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Race/Ethnic Difference in Diabetes and Diabetic Complications

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Abstract

Health disparities in diabetes and its complications and co-morbidities exist globally. A recent Endocrine Society Scientific Statement described the Health Disparities in several endocrine disorders, including type 2 diabetes. In this review we summarize that statement and provide novel updates on race/ethnic differences in children and adults with type 1 diabetes, children with type 2 diabetes and in Latino subpopulations. We also review race/ethnic differences in the epidemiology of diabetes, prediabetes, and diabetes complications and mortality in the United States and globally. Finally we discuss biological, behavioral, social, environmental, and health system contributors to diabetes disparities in order to identify areas for future preventive interventions.

Keywords

Diabetes; Disparities; Ethnic; Race; Diabetes Complications; Prediabetes

Introduction

Health disparities in diabetes and its complications and co-morbidities exist worldwide. It is well-documented that race/ethnic minorities have a higher prevalence of diabetes than non-minority individuals [1]. There are multiple factors that contribute to these disparities, including biological and clinical factors, as well as health system and social factors [1]. This review will expand on a prior comprehensive review of type 2 diabetes disparities in adults summarized in an Endocrine Society Scientific Statement on Health Disparities in Endocrine Disorders [1] by briefly touching on its major findings but also describing race/ethnic differences in (1) type 1 diabetes in children and adults, (2) type 2 diabetes in children, and (3) diabetes prevalence among a more comprehensive set of Hispanic subgroups. This review will also include more global and international data on the prevalence of diabetes and its complications outside of the United States (U.S.).

Defining Race and Ethnicity

Williams defines ethnicity as “a complex multidimensional construct reflecting the confluence of biological factors and geographical origins, culture, economic, political and

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Compliance with Ethics Guidelines

Conflict of Interest

Elias K. Spanakis and Sherita Hill Golden declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent

This article does not contain any studies with human or animal subjects performed by any of the authors.

legal factors, as well as racism" [2]. The concepts of "race" and "ethnicity" play important roles in understanding disparities in health and health care [3, 4].

The current literature describing disparities in diabetes varies in the terms used to define specific race/ethnic groups. As done previously and for consistency, we will use the term "non-Hispanic black" (NHB) to refer to individuals of African descent, "non-Hispanic white" (NHW) for non-minority individuals, Hispanic American for those of Mexican, South American, Cuban, or Puerto Rican descent born and/or residing in the U.S., Asian American for individuals of South Asian (e.g. Indian), East Asian (e.g. Japanese, Chinese, Korean), Southeast Asian (e.g. Cambodian, Vietnamese, Laotian, Thai), and Pacific Island (e.g. Filipino) descent born and/or residing in the U.S., and Native American to refer to American Indians and Alaska Natives [1]. We recognize that these categories are arbitrary and sometimes contain heterogeneous groups, particularly among Asian and Hispanic populations. In addition, NHB individuals include African-Americans, Africans, and Afro-Caribbeans and the latter may be of Hispanic or non-Hispanic ethnicity. When studies use more specific terms in defining ethnic subgroups, we will use them accordingly.

Epidemiology of Diabetes and Prediabetes: U.S. and Global Prevalence Data

Diabetes in Adults

Diabetes is an important global public health burden. In the U.S., 8.3% of the population or 25.8 million individuals have diabetes. Among them 7 million are estimated to be undiagnosed [1, 5]. The prevalence of diabetes is highest among Native Americans (33%) and lowest among Alaska natives (5.5%; **Table 1)**. NHWs and Asian Americans have similar prevalence rates of 7.1% and 8.4%, respectively, where NHBs and Hispanic Americans overall have higher prevalence rates of 11.8% and 12.6%, respectively.

Recently, the Hispanic Community Health Study/Study of Latinos provided the first prevalence estimates for U.S. Latino subpopulations. Overall prevalence of diabetes in Latino/Hispanic Americans was higher than prior estimates--16.7% in men and 17.2% in women (**Table 2**) [6]. Importantly, the prevalence of diabetes varied among Hispanic American populations based on their countries of origin. South Americans had one of the lowest prevalence rates (10.1 % in men and 9.8% in women). Similarly low rates were found among Cuban men and women--13.2% and 13.9%, respectively. The prevalence of diabetes was the highest in those of Mexican, Puerto Rican, Central American, and Dominican descent, with rates of 16.2% to 19.3% for men and 18% to 19.4% for women (**Table 2**).

