The Dynamics of Diabetes Prevalence, Morbidity, and Mortality

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Introduction

Diabetes mellitus has caught the attention of the world as a major public health problem due to the explosive increases in prevalence that have occurred, affecting virtually all regions of the world and, within regions, affecting all age and demographic subgroups and across the full range of socioeconomic status [1–3]. The estimated global prevalence for 2021 is 536 million, with 10.8% of men and 10.2% of women affected. The highest regional prevalence was registered in the Middle Eastern and North African region (18.1%), while the lowest was in the African region (5.3%). The countries with the highest prevalence were Pakistan (30.8%), French Polynesia (25.2%), and Kuwait (24.9%) [1]. This growth has included both type 1 and type 2 diabetes, although between 90 and 95% of the cases and the predominant increase in prevalence have been driven by type 2 cases [4]. Dozens of individual-level genetic and environmental factors have been prospectively associated with type 2 diabetes, but the increases in prevalence in most societies have likely been driven by a smaller set of trends, including the increasing prevalence of overweight and obesity, declining levels of physical activity, poor-quality carbohydrate in our diets, sugary drinks, increased fast food and portion sizes, aging and a longer lifespan, and increasingly diverse socioeconomics [5, 6]. There is also increasing recognition of heterogeneity in diabetes types, even within the classic categories of type 2 and type 1 diabetes, that likely have different patterns of risk factors that may further vary by region and context [7].

The growth of diabetes prevalence has ominous implications for numerous health and economic-related reasons. Ultimately, diabetes places an enormous burden on individuals, families, health systems, and societies because of the treatment required, the acute and chronic complications, the demand for health services, the direct impact on quality of life, and the loss of years of life [8, 9]. Apart from the already established macrovascular and microvascular complications, reductions in cardiovascular and all-cause mortality are leading to a shift in the morbidity profile and causes of death of those living with diabetes [10–12].

While the growth of diabetes is most apparent in prevalence trends, there are numerous dynamics in the epidemic underway, with important implications for the clinical and public health priorities that follow. We have synthesized primary findings from population studies of the burden and trends in prevalence, incidence, morbidity, and mortality, with a particular focus on the status in North America and Latin America.

Current Burden of Prevalence and Incidence

Prevalence

Countries of the Americas tend to be around the median of the worldwide prevalence of adult diabetes, now estimated at 10.5%, with almost one-in-two adults with diabetes being unaware that they have the condition [1]. The highest estimates from the Americas region come from the Caribbean Islands and Belize, where, except for Aruba, prevalence ranges from 8.7% in the British Virgin Islands to 16.1% in Saint Kitts and Nevis, making it one of the higher diabetes prevalence regions in the world. Similarly, the Central America region contains countries with a particularly high prevalence (Guatemala, the Dominican Republic, Nicaragua, and Puerto Rico), ranging between 9.3% and 13.3% [1]. Prevalence estimates for subregions of the Americas from the Global Burden of Disease Study are generally highest in Mexico, the Caribbean, Central Latin America, and high-income North America, and lowest in Southern Latin

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America, Tropical Latin America, and Andean South America. Other estimates within the past ten years suggest that prevalence is similar for Canada (6.7% diagnosed diabetes in 2014 and an additional 3% undiagnosed in 2007-2009) and Brazil (6.6%) but higher for Mexico (8.9% diagnosed in 2012) and Colombia (12.3% diagnosed in 2016-2017) [13–15]. Prevalence is strongly associated with age, ranging from 2% to 7% across subregions among young adults (age 15-49 years), from 8% to 25% in adults aged 50-69, and from 12% to almost 30% in those aged >70 years.

