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Projections of Type 1 and Type 2 Diabetes Burden in the U.S. Population Aged <20 Years Through 2060: The SEARCH for Diabetes in Youth Study

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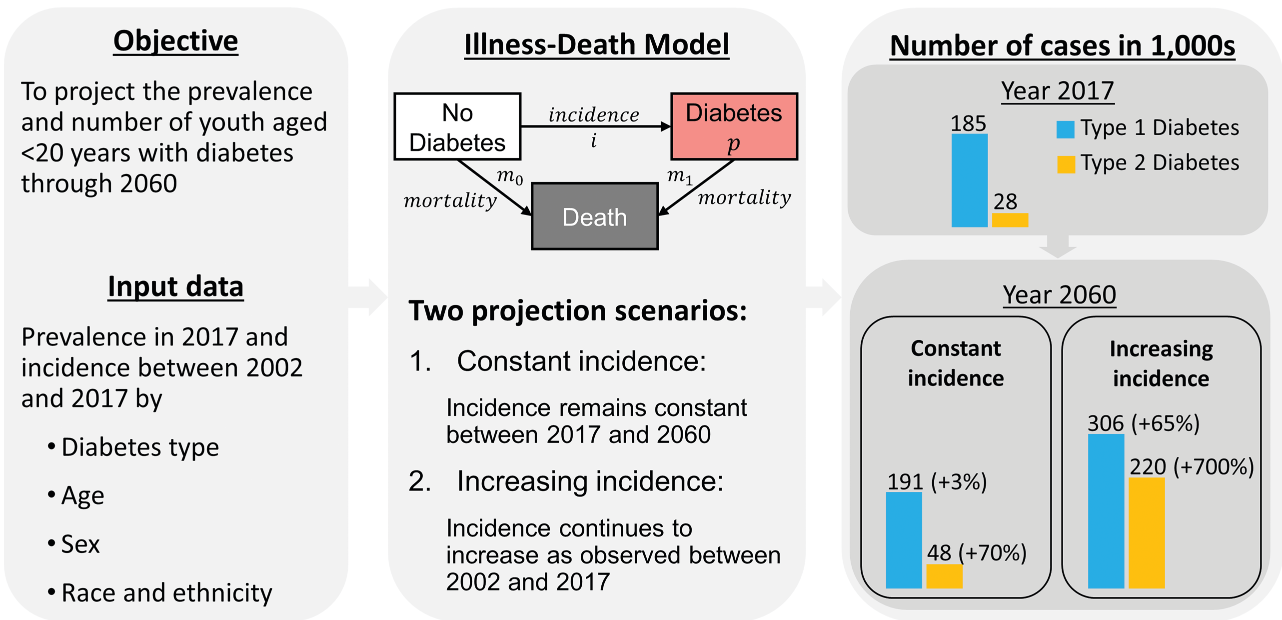

ARTICLE HIGHLIGHTS

- We aimed to project the future burden of diabetes in U.S. youth.
- We sought to answer the question of how many youth aged <20 years will be affected by diabetes in 2060.
- Assuming continuing trends in incidence, the number of youth with type 1 and type 2 diabetes is projected to increase to 306,000 (65%) and 220,000 (700%), respectively, between 2017 and 2060.
- The results highlight the importance of prevention, particularly regarding type 2 diabetes.

Projections of Type 1 and Type 2 Diabetes Burden in the U.S. Population Aged <20 Years Through 2060: The SEARCH for Diabetes in Youth Study

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EPIDEMIOLOGY/HEALTH SERVICES RESEARCH

OBJECTIVE

To project the prevalence and number of youths with diabetes and trends in racial and ethnic disparities in the U.S. through 2060.

RESEARCH DESIGN AND METHODS

Based on a mathematical model and data from the SEARCH for Diabetes in Youth study for calendar years 2002–2017, we projected the future prevalence of type 1 and type 2 diabetes among youth aged <20 years while considering different scenarios of future trends in incidence.

RESULTS

The number of youths with diabetes will increase from 213,000 (95% CI 209,000; 218,000) (type 1 diabetes 185,000, type 2 diabetes 28,000) in 2017 to 239,000 (95% CI 209,000; 282,000) (type 1 diabetes 191,000, type 2 diabetes 48,000) in 2060 if the incidence remains constant as observed in 2017. Corresponding relative increases were 3% (95% CI −9%; 21%) for type 1 diabetes and 69% (95% CI 43%; 109%) for type 2 diabetes. Assuming that increasing trends in incidence observed between 2002 and 2017 continue, the projected number of youths with diabetes will be 526,000 (95% CI 335,000; 893,000) (type 1 diabetes 306,000, type 2 diabetes 220,000). Corresponding relative increases would be 65% (95% CI 12%; 158%) for type 1 diabetes and 673% (95% CI 362%; 1,341%) for type 2 diabetes. In both scenarios, substantial widening of racial and ethnic disparities in type 2 diabetes prevalence are expected, with the highest prevalence among non-Hispanic Black youth.