Diabetes prevalence rates among Asian Americans also differ by countries of origin, (**Table 3**) [7]. Asian Indians have the highest diabetes prevalence rate (14.2%), whereas Asian Americans from Korea and Japan have the lowest diabetes prevalence rates 4.0% and 4.9%, respectively. Similar prevalence rates have been found among other Asian American subgroups, including Vietnamese (6.1%), Chinese (6.2%), Filipino (8.9%) and Native Hawaiians/Pacific Islanders (6.7%).

Globally the prevalence of diabetes mellitus has increased at alarming epidemic rates [8]. In the summary statistics presented here, we report the comparative prevalence of diabetes in various regions, which adjusts for differences in the age distributions of various countries and allows regional comparisons [9]. In 2011, 365 million people worldwide had a diagnosis of diabetes [9]. The West Pacific region had the highest number of individuals (131.9 million) diagnosed with diabetes with a comparative prevalence rate of 8.3%, (**Table 4)**. The two countries in this region that had the highest prevalence rates were the Kiribati and

Marshall Islands, with rates of 25.7% and 22.2%, respectively. Middle East and North Africa regions had the highest comparative prevalence rates of diabetes at 11.0%. Six countries in this region are among the world's top ten countries for highest diabetes prevalence rates--Kuwait (21.1%), Lebanon (20.2%), Qatar (20.2%), Saudi Arabia (20.0%), Bahrain (19.9%) and United Arabian Emirates (19.2%). The North America/Caribbean region had the second highest comparative prevalence rate of diabetes at 10.7%. South-Central America and South East Asia had similar diabetes prevalence rates of 9.2%, whereas Europe had a 6.7% comparative prevalence rate. Africa had the lowest comparative prevalence rate of diabetes (4.5%); however the Africa region has the highest proportion of undiagnosed diabetes, with at least 78% of affected individuals being undiagnosed [9].

Prediabetes in Adults

In U.S. adults 20 years of age or older the age adjusted prevalence rate of prediabetes in 2005-2008 was 35% [1]. The definition of prediabetes was based on fasting glucose levels and hemoglobin A_{1c} (HbA_{1c}) and was similar among NHWs, NHBs and Mexican Americans. Native Americans had a 20% of prevalence of prediabetes between 2001-2004, based only in fasting glucose values [1].

Globally, the highest comparative prevalence rate of prediabetes (based on impaired glucose tolerance [IGT] values) was reported in the North American and Caribbean region and was 10.7% (**Table 4**) [9]. The comparative prevalence rates in Africa, Europe and Middle East/ North Africa were 9.7%, 8.6% and 7.6%, respectively. South/Central America and the Western Pacific regions had similar comparative prevalence rates of 5.4% whereas South East Asia had the lowest reported comparative prevalence rate of 3%.

Diabetes in Youth

Although incidence rates of newly diagnosed diabetes have been reported for both type 1 and type 2 diabetes, there are limited global prevalence data regarding children with these conditions. The prevalence of type 1 diabetes was highest in NHWs in the U.S. between the ages of 0-9 and 10-19, with rates of 1.03 and 2.89 per 1000 persons, respectively (**Table 5**) [10]. NHB children between the ages of 0-9 and 10-19 years have prevalence rates of 0.57 and 2.04 per 1000 persons, respectively [11], where Hispanic American children have prevalences of 0.44 and 1.59 per 1000 persons between the ages of 0-9 and 10-19, respectively [12]. Children of Asian and Pacific Island and Navajo origin had the lowest prevalence rates of type 1 diabetes (**Table 5**) [13] [14].