In the USA, 11.2% of adults have diagnosed diabetes, and 3.4% have undiagnosed diabetes, for a total of 14.6% [16]. The national prevalence in the USA conceals considerable geographic variation, ranging from less than 5% in low prevalence areas of the USA to greater than 16% in high prevalence areas, including areas of concentration in the Mississippi Valley and Deep South, the Appalachian Mountain chain, and selected areas of the West and Midwest corresponding to Native American lands [17, 18]. Prevalence is also notably high in areas corresponding to areas of high concentration of Native Americans and, in Canada, in areas with large populations of First Nations residents.

In the USA, diabetes prevalence is similar across genders but increases steeply with age, such that young adults (age 18-44), middle-aged (45-64), and older (≥65 years), have a prevalence of 2.4, 12.2, and 20.7, respectively. Prevalence also has a strong association with race and ethnicity in the USA, as compared to white women, American-Indians, Alaska Natives, and non-Hispanic blacks have a prevalence that is about twice that of whites, while Hispanics and Asians have a prevalence that is about 80% higher than whites [16, 19]. Education level is also a key factor, as adults with less than a high school education have a prevalence rate of 19.6% that is about 67% higher than that of those with a college or higher education (11.6%) [16]. Within Latin America, indigenous populations have historically had a low prevalence but now represent the populations with the greatest magnitude of recent increase, as evident in indigenous populations in Brazil and Chile [20].

Undiagnosed Diabetes

Because early stages of diabetes are usually without symptoms, many individuals have several years with the disease before detection and diagnosis, and thus a large proportion of the population with diabetes is undiagnosed. In the USA, the prevalence of undiagnosed diabetes is about 3.4%, representing 23.3% of the adult population with diabetes [16]. Older adults, Mexican Americans, and persons with lower education are somewhat less likely to be diagnosed. Although it is commonly believed that awareness and detection of diabetes are increasing over time, changes in the proportion of the population with undiagnosed diabetes converting to the diagnosed state have been relatively unchanged over time, with the exception of recent improvements in detection in older adults, non-Hispanic whites, and wealthy individuals and worsening detection in Mexican-Americans [16, 21, 22]. Few other studies in the Americas have reported undiagnosed diabetes. Considerably higher proportions of cases remaining undiagnosed have been documented in many other regions of the world. Although diagnostic definitions and time periods vary across studies, the proportion of undiagnosed diabetes has been reported to range from 20 to 53% in the South and Central American regions [1]. However, national data from Mexico suggests that up to 50% of cases remain undiagnosed, and in Canada, 20%-40%, depending on the glycemic definition [23].

Incidence

Incidence, or the rate of new cases per population, is less directly affected by mortality rates than is prevalence and is thus a more sensitive indicator of the trajectory of the epidemic. The current adult incidence of diagnosed diabetes is about 6 cases per 1000 adults per year. The incidence is higher for men, with incidence rates of around 7 per 1000 adults, while women had an incidence of 6 cases per 1000 adults in 2019. race-ethnic patterns that parallel the estimates for prevalence [19]. Like prevalence, incidence increases steeply with age, from 4 per 1000 in young adults (age 18-44) to 10 per 1000 in middle age (45-64 years), but there is no further age-related increase thereafter, as incidence is 7 per 1000 among persons aged ≥65, reflecting the age-related incidence peak in the early 60s; Incidence estimates from population-based studies only include the detected cases and thus do not reflect true incidence. When undiagnosed cases are included, estimates in the USA approach 1% per year, and can be used as a general benchmark of the risk of a population, as subpopulations with different designations of prediabetes, such as impaired fasting glucose and impaired glucose tolerance, have incidence estimates that range from 1 to 5% per year [24].

Prediabetes

Estimates of prediabetes vary considerably with the definition used, which remains an area of debate because of the high degree of discordance that exists across different glycemic markers, including fasting plasma glucose, post-challenge glucose response, and HbA1c. Using the American Diabetes Association-like prediabetes definition of fasting plasma glucose or elevated HbA1c, 35% of adult Americans have prediabetes, with estimates ranging from 24% among young adults (age 18-44) to 47% among adults aged ≥ 65 years [22]. It is noteworthy that, while only about 15% of persons with prediabetes are aware of their risk status, this represents a 50% increase from the last estimates of 10%. Since the risk of progression from prediabetes to diabetes with the ADA definition is relatively low, the Center for Medicare and Medicaid Services (CMS) has adopted a definition of FPG > 110 mg/dl or HbA1c > 5.7%.