CONCLUSIONS

The number of youths with diabetes in the U.S. is likely to substantially increase in future decades, which emphasizes the need for prevention to attenuate this trend.

The incidence and prevalence of youth-onset diabetes have been on the rise in the U.S. in recent decades (1,2). Historically, youth-onset diabetes mainly referred to type 1 diabetes (3). However, one striking feature of more recent data is the rapid rise of type 2 diabetes among adolescents, with an annual percent change in incidence of 4.8% between 2002 and 2015 compared with 1.9% for type 1 diabetes (1). Whereas the reasons for increases in type 1 diabetes incidence are largely unknown, several explanations for the increase in type 2 diabetes incidence are likely. For instance, data from U.S. health surveys suggest that increasing prevalence of obesity in childhood and adolescence parallels trends in the incidence of type 2 diabetes (4,5). In addition, the increasing prevalence of type 2 diabetes in adulthood might be another important factor because exposure to diabetes in utero is associated with an increased risk of diabetes in offspring (3,6).

In addition to this increase in type 2 diabetes, recent trends in youth-onset diabetes also suggest a widening in racial and ethnic disparities in incidence and prevalence (1,2). Regarding health disparities, type 1 diabetes and type 2 diabetes are characterized by opposite patterns. Type 2 diabetes is more frequent among Hispanic/Latino, non-Hispanic Black/African American (NHB), Asian/Pacific Islander, and American Indian/Alaska Native youth compared with non-Hispanic White (NHW) youth, whereas in type 1 diabetes, this pattern is reversed (2,3). However, regarding type 1 diabetes, disparity patterns similar to type 2 diabetes are currently emerging, since increases in incidence and prevalence were faster in all racial and ethnic groups other than NHW youth (1,2).

The increasing trends in incidence raise concerns about the future burden of diabetes in youth regarding prevalence and the number of people affected. In particular, the rise of type 2 diabetes seems worrying because compared with youths and young adults with type 1 diabetes, those with type 2 diabetes have a worse cardiovascular risk profile and increased risk of complications and mortality (7–9). Furthermore, health disparities in type 2 diabetes prevalence might further increase in the future as a result of heterogeneous trends in incidence.

Hence, in this study, we aimed to project the future burden of diabetes in the U.S. youth through 2060 while accounting for age, sex, race and ethnicity, diabetes type–specific trends in incidence, and projected demographic changes. We built on the SEARCH for Diabetes in Youth (SEARCH) study, which allows for detailed analysis of trends in incidence by race and ethnicity, sex, and diabetes type between 2002 and 2017, and an estimate of diabetes prevalence by these same characteristics in 2017.

RESEARCH DESIGN AND METHODS

Study Design and Data Sources

We used an illness-death model and data on prevalence and incidence of diabetes in youth from the SEARCH study to project the prevalence and number of youths with diabetes in the U.S. through 2060. SEARCH is a population-based multicenter study among youth in the U.S. aged <20 years. A detailed description of the study is available elsewhere (2,10,11). Briefly, data were collected from clinical centers in 6 regions, including Colorado (covering 14 counties), Ohio (covering 8 counties), California (Kaiser Permanente Southern California covering 7 counties), Washington State (covering 5 counties), South Carolina (covering 4 counties), and beneficiaries of the Indian Health Service in select parts of Arizona and New Mexico (data collection coordinated by the Colorado center). The SEARCH study centers ascertained clinically diagnosed prevalent and incident cases of diabetes. Completeness of case ascertainment within the regions was estimated to be >90% (1,11). For this study, we used data on diabetes prevalence in 2017 and diabetes incidence from 2002 to 2017. To project the future prevalence of diabetes in youths, these data were used as input data for a partial differential equation that governs the illness-death model (12). Institutional review boards for each site approved the study protocol of the SEARCH study.