The prevalence of type 2 diabetes is generally low among children in all race/ethnic groups and it should be noted that very few cases of type 2 diabetes have been reported in some populations, especially in children between 0-9 years (**Table 5**). Prevalence rates are generally very low in children 0-9 years in all race/ethnic groups. The highest prevalence has been reported in Native Americans with prevalence rates, of 0.021 and 1.45 per 1000 persons between ages 0-9 and 10-19 years, respectively [14]. In NHB children the prevalence in those ages 10-19 years (1.06 per 1000 persons) is similar to that in Native American children [11]. Asian and Pacific Island children ages 10-19 years have similar prevalence rates of 0.52 and 0.46 per 1000 persons, respectively[12, 13]. Finally, one of the lowest prevalence rates of type 2 diabetes among children 10-19 years has been reported in NHWs at 0.18 per 1000 person years [10]. To our knowledge, there are no data available on the prevalence of prediabetes in children and adolescents.

Race/Ethnic Differences in Mortality and Diabetic Complications

Race/Ethnic Differences in Mortality

In 2007 diabetes was listed as an underlying cause of death in 71,382 death certificates and it was listed also as a contributing factor in another 231,404 death certificates in the U.S [15]. NHBs, Native Americans and Alaskan Natives and Hispanic Americans are 2.3, 1.9 and 1.5 times more likely to die from diabetes compared to NHWs, whereas Native Hawaiian's and Filipinos living in Hawaii are 5.7 and 3.0 times more likely to die from diabetes compared to NHWs living in Hawaii [1].

Globally 4.6 million people between ages 20-79 years of age are estimated to have died from diabetes in 2011 [9]. The International Diabetes Federation estimated diabetes mortality rates in various regions using two data sources—the World Health Organization estimates of the total number of deaths in each country and published regional estimates of the relative risk of death in individuals with diabetes compared to those without diabetes [9]. The Western Pacific region has the highest rate of recorded deaths attributable to diabetes as a percentage of all deaths between 20-79 years of age, with a rate that was close to 16%. Death rates attributable to diabetes of other regions were 14% (South East Asia and North America and Caribbean regions), 12% (South and Central America), and close to 10% (Middle East/ North Africa and Europe). The lowest recorded death rate attributable to diabetes was reported for Africa at 6%. It should be noted that mortality rates need always to be interpreted with caution as the diagnosis of diabetes is oftentimes omitted from death certificates [9].

Race/Ethnic Differences in Macrovascular Complications of Diabetes

Cardiovascular disease (Coronary Artery Disease, Strokes and Congestive Heart Failure)

A systematic review of the literature concluded that NHBs, Hispanic Americans and Asian Americans had a lower risk for developing cardiovascular complications of diabetes compared to NHWs [16]. Data from the Centers for Disease Control and Prevention showed that Hispanic Americans with diabetes had a lower percentage of stokes or heart disease among those ages 35 years and older (24.5%) compared to NHWs (33.9%) or NHBs (33.0%) [17]. Although NHBs and Hispanic Americans seem to have a lower or equal incidence of diabetic cardiovascular disease (CVD) compared to NHWs, the mortality rate for NHBs from CVD and the mortality rate for Hispanic Americans from acute stroke is higher compared to NHWs [18, 19]. In two studies from the United Kingdom, NHBs and Asians (i.e., Asians, Indo Asians, and South Asians) had a lower risk of CVD compared to NHWs, although Asians had a similar rate of heart vascular disease (i.e. angina and myocardial infarction) as NHWs [16].

Recently, the Hispanic Community Health Study/Study of Latinos found that the overall self-reported prevalence for coronary heart disease (CHD) and stroke among Hispanic Americans between ages 18-74 was 4.2% and 2.0%, respectively, in men and 2.4% and 1.2%, respectively, in women [6]. Among men, individuals from Puerto Rico, Cuba and the Dominican Republic had the highest prevalence for CHD--5.0%, 4.6% and 4.6% respectively--whereas individuals from South America had the lowest prevalence rate of 2.4%. Among women, the highest self-reported prevalence for CHD was also found in Puerto Ricans (5%), whereas Central American women had the lowest prevalence rate (1%). Men from Puerto Rico had the highest self-reported stroke prevalence rate (3.9%) whereas Central American men had the lowest rate (1%). Women from Puerto Rico and Mexico had the highest and lowest self-reported stroke prevalence rate, of 2.2% and 0.7%, respectively.

Data on macrovascular complications among Native Americans are generally limited [1]; however, available data indicate that the overall prevalence of CHD was 2.2 fold higher in Native Americans compared to the NHWs [20].