Trends and Trajectories in the Epidemic

Prevalence and Incidence

The prevalence of diagnosed and total diabetes has been increasing in most regions for as long as population-based estimates have existed [2, 25, 26]. From 1990 to 2019, worldwide prevalence among adults (20 years of age or older) increased from 4.8% to 8.7% in men and from 4.6% to 7.8% in women, corresponding to an increase in total numbers from 143 to 418 million adults [27]. Diabetes prevalence increased in virtually all regions of the world, with the greatest absolute increases in the Middle Eastern and North African region [27]. Although the growth of mega-urban areas in low- and middle-income countries is often regarded as an accelerator of the diabetes epidemic, large increases have also been observed in rural areas [28].

In the United States, national-level prevalence was first recorded in 1960 at less than 1% of the population and grew steadily in the 1960s through the 1980s to about 3.5% in 1980 (Diabetes in America, 1995) [29–31]. However, in the 1990s, prevalence and incidence increased more rapidly, with a dramatic 50% increase in prevalence from 1990 to 2010 and a continued increase until a peak incidence of 9 per 1000 in 2008 [19]. The increase in prevalence continued from 2009 up to 2018, with total and diagnosed cases being responsible for the trend, while undiagnosed cases remained stable. These trends followed large increases in the prevalence of overweight and obesity occurring during the same period. Throughout this period, the increases in prevalence were paralleled by increases in incidence, from around 4 cases per 1000 per year in the 1980s and early 1990s to almost 10 cases per 1000 adults in 2009 [19, 32].

Prevalence increased in both men and women and in all age groups; the greatest relative increases were observed in youth and young adults, while the greatest absolute increases occurred in older adults [33, 34]. However, the greatest increase in total numbers was observed among middle-aged adults, driven by the USA's baby boom generation, born between 1945 and 1965, reaching the ages of peak diabetes incidence. The increases in diagnosed diabetes increased in virtually all other demographic subgroups of the population, but were particularly notable in those of low education and socioeconomic status, leading to a particular widening of prevalence by social class [32, 35]. This is also evident in geographic trends, where the poorest areas of the USA saw the greatest increase in diabetes prevalence [36].

Impact on Lifetime Risk and Years of Life

The enormous increases in incidence, combined with large decreases in mortality, described in more detail below, have had a large impact on the lifetime risk of diabetes, or the probability of developing diabetes before death, and the number of years spent with and lost due to the disease. Considering Latin America, those metrics have so far have been estimated only for Mexico and Brazil. In Mexico, the lifetime risk through life for women was estimated at 57.7%, whereas for men it was 48.8% [15]. In Brazil, the lifetime risk of diabetes for a healthy 35-year-old woman was 23.8% for those who self-reported as white and 32.2% for those who self-reported as brown or black, the same pattern was observed among men, with a 23.0% and 29.3% risk, respectively. On average, a Brazilian woman diagnosed with diabetes at the age of 35 will lose 2 years of life, whereas a man will lose 4 years [37]. Although this changing burden is a function of both increasing incidence and declining mortality in the diabetic population, the increases and sustained incidence are the predominant factor, underscoring the continued need for effective prevention strategies at the policy, community, clinical, and individual levels.

A Turn of the Tide?

