International Diabetes Federation

# IDF **DIABETES ATLAS**

## Eighth edition 2017


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## Data

The list of studies on which estimates in the IDF Diabetes Atlas can be found at:

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# Forewords

Diabetes, a disease no longer associated with affluence, is on the rise across the globe as reported in this 8th edition of the *IDF Diabetes Atlas 2017.* The indicators are significant: millions of people are being destroyed by the current diabetes pandemic which substantiates IDF's mission and rigorous efforts to provide solutions to this worldwide health crisis. Already for some time, diabetes and other noncommunicable diseases (NCDs) that share similar risk factors have represented a primary threat to health and human development. Since the first IDF Diabetes Atlas was published in 2000, the fact that the incidence and prevalence of diabetes continues to rise is self-evident. However, the devastating short and long-term effects of the disease on our world become more detailed with each new edition of the Atlas.

At present, nearly half a billion people live with diabetes. Low and middle income countries carry almost 80% of the diabetes burden. Rapid urbanization, unhealthy diets and increasingly sedentary lifestyles have resulted in previously unheard higher rates of obesity and diabetes and many countries do not have adequate resources to provide preventive or medical care for their populations. Up-to-date studies and analysis reveal clearly that we need a robust and more dynamic response not only from different governmental sectors, but also from civil societies, patient organizations, food producers and pharmaceutical manufacturers.

Diabetes is not only a health crisis; it is a global societal catastrophe. Due to its chronic nature, diabetes causes devastating personal suffering and drives families into poverty. Governments worldwide are struggling to meet the cost of diabetes care and the financial burden will continue to expand due to the growing number of people developing diabetes.

Despite the horrifying picture depicted by the new *IDF Diabetes Atlas* figures, we have both the knowledge and the expertise to create a brighter future for generations to come. We must raise awareness on the importance of a healthy diet and physical activity, especially among children and adolescents, and incorporate healthy environments into urban planning.

Health professionals in primary healthcare should be adequately and appropriately trained about diabetes prevention and care, and provided with necessary screening tools and diabetes medications.

As part of the 2030 Agenda for Sustainable Development, Member States of the United Nations set an ambitious target to reduce premature mortality from NCDs—including diabetes—by one-third; provide access to affordable essential medicines; and achieve universal health coverage, all by 2030. We have an enormous task ahead of us, which is why we welcome the new edition of *IDF Diabetes Atlas.*

Going forward, IDF is calling for all nations around the globe affected by the diabetes pandemic to work towards the full implementation of Sustainable Development Goals and raise awareness about diabetes since ignorance and misconception remain widespread.

This report reminds us that effectively addressing diabetes does not just happen. It is the result of a collective consensus, commitment and public investment in interventions that are affordable, cost-effective and based upon the best available evidence. Please join me in ensuring that the findings in this report are utilised and its recommendations implemented and adhered to so that we may indeed halt the rise in diabetes.

Dr. Shaukat Sadikot
President 2016-2017,
International Diabetes Federation

I am honoured to introduce the 8th edition of the *IFF Diabetes Atlas 2017,* a global reference report setting the standard for estimates of diabetes prevalence and its related burden. Building on the substratum of the previous editions, the data affirm an abrupt rise in diabetes and forecast for doubling the current numbers in many regions by 2045.

There is an urgency for greater action to improve diabetes outcomes and reduce the global burden of diabetes now affecting more than 425 million people, of which one-third are people older than 65 years. The estimates of children and adolescents below age 19 with type 1 diabetes has risen to over a million. If nothing is done, the number of people with diabetes may rise to 693 million in 2045, although positively the incidence has started to drop in some high income countries. At the same time, a further 352 million people with impaired glucose tolerance are at high risk of developing diabetes.

By the end of this year, 4 million deaths will happen as a result of diabetes and its complications. Alongside other noncommunicable diseases, diabetes is increasing most markedly in the cities of low and middle income countries. The IDF South-East Asia and Western Pacific regions are at the epicentre of the diabetes crisis: China alone has 121 million people with diabetes and India's diabetes population totals 74 million. African, Middle Eastern and Northern African and South-East Asian regions are expected to face the highest upsurge in the next 28 years. People from these regions develop disease earlier, get sicker and die sooner than their counterparts in wealthier nations.

Notably, this year healthcare costs reached USD 727 billion of global healthcare expenditure dedicated to diabetes treatment and related complications. This represents an 8% growth since the previous statistics published in 2015. Despite imposing a heavy economic burden on public health as well as socio-economic development, the prevention of diabetes remains inexplicably underfunded.

Diabetes is a major contributor to cardiovascular diseases and is the eleventh common cause of disability worldwide. Undiagnosed or poorly managed diabetes can lead to lower limb amputation, blindness and kidney disease. Diabetes also exacerbates major infectious diseases such as TB, HIV/AIDS and malaria. For the first time, diabetes complications have a dedicated chapter in this edition.

Diabetes can be successfully managed and complications prevented, especially when detected early. Even better, by making lifestyle changes, such as improving diet and physical exercise, the risk of developing type 2 diabetes can be diminished markedly. Type 2 diabetes starts long before symptoms present. However, diagnosing and treating the disease timely and appropriately reduces serious and costly complications and death.

Many countries still lack prevalence studies and many populations are not systematically surveyed. Still, more multi-dimensional and multi-sectoral research is needed to strengthen the evidence base and to gather greater knowledge as a basis for methods and programmes to tackle the diabetes epidemic.

Professor Nam Han Cho
Chair, IDF Diabetes Atlas Committee, 8th Edition
President-elect, International Diabetes Federation

# Executive Summary

The *IDF Diabetes Atlas* is the authoritative source of evidence for health professionals, academics and policy-makers on the burden of diabetes. Global, regional and national estimates are produced for prevalence of diabetes, impaired glucose tolerance (IGT), undiagnosed diabetes, mortality, healthcare expenditure, hyperglycaemia in pregnancy, and type 1 diabetes in children and adolescents. The *IDF Diabetes Atlas*, published since 2000, is available in print and as a free digital download. The *Atlas* website includes an interactive and dynamic map, scientific publications and detailed data.

## Framework of analysis

The *IDF Diabetes Atlas* methodology and data sources are reviewed every two years, with a scientific committee composed of representatives from each of the seven IDF regions. Since the *IDF Diabetes Atlas* 2015 edition, confidence intervals have been produced that provide a plausible range within which 95% of the true diabetes prevalence can be expected to belong. The prevalence and incidence of type 1 diabetes among children and adolescents have been estimated since 2015.

There may be some discrepancies between estimates in the *IDF Diabetes Atlas* and other reported national estimates. This may be due to a difference in sampling methods or populations. This 8th edition of the *IDF Diabetes Atlas* uses age-stratified diabetes prevalence and a consistent methodology to estimate the diabetes prevalence for people aged 18-99 and 20-79 with diabetes across 221 countries and territories. As a result, other national estimates may report a different number of diabetes cases but the numbers are similar compared to the estimation of the *IDF Diabetes Atlas.*

## What the IDF Diabetes Atlas analyses

*IDF Diabetes Atlas* estimates the prevalence of diabetes and impaired glucose tolerance (IGT) and the percentage of diabetes that is undiagnosed.

For the 8th edition, 43 new data sources published between January 2015 and December 2016 from 39 countries were added to the *IDF Diabetes Atlas* database. The total number of data sources, which were selected to estimate diabetes prevalence, was 221, which represents 131 countries. For the remaining countries, without good-quality local data sources, the prevalence was estimated from countries with similar characteristics such as ethnicity, language, income level and geography.

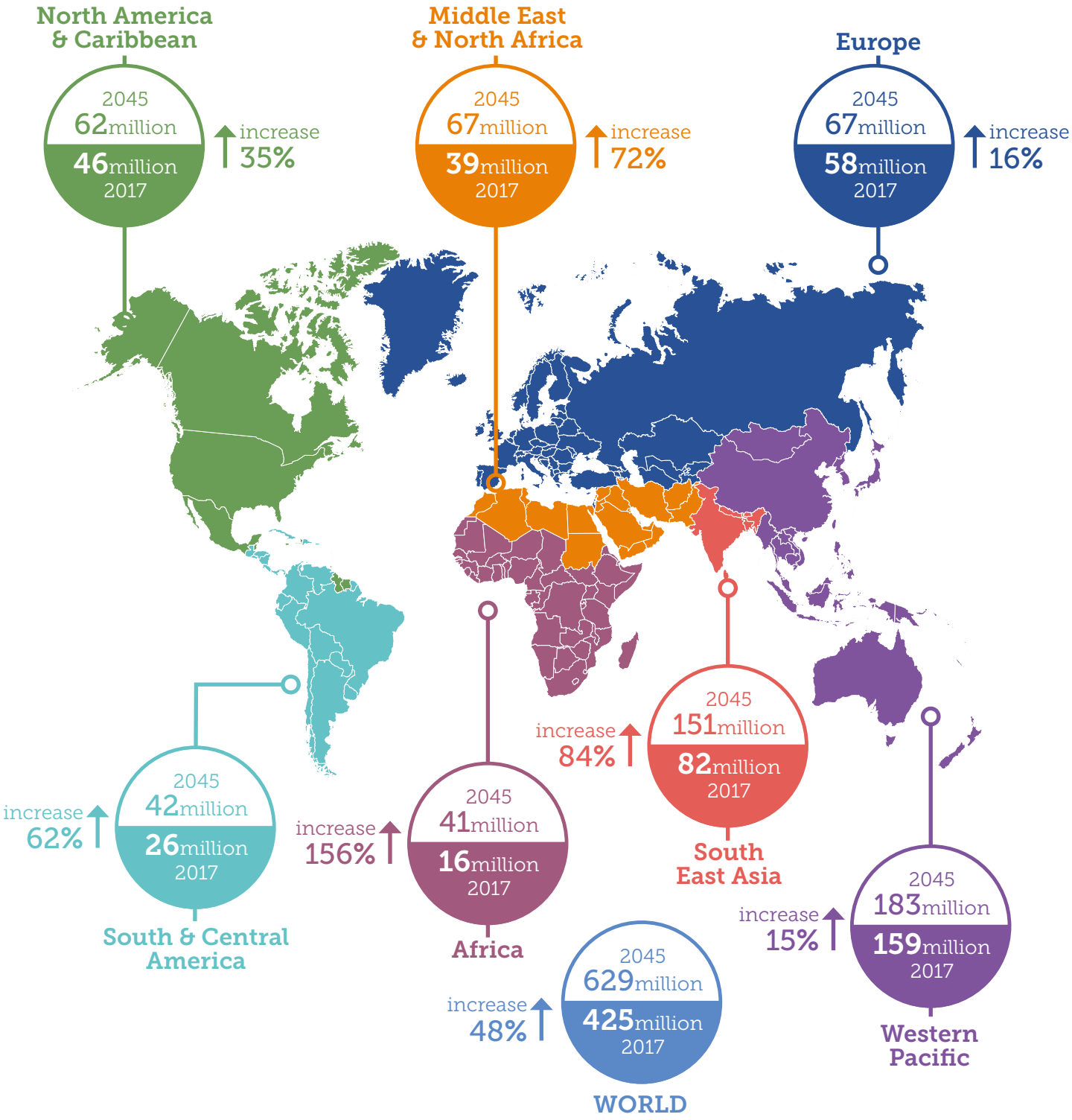
Two sets of prevalence figures, crude prevalence and age-adjusted comparative prevalence, are provided for each estimate. The crude prevalence indicates the percentage of each population that has diabetes and is appropriate for assessing the burden of diabetes for each area. The age-adjusted comparative prevalence has been calculated by assuming that every country and territory has the same age profile, which makes this figure appropriate for making comparisons between countries and between IDF regions.

## New in 2017

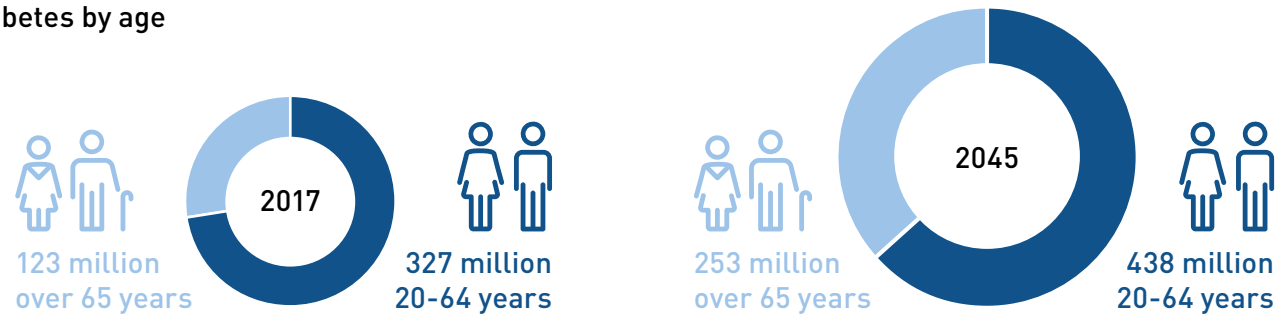
The methodology for the 8th edition of the *IDF Diabetes Atlas* has been improved. The relative risk ratio of mortality has been updated, the children and adolescent age group has been expanded to 0-19 years old, and estimates for diabetes prevalence among the 18-99 years group has been calculated in addition to that for the 20-79 age-group.

Diabetes among people older than 65 years has been further analysed and a new chapter has been added to describe diabetes related complications including cardiovascular disease, eye disease, nephropathy, diabetic foot, oral health and pregnancy-related complications.

Number of people with diabetes worldwide and per region in 2017 and 2045 (20-79 years)

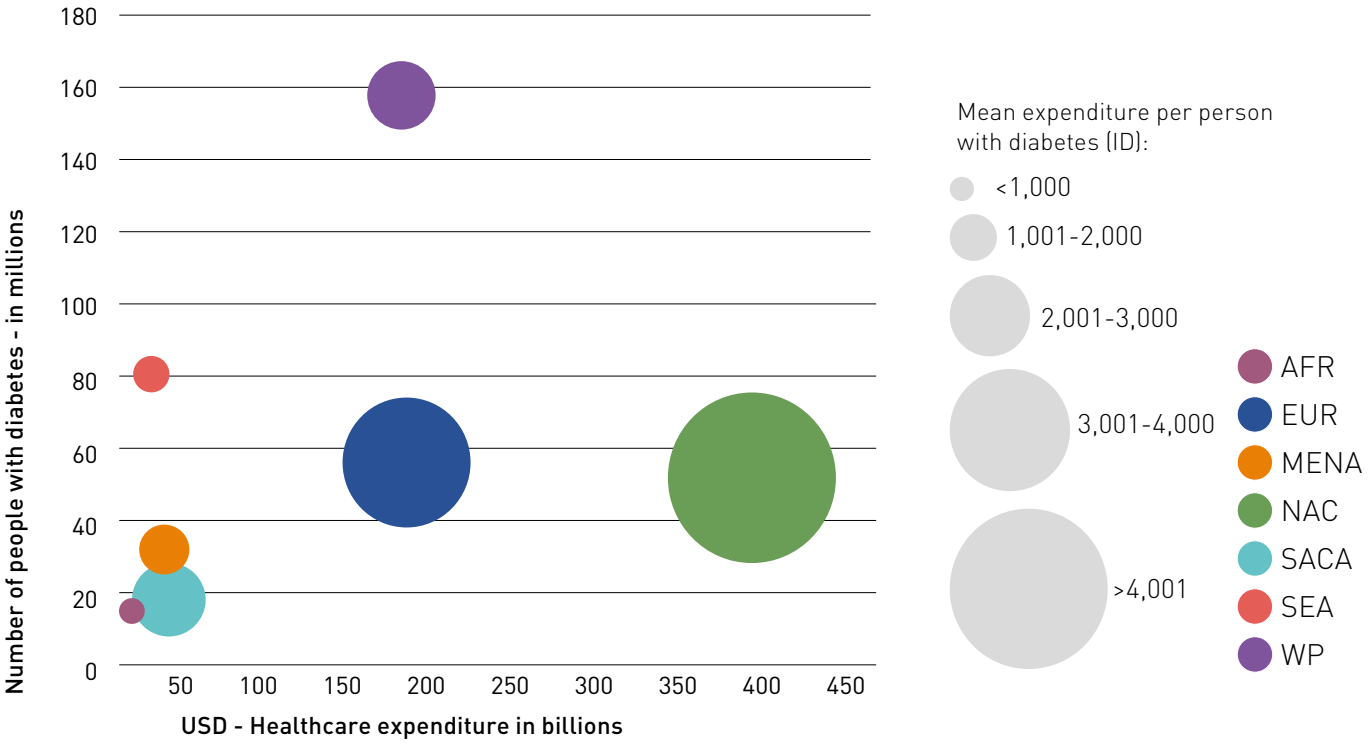



Diabetes by age



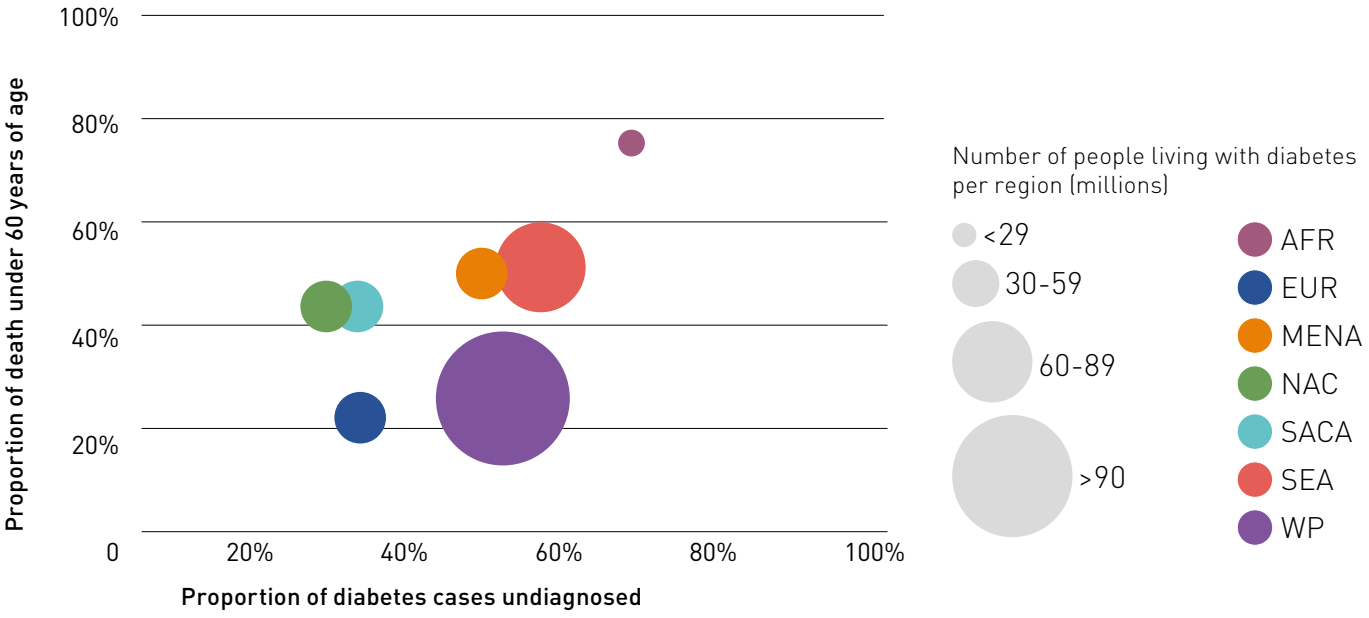
## Expenditure gap in diabetes

The total amount spent and the amount per person spent varies widely between IDF regions.