Peripheral Arterial Disease/ Risk of Amputations

In general, most studies suggest that ethnic/racial minorities have an increased risk for lower extremity amputations compared with NHWs although one study found that race or ethnicity was not associated with increased lower extremity amputation [1, 21]. Many of these studies were limited by lack of adjustment for potentially confounding factors that might explain the increased risk for lower extremity amputations in these populations [16]. After a more comprehensive adjustment for confounders, two studies showed an increased risk and four studies showed no difference in risk for developing lower extremity amputations among NHBs compared with NHWs [16]. In one study, Native Americans also had an increased risk for lower extremity amputations compared to NHWs [16]. Among Hispanic Americans, two studies found an increased risk and two studies found no risk difference in lower extremity amputations compared to NHWs following multivariable adjustment for confounders. In contrast, Asian Americans had a decreased risk for lower extremity amputations compared to NHWs [16].

Race/Ethnic Differences in Microvascular Complications of Diabetes

Retinopathy

Overall, minority populations are more likely to develop retinopathy than NHWs [1, 16]. Native Americans have one of the highest prevalence rates of diabetic retinopathy, with a rate of 45.3% compared with non-Native American populations [22]. Data from the NHANES III study showed that diabetic retinopathy prevalence was 33.4% in Mexican Americans and 26.5% in NHBs compared to 18.2% in NHWs [23]. Mexican Americans and NHBs also had an increased risk of developing moderate/severe retinopathy compared to NHWs [23]. Although Hispanic Americans and NHBs appeared to have similar prevalence rates of clinically significant macular edema and diabetic retinopathy, Hispanic Americans were more likely to have intraretinal hemorrhages involving a greater area of retina [24].

In contrast, international data show that in the United Kingdom, NHBs had a similar risk and Asians had a lower risk of retinopathy compared to NHWs after adjusting for retinopathy risk factors [16]. Algerian immigrants to France had similar adjusted retinopathy risk compared to the native French population [16]. Thus, minorities with diabetes in non-U.S. countries are not as adversely affected by retinopathy as diabetic minorities in the U.S.

Nephropathy

Ethnic and racial minorities have higher prevalence rates of end-stage renal disease (ESRD); however, interestingly, they have a lowest mortality rate on dialysis compared with NHWs [19]. NHBs, Native Americans and Asian Americans have a reported adjusted prevalence rate of ESRD of 5,284, 2,735 and 2,101 per million population, respectively, in 2009, compared to 1,279 per million population for NHWs. The rate among Hispanic Americans was 2,538 per million population in 2009, also higher compared to NHWs and 1.5 times higher compared to the non-Hispanic population [25].

International studies have found higher rates of ESRD among Asians compared to NHWs living in the United Kingdom [16]. A Dutch study similarly found a similarly increased risk of ESRD in Asians compared to Danes [16]. In the United Kingdom, there was no difference in proteinuria between NHBs and NHWs; and in France, there was no difference in renal disease between Algerian immigrants and the native French [16].

Neuropathy

Many studies have been performed regarding the prevalence rate of diabetic neuropathy among different ethnic/ racial groups with conflicting results. A comprehensive review of the available studies found no difference among them [16], however, these results should be interpreted with caution, as there was variability in the definition of diabetic neuropathy, methodology of each study that was performed and also cultural and language barriers that all can affect the results. A French study found neuropathy rates to be higher among Algerian immigrants to France compared to the native French. Otherwise, there are very limited international data examining race/ethnic differences in neuropathy [16].

In a questionnaire based study from the National Health Interview Survey, prevalence of diabetic neuropathy was equal (25%) among NHWs, NHBs and Mexican Americans [26]. In the San Luis Valley Diabetes Study, NHWs had diabetic neuropathy prevalence rate of 31.6% where Hispanic Americans had a prevalence rate of 23.3% [26]. In another study, NHWs had a higher prevalence rate of sensorimotor neuropathy (47%) compared to NHBs (37%) and Hispanic Americans (35%). In contrast, Hispanic Americans had a higher prevalence rate of autonomic neuropathy (51%), compared to NHBs (45%) and NHWs (44%) [26]. Among Native Americans the highest prevalence rate was reported in individuals from Arizona (22%). Similar prevalence rates were reported among Hopi and Navajo Native Americans (12%), Native Americans from Dakotas (9%) and Native Americans from Oklahoma (8%) [26].