Following the large increases in prevalence in the 1990s, 2000s, and 2010s, data from the U.S. National Health Interview Survey described a peak at an incidence level of 8.5 per 1000 in 2008, followed by a 28% decline to 6.1 per 1000 in 2019 [19]. In contrast with incidence, the prevalence of total and diagnosed diabetes increased from 2009 up until 2018. The prevalence of undiagnosed cases had no significant changes during the period. Similar trends have been reported in state-level prevalence from a separate survey (the Behavior Risk Factor Surveillance System), confirming the encouraging reduction in incidence observed in the NHIS. The reductions appear to have generally affected all major subgroups of the population [33]. Youth and young adults stand out as remaining areas of concern, however, as prevalence and incidence continue to grow in these subgroups [38, 39]. Findings from the SEARCH Study (SEARCH for Diabetes in Youth) revealed a 4.8% yearly increase in the incidence of type 2 diabetes from 2003 to 2012. The increases in incidence were greatest for American Indians and Alaska Natives (8.9% increase), Asian or Pacific

Islanders (8.5%), non-Hispanic Blacks (6.3%), and Hispanics (3.1%), as whites were the only group with no change. Follow-up studies covering the period up to 2015-2017 showed the same annual percent change of 4.8% for both incidence and prevalence of type 2 diabetes, but a change in the most affected subpopulations was observed. In this time period, yearly increases in incidence were greatest for Asians and Pacific Islanders (7.7% per year), Hispanics (6.5% per year), Blacks (6.0%), and American Indians and Alaska Natives (3.7%), and Blacks (3.7). Whites were still the only group with no increase [39–41]. The increases in type 2 diabetes incidence were also accompanied by increases in type 1 diabetes incidence of about 2% per year from 2002 to 2015, and 1.4% from 2009 to 2017, paralleling concerning trends observed in other areas of the world [39, 40].

The continued increases in prevalence and incidence in youth are a discouraging harbinger for the future, given the implications of such early diabetes diagnosis on long-term cumulative diabetes-related complications.

Several explanations for the reduction in incidence have been raised, ranging from true reductions in the rate of the disease due to declining underlying risk in the population, to measurement biases stemming from changes in detection, diagnosis, or definitions of diabetes [32]. Midway through the past decade, surveillance reports also described peaks and decreases in total dietary intake, sugared beverage intake, and plateaus in the prevalence of obesity and physical inactivity. The 2010 American Diabetes Association recommendation to use HbA1c for the diagnosis of diabetes is another potential factor because the HbA1c threshold of 6.5% selects fewer people than the fasting glucose threshold of 126 mg/dl. Thus, a shift from FPG to HbA1c for diagnostic purposes would lower incidence and prevalence [42]. However, if health care providers use both tests, it could actually increase prevalence and incidence. As no surveillance systems measure the actual rates of diagnostic testing or the method of diagnosis, it is unclear how testing or changing awareness of diabetes is affecting incidence rates.

The Burden and Trends in Diabetes Complications

Prevalence and Incidence

Diabetes is notorious for its systemic effect on a diverse array of diabetes-related complications, including macrovascular, microvascular, neuropathic conditions, and infections with coronary heart disease, stroke, foot ulcers, vision loss, kidney failure, amputations, and death regarded as many of the most feared outcomes [43–45]. Diabetes is also increasingly associated with nontraditional complications, including cancers, liver disease, dementia, disability, and other geriatric syndromes [43, 46]. The etiology of diabetes is believed to be multifactorial, with genetic and environmental influences and a key influence of level of glycemic and blood pressure control on most complications.

Diabetic retinopathy is recognized as the signature complication of diabetes and, being the complication that is most specific to diabetes, has been used to guide diagnostic thresholds for diabetes. The prevalence of any diabetic retinopathy has been estimated at 28.5% of the adult diabetic population in the USA, with 4.4% of them having vision-threatening retinopathy [47]. However, no nationally representative estimates of retinopathy exist within the past decade. While it is conceivable that the reductions in incidence of diabetes complications (described in detail below) have served to reduce the prevalence of retinopathy, it is also possible that the concomitant reductions in mortality have resulted in the maintenance of similar or even higher levels of retinopathy.

