined as self-report of type 1 diabetes and current insulin use. ‡Respondents with a reported BMI ≥30 were classified as obese.

§Respondents who reported performing no physical activity during their leisure time were classified as physically inactive. || Respondents who reported ever being diagnosed with coronary heart disease, angina, myocardial infarction, any other heart conditions, or stroke were classified as having CVD.

¶Estimate may be unreliable because of large relative SE (>30%) and should be interpreted with caution. #P values are from χ^2 (for categorical measures) and t tests (for continuous measures) assessing differences across diabetes subtype.

populations. The NHIS sampled from the general U.S. adult population, and all information was self-reported. Past research generally recruited clinical populations, often outside of the U.S., but has involved more objective measures of complications.

Limitations included possible misclassification, especially for type 1 diabetes.

We attempted to minimize this by using self-reported diabetes subtype and insulin usage for classification. Additionally, because young-onset diabetes was rare, we may have lacked power to detect moderate differences in complications. Survival bias is also a potential concern given the cross-sectional nature of these data. Differential survival from complications may have

affected our comparison across diabetes subtypes.

In conclusion, we found a high burden of complications among U.S. adults with young-onset diabetes. Rates of CVD and kidney disease were similar across type 1 and type 2 diabetes, while rates of diabetic retinopathy were notably higher among those with young-onset type 1 diabetes.

Given the rising incidence of young-onset diabetes in the U.S. (5), our results highlight the need for early and aggressive monitoring and management of diabetes and cardiovascular risk factors.

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