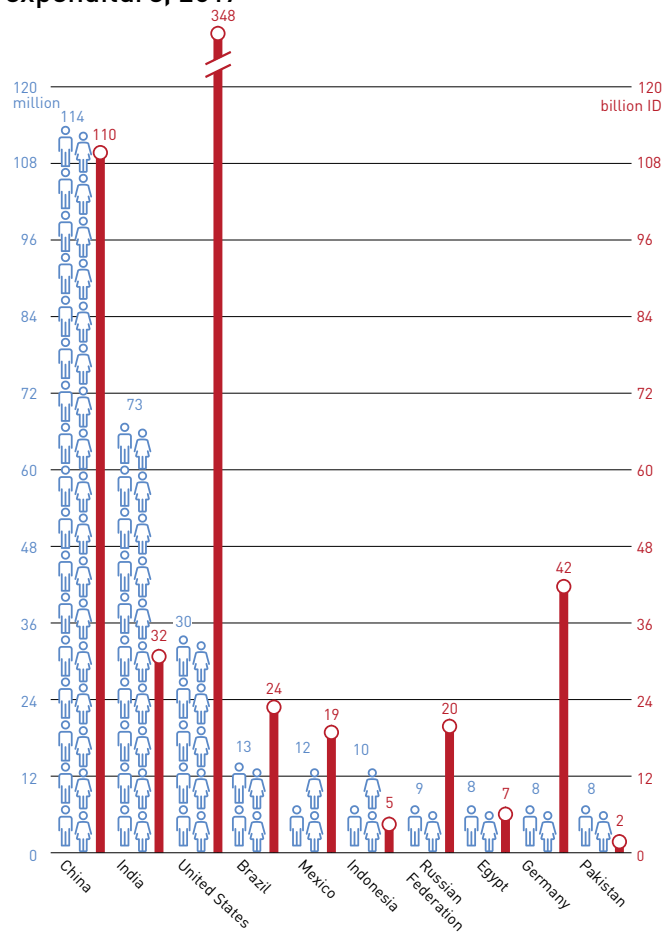



## The hidden diabetes epidemic

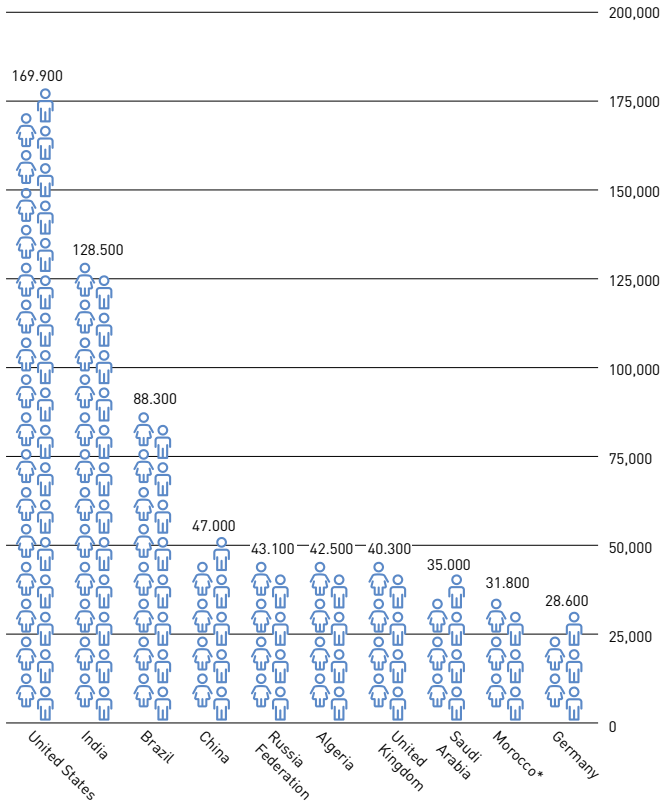
Proportion of early deaths, undiagnosed diabetes and number of diabetes per region.



## Top 10 countries for number of adults with diabetes (20-79 years) and their healthcare expenditure, 2017

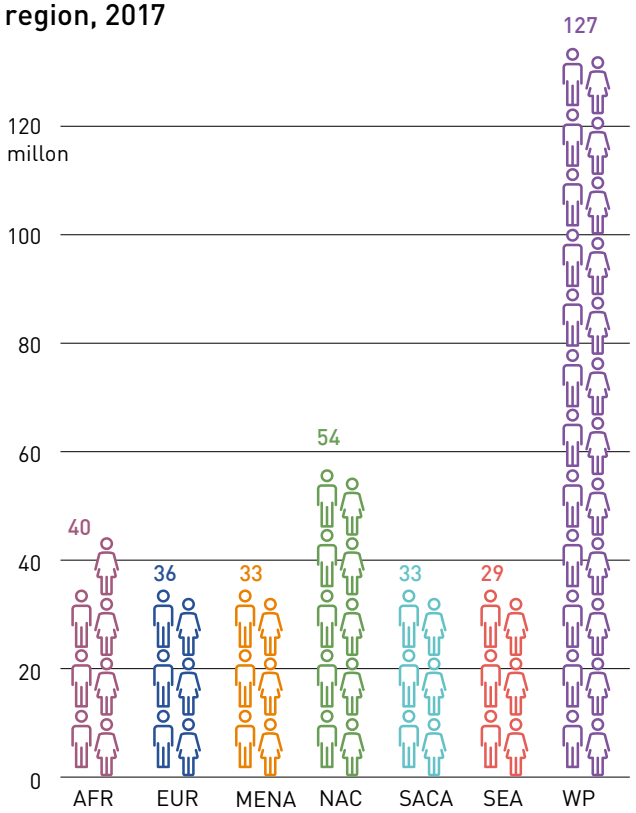



## Top 10 countries for number of children and adolescents with type 1 diabetes (<20 years), 2017

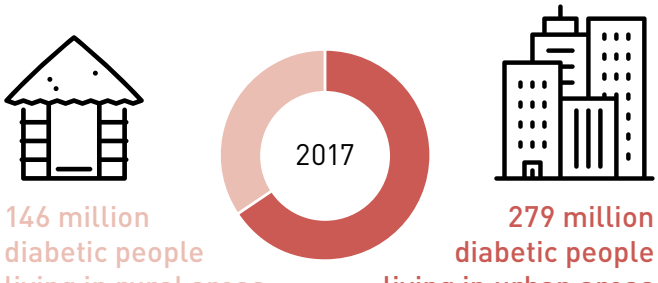


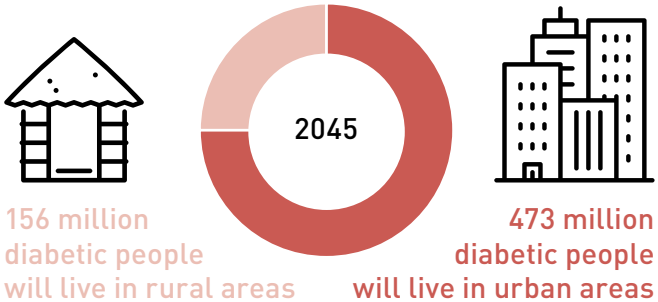

*The data for Morocco is extrapolated from Algeria

## Number of adults (20-79 years) with IGT per IDF region, 2017




## Rural and urban prevalence



# Introduction

Diabetes in all forms imposes an unacceptably high human, social and economic cost on countries at all income levels. Since the first edition in 2000, the *IDF Diabetes Atlas* has been reporting the results and analysis of the continuing growth in rates of diabetes incidence and prevalence worldwide. This 8th edition brings new evidence of a similar kind and carries a drastic and unescapable message: despite the numerous tools available to tackle the disease, diabetes and its complications are more and more prevalent.

This 8th edition of the *IDF Diabetes Atlas* contains expanded information unavailable in previous editions and aims to stimulate action where gaps in knowledge about diabetes exist. This edition provides the evidence required for governments, civil society, international health organisations and the health community to make informed decisions about diabetes prevention and care strategies.

In **Chapter 1, What is Diabetes?** of the IDF Diabetes Atlas 2017, we define diabetes and describe the different types alongside various prevention and management strategies.

In **Chapter 2, Methodology**, the methodology employed to generate estimates for 2017 and 2045 is explained with additional details available on **www.diabetesatlas.org.** *IDF Diabetes Atlas 2017* estimates, derived from sources and surveys conducted in communities around the world, provide the raw data from which we have modelled our estimates at global, regional and national levels. All data is validated by a global scientific committee.

In **Chapter 3, The global picture**, the global figures on the prevalence of diabetes, impaired glucose tolerance (IGT) and undiagnosed diabetes for 2017 and 2045 are based on estimates from 221 countries and territories.

The estimates of mortality due to diabetes show that the number of deaths is considerable and is of a similar or greater magnitude to other non-communicable diseases. At the same time, the projections for healthcare expenditures due to diabetes show that there is a wide variation in spending between countries and that more resources should be invested in cost-effective interventions, particularly in low and middle income countries.

**Chapter 4, Diabetes by region** provides an overview of the diabetes situation in each of the seven IDF Regions. The summaries show the differences in the burden of diabetes, its mortality and economic costs, and the expected changes over the next 28 years.

**Chapter 5, Diabetes complications** shows how diabetes and its complications are inextricably linked, affecting all corners of the globe. This chapter covers the most common and severe complications related to diabetes, namely cardiovascular disease, diabetic eye disease, nephropathy, diabetic foot, oral health and pregnancy-related complications.

Finally, **Chapter 6, Action on Diabetes** features IDF global solutions for meeting the challenge of the diabetes pandemic and includes the main activities and recent reports of IDF as well as illustrations on how IDF is turning political agenda into reality.

This chapter highlights activities that unite the global diabetes community through the global campaign such as IDF Congress and Blue Circle Voices; the prioritisation of global diabetes awareness with World Diabetes Day (November 14); and the promotion of best practice in diabetes education with IDF School of Diabetes. It also provides useful resources and web links, and includes a list of recently published IDF clinical guidelines.

A summary table of country estimates of key data is provided in the appendices. Background papers on which the summaries have been based are available on the website, **www.diabetesatlas.org.** Tables with more detailed estimates of the prevalence of diabetes and IGT, mortality, and healthcare expenditures are also available on the website.

While much research has been done, further studies are required to provide a more accurate picture of the prevalence of diabetes. Almost half of all countries worldwide have no original studies or only poor quality studies and their estimates are based on extrapolations from other similar countries. In the IDF Africa Region, over three quarters of all countries and territories lack primary data on diabetes prevalence in adults.

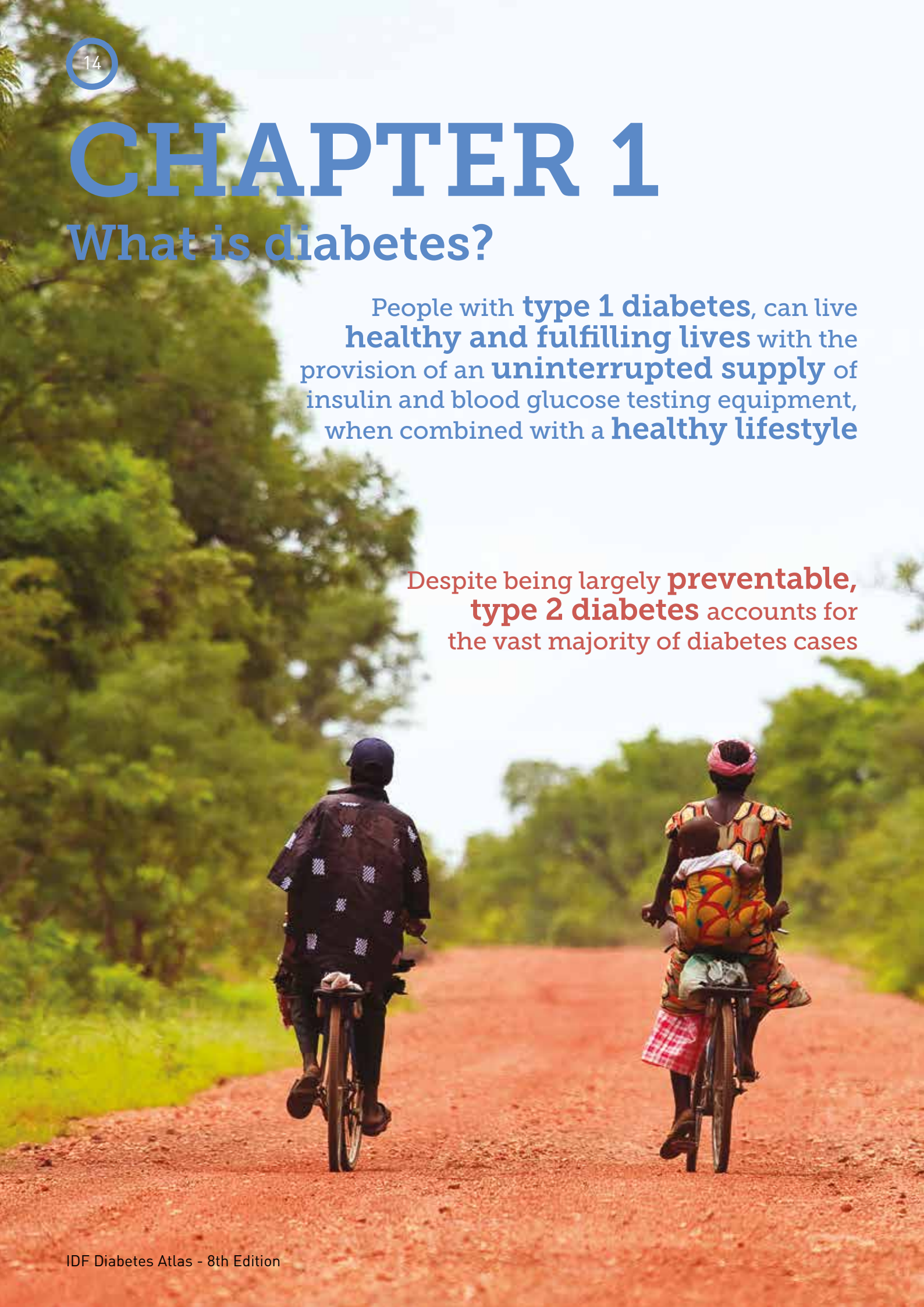
Further research will serve as a catalyst for governments and organisations to act with more haste and greater effectiveness to put early interventions, improved screening and timely management in place to reduce the impact of diabetes on the individual and society.

# CHAPTER 1

## What is diabetes?

People with **type 1 diabetes**, can live **healthy and fulfilling lives** with the provision of an **uninterrupted supply** of insulin and blood glucose testing equipment, when combined with a **healthy lifestyle**

Despite being largely **preventable, type 2 diabetes** accounts for the vast majority of diabetes cases



Women with **hyperglycaemia during pregnancy** can control their blood glucose levels through a **healthy diet, moderate exercise and blood glucose monitoring**

**Type 2 diabetes** can be effectively managed by reducing overweight and adopting a **healthy lifestyle** (diet and physical activity), combined with **medication** when required

Women with **GDM** can have high blood pressure and large babies for gestational age, which increases the risk of **pregnancy complications**

# What is diabetes?

Diabetes mellitus, more simply called diabetes, is a chronic condition that occurs when there are raised levels of glucose in the blood because the body cannot produce any or enough of the hormone insulin or use insulin effectively.[1] Insulin is an essential hormone produced in the pancreas gland of the body, and it transports glucose from the bloodstream into the body's cells where the glucose is converted into energy. The lack of insulin or the inability of the cells to respond to insulin leads to high levels of blood glucose, or hyperglycaemia, which is the hallmark of diabetes. Hyperglycaemia, if left unchecked over the long term, can cause damage to various body organs, leading to the development of disabling and life-threatening health complications such as cardiovascular disease, neuropathy, nephropathy and eye disease, leading to retinopathy and blindness. On the other hand, if appropriate management of diabetes is achieved, these serious complications can be delayed or prevented.

The classification and diagnosis of diabetes are complex and have been the subject of much consultation, debate and revision stretching over many decades, but it is now widely accepted that there are three main types of diabetes, type 1 diabetes, type 2 diabetes and gestational diabetes (GDM).

There are also some less common types of diabetes which include monogenic diabetes and secondary diabetes. Monogenic diabetes is the result of a single genetic mutation in an autosomal dominant gene rather than the contributions of multiple genes and environmental factors as seen in type 1 and type 2 diabetes. Examples of monogenic diabetes include conditions like neonatal diabetes mellitus and maturity-onset diabetes of the young (MODY). Around 1-5% of all diabetes cases are due to monogenic diabetes.[2,3,4,5,6,7] Secondary diabetes arises as a complication of other diseases such as hormone disturbances (e.g., Cushing's disease or acromegaly), diseases of the pancreas (e.g., pancreatitis) or as a result of drugs (e.g., corticosteroids).

For diagnosing diabetes, diagnostic criteria have been debated and updated over decades but the current criteria from the World Health Organization (WHO) state that diabetes is diagnosed by observing raised levels of glucose in the blood (Figure 1.1).

**Figure 1.1 Diabetes diagnostic criteria[8,9]**

| **DIABETES** should be diagnosed if **ONE OR MORE** of the following criteria are met | **IMPAIRED GLUCOSE TORELANCE** (IGT) should be diagnosed if **BOTH** of the following criteria are met | **IMPAIRED FASTING GLUCOSE** (IFG) should be diagnosed if **ANY** of the following criteria are met |
|---|---|---|
| Fasting plasma glucose ≥7.0 mmol/L (126 mg/dL) | Fasting plasma glucose <7.0 mmol/L (126 mg/dL) | Fasting plasma glucose 6.1-6.9 mmol/L (110 to 125 mg/ dL) |
| or | and | or |
| Two-hour plasma glucose ≥11.1 mmol/L (200 mg/dL) following a 75g oral glucose load | Two-hour plasma glucose ≥7.8 <11.1mmol/L (≥140 to <200 mg/dL) following a 75g oral glucose load | Two-hour plasma glucose <7.8mmol/L (140mg/dL) following a 75g oral glucose load |
| or | | |
| A random glucose > 11.1 mmol/L (200 mg/ dL) or HbA1c ≥ 48 mmol/mol (equivalent to 6.5%) | | |

# Type 1 diabetes

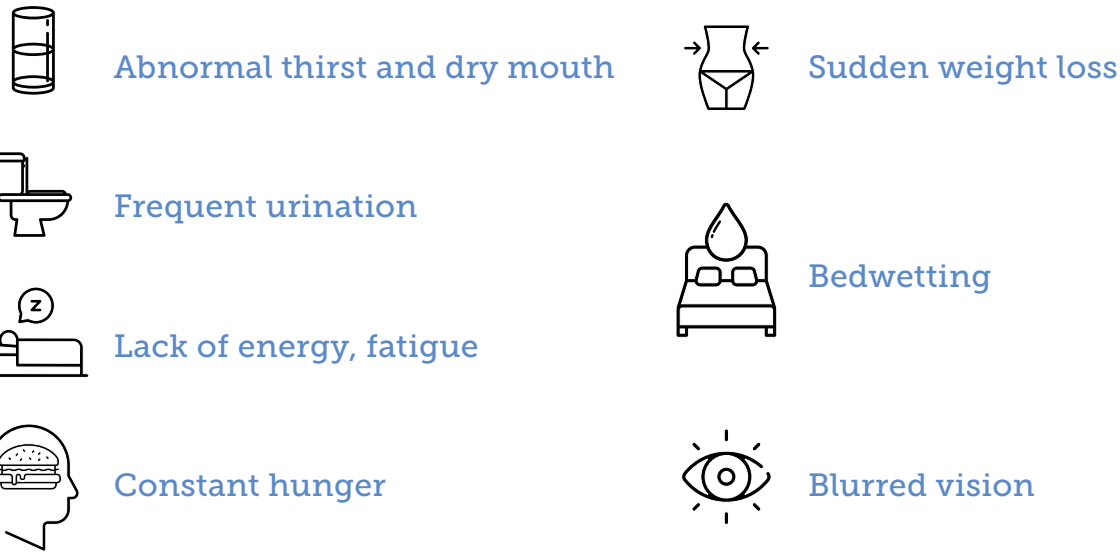
Type 1 diabetes is caused by an autoimmune reaction where the body's immune system attacks the insulin-producing beta cells in the islets of the pancreas gland. As a result, the body produces none to very little insulin with a relative or absolute deficiency of insulin. The causes of this destructive process are not fully understood but a combination of genetic susceptibility and environmental triggers such as viral infection, toxins or some dietary factors have been implicated.[10] The disease can develop at any age but type 1 diabetes occurs most frequently in children and adolescents. People with type 1 diabetes need daily insulin injections in order to maintain a glucose level in the proper range and without insulin would not be able to survive.

People with type 1 diabetes, with proper daily insulin treatment, regular blood glucose monitoring and maintenance of a healthy diet and lifestyle can live a healthy life and delay or avoid many of the complications associated with diabetes.

Type 1 diabetes is diagnosed by an elevated blood glucose level (Figure 1.1) in the presence of the symptoms listed in Figure 1.2. However, diagnosing type of diabetes is sometimes difficult to determine and additional testing may be required to distinguish between type 1 or type 2 diabetes or other forms of diabetes.[11]

The incidence of type 1 diabetes is increasing worldwide, but there is huge variation by country with some regions of the world having much higher incidence than others.[10] The reasons for this are unclear but an interplay between genetic and environmental factors is suspected.[12]

**Figure 1.2 The symptoms of type 1 diabetes**



# Type 2 diabetes

Type 2 diabetes is the most common type of diabetes, accounting for around 90% of all cases of diabetes.[13-15] In type 2 diabetes, hyperglycaemia is the result of an inadequate production of insulin and inability of the body to respond fully to insulin, defined as insulin resistance. During a state of insulin resistance, insulin is ineffective and therefore initially prompts an increase in insulin production to reduce rising glucose levels but over time a state of relative inadequate production of insulin can develop. Type 2 diabetes is most commonly seen in older adults, but it is increasingly seen in children, adolescents and younger adults due to rising levels of obesity, physical inactivity and poor diet.

The symptoms of type 2 diabetes may be identical to those of type 1 diabetes (Figure 1.1) including in particular, increased thirst, frequent urination, tiredness, slow-healing wounds, recurrent infections and tingling or numbness in hands and feet (Figure 1.3). However, the onset of type 2 diabetes is usually slow and its usual presentation without the acute metabolic disturbance seen in type 1 diabetes means that the true time of onset is difficult to determine.