Chronic kidney disease and coronary heart disease are prevalent at similarly concerning levels in the adult diabetic population, with 19% of adults having stage 3 or stage 4 chronic kidney disease and 18.3% of adults having coronary heart disease [48]. CKD is notably higher in African Americans than in whites, and although coronary heart disease prevalence is similar across race and ethnic groups, a strong gradient with education level has been noted for coronary heart disease, wherein persons with less than a high school education have a prevalence that is 8% points higher (26%) than those with more than a high school education (18%). Although recent estimates of CKD represent a reduction relative to the early 2000s, when prevalence was around one-fourth, there has been no significant reduction in prevalence between 2003-2004 and 2011-2012. Finally, estimates of the prevalence of specific complications do not reveal the full burden of diabetes-related morbidity; when the prevalence of the full range of vascular, musculoskeletal, neurologic, and cancer conditions is considered, most persons with diabetes have multiple chronic conditions present, and the mean number of comorbid conditions is already 3 at the time of diagnosis [49].

Trends in Complications

Despite the high prevalence of morbidity among patients with diagnosed diabetes, there have been large reductions in the incidence rates of diabetes complications over recent decades [29]. In a report of nationally representative data from 1990 to 2010 in the USA, there were substantial declines in a diverse spectrum of diabetes complications, including myocardial infarction, stroke, lower extremity amputation, end-stage renal disease, and hyperglycemic death, resulting in an overall halving of rates of complications for the average U.S. adult with diagnosed diabetes

[29]. The magnitude of decline was greatest for myocardial infarction, declining 68% to draw even with stroke, which also declined by 53%. Rates of amputation declined by 51%, end-stage renal disease by 28%. Rates of death due to hyperglycemia, which were less common in absolute terms, also declined substantially. These reductions in complications generally included men and women and both whites and non-whites. However, the declines in complications were substantially greater in older adults (age > 65 years), moderate in middle-aged adults, and either modest or nonexistent in young adults. Although no national data exist on rates of diabetic retinopathy, the prevalence of vision impairment in the USA declined by 25%, from 24 to 18%, paralleling the other improvements in rates. From 2017 to 2019, following a redesign of the survey, the prevalence of visual impairment for all age groups was estimated at 26% [19]. Improvements in diabetes-related complications of a similar magnitude have also been observed for hospitalizations due to vascular disease, amputations, and diabetes in the UK [10].

While the long-term perspective on trends in diabetes complications has clearly been encouraging, more recent reporting of results from the 2010 to 2016 period from the U.S. National Diabetes Surveillance System suggests that the improvements in complications have stalled, and in young adults, even increased [50]. Rates of lower extremity amputations increased overall, particularly among men and the middle-aged population, and were potentially driven by an increase in amputations of the toe, as trends in amputations above the foot have been stable. Similarly, trends in myocardial infarction, stroke, and end-stage kidney disease appear to have plateaued [19, 50–52]. It remains unclear whether such apparent shifting trends are related to changing characteristics of the population with diagnosed diabetes, changes in self-care, risk factor management or treatment, health policy effects, or even broader secular trends in the health of the population.

The encouraging trends in incidence of diabetes-related complications described above take the perspective of the average risk for a person with diagnosed diabetes. When trends in diabetes-related events are expressed as the absolute number of events, wherein the increases in diabetes prevalence over time are permitted to influence rates, the trends have been less encouraging [29]. From this general population burden perspective, rates of diabetes-related MI and mortality declined by 32% and hyperglycemic death declined by 42%, perhaps reflecting the impressive gains that have been made in smoking and the management of hypertension and hyperlipidemia in recent decades. However, trends in amputation stroke have been flat and ESRD has increased when viewed from this population perspective, reflecting the continued wave of new diabetes cases and perhaps an indication that there has been less success in reducing microvascular disease risk than macrovascular disease risk in many countries.