Statistical Analysis

Estimating Prevalence in 2017

In line with a previous analysis (2), the numerator of diabetes prevalence in 2017 included all individuals with prevalent diabetes aged <20 years in 2017. To be eligible as a participant, youths needed to be residents of the SEARCH geographic sites, Indian Health Service beneficiaries, or enrollees in the study's California health plan. Age, sex, date of diagnosis, and diabetes type were obtained from medical records. Race and ethnicity were investigated because of known disparities in diabetes prevalence (2). In the context of these health disparities, race and ethnicity are considered social constructs rather than biological constructs (13). Race and ethnicity were obtained from self-report, medical records, or geocoding based on participants' residential address in the prevalent year when data were missing (∼3% of the total participants with prevalent diabetes) and categorized into the four groups: Hispanic/Latino, NHB, NHW, and non-Hispanic other race(NH other race). While the degree of accuracy of the geocoding to estimate missing race and ethnicity is not known, we assumed that the impact of potential inaccuracies on the race and ethnicity distribution of the total population is low because the proportion of missing data was very low. Corresponding denominators consisted of all residents of the SEARCH study geographic sites, Indian Health Service beneficiaries, or enrollees in the study's California health plan. Age-specific diabetes prevalence in youth aged <20 years in 2017 was estimated for 1-year age-groups.

Estimating Incidence Between 2002 and 2017

Participants with incident diabetes (numerator) who were aged <20 years in the year of diagnosis were included for diabetes incidence estimation between 2002 and 2017. The corresponding annual population at risk (denominator) included the population aged <20 years who were residents of the geographic study areas, Indian Health Service beneficiaries, or enrollees in the study's California health plan.

We used Poisson regression with the number of participants with incident diabetes as the dependent variable and the logarithm of the population size at risk as an offset variable to estimate diabetes incidence rates. Independent variables were age, race and ethnicity, sex, and calendar year. We also included interactions between race and ethnicity and age, as well as race and ethnicity and calendar year, to allow for race and ethnicity–specific age patterns and temporal trends in diabetes incidence. Age was modeled using natural cubic splines, with the number knots providing the best fit according to the Bayesian information criterion. Calendar year was modeled linearly to reflect the long-term temporal trend between 2002 and 2017. The models were fitted separately for type 1 and type 2 diabetes as well as for males and females. Predicted incidences from these regression models were used as input data for the projection model.

Projection Model

Illness-Death Model

We used an illness-death model for the projection of diabetes prevalence. In this model, the population was divided into the three states of no diabetes, diabetes, and death. Using a partial differential equation and SEARCH input data, the model was used to project the age-specific prevalence (14,15) (Supplementary Methods 1). Since excess mortality associated with diabetes in youth has a negligible impact on future prevalence, we assumed mortality rates to be equal between youth with and without diabetes (15) (Supplementary Methods 1). We projected the future age-specific prevalence by solving the partial differential equation using SEARCH input data for prevalence and incidence. To quantify racial and ethnic disparities, prevalence ratios were estimated by dividing the prevalence among each racial and ethnic group by the prevalence among NHW youth (reference group).

For the incidence rate, input values for all years through 2060 were needed. Hence, we considered two different scenarios regarding assumed future trends in the incidence rate described in detail below.

Constant Incidence Scenario

In the constant incidence scenario, we assumed that the incidence rate will not change between 2017 and 2060 and used the age-specific incidence rate of diabetes estimated using SEARCH data for 2017 for all years until 2060. Estimation of the incidence rate in 2017 for each age-sex-race and ethnicity combination was based on Poisson regression models as described above.

Increasing Incidence Scenario

In the increasing incidence scenario, we assumed that the trends in the incidence rate observed in SEARCH between 2002 and 2017 will continue unchanged until 2060. Hence, we extrapolated the log-linear trend until 2060 by predicting incidence from Poisson regression models for each year of the projection period and for each age-sex-race and ethnicity combination.

All projections of the age-specific prevalence were stratified by sex, race and ethnicity, and diabetes type. The number of youth with diabetes was estimated by multiplying the projected prevalence with the corresponding population size as projected by the U.S. Census Bureau for 2060 (16). Handling of different classifications regarding race and ethnicity in the population projections and SEARCH is described in Supplementary Methods 2. We estimated 95% CIs using Monte Carlo simulation (Supplementary Methods 3).

Sensitivity Analyses

As a sensitivity analysis, we modeled the impact of three hypothetical interventions that annually attenuate the increasing trend in incidence of type 1 and type 2 diabetes by 1%, 2%, and 3%, respectively, from the year 2018 onward. We chose these reductions arbitrarily because of the lack of evidence for effective prevention of diabetes in youth. All analyses were performed using R version 4.0.4 statistical software (R Foundation for Statistical Computing).

RESULTS

Input Data

In 2017, among 3.6 million youth under surveillance, SEARCH identified 7,759 participants with prevalent type 1 diabetes and 1,230 with prevalent type 2 diabetes (2). Age-specific prevalence is shown in Supplementary Figs. 2 and 3.