As a result, there is often a long pre-detection period and as many as one-third to one-half of type 2 diabetes cases in the population may be undiagnosed because they may remain without symptoms for many years. When unrecognized for a prolonged time period, the complications of chronic hyperglycaemia may develop. Some patients with type 2 diabetes are first diagnosed with this condition when they present with a complication due to hyperglycaemia such as a foot ulcer, change in vision, renal failure or infection.

The causes of type 2 diabetes are not completely understood but there is a strong link with overweight and obesity and with increasing age as well as with ethnicity and family history. Some important modifiable risk factors include: excess adiposity (obesity), poor diet and nutrition, physical inactivity, prediabetes or impaired glucose tolerance (IGT), smoking and past history of GDM with exposure of the unborn child to high blood glucose during pregnancy. Among dietary factors, recent evidence has also suggested an association between high consumption of sugar-sweetened beverages and risk of type 2 diabetes.[16-18]

**Figure 1.3 The symptoms of type 2 diabetes**

Other factors include inadequate intake of fruit and vegetables, wholegrains and dietary fibre and high intake of energy as saturated fat. Overall, according to the latest research, emphasis for diet should move away from that on nutrients to consuming whole foods and instead following dietary patterns such as, but not limited to, the Mediterranean-type diet pattern and others.[19-21]

The cornerstone of type 2 diabetes treatment is healthy lifestyle which includes the adoption of a healthy diet, increased physical activity, smoking cessation plan and maintenance of a healthy body weight. If attempts to change lifestyle are not adequate to control blood glucose levels, oral medication is usually initiated for treatment of hyperglycaemia with metformin being the most commonly used initial treatment worldwide. If treatment with a single antidiabetic medication is not adequate, a range of combination therapy options are now available, including; sulphonylureas, thiazolidinediones, DPP-4 inhibitors, SGLT2 inhibitors, GLP-1 agonists, and acarbose. When oral hypoglycaemic medications are unable to control hyperglycaemia to recommended targets, insulin injections may be prescribed. Beyond the control of raised glucose levels, it is vital to manage blood pressure and to screen regularly (at least annually) and manage the risk for or developm ent of renal (kidney) complications, retinopathy (eye disease) and foot ulcer. It is important to note that with regular check-ups and good management with lifestyle and medications when needed, it is possible for people with type 2 diabetes to lead long and healthy lives.

Globally, the prevalence of type 2 diabetes has been high and is rising across all world regions. This rise is likely fuelled by an aging population, economic development and increasing urbanisation leading to more sedentary lifestyles and greater consumption of unhealthy foods linked with obesity.[22]

**Type 2 diabetes** is most commonly seen in older adults, but it is increasingly seen in children, adolescents and younger adults due to rising levels of **obesity, physical inactivity and poor diet**

# Hyperglycaemia in Pregnancy

Hyperglycaemia (high blood glucose level) that is first detected during pregnancy is classified as either gestational diabetes mellitus (GDM) or hyperglycaemia in pregnancy. Women with slightly elevated blood glucose levels are classified as having GDM and women with substantially elevated blood glucose levels are classified as women with hyperglycaemia in pregnancy.[23] It has been estimated that most (75–90%) of cases of high blood glucose during pregnancy are gestational diabetes.[24]

GDM is a type of diabetes that affects pregnant women usually during the second and third trimesters of pregnancy though it can occur at any time during pregnancy. In some women diabetes may be diagnosed in the first trimester of pregnancy but in most such cases diabetes likely existed before pregnancy, but was undiagnosed.

As overt symptoms of hyperglycaemia during pregnancy are rare and may be difficult to distinguish from normal pregnancy symptoms, an oral glucose tolerance test (OGTT) is recommended for screening of GDM between the 24$^{th}$ and 28$^{th}$ week of pregnancy, but for high risk women the screening should be conducted earlier in pregnancy.[25] An OGTT is performed by measuring the plasma glucose concentration while fasting and two hours after ingesting a drink containing 75 grams of glucose. For diagnosing gestational diabetes (GDM), the following criteria are recommended (Figure 1.4)

GDM arises because the action of insulin is diminished (insulin resistance) due to hormone production by the placenta.[26] Other risk factors for GDM include older age, overweight or obesity, excessive weight gain during pregnancy, a family history of diabetes and a history of stillbirth or giving birth to an infant with a congenital abnormality.

GDM usually exists as a transient disorder during pregnancy and resolves once the pregnancy ends. However, pregnant women with hyperglycaemia are at higher risk of developing GDM in subsequent pregnancies and about half of women with a history of GDM will develop type 2 diabetes within five to ten years after delivery. Babies born to mothers with GDM also have a higher lifetime risk of obesity and developing type 2 diabetes.[27-29]

Women with hyperglycaemia detected during pregnancy are at greater risk of adverse pregnancy outcomes. These include high blood pressure and a large baby for gestational age, a condition called foetal macrosomia, which can make a normal delivery difficult and risky. Identification of hyperglycaemia in pregnancy combined with good control of blood glucose during pregnancy can reduce these risks. Women of child-bearing age who have known pre-existing diabetes prior to pregnancy should receive pre-conception advice and all women who have hyperglycaemia in pregnancy whether it is GDM, previously undiagnosed diabetes in pregnancy or existing and known diabetes, require optimal antenatal care and appropriate postnatal management. Women with hyperglycaemia during pregnancy can control their blood glucose levels through a healthy diet, gentle exercise and blood glucose monitoring. In some cases, insulin or oral medication may also be prescribed.

**Figure 1.4 Diagnostic criteria in studies used for hyperglycaemia in pregnancy[24]**

| Criteria | Fasting | | 1h | | 2h | | 3h | |
|---|---|---|---|---|---|---|---|---|
| | mg/dL | mmol/L | mg/dL | mmol/L | mg/dL | mmol/L | mg/dL | mmol/L |
| ADA/NDDG | 105 | 5.8 | 190 | 10.5 | 165 | 8.6 | 145 | 7.8 |
| ADA | 95 | 5.3 | 180 | 10 | 155 | 8.6 | Not measured | |
| ADIPS | 99 | 5.3 | Not measured | | 144 | 8 | | |
| CDA | 95 | 5.3 | 191 | 10.6 | 160 | 8.9 | | |
| WHO | 140 | 7.8 | Not measured | | 140 | 7.8 | | |
| WHO | 126 | 7 | | | 140 | 7.8 | | |
| IADPSG | 92 | 5.2 | 180 | 10 | 153 | 8.5 | | |

# Impaired glucose tolerance and impaired fasting glucose

Raised blood glucose levels above the normal range and below the diabetes diagnostic thresholds meet criteria for impaired glucose tolerance (IGT) based on a two-hour post 75 grams oral glucose load or impaired fasting glucose (IFG). These conditions are also called intermediate hyperglycaemia or prediabetes.

In IGT, the glucose level is higher than normal, but not high enough to make a diagnosis of diabetes (between 7.8 and 11.0 mmol/L (140 to 199 mg/dL)) at two-hours after an OGTT. IFG is present when the fasting glucose level is higher than normal (> 6.1 mmol/L), but not high enough to make a diagnosis of diabetes which is made when the fasting glucose is above 7.0 mmol/L (or > 126 mg/dL). IFG is diagnosed with fasting glucose level between 6.1 to 6.9 mmol/L (110 to 125 mg/dL) (Figure 1.1). Raised levels of HbA1c in the non-diabetic range can also be used to identify persons at risk of developing type 2 diabetes.

People with prediabetes are at high risk of developing type 2 diabetes. Prediabetes is also characterised by decreased insulin sensitivity or increased insulin resistance. The risk factors of prediabetes are the same as for type 2 diabetes: overweight, advanced age, poor diet and excess calories or poor nutrition, lack of physical activity, smoking and family history.[30,31] However, not everyone with prediabetes goes on to develop type 2 diabetes. High quality evidence exists from randomised controlled trials of primary prevention to support the effectiveness of lifestyle interventions in preventing the progression of prediabetes to diabetes.[32-35]

In **IGT**, the glucose level is higher than normal, but not high enough to make a diagnosis of diabetes

**IFG** is present when the fasting glucose level is higher than normal, but not high enough to make a diagnosis of diabetes

# Preventing diabetes

No effective intervention currently exists to prevent type 1 diabetes. Therefore, this section focuses on factors that have been identified for the prevention of type 2 diabetes.

Of the established risk factors for type 2 diabetes, some are potentially amenable to change while others are not. For example, non-modifiable risk factors for type 2 diabetes include ethnicity, genetics and age. Other risk factors such as diet, adiposity, physical activity and environmental exposures are modifiable using a combination of approaches at both population and individual levels.

While there are many factors that influence the development of type 2 diabetes, it is evident that the most influential are the behaviours commonly associated with urbanisation and a modern lifestyle. These include consumption of unhealthy foods and inactive lifestyles with sedentary behaviour. Randomised controlled trials from different parts of the world including Finland, USA, China, India and elsewhere have established the proof of principle that lifestyle modification with physical activity[36] and/or healthy diet[21,37-40] can delay or prevent the onset of type 2 diabetes.

IDF has released nine recommendations for a healthy diet for the general population (Table 1.1). Additionally, dietary recommendations of WHO for the prevention of type 2 diabetes include limiting saturated fatty acid intake to less than 10% of total energy intake (and for high risk groups, less than 7%); and achieving adequate intake of dietary fibre (minimum daily intake of 20 grams) through consumption of wholegrain cereals, legumes, fruits and vegetables.[41] WHO strongly recommends reducing the intake of free sugars to less than 10% of total energy intake.[42] IDF fully supports these recommendations and in response published the IDF Framework for Action on Sugar.[43]

Modern lifestyles are characterised by physical inactivity and long sedentary periods. Community-based interventions can reach individuals and families through campaigns, education, social marketing and encourage physical activity both inside and outside school and the workplace.[44,45] IDF recommends physical activity at least between three to five days a week for a minimum of 30-45 minutes.[46] WHO has also developed recommendations on physical activity among different age groups.[47] (Table 1.2)

Taking a life course perspective is essential for preventing type 2 diabetes and its complications. Early in life, when eating and physical activity habits are established and when the long-term regulation of energy balance may be programmed, there is an especially critical window to prevent the development of overweight and mitigate the risk of type 2 diabetes.[48] Healthy lifestyles can improve health outcomes at later stages of life as well.[49-51]

Population based interventions and policies allow healthy choices through policies in trade, agriculture, transport and urban planning to become more accessible and easy. Healthy choices can be promoted in specific settings (school, workplace and home) and contribute to better health for everyone. They include exercising regularly and eating wisely which will help to maintain normal levels of blood glucose, blood pressure and lipids.[41,52]

**Table 1.1 IDF recommendations for a healthy diet for the general population[53]**

Choosing water, coffee or tea instead of fruit juice, soda or other sugar sweetened beverages

Eating at least three servings of vegetables every day, including green leafy vegetables.

Eating up to three servings of fresh fruit every day.

Choosing nuts, a piece of fresh fruit or unsweetened yoghurt for a snack.

Limiting alcohol intake to a maximum of two standard drinks per day.

Choosing lean cuts of white meat, poultry or seafood instead of read of processed meat.

Choosing peanut butter instead of chocolate spread of jam.

Choosing whole-grain bread, brown rice, or whole-grain pasta instead of white bread, rice, or pasta.

Choosing unsaturated fats (olive oil, canola oil, corn oil or sunflower oil) instead of saturated fats (butter, ghee, animal fat, coconut oil or palm oil).

**Table 1.2 WHO recommendations on physical activity for different age groups[45,51]**

- Children and youth aged 5–17 years should do at least 60 minutes of moderate- to vigorous- intensity physical activity daily.

- Adults aged 18–64 years should do at least 150 minutes of moderate-intensity aerobic physical activity (brisk walking, jogging, gardening) spread throughout the week, or at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity.

- For older adults, the same amount of physical activity is recommended, but should also include balance and muscle strengthening activity tailored to their ability and circumstances.

# Management of diabetes

For those diagnosed with diabetes, a series of interventions can improve health outcomes and these can be cost-effective or even cost-saving over time.[54] Diabetes is a chronic, progressive disease but people who have diabetes can live long, high quality lives with good diabetes management. This includes management of not only glycaemia but also cardiovascular disease risk factors such as hypertension and hypercholesterolemia with a healthy diet, recommended levels of physical activity and correct use of medicines as appropriately prescribed by a physician.[55-57]

People with diabetes require access to systematic, regular and organized healthcare delivered by a team of skilled providers. Outcomes can be improved at the primary care level with basic interventions such as medication, health and lifestyle counselling, and individual and/or group education with regular and appropriate follow-up. This systematic care should include a periodic review of metabolic control and complications, a continually updated diabetes care plan and access to patient-centred care provided by a multidisciplinary team when indicated.

Such care is especially needed if resources are limited in many parts of the world, where self-care may be more difficult due to lack of education and limited or no availability of monitoring of glycaemia with home devices or programmes to detect diabetes complications.[46,58] Such limitations may be effectively addressed by local adaptations of comprehensive lifestyle programmes[54] or new technology innovations such as telemedicine and mobile health tools.

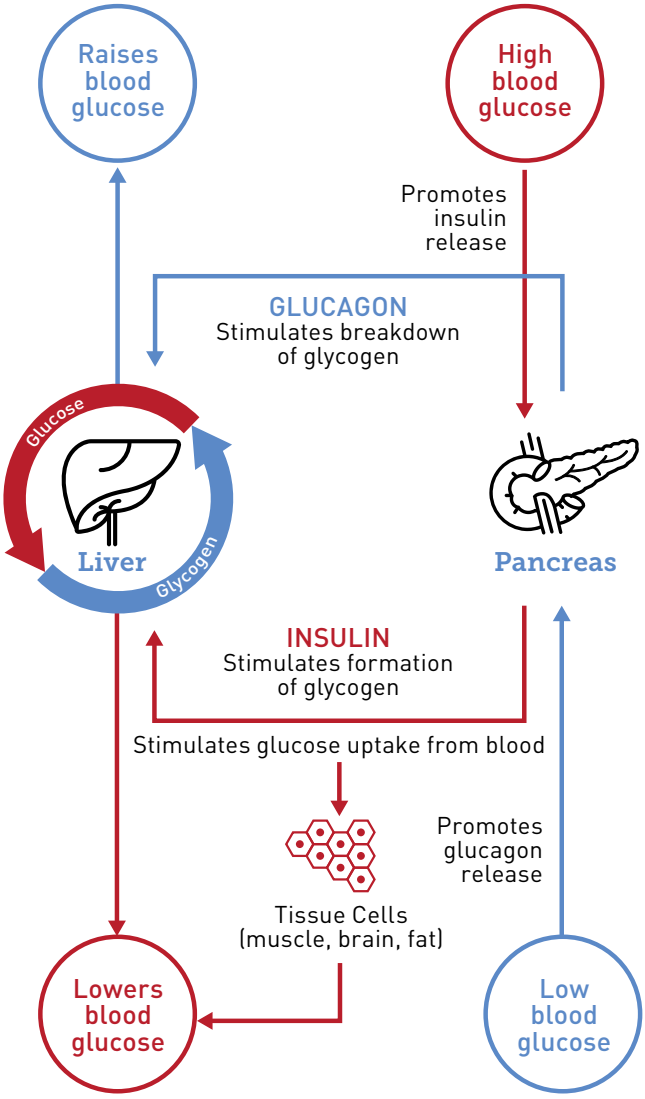
Periodic referral may be needed for specialist care such as comprehensive eye examinations, treatment of eye complications (retinopathy) if needed, measurement of urine albumin and creatinine and estimated glomerular function (eGFR) for kidney health, foot examinations, and assessment and treatment of cardiovascular diseases. In addition, the availability of inpatient hospitalization is necessary when needed to manage acute and chronic complications such as stroke, myocardial infarction, critical limb ischemia, ketoacidosis, hyperosmolar coma, kidney failure, serious foot infections requiring amputation, treatment of hypoglycaemic episodes or stabilisation of poor control of hyperglycaemia.

Uninterrupted supply of high quality insulin is essential for survival in people with type 1 diabetes (Figure 1.5). Regular short-acting human insulin and long–acting NPH or isophane insulin should be available to everyone in all parts of the world. Versus more recently developed and costly insulin analogs, commonly available in more economically developed countries.[59] Insulin is also frequently prescribed for treatment of type 2 diabetes and hyperglycaemia in pregnancy if other hypoglycaemic medication and lifestyle intervention don't succeed in reaching glycaemic treatment goals.

The commonly used medications for type 2 diabetes are metformin, sulphonylureas, GLP-1 analogues and DPP4 inhibitors. These treatments both enhance the body's natural response to ingested food, and reduce glucose levels after eating.

Unfortunately, insulin is not readily available in many regions of the world. According to the *IDF Access to Medicines and Supplies* report, no low income country had full government provision (at no or low cost) of essential insulins to children or adults. Even for those who can pay for their insulin, less than half of middle income countries and only one low income country reported that insulin was always available. Additionally, full provision and availability of injection and monitoring equipment is even lower than it is for insulin especially for adults with diabetes. The cost of blood glucose supplies often exceeds the cost of insulin especially in some of the poorest countries.[59] Through IDFs Life For A Child programme, IDF provides insulin to over 18,000 of the poorest children and adolescents with type 1 diabetes in over 41 countries.[60]

**Figure 1.5 Insulin production and action**




WHO lists five diabetes-related medicines on its Model List of Essential Medicines including short-acting insulin, intermediate-acting insulin, metformin, gliclazide, and glucagon. These same medicines should be included on the National Essential Medicines List (NEML) of countries although assuring their availability and proper use may require changes in procurement decisions, staff training, reimbursement mechanisms and pharmacy systems. Essential medicines are defined by WHO as "those that satisfy the priority healthcare needs of the population."[61]

The use of medications to treat diabetes does not obviate the importance of other measures to combat this disease. Both healthy nutrition and physical activity have beneficial effects on insulin action, blood glucose control and metabolic abnormalities. Dietary management of diabetes includes a lower calorie intake for overweight patients, replacing saturated fats with unsaturated fats, intake of dietary fibre, and avoiding tobacco use, excessive alcohol use and added sugar.[21] Physical activity is most effective when it includes a combination of both aerobic exercise and resistance training, as well reduction of sedentary time.[62-65] For refractory obesity resulting in metabolic diseases, bariatric surgery ( gastric bypass, gastric banding) has been demonstrated as an effective treatment for severe obesity-related type 2 diabetes, but currently its availability is primarily accessible in wealthier countries.[66]

# CHAPTER 2

## Methodology

Current Diabetes Atlas data sources come from countries, which have over **91.2%** of the global population

**221 data sources** from **131 countries** were selected to estimate the diabetes prevalence

Not all countries have national estimates of diabetes prevalence - therefore IDF calls for **more research** on diabetes epidemiology

# Methodology

Accurate diabetes estimates at the national and global levels rely heavily on the quality and availability of data sources. These sources represent the basis for IDF to produce modelled estimates of prevalence, incidence and mortality for 221 countries and territories which are then aggregated into regional and global estimates.

The technical details behind the *IDF Diabetes Atlas* are described in depth in the methodology paper by Guariguata and colleagues.[1] Data sources were searched and selected according to established criteria, and the standardized, age-specific prevalence of diabetes and impaired glucose tolerance (IGT) were estimated. For countries where data sources were not available, prevalence was extrapolated based on data sources from similar countries.

# Gathering data sources

The data sources used for the estimation of diabetes prevalence in the *IDF Diabetes Atlas 2017,* came from a variety of sources. The majority were extracted from peer-reviewed journals and national health surveys including WHO STEP surveys.[2] Data from other official sources such as ministries of health, and reports obtained via informal communication within the IDF network were also used. Data sources with sufficient methodological information on key areas of interest–method of diagnosis, the representativeness of the sample, and at least three age-specific estimates–were included. Among all data sources, only population-based data sources were used. Data sources published before 1990 were also excluded.

In the *IDF Diabetes Atlas 2017*, data sources published between January 2015 and December 2016 were taken from the scientific literature adding a further 43 data sources from 39 countries to the *IDF Diabetes Atlas* database (Map 2.1).

**Map 2.1 Countries and territories where data sources were reviewed with information on diabetes or IGT in adults**

# Selecting data sources

Only a few studies from the hundreds available meet the rigorous inclusion criteria established for the *IDF Diabetes Atlas estimates*. The selection of data sources follows a scoring system assessing the following criteria: method of diagnosis, sample size, representation, age of data source and type of publication. In Table 2.1, the classification possibilities for each of the criteria are presented, from the highest to the lowest degree of preference.

The criteria were weighted based on input and discussions from a group of international experts. Subsequently, a scoring system was developed as a synthesis of different opinions from a group of international experts to allow the comparison and weighting of different characteristics. The final score of a data source is the summary of all scores on the five criteria. Therefore, every data source was assigned a score to indicate their quality based on the criteria. Data sources that received a score over a certain threshold were included in the model and used to generate the IDF Diabetes Atlas estimates.[3] Preference was given to data sources that were nationally representative, conducted within the last five years, published in peer-reviewed scientific literature and based on objective measurement of diabetes status (Map 2.2).