Contributors to Race/Ethnic Disparities in Diabetes

Biological Factors

Glucose Metabolism and Insulin Resistance—Most studies show that compared to NHWs, NHBs and Mexican Americans have increased insulin resistance [1, 27] and augmented insulin secretion/hyperinsulinemia [1, 27, 28] independent of adiposity. It should be noted, however, that one study showed no difference in insulin secretion between Hispanic Americans of Mexican origin and NHWs [29]. Results are mixed in the small number of studies in Cuban Americans, with one study showing increased insulin resistance [30] and one study showing no difference in insulin resistance compared to NHWs [31]. In Asian Americans most studies showed a higher degree of insulin resistance [31, 32] and lower insulin secretion compared to NHWs [1, 31, 33]. Very few studies have been conducted in Native American populations. Native Americans with diabetes had reduced insulin sensitivity compared with NHWs, NHBs and Hispanic Americans in one study [34]. Similar results were reported in another study where Pima Indians had reduced insulin sensitivity compared to NHWs [35].

Obesity—Obesity represents one of the strongest contributors for the development of type 2 diabetes. In 2008, WHO estimated that 500 million individuals worldwide were obese [36]. In 2010 the WHO reported that the highest obesity prevalence rates for men and women 15 years of age and older were found in Nauru, Tonga and Micronesia, all located in the South Pacific [37].

Among adults in the U.S., the age adjusted prevalence rate of obesity in 2009-2010 was 35.7% [38]. NHBs had the highest prevalence rate of age-adjusted obesity of 49.5% whereas Mexican Americans and NHWs had rates of 40.4% and 34.3%, respectively. Among Asian Americans there is important variation in age adjusted obesity prevalence rates among Asian subgroups [1, 39]. The lowest obesity prevalence rates are reported among Korean (2.8%) and Chinese (4.2%). Vietnamese and Japanese have obesity prevalence rates of 5.3% and 8.7%, respectively, where Asian Indians have one of the lowest obesity prevalence rates

(6.0%), although they have one of the highest prevalence rates of type 2 diabetes [1]. The highest obesity prevalence rates are reported to be 14.1% among Filipinos (14.0%) and other Asian and Native Hawaiian/Pacific Islanders (12.5%) [39]. The high prevalence of type 2 diabetes in certain Asian subgroups despite a lower prevalence of obesity compared to NHW populations is related to the higher degree of visceral adiposity at a given body mass index (BMI) and/or waist circumference compared to NHWs [1].

Among Hispanic Americans, a recent study found that the overall prevalence of obesity was 36.5% but, as in Asian subpopulations, there was some variability depending on the country of origin. The obesity highest prevalence rate was reported among Puerto Ricans (40.9%), Dominicans (38.6%) and Mexicans (36.8%). Similar prevalence rates of obesity were reported in Cubans (33.6%) and Central Americas (32.7%), whereas South Americans had the lowest obesity prevalence (26.8%) [6].

Obesity is also an important contributor to type 2 diabetes in children and adolescents. Data from NHANES 2007-2008 showed that among adolescents boys aged 12-19 years, Mexican American boys had the highest prevalence rate of obesity (26.8%), whereas NHB and NHW boys had lower prevalence rates of 19.8% and 16.7%, respectively [40]. NHB girls had the highest prevalence rate of obesity between ages 12-19 years (29.2%), whereas Mexican American and NHW girls had prevalence rates of 17.4% and 14.5%, respectively [40].

Genetics: Genetic factors have been considered as a potential explanation for race/ethnic differences in diabetes risk; however, the majority of studies suggest that the genetic architecture conferring an increased risk of type 2 diabetes is similar across race/ethnic groups, at least as far as common variants are concerned. Over 40 confirmed loci are associated with an increased risk for type 2 diabetes regardless of race or ethnicity [1, 41]. As there are few large-scale genetic studies in minority populations, these groups deserve focused attention for novel discovery in ongoing and future genome wide association studies of type 2 diabetes [1, 40].