Between 2002 and 2017, the mean annual number of incident cases identified in SEARCH was ~1,100 (type 1 diabetes) and ~300 (type 2 diabetes) among ~5 million youth at risk each year. More detailed results about trends in incidence are subject to further investigations and are planned to be published in another article.

Projected Prevalence

The trends in projected prevalence and number of cases of diabetes were similar for males and females. Therefore, we report results for both sexes combined in the following sections.

Figure 1*A* shows the projected prevalence under the constant incidence and increasing incidence scenarios between 2017 and 2060. For type 1 diabetes, the highest prevalence in 2017 was observed among NHW youth, followed by NHB, Hispanic/Latino, and NH other race youth. Under the constant incidence scenario, the prevalence was projected to remain stable until 2060, whereas under the increasing incidence scenario, the prevalence increased in all racial and ethnic groups. These increases were most pronounced among NHB youth.

For type 2 diabetes, the highest prevalence in 2017 was observed among NHB youth, followed by Hispanic/Latino, NH other race, and NHW youth. In contrast to type 1 diabetes, slight increases in prevalence were seen in the constant incidence scenario until 2025, particularly among NHB youth. From 2025 onward, the prevalence was projected to remain stable. In the increasing incidence scenario, the prevalence increased among all groups, particularly among NHB youth.

These projected trends in prevalence corresponded to a widening gap in racial and ethnic disparities for type 2 diabetes prevalence (Fig. 2). For instance, under the increasing incidence scenario, the prevalence ratio comparing NHB and NHW youth increased from 8.9 (95% CI 7.5; 10.6) in 2017 to 36.5 (95% CI 31.6; 42.7) in 2060. In contrast, racial and ethnic differences in type 1 diabetes prevalence showed a tendency to narrow in both projection scenarios (Fig. 2). However, this narrowing was not due to declining prevalence among NHW youth but increasing prevalence in all other racial and ethnic groups.

Projected Number of Youth With Diabetes

The projected number of diabetes cases is partly determined by trends in population growth, which is projected to differ among populations by race and ethnicity (16). Hence, despite stable prevalence in the constant incidence scenario (Fig. 1*A*), the number of type 1 and type 2 diabetes cases is projected to increase among NHB, Hispanic/Latino, and NH other race youth due to projected population growth, whereas a decrease can be seen in type 1 diabetes among NHW youth due to a projected population decline (16) (Fig. 1*B*). In the increasing incidence scenario, the increases in the number of cases are considerably larger, and the decline among NHW youth is reversed. The largest increases in this scenario occurred among NHB youth.