**Table 2.1 Classification of data sources**

### Method of Diagnosis

- Oral glucose tolerance test (OGTT)
- Fasting blood glucose (FBG)
- Self-reported
- Medical record or clinical diagnosis
- $HbA_{1c}$

### Sample Size

- Greater than 5,000 people
- 1,500 to 4,999 people
- 1,499 to 700 people
- Less than 700 people

### Representation

- Nationally representative
- Regionally representative
- Locally representative
- Ethnic or other specific

### Age of the data source

- Less than 5 years old
- 5 to 9 years old
- 10 to 19 years old
- 20 or more years old

### Type of publication

- Peer-reviewed publication
- National health survey
- WHO STEPS study
- Other official report
- Personal communication

# Data sources for IDF Regions

## Africa

The number of data sources examining the prevalence of diabetes in adults in the IDF Africa Region (AFR) was very low. For this edition of *IDF Diabetes Atlas*, a total of 20 sources from 17 countries were selected. More than half of the countries in AFR lack high quality data sources. Botswana, Kenya, Rwanda, Seychelles, and Uganda had studies conducted within past five years. Comoros, Kenya, Reunion, Seychelles, South Africa and Zimbabwe had data sources based on oral glucose tolerance tests. Diabetes prevalence figures for other countries in the region were based on studies that used self-reports, fasting blood glucose, or were older than five years and may be under- or overestimated.

Data to estimate the numbers of children and adolescents with type 1 diabetes remain very scarce. Estimates for type 1 diabetes in children and adolescents were derived from Sudan, Mauritius, Algeria, Ethiopia, Nigeria, Rwanda, United Republic of Tanzania and Zambia.

As the prevalence estimates for AFR were derived from a small number of studies, there is a high degree of uncertainty around them and, as a consequence, around the estimates for mortality and expenditures. The regional estimate of 15.5 million is provided as a guide, and for AFR, IDF recommends using the confidence interval when describing the prevalence. There is an urgent need for further epidemiological research and improved data collection systems in the region

## Europe

A total of 63 data sources from 35 countries were used to generate adult diabetes estimates for the 57 countries and territories in the IDF European Region (EUR). Estimates for Bulgaria, Greenland, Hungary, Israel, Moldova, Romania, Russian Federation, Sweden, United Kingdom, and Uzbekistan were based on studies conducted within the last five years. Only 16 countries in EUR had nationwide studies based on oral glucose tolerance tests, and only Bulgaria and Romania had conducted theirs with the last five years. Diabetes prevalence figures for the remaining countries may be underestimated.

Northern Europe had by far the most complete and reliable data for type 1 diabetes in children and adolescents. A large proportion of countries have type 1 diabetes registries that are either nationwide or cover several different parts of a country.

## Middle East and North Africa

A total of 33 sources from 16 countries were used to estimate diabetes prevalence in adults for the 21 countries in IDF Middle East and North Africa Region (MENA). Only Kuwait had a nationwide study conducted with the last five years. Algeria, Jordan, Oman, Pakistan, Saudi Arabia, Palestine, Sudan and United Arab Emirates had estimates partly based on oral glucose tolerance tests. Diabetes prevalence figures for the remaining countries may be underestimates.

Estimates from type 1 diabetes in children and adolescents were derived from Egypt, Kuwait, Libya, Pakistan, Qatar, Saudi Arabia, Sudan, Tunisia Uzbekistan, Oman, Islamic Republic of Iran, Jordan and Algeria.

MENA poses a particular challenge for estimating diabetes prevalence because a large proportion of the resident population in many countries consists of migrants and refugees. As a result, studies that include only national citizens provide a limited contribution to the overall picture of diabetes for the whole country.

## North America and Caribbean

Estimates for diabetes in adults were taken from 24 data sources in IDF North America and Caribbean Region (NAC), representing 14 of 28 countries. Barbados, Mexico, Suriname, Trinidad and Tobago and the US had studies conducted within the last five years. Belize, Haiti, Mexico and the US Virgin Islands had studies that used oral glucose tolerance tests. Prevalence rates for other countries may be underestimates.

Estimates for type 1 diabetes in children and adolescents were derived from studies in Antigua and Barbuda, Venezuela, Mexico, Cuba, the US Virgin Islands, Cuba, Barbados, Dominica, and Dominican Republic.

## South and Central America

For this region, 23 sources from 15 countries were used to estimate adult diabetes prevalence for the 20 countries in IDF South and Central America Region (SACA). Only Peru had data sources from studies conducted in the last five years. Estimates for Argentina, Bolivia, Brazil, Guatemala, Honduras, and Nicaragua were based on studies that used oral glucose tolerance tests. Diabetes prevalence figures for other countries may be underestimates.

The adult diabetes prevalence estimate for SACA is also particularly influenced by changes of data sources in some countries. Old studies from Guatemala, Honduras, Nicaragua and Venezuela were used to estimate the diabetes prevalence instead of extrapolation from similar countries, when the estimation were much closer to the real figure. So the reduction in the prevalence in this region compared to *IDF Diabetes Atlas 7th edition* was due to data sources change, but not reflection of real reduction of diabetes prevalence.

Estimates of the number of children and adolescents with type 1 diabetes were derived from studies in Peru, Colombia, Venezuela and Mexico.

## South-East Asia

All 7 countries except Bhutan had primary data sources that were used to generate estimates for diabetes in adults in the IDF South-East Asia Region (SEA). A total of 14 data sources from six countries were used. However, except Nepal, diabetes prevalence for other countries were based on data sources that were more than five years old and maybe underestimates. Estimates for type 1 diabetes in children and adolescents were largely based on incidence data from India and China.

## Western Pacific

For this edition of the IDF Diabetes Atlas, 52 data sources from 28 countries were used to generate estimates of diabetes in adults for the 39 countries in this region. Estimates for Indonesia, Kiribati, Myanmar, Palau, Republic of Korea and Vietnam were based on studies conducted within the last five years. Only 11 countries in the Western Pacific (WP) Region had nationwide studies based on oral glucose tolerance tests. Diabetes prevalence figures for other countries may be underestimates.

Estimates for type 1 diabetes in children and adolescents were based on studies conducted in Australia, Thailand, China, Fiji, Republic of Korea, Papua New Guinea, Hong Kong China, New Zealand, Taiwan and Singapore.

# Estimating diabetes prevalence

After the selection of data sources, a generalized linear regression model was used to estimate the age- and sex-specific diabetes prevalence per data source. The country level diabetes estimates were produced based on the weighted average of the scores of all data sources for each country. Therefore, very high quality studies contribute more to the final country estimate, than those with high scores only (Map 2.2). The details of the generalized linear regression model were described in a previous methodology publication.[1] For each country, the age and gender specific diabetes estimates were generated accounting for diabetes prevalence differences from urban and rural settings. This was achieved by updating urban and rural diabetes prevalence ratios according to weighted average of the ratios reported in different data sources of IDF and economic regions. The number of data sources selected to estimate diabetes prevalence per country was 221, which represent 131 countries.

The 2017 population data from the United Nations Population Division (UNPD) for each country and territory was used to estimate the number of people with diabetes.[4] In order to project diabetes estimates in the year 2045, the population projections from the United Nations Population Division were used. The 2045 diabetes estimates projection assumes the diabetes prevalence does not change for each age group, but takes into account of the changes in population age structure and rates of urbanisation.[5] This leads to a conservative underestimate of diabetes prevalence without taking into account changes in obesity and other risk factors.

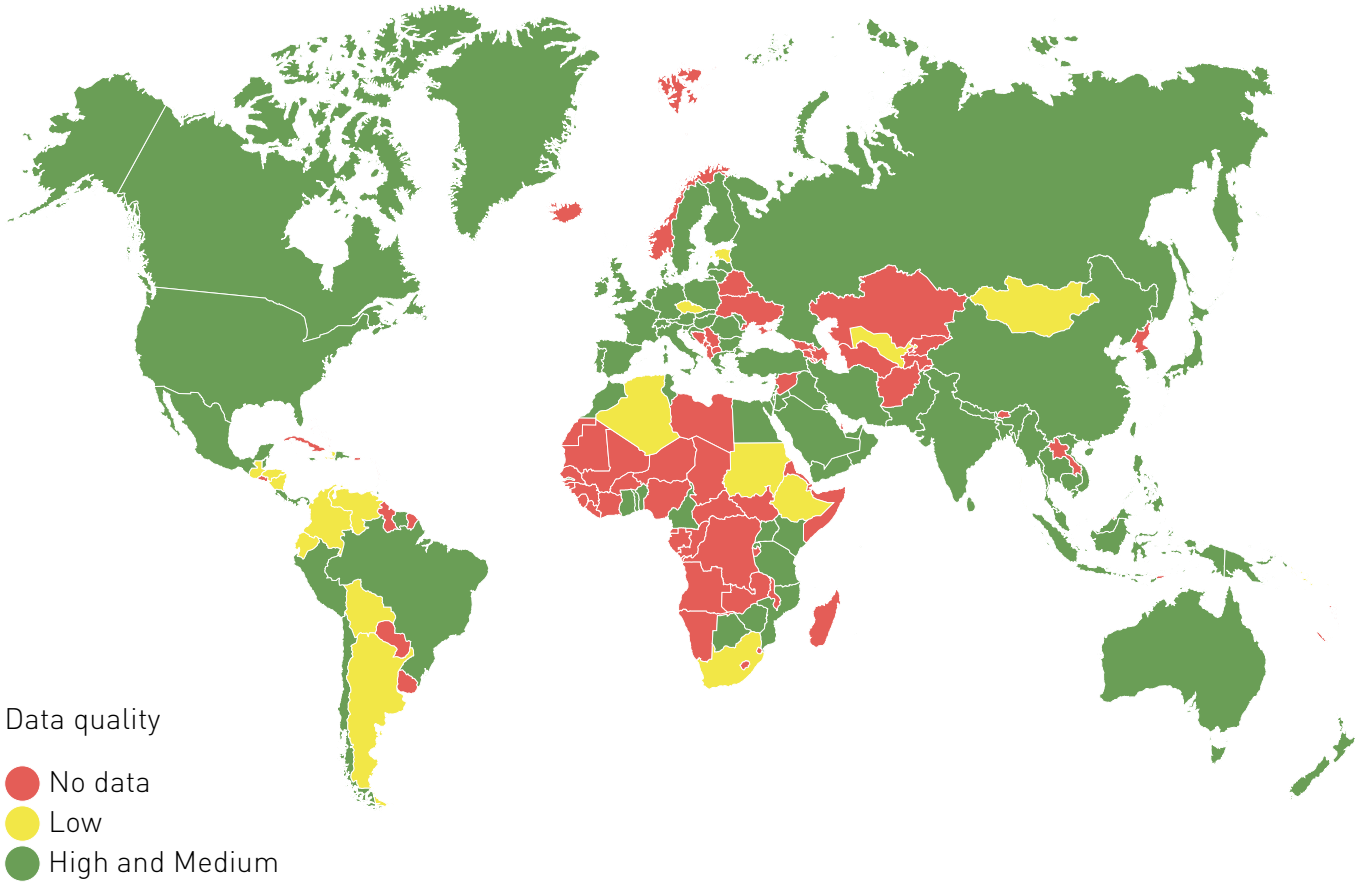
## Increase/Decrease of Diabetes Prevalence

The increase/decrease of diabetes prevalence in particular countries compared to the previous editions of the Atlas was due to data sources changes rather than to a real reflection of changes in diabetes prevalence in that country.

# Age-adjusted comparative estimates

In order to make comparison of diabetes prevalence between countries, age-adjusted diabetes prevalence was generated for each country by applying the country's age-specific diabetes prevalence estimates to each age-group and standardising the country's population age structure to the global age structure of 2001[6].

**Map 2.2 Countries and territories with selected data sources quality**

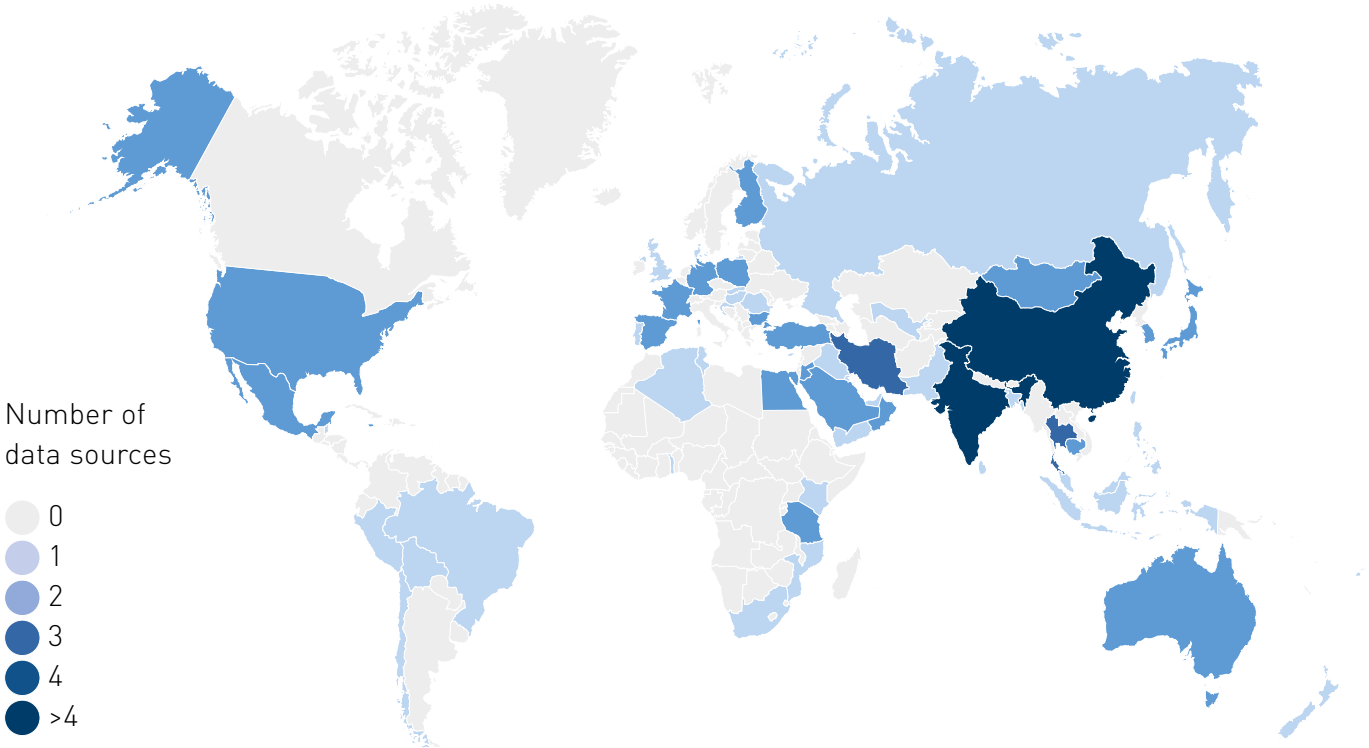


# Estimating undiagnosed diabetes prevalence

Population-based studies provide the basis for estimating undiagnosed diabetes. A group of people living in a particular area is tested for diabetes using a blood test which identifies both known and previously undiagnosed cases. The results will allow determining whether a participant has diabetes or not. These ratios will be used to compute country level estimates for undiagnosed diabetes.

For countries with reported data sources on undiagnosed diabetes estimates, the weighted average of the estimates of their data sources were calculated. For countries without original data sources of undiagnosed diabetes estimates, values on the generalized linear random effects model were attributed based on IDF regions and the income level of the country to estimate the rates of undiagnosed diabetes (Map 2.3).

**Map 2.3 Countries and territories with selected data sources reporting the percentage of people (20-79 years) with previously undiagnosed diabetes**



# Extrapolating data

There is a significant number of countries without sources on diabetes prevalence, fulfilling the inclusion criteria previously described. For these countries without high quality original data sources, estimates were generated by extrapolation, making use of the diabetes prevalence data sources from similar countries matched by ethnicity,[7] language,[8] World Bank income level[9] and geography.

Therefore, extrapolated estimates are less reliable, than for countries with original data sources and should be interpreted with caution. Countries with extrapolated estimates are marked in the prevalence table in the appendices. It is essential that high quality studies be conducted in these countries to close the evidence gap on diabetes prevalence.

# Estimating confidence intervals

Confidence interval estimates were produced to estimate the impact of each of the analytical decisions on the final prevalence estimates. In order to quantify the potential sources of uncertainty associated with the study selection process, two separate analyses were performed:

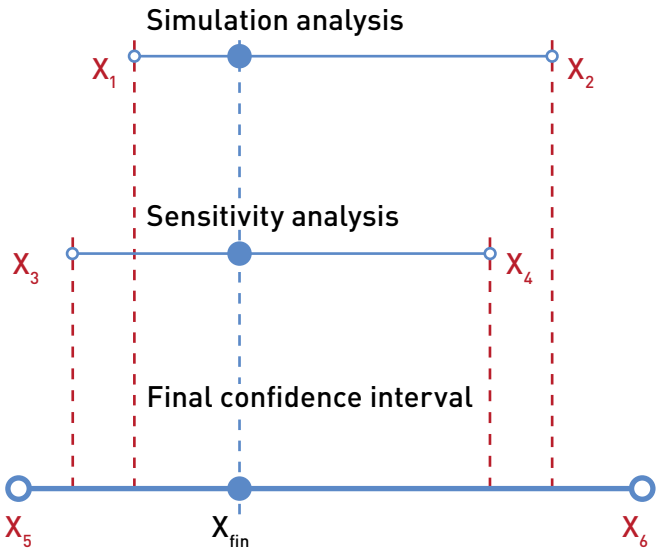
- A bootstrap analysis of the sensitivity of the prevalence estimates to create the study selection process.
- A simulation study to assess a variation of results in a range of 95% simulated distribution that reflect raw data uncertainty based on data sample sizes.

In the bootstrap analysis, 221 data sources from 131 countries were selected for diabetes prevalence analysis and each time one study is excluded for analysis. Therefore, there were 221 runs of analyses and 221 results for each age group/gender per country. Thus, the maximum and minimum values of the 221 results were taken as the confidence interval for bootstrap analysis.

In the simulation analysis, samples in each data source were considered as binomial distribution and the confidence interval was first generated, thus 1000 random samples from each confidence interval were uniformly generated in all data sources and new samples were generated in all data sources 1000 times. Therefore, 1000 runs of analyses were performed, and 95% quantile of the maximum and minimum values were taken as confidence interval in the simulation analysis.

Overall, the confidence interval for each age group, gender and country was constructed based on the maximum and minimum value of both bootstrap and simulation analysis to reflect the confidence intervals around the diabetes prevalence estimates (Figure 2.1).

**Figure 2.1. Bootstrap and simulation analysis**

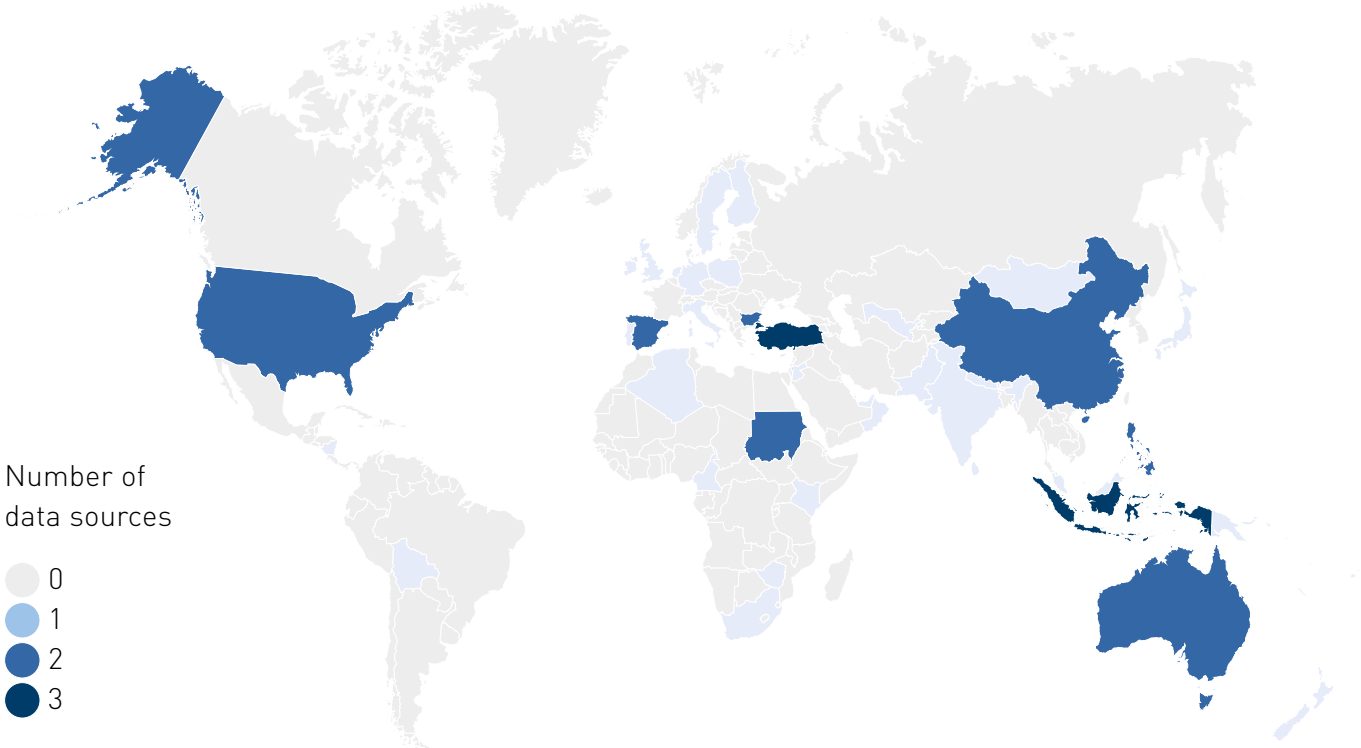


# Estimating impaired glucose tolerance prevalence

A generalized linear regression model was used to estimate age, gender and urban/rural specific impaired glucose tolerance (IGT) prevalence per country. Data sources were searched and selected according to the previously described criteria. The urban and rural IGT prevalence ratios were updated according to weighted average of the ratios reported in different data sources from 19 IDF and economic regions.