Glycemic Control and Diabetes Complications: Hyperglycemia is an important risk factor for the development of diabetic microvascular complications [42]. Several studies have shown that race/ethnic minorities with type 2 diabetes have worse glycemic control [43]. NHBs and Hispanic Americans have HbA_{1c} values that are 0.6% and 0.5% higher, respectively, compared to NHWs [44, 45]. It should be noted, however, that non-glycemic factors may contribute to the higher HbA_{1c} seen in minority populations [1, 46]. These factors include variations in erythrocyte membrane permeability to glucose, glucose transport across the erythrocyte membrane, differences in glycolytic rates, non-enzymatic glycation reactions and deglycation [46]. However, glycated albumin and fructosamine, which have been shown to be less affected by non-glycemic factors, have been found to be elevated in NHBs compared to NHWs [47], suggesting that race/ethnic differences in hyperglycemia in NHBs compared to NHWs is real and an important contributor to development of complications and poor clinical outcomes in minorities with diabetes.

Health Behavior and Other Non-Biological Contributors to Race/Ethnic Disparities in Diabetes

Physical activity and smoking are well-recognized risk factors for developing type 2 diabetes [48, 49]. NHBs, Native Americans and Alaska Natives are less physically active compared to NHWs and Mexican American women are reported to have lower levels of physical activity compared to NHWs and NHBs [50]. Data on physical activity in Asian Americans are very limited [39].

NHBs and NHWs have been reported to have similar smoking rates whereas Native Americans and Alaska Natives have higher smoking rates compared to NHBs and NHWs. Mexican Americans have the lowest smoking rates [50]. In the Asian population there is great variability in the rates of smoking with the highest rates among Korean men and the lowest among the Asian Indian men [39]. Higher smoking rates among Native Americans may explain the higher prevalence of diabetes and peripheral arterial disease in this population.

Self-monitoring of blood glucose (SMBG) is recognized an important behavior contributing to achieving glycemic control, reducing hypoglycemic events and reducing the risk of diabetes complications [1, 51]. Although some studies have shown that there is no difference in SMBG between race/ethnic groups, several others have shown decreased rates of SMBG among NHBs, Hispanic Americans, and Asian Americans compared to NHWs, whereas two studies found no difference in SMBG between Native Americans and NHWs [1, 52].

Depression also is a well-recognized comorbidity of type 2 diabetes and diabetic patients with depression have poorer adherence to self-management behaviors compared with those without depression [1, 53]. Minorities are more likely to suffer from depression and Native Americans and Alaska Natives have high prevalence rates of depression [1, 54]. NHBs are also more likely to underreport their depressive symptoms, raising concerns that the presence of depression in NHBs maybe under diagnosed and undertreated [55]. Finally, minorities also have been found to have a poorer adherence to medications [56] and less frequent preventive health screening [57], which may result in more advanced disease at presentation.

Social and Environmental Contributors to Disparities in Diabetes

Minorities commonly live in “inferior” neighborhood environments with respect to access to healthy food sources, places to exercise or crime related safety [1]. Lack of healthy food stores, lack of places to exercise and increased psychosocial stressors related to crime or limited social cohesion have been linked to poor health outcomes [58, 59]. Poor access to supermarkets has been associated with increased BMI [60] and neighborhoods with increased walkability have been associated with lower BMI [61]. Evidence from the Multi-Ethnic Study of Atherosclerosis found that better neighborhoods were associated with improved insulin sensitivity and decreased risk of type 2 diabetes [62, 63]. ‘Inferior” neighborhoods have also been associated with increased smoking, physical inactivity and poorer control of blood pressure, which can contribute to development of diabetes and its complications [64]. Management of chronic diseases can also be more difficult in low socioeconomic areas [65]. Price differences are greater in poorer compared to wealthier neighborhoods [66], low income communities have fewer groceries stores and supermarkets [67], and as already stated, access to healthier foods is limited in low income and minority neighborhoods [1, 68].