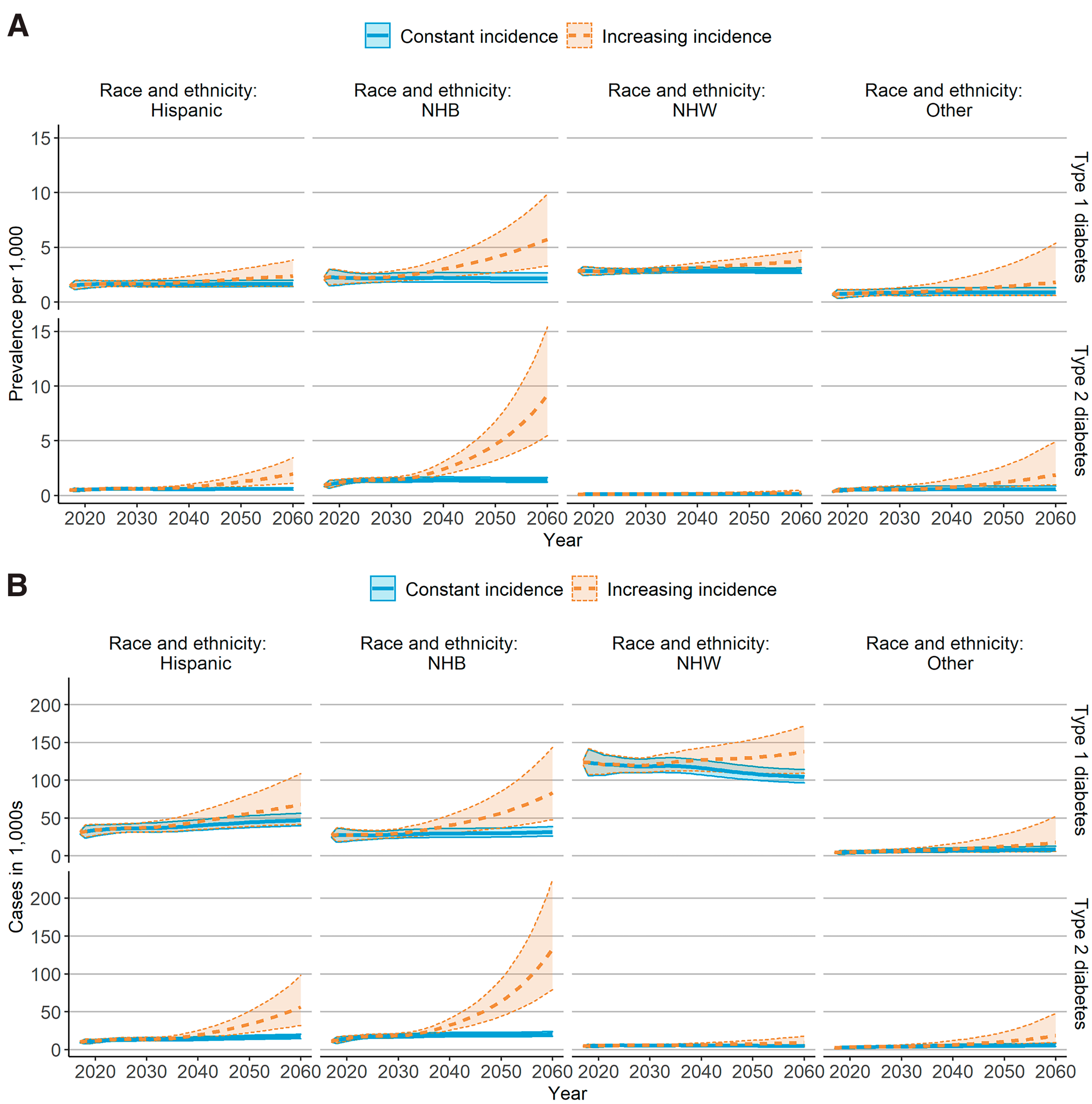

Figure 1—Projected prevalence of (*A*) and number of youths with (*B*) diabetes aged <20 years in the U.S., 2017–2060. In the constant incidence scenario, prevalence was projected under the assumption that the incidence rate did not change between 2017 and 2060. In the increasing incidence scenario, prevalence was projected under the assumption that trends in incidence observed between 2002 and 2017 continued until 2060. Shaded areas indicate 95% CIs.

We combined youths from all racial and ethnic groups to estimate the overall prevalence and number of cases of diabetes (Table 1). The overall number of youths with type 1 diabetes is projected to remain stable at ∼190,000 between 2017 and 2060 in the constant incidence scenario, and to increase to ∼306,000 in the increasing incidence scenario, corresponding to a relative increase of 65% (Table 2). The number of youths with type 2 diabetes is projected to increase from 28,000 to 48,000 in the constant incidence scenario and to 220,000 in the increasing incidence scenario (Table 1), corresponding to relative increases of ∼70% and 700%, respectively (Table 2). Results for short-term projections for the years 2030 and 2040 are provided in Supplementary Table 3. Combining both diabetes types resulted in case increases from 213,000 (95% CI 209,000; 218,000) in 2017 to 239,000 (95% CI 209,000; 282,000) in 2060 in the constant incidence scenario and 526,000 (95% CI 335,000; 893,000) in the increasing incidence scenario.

In sensitivity analyses, we modeled three hypothetical interventions that annually attenuate the increasing trend in incidence by 1%, 2%, and 3%. These analyses resulted in 396,000 (95% CI 255,000; 686,000), 294,000 (95% CI 187,000;

Year and scenario	Prevalence ratio (95%-CI)
Type 1 diabetes	
2017	0.5 (0.5;0.6)
	0.8 (0.7;0.8)
	reference
	0.3 (0.2;0.3)
2060 constant incidence	0.6 (0.5;0.6)
	0.8 (0.7;0.9)
	reference
	0.3 (0.2;0.4)
2060 increasing incidence	0.6 (0.5;0.8)
	1.5 (1.1;2.1)
	reference
	0.5 (0.2;1.1)
Type 2 diabetes	
2017	4.8 (4.1;5.6)
	8.9 (7.5;10.6)
	reference
	3.6 (2.9;4.4)
2060 constant incidence	4.5 (4.2;4.7)
	10.6 (9.8;11.3)
	reference
	4.1 (3.7;6.5)
2060 increasing incidence	7.9 (7.1;8.8)
	36.5 (31.6;42.7)
	reference
	7.2 (5.3;19.8)