However, the number of studies which pass the selection threshold was limited, due to lack of data sources on reported IGT prevalence. Only 89 studies representing 47 countries were selected to estimate IGT prevalence and the IGT estimates in the rest of the countries were extrapolated from similar countries with similar ethnicity, language, income level and geography (Map 2.4).

**Map 2.4 Data sources selected for impaired glucose tolerance estimates in adults (20-79 years)**



# Estimating the prevalence of hyperglycaemia in pregnancy

Hyperglycaemia (high blood glucose level) that is first detected during pregnancy (See Chapter 1) is classified as either:

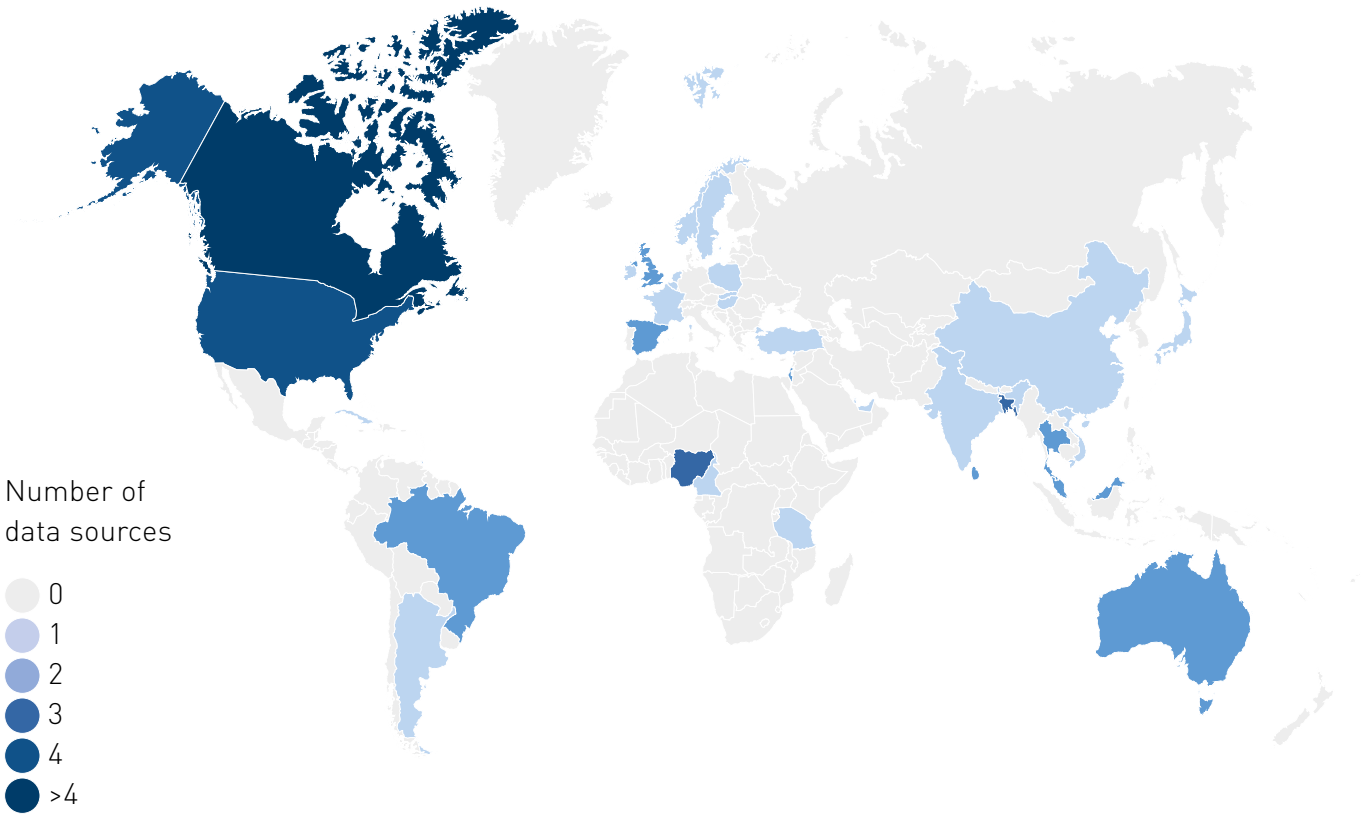
- Gestational diabetes mellitus (GDM)
- Diabetes mellitus in pregnancy[10]

Data sources reporting country level age specific prevalence of gestational diabetes and diabetes first detected in pregnancy were searched and selected by literature review. The studies were scored according to the diagnostic criteria, year of the study, study design and representativeness of the study. The studies over a threshold were selected for country level gestational diabetes estimation.

United Nations fertility projections and IDF estimates of diabetes detected prior to pregnancy were used to estimate the total percentage of live births affected by hyperglycaemia in pregnancy. In the year 2017, 57 studies from 37 countries were used to estimate country level age specific GDM prevalence by generalized linear regression (Map 2.5).

The methods for estimation of prevalence of hyperglycaemia in pregnancy were described with further details in the Diabetes Research and Clinical Practice paper by Linnenkamp and colleagues.[11]

**Map 2.5 Countries and territories with data sources reporting the prevalence of hyperglycaemia in pregnancy (20-49 years)**



# Estimating type 1 diabetes in children and adolescents

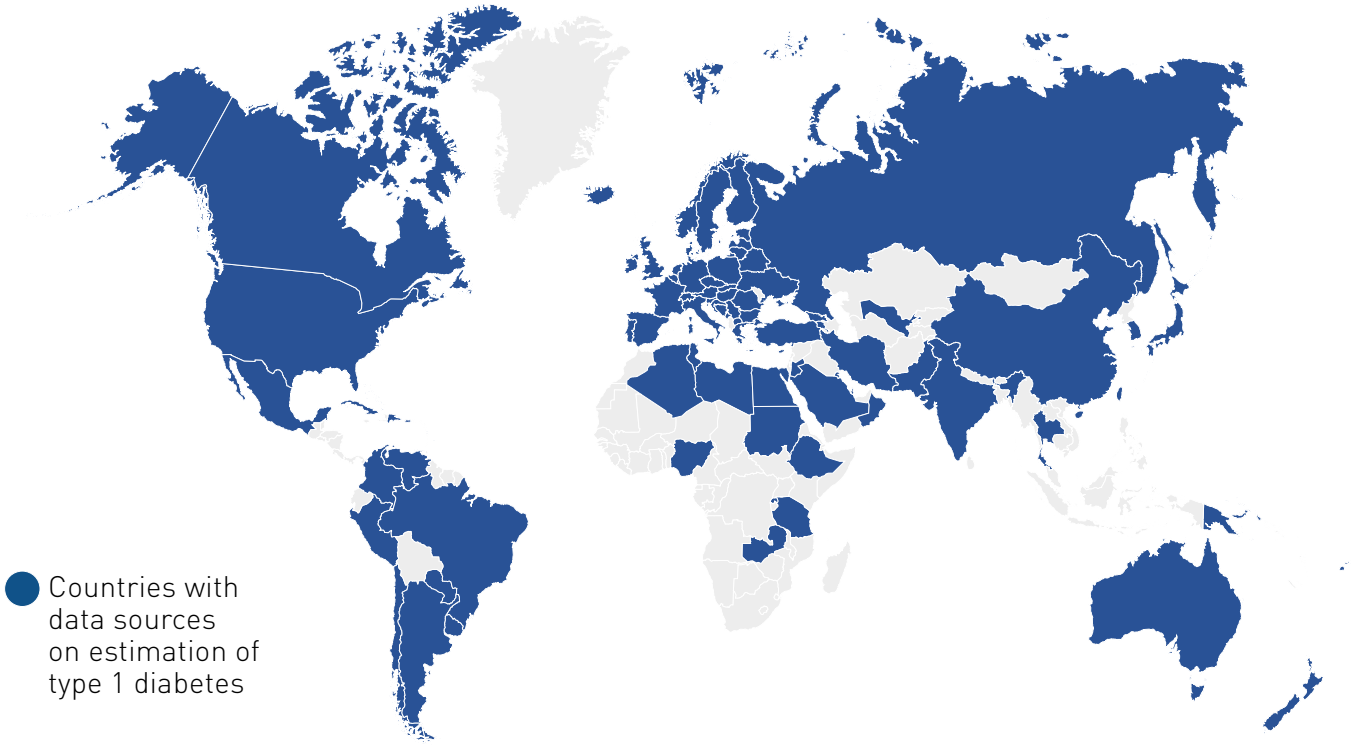
The incidence and prevalence estimates of type 1 diabetes in children and adolescents were produced by researchers from Queen's University, Belfast, Ireland.[12]

The scientific literature was searched for data sources that contained population-based studies on type 1 diabetes incidence (new cases each year) or prevalence (cumulative incidence from total cases) in children and adolescents aged up to 20 years. The majority of relevant studies provided incidence rates derived from registers of newly diagnosed cases up to 14 years of age. Studies were graded on quality criteria. If no information was available in the published literature for a country, then for ages under 15 years, its rate was extrapolated using the rate from a nearby similar country. For ages 15-19, its rate was estimated using the average regional ratio of incidence rates in the 15-19 year and 0-14 year age-groups. Prevalence rates were then derived from these incidence rates and both were applied to United Nations population estimates for each country to obtain estimates of the numbers of incident and prevalent cases (Map 2.6).

Therefore, there is a need to adjust prevalence estimates derived from incidence rates to allow for case fatality. In contrast to previous *IDF Diabetes Atlas* editions, numbers of prevalent cases have been derived by making an allowance for case fatality, which mainly affects figures in less developed countries and results in reduced numbers of prevalent cases.

The methodology for calculating prevalence from incidence used in previous *IDF Diabetes Atlas* editions assumed the effects of mortality were minimal which may not be accurate in low income countries. In this edition, to reduce prevalence overestimation in such countries, a standardised mortality ratio for patients with type 1 diabetes was estimated for each country from its infant mortality rate[13] and along with life tables,[14] a mortality-adjusted prevalence was calculated.

**Map 2.6 Countries and territories with data available on the incidence or prevalence of type 1 diabetes in children and adolescents (<20 years)**



# Estimating diabetes-related mortality

The mortality estimates should be interpreted with caution. The mortality is calculated from relative risks and total numbers of deaths. Relative risks attributable to diabetes do not come from death certificates listing diabetes, but come from cohort studies comparing death rates in those with and without diabetes.[15,16] The methods of estimating diabetes related mortality were described previously in the Diabetes Research and Clinical Practice scientific paper[17] and remained unchanged, although the following inputs of estimating the mortality due to diabetes were updated:

- 2017 *IDF Diabetes Atlas* estimates of diabetes prevalence stratified by age and gender from 20-79 years.
- WHO estimates of the number of annual deaths from all causes stratified by age and gender.[18]
- Regional estimates of the mortality relative risk ratio of people with diabetes compared to those without diabetes stratified by age and gender. In the year 2017, new publications about country level diabetes mortality relative risk ratio were from 5 countries: Saudi Arabia,[19] Korea,[20] China,[21] Australia[22] and Latvia.[23]

The ratio from Saudi Arabia was used to approximate the ratio for MENA high income countries; the ratio from Korea was used for WP high income countries; the ratio from China was used for WP middle income countries; the ratio from Australia was used for Western Europe high income countries, New Zealand, Canada and USA; the ratio of Latvia was used for East Europe high income countries. For the rest of the countries, the ratio was the same as in 7th Edition of *IDF Diabetes Atlas.*

# Estimating healthcare expenditures

Healthcare expenditure on diabetes is based on the WHO definition of total healthcare expenditure, which covers the provision of health services (preventive and curative), family planning activities, nutrition activities and emergency aid designated for health, but does not include provision of water and sanitation. It does include both public and private healthcare expenditures.[24]

The estimation of the healthcare expenditures on diabetes for each country was based on an attributional fraction model, which relied on the five inputs:

1. IDF Diabetes Atlas estimates of diabetes prevalence produced for this edition.
2. United Nations population estimates for 2015 and 2045.[4]
3. WHO annual healthcare expenditures for 2017.[25]
4. WHO mortality rates.[26]
5. The ratios of healthcare expenditures for people with diabetes compared to people without diabetes.[27]

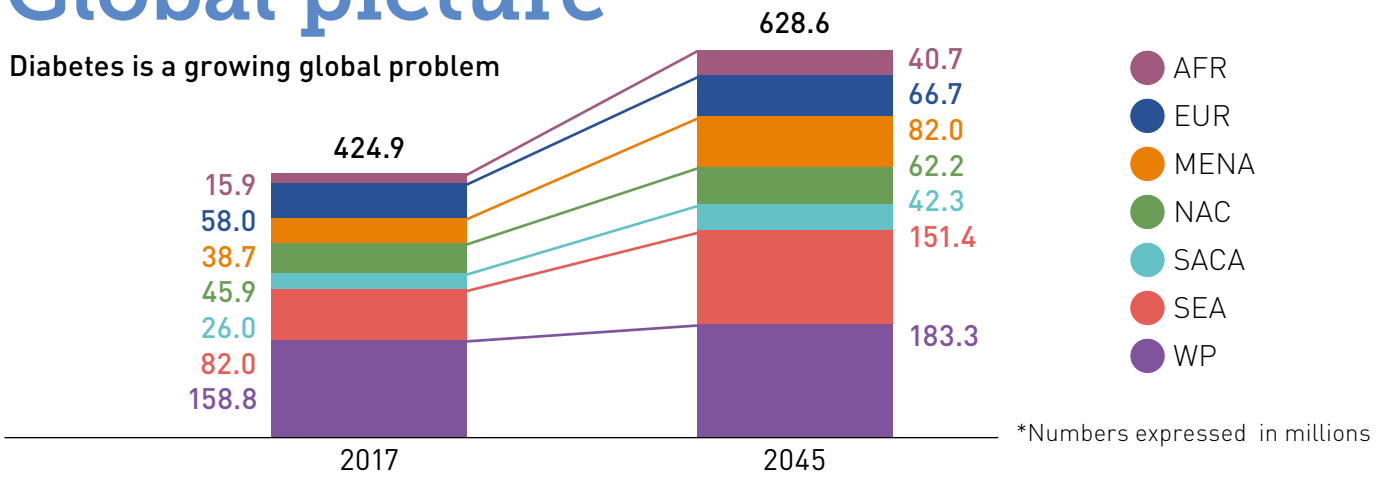
The critical component in this method is the ratio of diabetes healthcare expenditure of people with diabetes compared to those without diabetes. The number of data sources is very heterogeneous. While in high income countries many studies have been conducted, in low and middle income countries there is very little evidence. Generally, healthcare expenditures for people with diabetes are on average two to three-fold higher than for people without diabetes.[28–37] This is justified by differences in healthcare provision, demographics and economic development. The expenditure estimates are presented in US dollars (USD) and international dollars (ID).

The estimates in this edition of the *IDF Diabetes Atlas* are based on the latest WHO estimates from 2015, adjusted to 2017 based on a standard growth rate. Global estimates are presented in USD and ID. International dollars are used to evaluate regional estimates against each other to ensure comparability.