Despite the large reductions in the incidence of diabetes complications, the excess rates of complications associated with diabetes remain substantial, and areas of important disparities remain. Relative risks for lower extremity amputation and ESRD were 10.5 and 6.1, respectively, and adults with diabetes still have an 80% increased risk of myocardial infarction and a 60% increased risk of stroke, respectively [29]. Considerable disparities still exist across subgroups, as non-Hispanic blacks still have more than three times the risk of ESRD, a 50% higher incidence of amputations and stroke, Hispanics have a double incidence of ESRD, and Asians have a 30% higher risk of ESRD than Whites [19]. In addition, compared to women, men have 50% higher rates of ischemic heart disease and more than twice the rate of lower extremity amputation.

Limited population-based data on trends in other areas of the world exists to confirm whether the encouraging trends from the USA are also occurring elsewhere. Although reviews of international data have revealed reductions in rates of lower extremity amputations in numerous settings, these data generally come from Canada, Europe, and Australia. There is limited data on the trends in complications in the Americas or the remainder of middle- or lower-income countries around the world.

Diabetes and Mortality

Adults with diabetes in the USA, Canada, and several countries in Europe have been shown to have overall mortality rates that are approximately 60-80% higher than those of equivalent-aged adults without diabetes [11, 53]. However, data from a Mexico City cohort finding a considerably higher relative risk of death, ranging from 1.9 in persons aged 75-84, to 3.1 in those aged 60-74, to 5.4 for adults aged 35-59 years, serves as a reminder that there may be considerable variation across populations in excess mortality associated with diabetes [54].

Cardiovascular disease is the leading cause of death among adults with diabetes in the United States, accounting for 34% of the total, followed by cancer (20%), diabetes itself, and renal disease. In addition to the five most common causes of death described above, diabetes is associated with an increased risk of several other causes, including unintentional injuries, lower respiratory diseases, sepsis, influenza, and liver diseases. Comprehensive data from the Emerging Risk Factors Collaboration reveals several other specific causes of death that are notably increased in adults with diabetes, including cancers of the liver, pancreas, ovary, and colorectum [53]. These differential rates likely reflect multiple factors, including the chronic hyperglycemia associated with diabetes as well as the underlying risk factors, including hypertension, insulin resistance, and inflammation commonly recognized in persons with diabetes.

The association of diabetes with mortality varies considerably by demographic subgroup. For example, the relative risk of all-cause, CVD, and renal disease mortality decreases steeply with age. In the USA, among young adults (age 20-44) and middle-aged adults (age 45–64), diabetes is associated with about three times the death rate of those without diabetes. Among those age 65-74, diabetes is associated with twice the death rate and about a 25% increased rate among adults age >75 years. The lower relative risk among older age groups likely reflects several factors, including the possibility that type 2 diabetes onset in young adulthood is a more severe form that is more difficult to manage for physiological as well as environmental and behavioral reasons.

A Diversification of Long-Term Diabetes Associated with Diabetes

Several dynamics in the diabetes epidemic may be leading to relative shifts and diversification in the character of diabetes-related complications [29]. First, the proportionately greater declines in diabetes complications among older adults mean that proportionately more diabetes-related complications now occur in middle age than in previous decades. This is particularly evident in the United States, where adults age 45-64 accounted for only one third of amputations in 1990 and now account for more than half. Second, this may be further compounded by the greater relative increase in diabetes incidence in youth and the earlier exposure to long-term hyperglycemia and the development of diabetes-related complications [55, 56]. The large reductions in cardiovascular disease events and related mortality may be responsible for the relative persistence of end-stage renal disease, as people with diagnosed diabetes are living longer to develop renal disease. Similarly, the reduction in cardiovascular disease mortality observed in most populations with diagnosed diabetes is now accompanied by a proportional increase in deaths due to other causes. Among the US population with diabetes, the proportion of total deaths that were due to cardiovascular causes declined from almost 50% in the early 1990s to 33% in 2010. A similar shift in the specific causes of death has recently been reported in the UK, consistent with the observation of the gradual diversification of the **CVD** types of morbidity associated with diabetes [12]. During the same period, deaths due to cancer in the population with diabetes stayed stable around 18%, and deaths due to all non-CVD, non-cancer causes increased from 33% to 50% of the total. This latter group of "other causes" included several causes, including influenza, pneumonia, sepsis, renal disease, and chronic liver disease, that have an increased association with diabetes. For these latter causes, there has been no improvement or even an increase in the rates in recent decades.