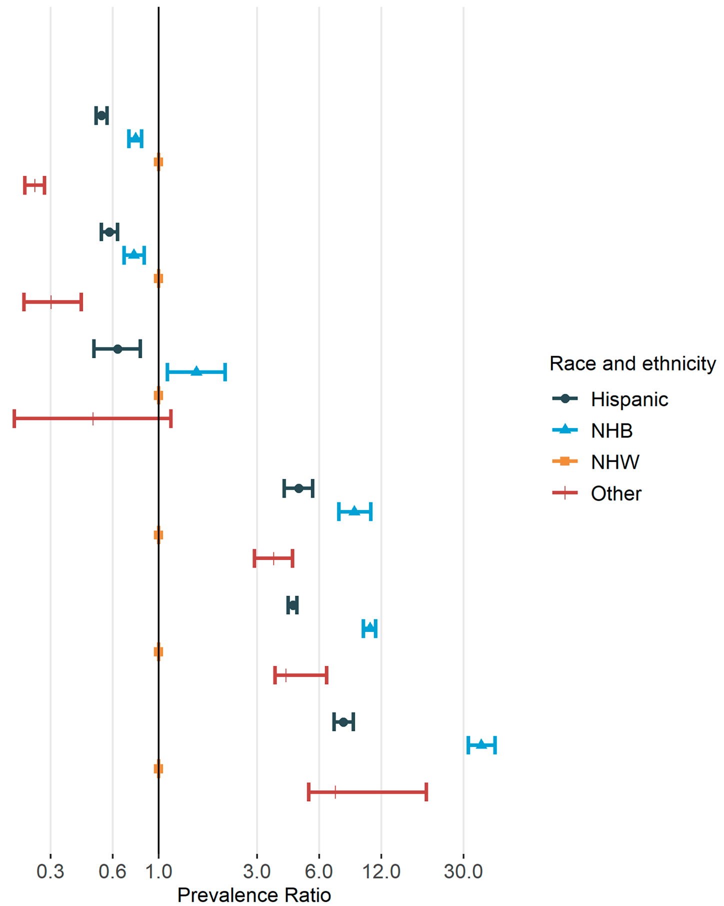

Figure 2—Projected racial and ethnic disparities in diabetes prevalence among youth aged <20 years in the U.S., 2017–2060. In the constant incidence scenario, prevalence was projected under the assumption that the incidence rate did not change between 2017 and 2060. In the increasing incidence scenario, prevalence was projected under the assumption that trends in incidence observed between 2002 and 2017 continued until 2060.

485,000), and 218,000 (95% CI 139,000; 366,000) cases (type 1 and type 2 diabetes) in 2060, respectively (see Supplementary Table 4 for results by diabetes type). These numbers correspond to 122,000 (95% CI −499,000; 197,000), 231,000 (95% CI −611,000; 52,000), and 308,000 (95% CI −528,000; −196,000) prevented prevalent cases, respectively.

CONCLUSIONS

Based on an illness-death model and data on prevalence and incidence of diabetes in youth in the U.S., we projected the prevalence and number of youth with diabetes through 2060. We accounted for differences in prevalence, incidence, and annual percent change in incidence by race and ethnicity, sex, and diabetes type, as well as projected demographic changes until 2060. We found that the number of youth with diabetes will increase 12% from 213,000 (type 1 diabetes 185,000, type 2 diabetes 28,000) in 2017 to 239,000 (type 1 diabetes 191,000, type 2 diabetes 48,000) in 2060, if the incidence remains as observed in 2017. Assuming that trends in incidence observed between 2002 and 2017 continue, the projected number of youth with diabetes will more than double to 526,000 (type 1 diabetes 306,000, type 2 diabetes 220,000). In both scenarios, we observed a substantial widening of disparities among race and ethnicity groups in type 2 diabetes prevalence. Increases in prevalence were least pronounced among NHW youth and most pronounced among NHB youth.

A similar analysis using SEARCH data published in 2012 also projected a substantial increase in the number of youths affected by diabetes in scenarios assuming constant and increasing incidence rates (17). However, the numerical results differ, particularly in the projected increases by diabetes type. As an example, assuming increasing incidence rates, Imperatore et al. (17) projected 672,000 (type 1 diabetes 587,000, type 2 diabetes 84,000) cases for 2050, whereas we estimated 526,000 (type 1 diabetes 306,000, type 2 diabetes 220,000) cases for 2060. Hence, our projections were lower for type 1 diabetes but considerably higher for type 2 diabetes. These differences are mostly due to our inclusion of empirically observed race and ethnicity–specific trends in incidence, whereas the data available for Imperatore et al. only allowed for applying trends in incidence to youth from all racial and ethnic groups equally. Comparison of these two studies highlights the additional benefit of accounting for type as well as for race and ethnicity–specific input data when projecting the future burden of diabetes in youth.