# CHAPTER 3

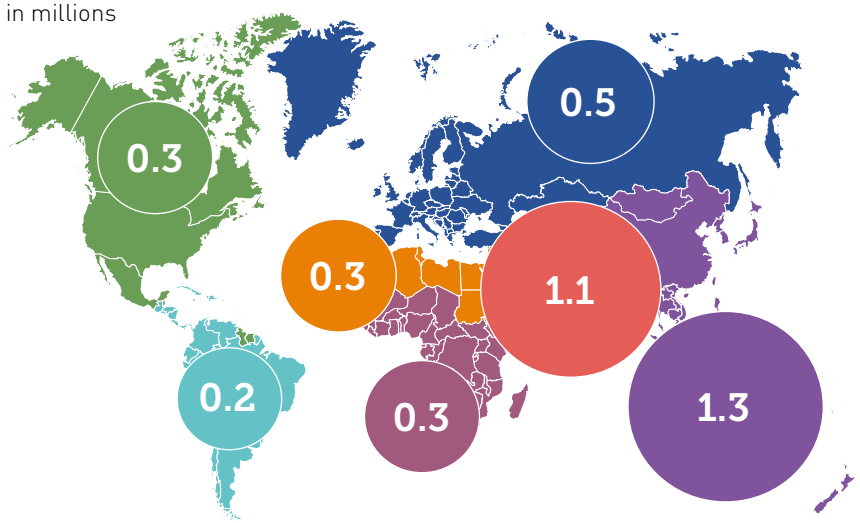
## Global picture

### Diabetes is a growing global problem



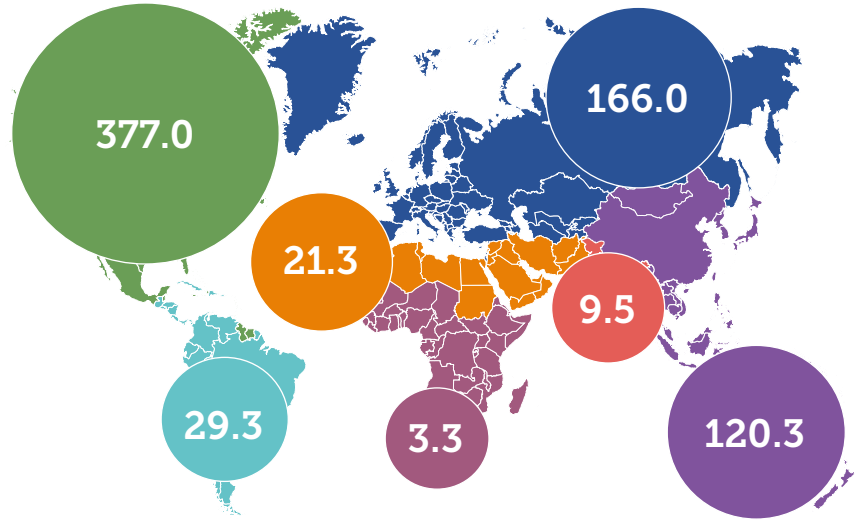

### Number of deaths due to diabetes (20-79 years) in 2017

in millions



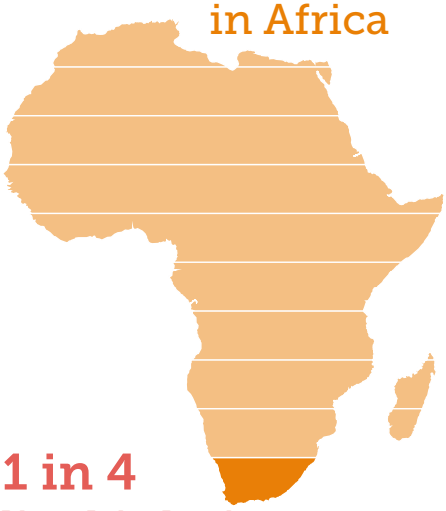

### Diabetes-related healthcare expenditure in adults (20-79 years) in 2017

USD in billions

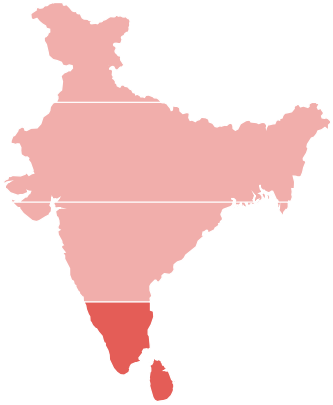



### Hyperglycaemia in pregnancy varies between

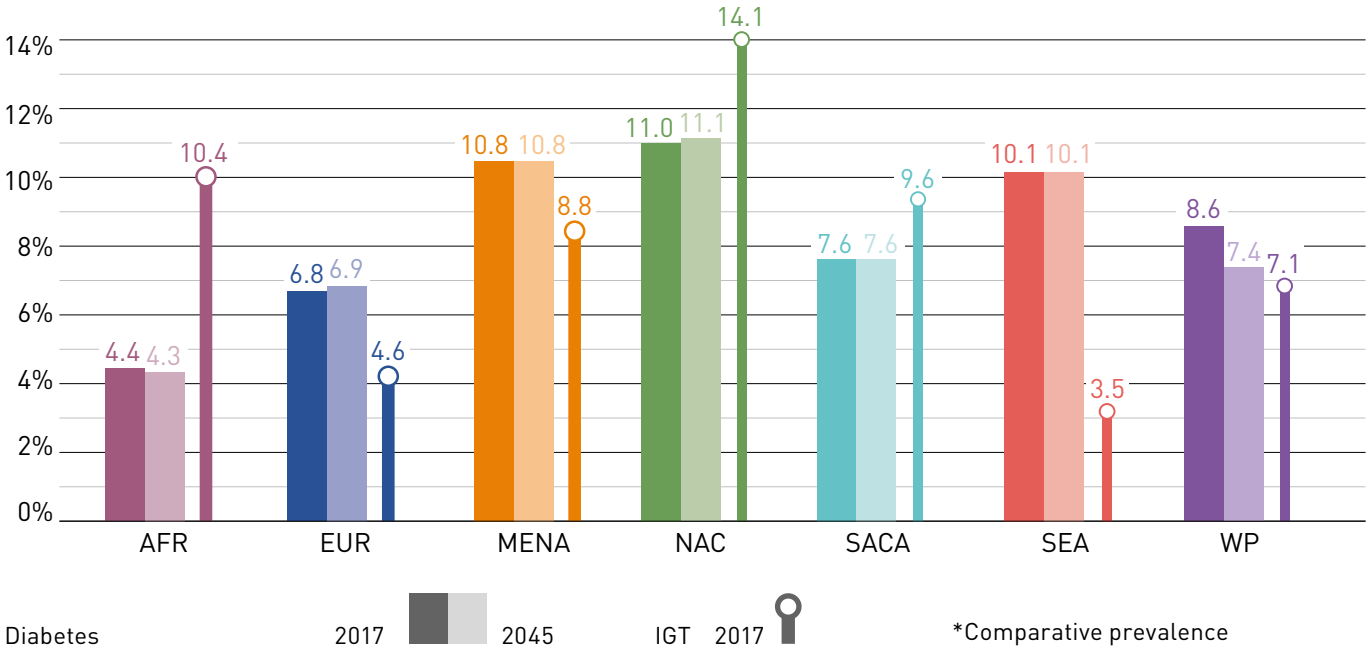
**1 in 10**
live births
in Africa



**1 in 4**
live births in
South-East Asia



## Prevalence* of diabetes and IGT (20-79 years) by IDF Region, 2017 and 2045




| At a glance | 2017 | 2045 |
|---|---|---|
| Total world population | 7.5 billion | 9.5 billion |
| Adult population (20-79 years) | 4.84 billion | 6.37 billion |
| **Diabetes global estimates** | | |
| Prevalence (20-79 years) | 8.8% (7.2-11.3%) | 9.9% (7.5-12.7%) |
| Number of people with diabetes (20-79 years) | 424.9 million (346.4-545.4 million) | 628.6 million (477.0-808.7 million) |
| Number of deaths due to diabetes (20-79 years) | 4.0 (3.2-5.0) million | - |
| Total Healthcare Expenditures for Diabetes (20-79 years), R=2* 2017 USD | USD 727 billion | USD 776 billion |
| **Hyperglycaemia in pregnancy (20-49 years)** | | |
| Proportion of live births affected | 16.2% | - |
| Number of live births affected | 21.3 million | - |
| **Impaired glucose tolerance (IGT) Estimates** | | |
| Global prevalence (20-79 years) | 7.3% (4.8-11.9%) | 8.3% (5.6%-13.9%) |
| Number of people with IGT (20-79 years) | 352.1 million (233.5 -577.3 million) | 531.6 million (353.8-883.9 million) |
| **Type 1 diabetes (0-19 years)** | | |
| Number of children and adolescents with type 1 diabetes | 1,106,500 | - |
| Number of newly diagnosed cases each year | 132,600 | - |

*Healthcare expenditures for people with diabetes are assumed to be on average two-fold higher than people without diabetes.

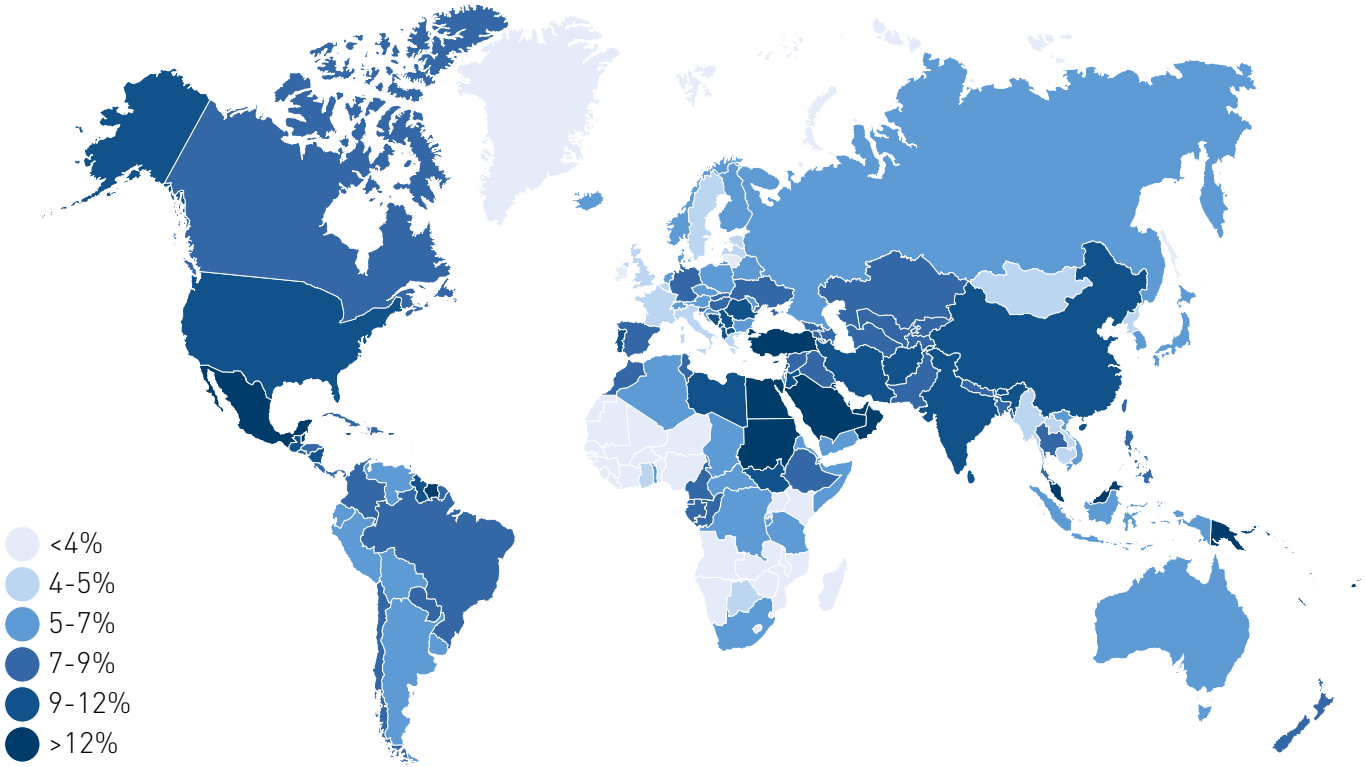
# Global picture

Diabetes is a global issue. Diabetes kills and disables, striking people at their most productive age impoverishing families or reducing the life-expectancy of older people. Diabetes is a common threat that does not respect borders or social class. No country is immune from diabetes and the epidemic is expected to continue. The burden of diabetes drains national healthcare budgets, reduces productivity, slows economic growth, causes catastrophic expenditure for vulnerable households and overwhelms healthcare systems.

Diabetes is one of the largest global health emergencies of the 21st century. Diabetes is among the top 10 causes of death globally and together with the other three major noncommunicable diseases (NCDs) (cardiovascular disease, cancer and respiratory disease) account for over 80% of all premature NCD deaths. In 2015, 39.5 million of the 56.4 million deaths globally were due to NCDs.[1] A major contributor to the challenge of diabetes is that 30-80% of people with diabetes are undiagnosed.[2]

Population-wide lifestyle change, along with early detection, diagnosis and cost-effective treatment of diabetes are required to save lives and prevent or significantly delay devastating diabetes-related complications. Only multi-sectoral and coordinated responses with public policies and market interventions within and beyond the health sector can address this issue.

**Map 3.1 Estimated age-adjusted prevalence of diabetes in adults (20-79 years), 2017**



# Prevalence and projections

In this new edition of the *IDF Diabetes Atlas*, the prevalence of diabetes and impaired glucose tolerance (IGT) are estimated for the years 2017 and 2045. The estimates are provided for 221 countries and territories, grouped into seven IDF regions: Africa (AFR), Europe (EUR), Middle East and North Africa (MENA), North America and Caribbean (NAC), South and Central America (SACA), South-East Asia (SEA) and the Western Pacific (WP).

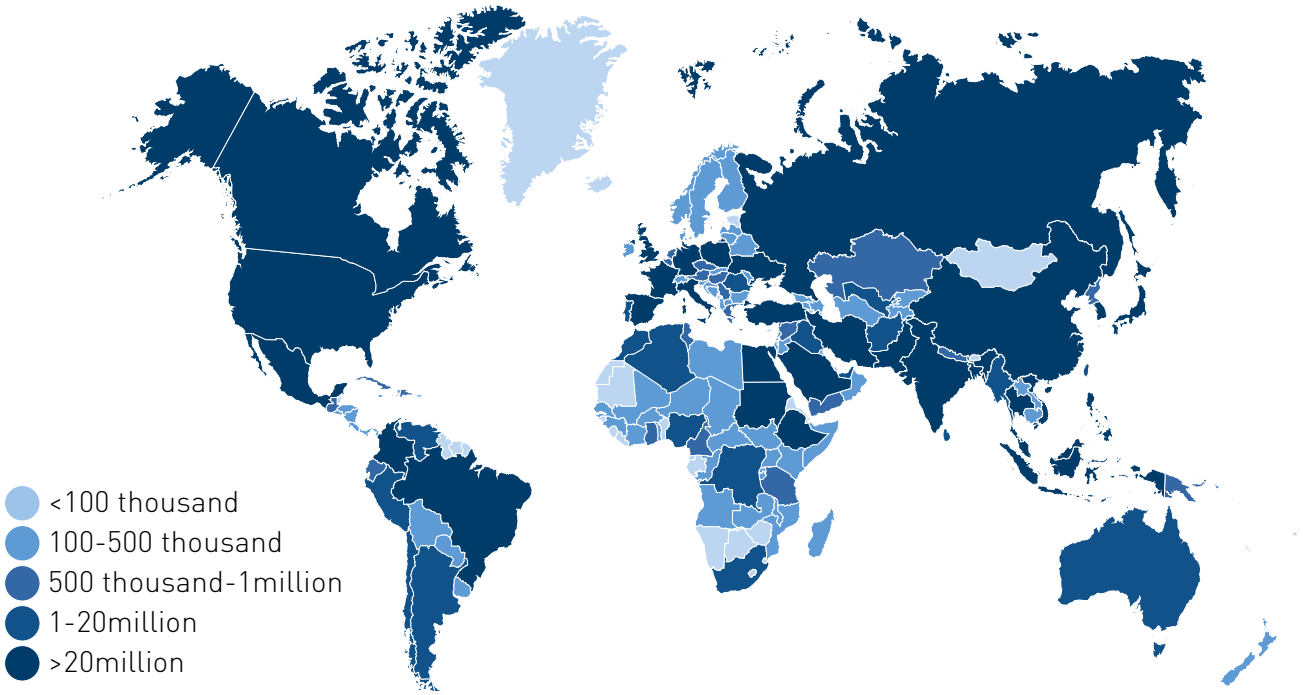
The methodology behind the estimates can be found in Chapter 2 (Methodology). The full details of the methods used to generate the prevalence estimates for diabetes in adults and the proportion of undiagnosed diabetes, including how the data sources were evaluated and processed, can be found online at diabetesatlas.org.

In high income countries, approximately 87% to 91% of all people with diabetes are estimated to have type 2 diabetes, 7% to 12% are estimated to have type 1 diabetes and 1% to 3% to have other types of diabetes.[3-6] In most high income countries, the majority of children and adolescents who develop diabetes have type 1 diabetes.

The relative proportions of type 1 and type 2 diabetes have not been studied in detail in low and middle income countries.

Some 425 million people worldwide, or 8.8% of adults 20-79 years, are estimated to have diabetes. About 79% live in low and middle income countries. The number of people with diabetes increases to 451 million if the age is expanded to 18-99 years. If these trends continue, by 2045, 693 million people 18-99 years, or 629 million of people 20-79 years, will have diabetes (Maps 3.1 and 3.2). The largest increases will take place in regions where economies are moving from low income to middle income levels. Diabetes estimates have been on the rise for several decades. More than one-third of diabetes cases are estimated to result from population growth and ageing, 28% from an increase in age-specific prevalences and 32% from the interaction of these two.[7] Globally diabetes results in USD 727 billion being spent yearly by people with diabetes only on healthcare, which corresponds to one for every eight dollars spent on healthcare.

**Map 3.2 Estimated total number of adults (20-79 years) living with diabetes, 2017**



## Age distribution

There are 326.5 million people of working age (20-64 years) with diabetes, and 122.8 million people 65-99 years with diabetes. The number of people of working age with diabetes is expected to increase to 438.2 million, and the number of people with diabetes 65-99 years will increase to 253.4 million in 2045 (Figures 3.1 and 3.2). Likewise, the economic burden of diabetes will increase in the next decades particularly among elder age groups (70-99) with an increase of USD 104 billion from 2017 to 2045.

## Gender distribution

The prevalence of diabetes for women 20-79 years is estimated to be 8.4% which is slightly lower than among men (9.1%). There are about 17.1 million more men than women with diabetes (221.0 million men vs 203.9 million women). The diabetes prevalence in women is expected to increase to 9.7% in women and to 10.0% in men (Figures 3.1 and 3.2). The age group 65-79 years shows the highest diabetes prevalence in both women and men.

**Figure 3.1 Prevalence of people with diabetes by age and sex, 2017**

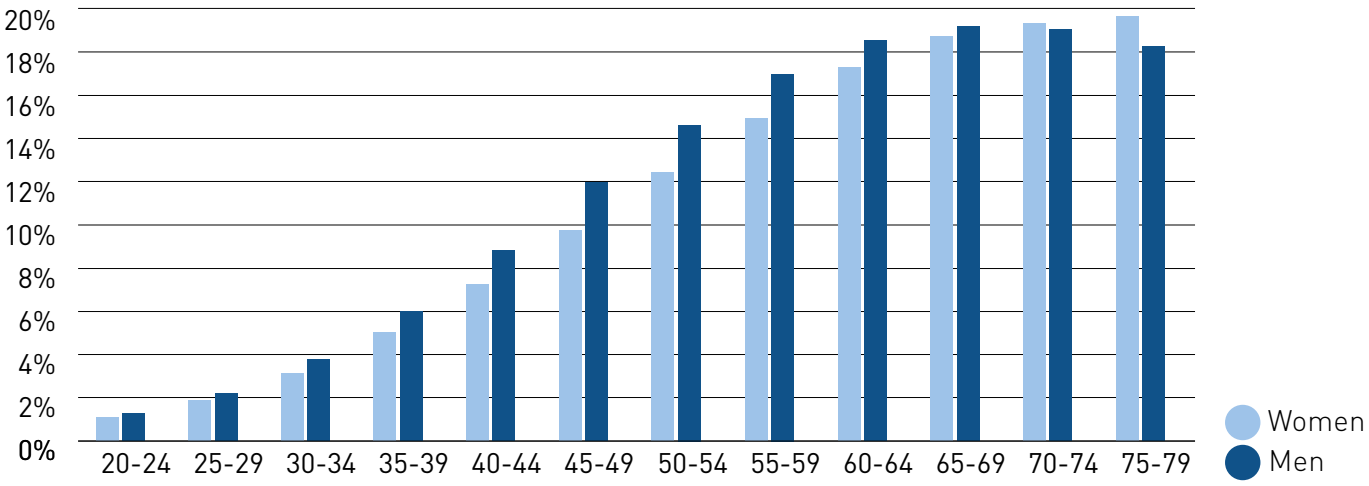
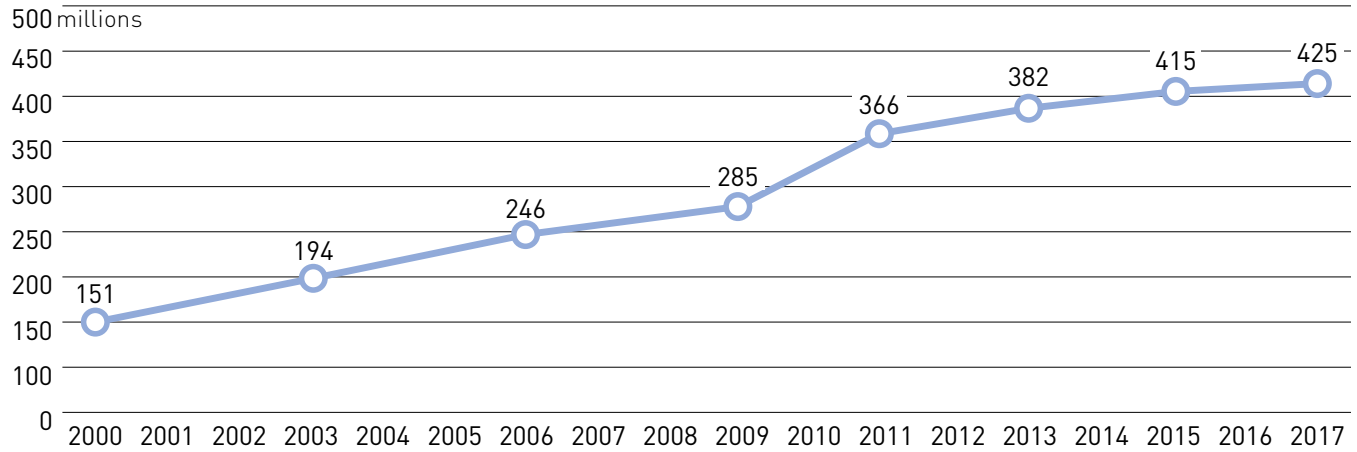



**Figure 3.2 Total number of adults with diabetes (20-79 years)**

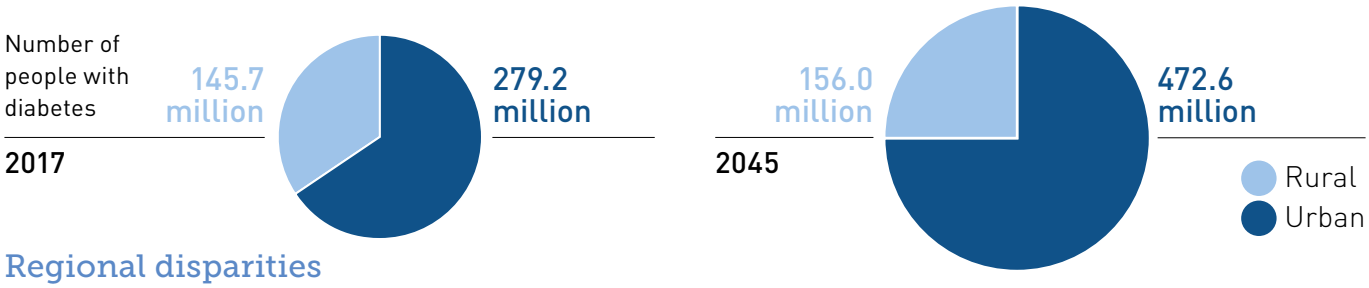


## Urban and rural environments

In 2017, there are more people 20-79 years with diabetes in urban (279.2 million) versus rural (145.7 million) settings, and the prevalence is higher in urban versus rural (10.2% vs 6.9%).

The number of people living with diabetes in urban areas is expected to increase to 472,6 million in 2045 due mainly to global urbanization (Figure 3.3).

**Figure 3.3 Diabetes prevalence in urban and rural settings in 2017 and 2045 (20-79 years)**




## Regional disparities

Age-adjusted comparative prevalence compares diabetes prevalences between countries and regions (Chapter 2). The North America and Caribbean region (NAC) has the highest age-adjusted comparative prevalence 20-79 years in 2017 and 2045 (11.0% and 11.1%). The Africa region has the lowest prevalence in 2017 and 2045 (4.2% and 4.1%), likely due to lower levels of urbanisation, under-nutrition, lower levels of obesity and higher rates of communicable diseases (Table 3.1).

The largest numbers of people with diabetes from age 20-79 years are in China, India and the United States in 2017 (Table 3.2).