Healthcare Contributors to Disparities in Diabetes

Health care access and health insurance are important factors that allow patients with diabetes to received adequate medical care. Compared to NHWs, minorities with diabetes often lack health insurance [69, 70]. Uninsured patients with diabetes have less frequent foot and ophthalmological examinations and are less likely to receive other preventive health care services [71]. This population has higher odds of developing diabetic eye disease and having poor glycemic control [1, 72, 73]. Among Hispanic patients with diabetes, the lack of insurance has been associated with higher rates of microvascular complications [74]. Studies have also shown that the quality of care in disadvantaged patients with diabetes is inferior compared with more affluent individuals [1]. Minorities with diabetes were less likely to

have a dilated ophthalmological examination and a lipid profile, compared to NHWs [75]. Even in countries with universal health care, studies have shown that minorities receive inferior quality of health [76].

Conclusion

Diabetes represents a significant global heath issue and it is estimated that 1 out of 3 adults could have diabetes by 2050, due to primarily to expansion of the elderly and minority populations that are high risk for type 2 diabetes [77]. Regional data indicate that certain areas of the world such as Middle East and North Africa will continue to bear the public health burden of diabetes. In the U.S., minority children are more likely to develop type 2 than type 1 diabetes, which has economic, public health, and health care system implications for these young individuals who develop a chronic condition at such an early age. Minorities in the U.S. are more likely develop microvascular complications of diabetes and lower limb amputations, which can contribute to disability. In order to prevent and eliminate race/ethnic disparities in diabetes outcomes, multi-level intentions are needed both in the U.S. and globally. The most effective interventions that have reduce disparities and improved the quality of diabetes care are those targeting the patients, providers, health care organizations, community and health care systems, and health policy [1, 78, 79]. Addressing and eliminating health disparities in diabetes and its complications will ultimately improve our overall global health.

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Table 1

Age-adjusted prevalence of diagnosed diabetes mellitus in the United States by race/ethnicity in adults ≥20 years of age [5]

Race/ethnic group	Age-adjusted prevalence (%)
Non Hispanic Whites	7.1
Asian- Americans	8.4
Hispanic-Americans overall	11.8
Non Hispanic Blacks	12.6
Alaska Natives	5.5
Native Americans	33

Table 1 is reproduced from Centers for Disease Control and Prevention National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States. Atlanta: U.S Department of Health and Human Services. 2011. Available from: http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf.

Table 2

Age-adjusted prevalence of diagnosed diabetes mellitus in the United States in Hispanic/ Latino groups [6]

Race/ Ethnicity	Men (%)	Women (%)
Hispanic/ Latino (All)	16.7	17.2
Cuban	13.2	13.9
Dominican	18.2	18
Mexican	19.3	18.5
Puerto Rican	16.2	19.4
Central American	16.3	17.9
South American	10.1	9.8

Table 3

Prevalence (%) of diagnosed diabetes mellitus in the United States in Asian Subgroups [7]

Asian Subgroup	Prevalence (%)
Chinese	6.2
Filipino	8.9
Asian Indian	14.2
Japanese	4.9
Vietnamese	6.1
Korean	4.0
Other Asian and NHOPI*	6.7
All Asian and NHOPI*	7.5

*NHOPI: Native Hawaiian or Pacific Islander

Table 4

Prevalence of Diabetes and Impaired Glucose Tolerance (IGT) in Different Regions of the World in 2011 [9]

Region	Diabetes Comparative Prevalence (%)*	IGT Comparative Prevalence (%)*
Africa	4.5	9.7
Europe	6.7	8.6
Middle East and North Africa	11.0	7.6
North America and Caribbean	10.7	10.7
South and Central America	9.2	5.4
South East Asia	9.2	3.0
Western Pacific	8.3	5.4

*Comparative prevalence adjusts for differences in the age distributions of various countries and regions and allows regional comparisons

Table 5

Prevalence of Type 1 and Type 2 Diabetes Mellitus in youth in the United States by Race/Ethnicity

Race/Ethnicity	Type 1 Diabetes Prevalence (per 1,000)		Type 2 Diabetes Prevalence (per 1,000)		Reference
	0-9 years	10-19 years	0-9 years*	10-19 years	
Non-Hispanic White	1.03	2.89	0.0046	0.18	[10]
Non-Hispanic Black	0.57	2.04	0.0005	1.06	[11]
Hispanic American	0.44	1.59	0.0003	0.46	[12]
Asian and Pacific Islanders	0.26	0.77	0.014	0.52	[13]
Native American	0.08	0.28	0.021	1.45	[14]