Implications for Public Health

Our results suggest a substantial increase in the number of youths with

Table 1—Projected prevalence and number of youth with diabetes in the U.S., 2060

	Year					
	2017		2060			
			Constant incidence*		Increasing incidence†	
	Prevalence per 1,000 youths (95% CI)	Number of cases × 1,000 (95% CI)	Prevalence per 1,000 youths (95% CI)	Number of cases × 1,000 (95% CI)	Prevalence per 1,000 youths (95% CI)	Number of cases × 1,000 (95% CI)
Type 1 diabetes	2.2 (2.2; 2.3)	185 (181; 189)	2.1 (1.9; 2.5)	191 (168; 222)	3.4 (2.3; 5.3)	306 (205; 476)
Hispanic/ Latino	1.5 (1.4; 1.6)	31 (29; 32)	1.7 (1.4; 2.0)	47 (40; 56)	2.4 (1.5; 3.8)	68 (42; 109)
NHB	2.2 (2.0; 2.3)	27 (25; 28)	2.2 (1.8; 2.7)	32 (26; 39)	5.7 (3.3; 9.9)	83 (48; 143)
NHW	2.8 (2.7; 2.9)	124 (120; 127)	2.9 (2.6; 3.1)	105 (97; 114)	3.8 (3.0; 4.7)	137 (109; 172)
NH other race	0.7 (0.6; 0.8)	4 (4; 5)	0.9 (0.6; 1.3)	8 (6; 13)	1.8 (0.6; 5.4)	18 (6; 52)
Type 2 diabetes	0.3 (0.3; 0.4)	28 (27; 30)	0.5 (0.5; 0.7)	48 (41; 58)	2.5 (1.4; 4.6)	220 (129; 410)
Hispanic/ Latino	0.5 (0.5; 0.5)	10 (9; 11)	0.6 (0.5; 0.7)	17 (15; 20)	2.0 (1.1; 3.5)	56 (32; 98)
NHB	0.9 (0.8; 1.0)	11 (10; 12)	1.4 (1.2; 1.6)	20 (18; 24)	9.2 (5.5; 15.4)	134 (80; 224)
NHW	0.1 (0.1; 0.1)	5 (4; 5)	0.1 (0.1; 0.2)	5 (4; 6)	0.3 (0.1; 0.5)	9 (5; 18)
NH other race	0.4 (0.3; 0.4)	2 (2; 3)	0.6 (0.5; 0.9)	5 (4; 8)	1.9 (1.0; 4.9)	18 (10; 48)

*In the constant incidence scenario, prevalence was projected under the assumption that the incidence rate did not change between 2017 and 2060. †In the increasing incidence scenario, prevalence was projected under the assumption that trends in incidence observed between 2002 and 2017 continued until 2060.

diabetes, indicating an increasing demand for diabetes specialists and care teams to care for children, adolescents, and emerging adults; medical devices; and programs aimed at optimizing glycemic control and preventing complications in future decades. The future burden of type 2 diabetes in youth may impose challenges on the treatment of type 2 diabetes. Since a growing number of people will spend much of their lives with type 2 diabetes and accumulate long disease duration, a potential exists for an increased risk of complications associated with diabetes duration. Hence, the trend toward longer diabetes duration due to increasing prevalence in youth and reductions in diabetes-related mortality among adults may result in increasingly diverse diabetes-related morbidity (e.g., because of increasing rates of diabetes-related cancers and disabilities) (18). One major challenge might be the rise in obesity among U.S. youth (4,5). During the severe acute respiratory syndrome coronavirus 2 pandemic, the rate of obesity increased among youth, which may contribute to the increased risk of type 2 diabetes (19).

From an intergenerational perspective, the projected growth in the prevalence of reproductive age women with diabetes seems particularly problematic, since exposure to maternal diabetes in utero is associated with an increased risk of obesity and type 2 diabetes in offspring (3,6,20). These future prospects raise the question of how to attenuate or reverse current trends in youth-onset diabetes. In a sensitivity analysis assuming an attenuation of increasing trends in incidence by 2% annually, we projected 126,000 type 2 diabetes cases compared with 220,000 cases without attenuation of incidence trends. Hence, it is hypothetically possible to considerably reduce the projected increased diabetes burden in youth. Unfortunately, evidence on prevention of type 2 diabetes in youth is scarce, and additional research would be needed to determine how a sustainable change in population-wide incidence of type 2 diabetes over the next few decades can be achieved. Besides interventions aimed at behavioral change on the individual level, social determinants of health, such as built environment, obesogenic food environments, and epigenetic factors, are increasingly gaining attention as manipulable causes of type 2 diabetes (3,20–22). Intervening in social determinants of health might also be a promising path to reduce racial and ethnic disparities in youth-onset type 2 diabetes (23). Regarding type 1 diabetes, faster increases in projected prevalence among all racial and ethnic groups other than NHW youth suggest changing disparity patterns. Further research on the causes of heterogeneous trends in type 1 diabetes incidence could help identify preventive measures.