Across IDF regions, large disparities were observed in the resources allocated to diabetes. While in the African region ID 444 on average was spent on people with diabetes yearly, this value was nearly 20 times higher in NAC, where ID 8,396 was spent on people with diabetes.

**Table 3.1 IDF regions ranked by prevalence (%) of diabetes (20-79 years) per region**

| | | 2017 | | 2045 | |
|---|---|---|---|---|---|
| Rank | IDF region | Age-adjusted comparative diabetes prevalence | Raw diabetes prevalence | Age-adjusted comparative diabetes prevalence | Raw diabetes prevalence |
| 1 | North America and Caribbean | 11.0% (9.2-12.5%) | 13.0% (10.8-14.5%) | 11.1% (9.1-12.7%) | 14.8% (11.7-16.7%) |
| 2 | Middle East and North Africa | 10.8% (7.5-14.2%) | 9.6% (6.7–12.7%) | 10.8% (7.4-14.3%) | 12.1% (8.4-15.9%) |
| 3 | South-East Asia | 10.1% (7.9-12.8%) | 8.5% (6.5–10.7%) | 10.1% (7.9-12.8%) | 11.1% (8.6-13.9%) |
| 4 | Western Pacific | 8.6% (7.6-11.0%) | 9.5% (8.4–12.0%) | 7.4% (5.8-9.2%) | 10.3% (7.8-12.8%) |
| 5 | South and Central America | 7.6% (6.3-9.5%) | 8.0% (6.7–9.8%) | 7.6% (6.2-9.6%) | 10.1% (8.3-12.4%) |
| 6 | Europe | 6.8% (5.4-9.9%) | 8.8% (7.0–12.0%) | 6.9% (5.5-9.9%) | 10.2% (8.2-13.7%) |
| 7 | Africa | 4.4% (2.9-7.8%) | 3.3% (2.1–6.0%) | 4.3% (2.9-7.7%) | 3.9% (2.6-6.8%) |

Table 3.2 Top ten countries/territories for number of people with diabetes (20-79 years), 2017 and 2045

| 2017 | | | 2045 | | |
|---|---|---|---|---|---|
| Rank | Country/territory | Number of people with diabetes | Rank | Country/ territory | Number of people with diabetes |
| 1 | China | 114.4 million (104.1-146.3) | 1 | India | 134.3 million (103.4-165.2) |
| 2 | India | 72.9 million (55.5-90.2) | 2 | China | 119.8 million (86.3-149.7) |
| 3 | United States | 30.2 million (28.8-31.8) | 3 | United States | 35.6million (33.9-37.9 ) |
| 4 | Brazil | 12.5 million (11.4-13.5) | 4 | Mexico | 21.8 million (11.0-26.2) |
| 5 | Mexico | 12.0 million (6.0-14.3) | 5 | Brazil | 20.3 million (18.6-22.1) |
| 6 | Indonesia | 10.3 million (8.9-11.1) | 6 | Egypt | 16.7million (9.0-19.1) |
| 7 | Russian Federation | 8.5 million (6.7-11.0) | 7 | Indonesia | 16.7million (14.6-18.2 ) |
| 8 | Egypt | 8.2million (4.4-9.4 ) | 8 | Pakistan | 16.1 million (11.5-23.2) |
| 9 | Germany | 7.5 million (6.1-8.3) | 9 | Bangladesh | 13.7 million (11.3-18.6) |
| 10 | Pakistan | 7.5 million (5.3-10.9) | 10 | Turkey | 11.2 million (10.1-13.3) |

# Undiagnosed Diabetes

It has been estimated that globally as many as 212.4 million people or half (50.0%) of all people 20-79 years with diabetes are unware of their disease. It is better for people with diabetes to be diagnosed as early as possible since the chances of preventing harmful and costly complications will be higher. Since half of the people with diabetes are undiagnosed, there is a global urgent need to screen, diagnose and provide appropriate care to people with diabetes. People with undiagnosed diabetes are also subject to higher usage of healthcare services compared to people without diabetes, and consequently likely to incur larger healthcare expenditures. Based on one American study, the total economic cost of undiagnosed diabetes was USD 33 billion in 2012.[8]

## Regional disparities in undiagnosed diabetes

No country has diagnosed every person that has diabetes. In Africa, where many low income countries with wide rural areas are located, the proportion of undiagnosed diabetes is 69.2%, likely due to limited resources and low prioritisation of diabetes screening. Even in high income countries, 37.3% of people with diabetes have not been diagnosed. Globally, 84.5% of all undiagnosed diabetes cases are in low and middle income countries (Tables 3.3 and 3.4 and Map 3.3). The highest numbers of people with undiagnosed diabetes are the same countries with largest number of people with diabetes: China, India and the United States (Table 3.5).

**Table 3.3 People living with diabetes (20-79 years) who are undiagnosed per region, 2017**

| Rank | IDF region | Proportion undiagnosed | Number of people with undiagnosed diabetes |
|---|---|---|---|
| 1 | Africa | 69.2% | 10.7million (6.8- 19.0) |
| 2 | South-East Asia | 57.6% | 47.2 million (36.0- 59.4) |
| 3 | Western Pacific | 54.1% | 85.9 million (76.1-108.0) |
| 4 | Middle East and North Africa | 49.0% | 19.0 million (13.1-25.3) |
| 5 | South and Central America | 40.0% | 10.4 million (8.8-12.6) |
| 6 | Europe | 37.9% | 22.0 million (17.6-30.3) |
| 7 | North America and Caribbean | 37.6% | 17.3 million (14.4-19.3) |

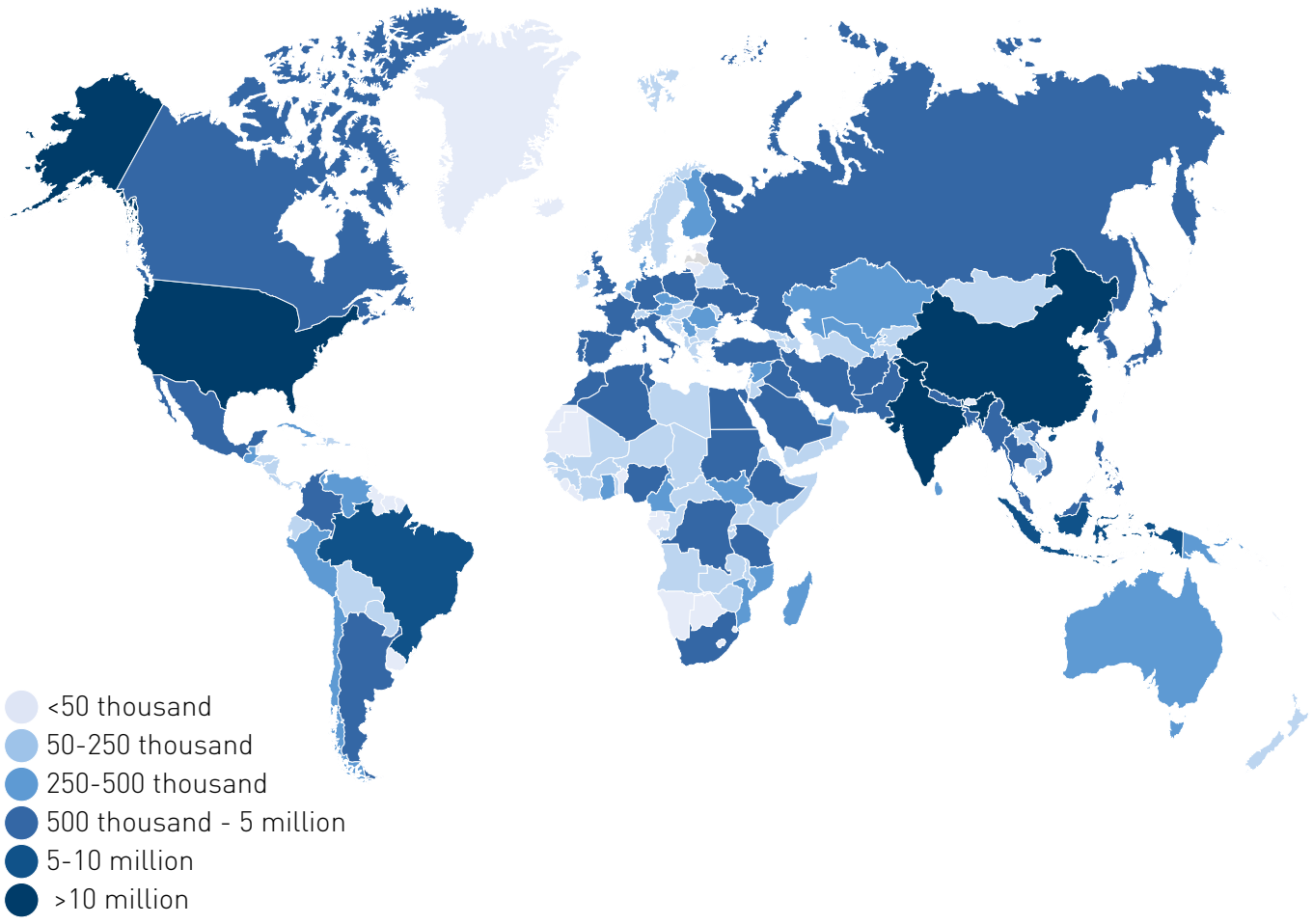
**Table 3.4 People living with diabetes (20-79 years) who are undiagnosed per World Bank income classification, 2017**

| World Bank income classification | Proportion undiagnosed | Number of people with undiagnosed diabetes |
|---|---|---|
| High income countries | 37.3% | 32.9 million (28.6-40.5) |
| Middle income countries | 52.5% | 170.5 million (138.1-218.7) |
| Low income countries | 76.5% | 9.0 million (6.1-14.6) |

Table 3.5 Top 10 countries for the number of people with undiagnosed diabetes (20-79 years) in 2017

| Rank | Countries | Number of people with undiagnosed diabetes | Proportion undiagnosed |
|---|---|---|---|
| 1 | China | 6.1 million (5.6-7.8) | 53.6% |
| 2 | India | 4.2 million (3.2-5.2) | 57.9% |
| 3 | United States | 1.15 million (1.10-1.21) | 38.2% |
| 4 | Brazil | 0.76 million (0.65-0.82) | 73.7% |
| 5 | Mexico | 0.57 million (0.53-0.62) | 46.0% |
| 6 | Indonesia | 0.50 million (0.32-0.67) | 53.7% |
| 7 | Russian Federation | 0.47 million (0.36-0.59) | 61.5% |
| 8 | Egypt | 0.45 million (0.22-0.54) | 37.4% |
| 9 | Germany | 0.44 million (0.23-0.50) | 53.1% |
| 10 | Pakistan | 0.39 million (0.32-0.53) | 56.0% |

Map 3.3 Number of people (20-79 years) living with diabetes who are undiagnosed, 2017



# Mortality

Approximately 4.0 (3.2-5.0) million people aged between 20 and 79 years are estimated to die from diabetes in 2017, which is equivalent to one death every eight seconds. Diabetes accounted for 10.7% of global all-cause mortality among people in this age group. This is higher than the combined number of deaths from infectious diseases (1.1million deaths from HIV/AIDS[9], 1.8 million from tuberculosis[10] and 0.4 million from malaria in 2015[9]). About 46.1% of deaths due to diabetes among the 20-79 age group are in people under the age of 60 (Table 3.6 and Map 3.4).

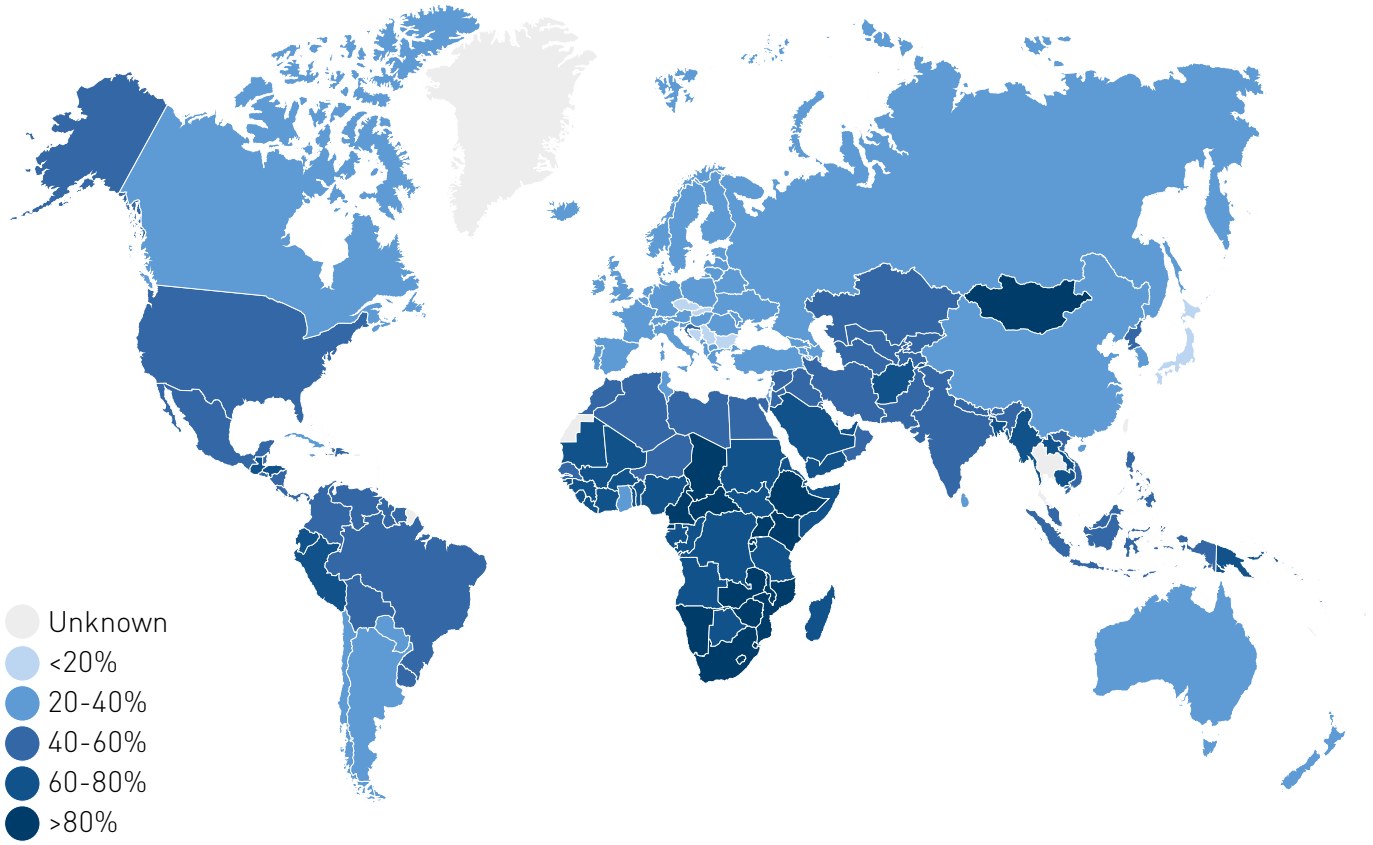
However, the mortality estimate is one million less than in 2015 likely due to global decrease in all-cause mortality estimates. Currently only the South and Central American region has an increasing mortality rate among all IDF regions.

Premature death and disability due to diabetes are also associated with a negative economic impact for countries, often called the indirect costs of diabetes. In the USA, it was estimated that premature death cost USD 19 billion to the economy, and a total USD 69 billion was indirectly lost due to diabetes.[11]

**Table 3.6 Proportion (%) of people who died from diabetes in 2017 before the age of 60 in IDF regions**

| IDF region | Number of deaths due to diabetes before age 60 | Proportion of all deaths due to diabetes occurring before age 60 |
|---|---|---|
| Africa | 0.23 million (0.16-0.39) | 77.0% |
| Europe | 0.16 million (0.13-0.22) | 32.9% |
| Middle East and North Africa | 0.16 million (0.12-0.21) | 51.8% |
| North America and Caribbean | 0.13 million (0.11-0.14) | 45.0% |
| South America and Central America | 0.09 million (0.08-0.11) | 44.9% |
| South East Asia | 0.58 million (0.47-0.69) | 51.5% |
| Western Pacific | 0.48 million (0.43-0.60) | 38.0% |

**Map 3.4 Proportions (%) of people who died from diabetes before the age of 60**




## Gender distribution in mortality

Globally, there are more deaths attributable to diabetes in women (2.1 (1.7–2.7) million) than men (1.8 (1.5–2.3) million).

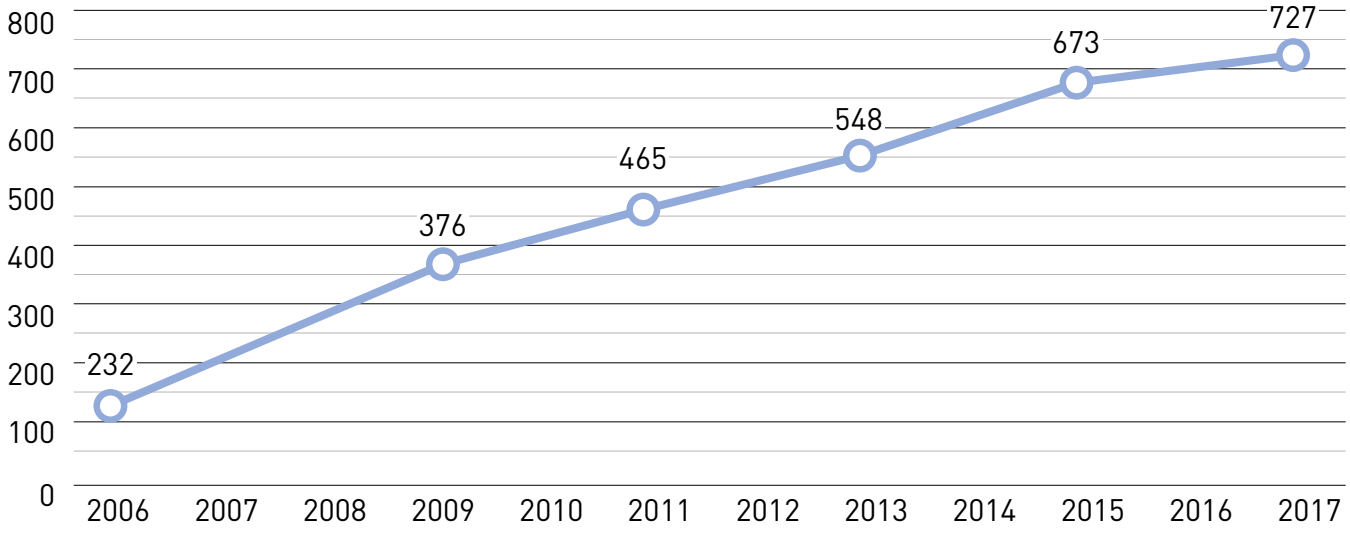
However North America and Caribbean region is the only region, where there are more deaths attributable to diabetes in men than women.

# Healthcare Expenditure

Despite the human burden characterized by premature mortality and lower quality of lifedue to diabetes-related complications, diabetes also imposes a significant economic impact for countries, healthcare systems, and above all, for individuals with diabetes and their families.[11-13]

Since its third edition in 2006, the IDF Diabetes Atlas has included estimates on the healthcare expenditure on diabetes.[14-18] The evolution has been tremendous, growing from USD 232 billion spent by people with diabetes worldwide in 2007, to USD 727 billion in 2017 for those aged 20-79 years (Figure 3.4).

**Figure 3.4 Total healthcare expenditure by people with diabetes (20-79 years)**

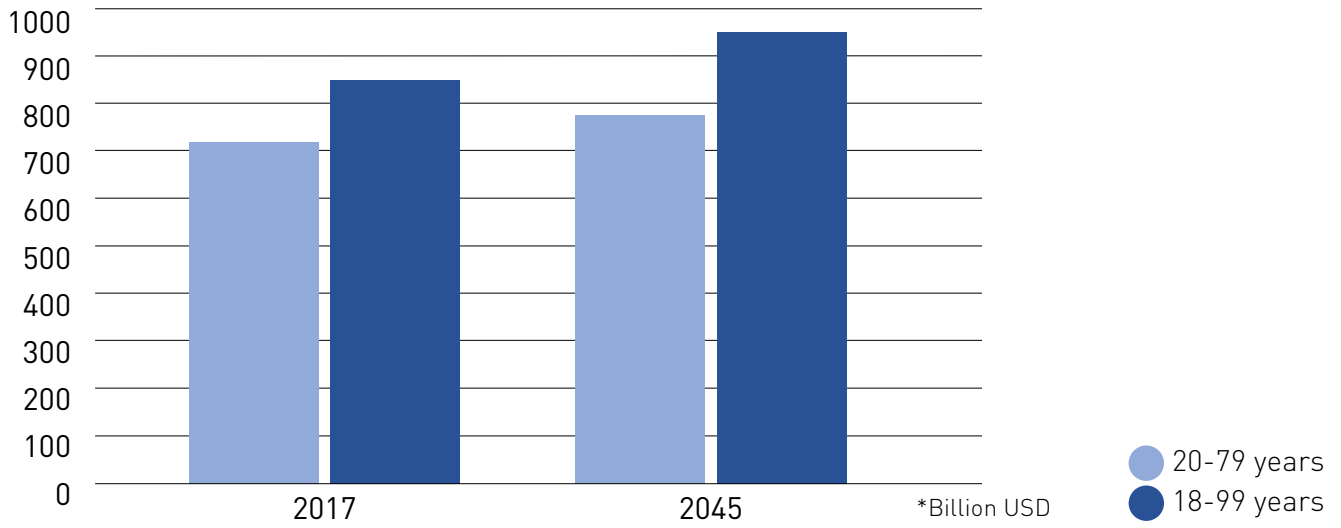



*Billion USD

In 2017, IDF estimates the total healthcare expenditure on diabetes will reach USD 727 billion (20-79 years), which represents an 8% increase compared to the 2015 estimate. When using the expanded age group of 18 to 99 years, the costs totalled USD 850 billion.