Primary Conclusions and Implications

This synthesis of the epidemiology and trends of diabetes and its complications reveals the following general observations:

1. Changes in the underlying risk of most societies have led to large increases in the incidence and prevalence of diabetes over recent decades, leading to an enormous burden for individuals, families, health systems, and societies.
2. Signs of a peak in the epidemic are apparent in the USA and selected other countries of the world, with recent decreases in incidence and a plateau in prevalence. However, the explanations for these trends are unclear, and the encouraging news is offset by continued increases in diabetes incidence in youth.
3. Diabetes leads to an extensive and diverse array of morbidity, including macrovascular, microvascular, and neuropathic complications and the health outcomes that result.
4. Rates of diabetes-related complications have declined in the USA and other selected countries, likely due to improved risk factor management and organization of care.
5. The disproportionate reduction in cardiovascular disease mortality and increasing lifespan among adults with diabetes, combined with the continued growth of diabetes prevalence in youth, is fueling a diversification of diabetes-related complications and continued population-wide exposure to hyperglycemia that will drive high rates of diabetes-related morbidity into the figure.

ECP: Estimated crude prevalence referes to non-adjusted prevalence of a disease

WNH = white non-Hispanic
BNH = black non-Hispanic
ANH = Aasian non-Hispanic
HIS = Hispanic
LHS = Lless than high school
HS = High sSchool gGraduate
MHS = More than high school
COL = College graduate or above

Multiple-Choice Questions

1. The global prevalence of diabetes is currently estimated to be:
   (a) 278 million
   (b) 324 million

(c) 435 million
(d) **536 million**
(e) 612 million

2. The region with the highest worldwide prevalence of diabetes:
(a) **Middle East and North Africa**
(b) Europe
(c) North America
(d) Africa
(e) South Asia

3. Increases in diabetes prevalence are likely driven by:
(a) By autosomal dominant genetic traits
(b) By Mendelian inheritance
(c) **By increasing the prevalence of obesity and overweight**
(d) By aging and having a longer lifespan
(e) By socioeconomic factors

4. Current estimated prevalence of adult diabetes in the Americas:
(a) 5.7%
(b) 6.8%
(c) 8.3%
(d) **10.5%**
(e) 12.1%

5. The percentage of undiagnosed cases of diabetes among those with diabetes is:
(a) **23.3%**
(b) 19.8%
(c) 16.4%
(d) 12.5%
(e) 10.9%

6. Estimated prevalence of persons with prediabetes aware of their risk status:
(a) 65%
(b) 50%
(c) 35%
(d) 20%
(e) **15%**

7. Greatest relative increases in diabetes have been observed:
(a) In newborns
(b) **In youth and young adults**
(c) In pregnant females
(d) In middle-aged adults
(e) In the elderly

8. The incidence of diabetes in the USA has peaked:
(a) In the late 1980s
(b) In the late 1990s
(c) **In the late 2000s**
(d) In the late 2010s
(e) Is still increasing, no observed peak so far

9. Lifetime risk of developing diabetes before death for a 35-year-old woman is:
(a) 73.2%
(b) 61.4%
(c) **57.7%**
(d) 44.4%
(e) 38.1%

10. The signature and most specific complication of diabetes:
(a) Coronary heart disease
(b) Renal failure
(c) **Diabetic retinopathy**
(d) Diabetic foot
(e) Stroke

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