To provide information about the main drivers of future dynamics of diabetes in youths, future modeling studies could incorporate risk factors such as obesity and family history of diabetes. For instance, our model can be extended to incorporate single risk factors or risk scores that account for several risk factors (24,25).

Strengths and Limitations

This study was based on population-based data from one source with standardized procedures and a unified study protocol over a period of 16 years. Given that diabetes in youths, type 2 diabetes in particular, is difficult to study because of small numbers, these data are a valuable resource. For instance, in a similar study from 2012 (17), data on trends in incidence were only available for type 1 diabetes among NHW and Hispanic/ Latino youth (26). In contrast, we were able to inform the projection model with incidence trend data stratified by sex, diabetes type, and four racial and ethnic groups. Our projection model allowed us to combine these data on the dynamics of diabetes with demographic changes as projected by the U.S. Census Bureau (16).

Table 2—Projected percent change in prevalence and number of youths with diabetes in the U.S., 2017–2060

	Relative change from 2017 to 2060			
	Constant incidence*		Increasing incidence†	
	Percent change in prevalence (95% CI)	Percent change in number of cases (95% CI)	Percent change in prevalence (95% CI)	Percent change in number of cases (95% CI)
Type 1 diabetes	−5 (−16; 11)	3 (−9; 21)	52 (3; 138)	65 (12; 158)
Hispanic/Latino	10 (−8; 33)	54 (29; 85)	59 (−2; 157)	121 (37; 259)
NHB	−1 (−18; 22)	18 (−3; 46)	163 (51; 358)	214 (80; 446)
NHW	1 (−6; 11)	−15 (−22; −7)	33 (6; 67)	11 (−11; 39)
NH other race	21 (−17; 86)	100 (36; 207)	155 (−14; 670)	321 (43; 1,171)
Type 2 diabetes	56 (31; 93)	69 (43; 109)	612 (325; 1,228)	673 (362; 1,341)
Hispanic/Latino	20 (0; 46)	67 (40; 103)	296 (132; 617)	452 (223; 899)
NHB	52 (27; 82)	82 (51; 117)	901 (484; 1,629)	1093 (596; 1,960)
NHW	28 (1; 68)	7 (−16; 41)	142 (24; 375)	102 (3; 297)
NH other race	49 (15; 137)	146 (90; 292)	406 (163; 1,220)	735 (334; 2,078)

*In the constant incidence scenario, prevalence was projected under the assumption that the incidence rate did not change between 2017 and 2060. †In the increasing incidence scenario, prevalence was projected under the assumption that trends in incidence observed between 2002 and 2017 continued until 2060.

Our study is also subject to some limitations. First, the SEARCH study only provides data on diagnosed diabetes. Hence, we could not account for undiagnosed diabetes. While this means that the true prevalence may be underestimated, the frequency of undiagnosed diabetes in the general population of youths appears to be quite low (27). This may hold true in particular for type 1 diabetes because of its severity and insulin requirement at disease onset. Undiagnosed type 2 diabetes might be more common in the adult population. However, in youths, pancreatic β-cell function appears to deteriorate more rapidly than in adults (28), suggesting that youth rapidly develop hyperglycemia and may require medical attention sooner than adults. Indeed, data from the National Health and Nutrition Examination Survey showed that in youth aged 10–19 years, undiagnosed diabetes is uncommon (29). Another limitation is the precision of the projected estimates. Although the SEARCH study comprises a large number of participants, wide CIs for some projected estimates were obtained, particularly in the increasing incidence scenario. Furthermore, although the SEARCH study is the largest population-based study of diabetes in youth in the U.S., it does not cover all geographic regions and may not be representative for all regions.

In summary, the number of youths with diabetes is projected to increase substantially, emphasizing the importance of additional research on, and implementation of, primary and secondary preventive interventions. The projected trends indicate a substantial widening of the gap in health disparities in type 2 diabetes prevalence, with the highest estimates for NHB youth. If the current trends continue, U.S. health care systems could face an increasing demand of youth-onset diabetes health care services, resulting in increasing health care costs.

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