Moreover, the economic burden of diabetes is expected to continue to grow. It is projected that the healthcare expenditure on diabetes will reach USD 776 billion by 2045 (20-79 years) which represents a 7% growth. When using the age group 18-99 years, the total expenditure on diabetes is expected to reach USD 958 billion (Figure 3.5). The 2045 projections are very conservative, as they assume that the mean expenditure per person and diabetes prevalence rate remain constant, while only demographic changes are observed. This dynamic is supported by the observation that countries with the largest health expenditure will experience a very small population growth.

**Figure 3.5 Total healthcare expenditure by people with diabetes, 2017 and 2045**




Regarding the country level estimates, and after adjusting for purchasing power differences, the highest expenditures on diabetes were observed in the US with ID 348 billion, followed by China, and Germany, with ID 110 billion, and ID 42 billion respectively (Table 3.7).

The countries with the lowest healthcare expenditures on diabetes were Tuvalu, Sao Tome and Principe, and Nauru with about ID 1 million spent on people with diabetes in 2017 (Map 3.5).

Looking at the amount of healthcare expenditure per person with diabetes in 2017, large disparities can be observed across countries. The countries with the highest yearly cost per person with diabetes are the US with ID 11,638, followed by Luxembourg and Monaco with ID 8,941, and ID 8634, respectively. The countries with the lowest expenditure per person with diabetes are Madagascar with ID 87 per year, the Democratic Republic of Congo, and Central African Republic with ID 66, and ID 47, respectively (Map 3.6).

**Table 3.7 Top 10 countries for total healthcare expenditure on diabetes in 2017 (20-79 years)**

| Rank | Countries | Total healthcare expenditure* |
|---|---|---|
| 1 | United States of America | 348 |
| 2 | China | 110 |
| 3 | Germany | 42 |
| 4 | India | 31 |
| 5 | Japan | 28 |
| 6 | Brazil | 24 |
| 7 | Russian Federation | 20 |
| 8 | Mexico | 19 |
| 9 | France | 18 |
| 10 | Canada | 15 |

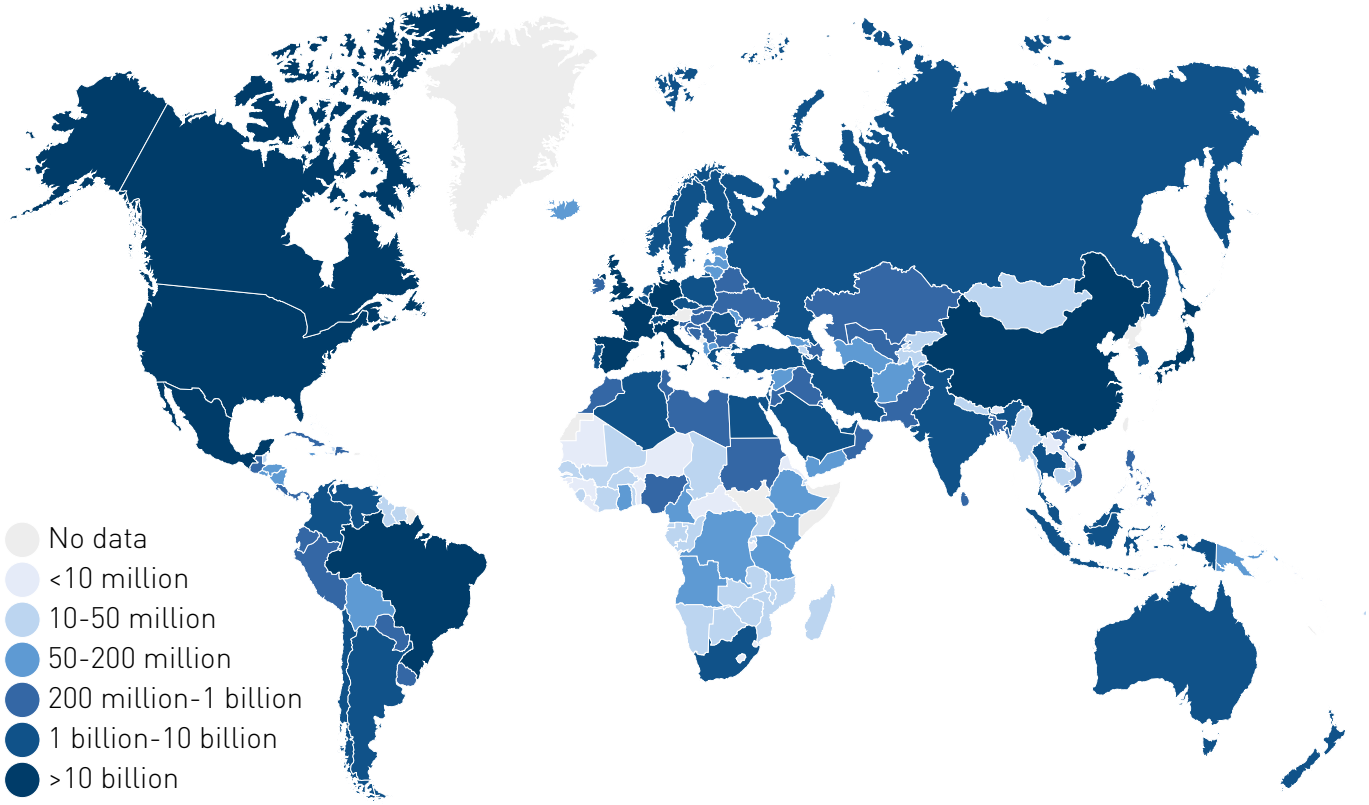
*Billion ID

**Table 3.8 Top 10 countries for mean healthcare expenditure per person with diabetes (20-79 years)**

| Rank | Countries | Mean healthcare expenditure per person* |
|---|---|---|
| 1 | United States | 11,638 |
| 2 | Luxembourg | 8,941 |
| 3 | Monaco | 8,634 |
| 4 | Norway | 8,020 |
| 5 | Switzerland | 7,907 |
| 6 | Netherlands | 6,430 |
| 7 | Sweden | 6,406 |
| 8 | Austria | 5,918 |
| 9 | Denmark | 5,748 |
| 10 | Canada | 5,718 |

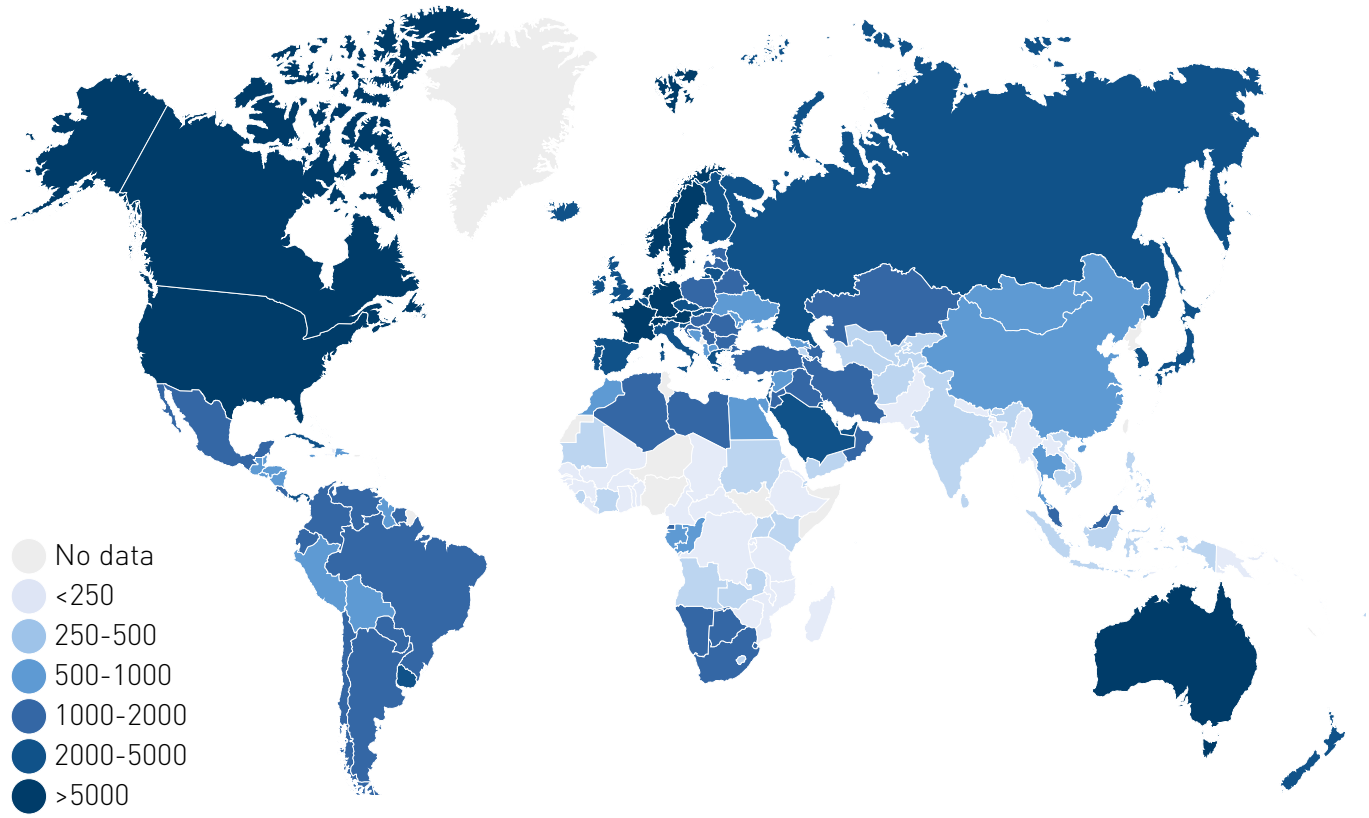
*ID

**Map 3.5 Total healthcare expenditure on diabetes (20-79 years) (ID)**




Regarding the other countries in the top 10 for the highest expenditure per person with diabetes, six countries are from the European region, and one is from the North American and Caribbean region (Table 3.8).

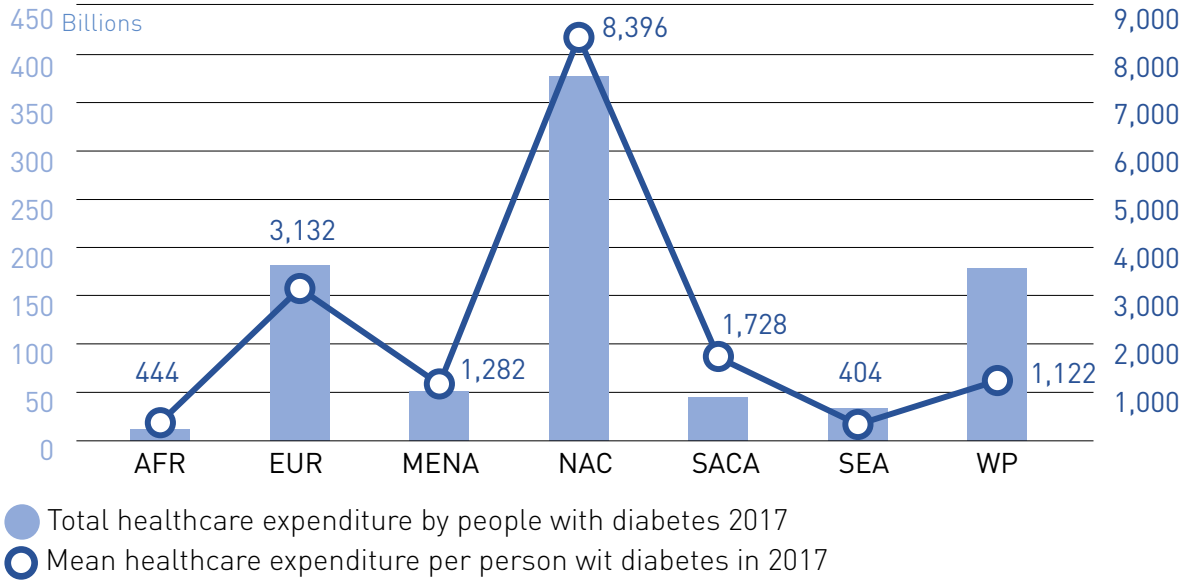
**Map 3.6 Mean healthcare expenditure per person with diabetes (20-79 years) (ID)**



## Regional burden

The North American and Caribbean region has the highest expenditure on diabetes of the seven IDF regions, with ID 383 billion (20-79 years), which corresponds to 52% of the total amount spent globally on diabetes in 2017. The second highest expenditure on diabetes is the European region with ID 181 billion, followed by the Western Pacific with ID 179 billion, which correspond to 23%, and 17%, respectively, of the total global spending. The other four regions spent significantly less on diabetes, despite being home to 27% of the cases, and were responsible only for 9% of the total spending (Figure 3.6).

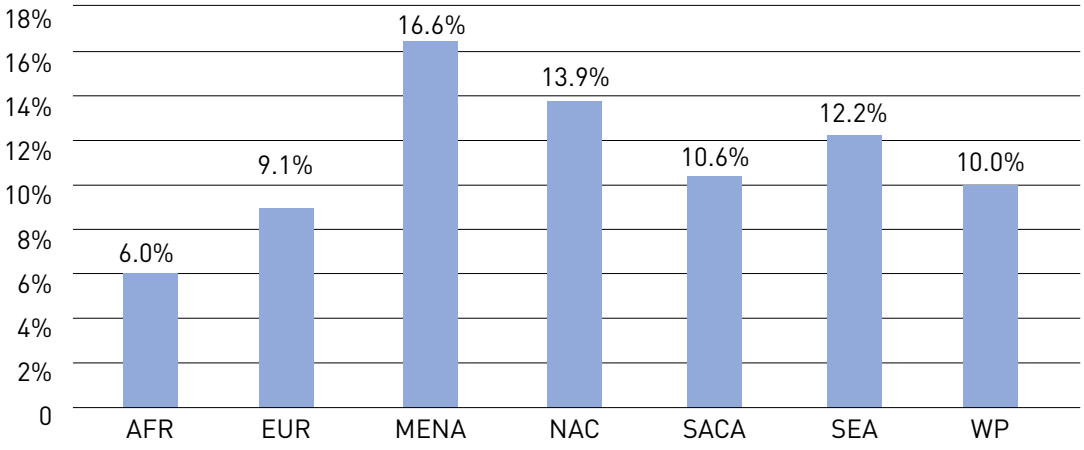
**Figure 3.6 Total healthcare expenditure on diabetes and mean expenditure per person with diabetes (ID) (20-79 years) in 2017 by IDF region**




## The national health sector budgets on diabetes

Expenditure on diabetes has a significant impact on healthcare budgets worldwide. On average 17% of the total healthcare budget was allocated to diabetes in the Middle East and North African region, the highest percentage from the seven IDF regions followed by 14% observed in the North American and Caribbean region. The region which spent the lowest amount of healthcare dollars was the African region with only 6% (Figure 3.7).

**Figure 3.7 Percentage of healthcare budget spent on diabetes (20-79 years) by IDF region in 2017**

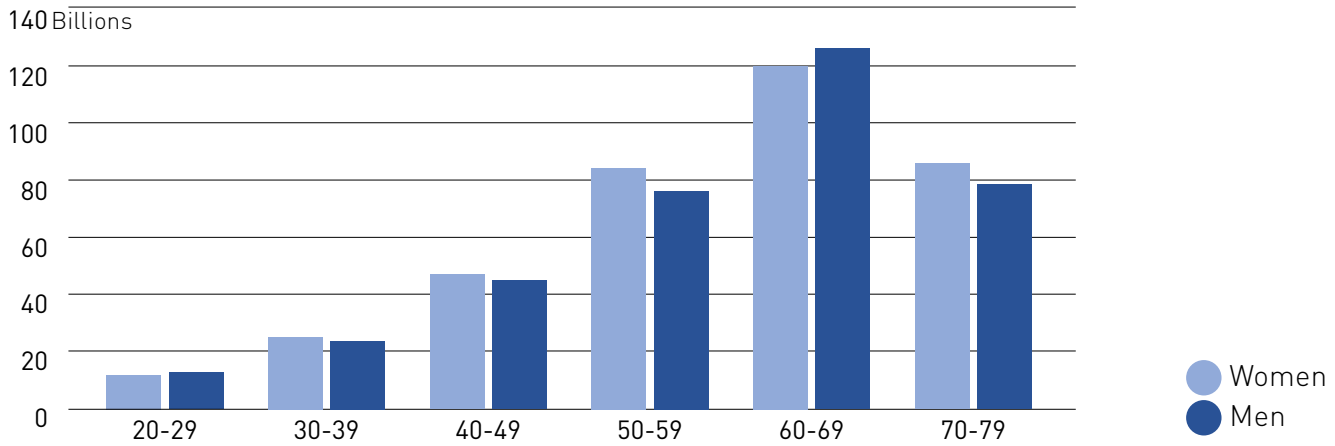


## Gender and age distribution in burden

The age group with the largest expenditure on people with diabetes was 60-69 years, USD 127 billion, men being 7% higher than women in the same age group. This group was followed by people 70-79 years, and then those 50-59 years, but in these cases women presented higher expenditure than men, USD 86 vs 78 billion, and USD 84 vs 76 billion, respectively (Figure 3.8).

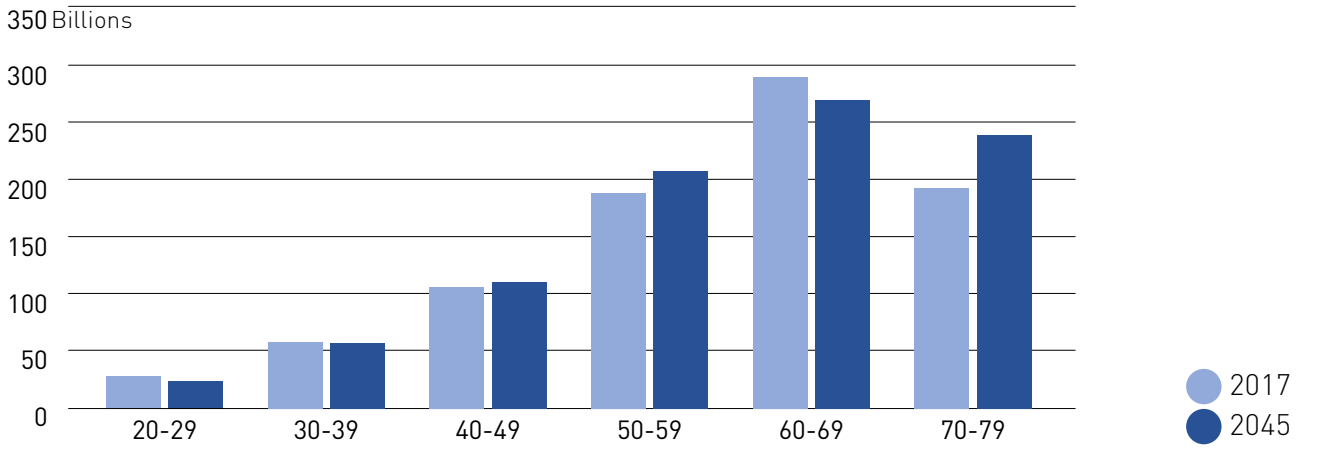
The reasons behind the large expenditure observed in the age group 60-69 are life expectancy, and costs associated with frequency of diabetes-related complications in later stages of life. Also, the fact that women in earlier stages of life experience higher healthcare expenditure than men is a pattern observed in healthcare in general and not exclusively from diabetes.

**Figure 3.8 Healthcare expenditure on diabetes by sex and age group, 2017 (USD)**




When analysing the projections for 2045, two findings can be observed. On one hand, expenditure for people less than 50 years will remain stable in the next decades, two percentage growth from 2017 to 2045, assuming that the cost per person remains contant. On the other hand, the expenditure for people above 70 years will grow by 37%, due to aging of the population in countries with highest expenditure on diabetes (Figure 3.9).

**Figure 3.9 Healthcare expenditure on diabetes by age group in 2017 and 2045 (USD)**

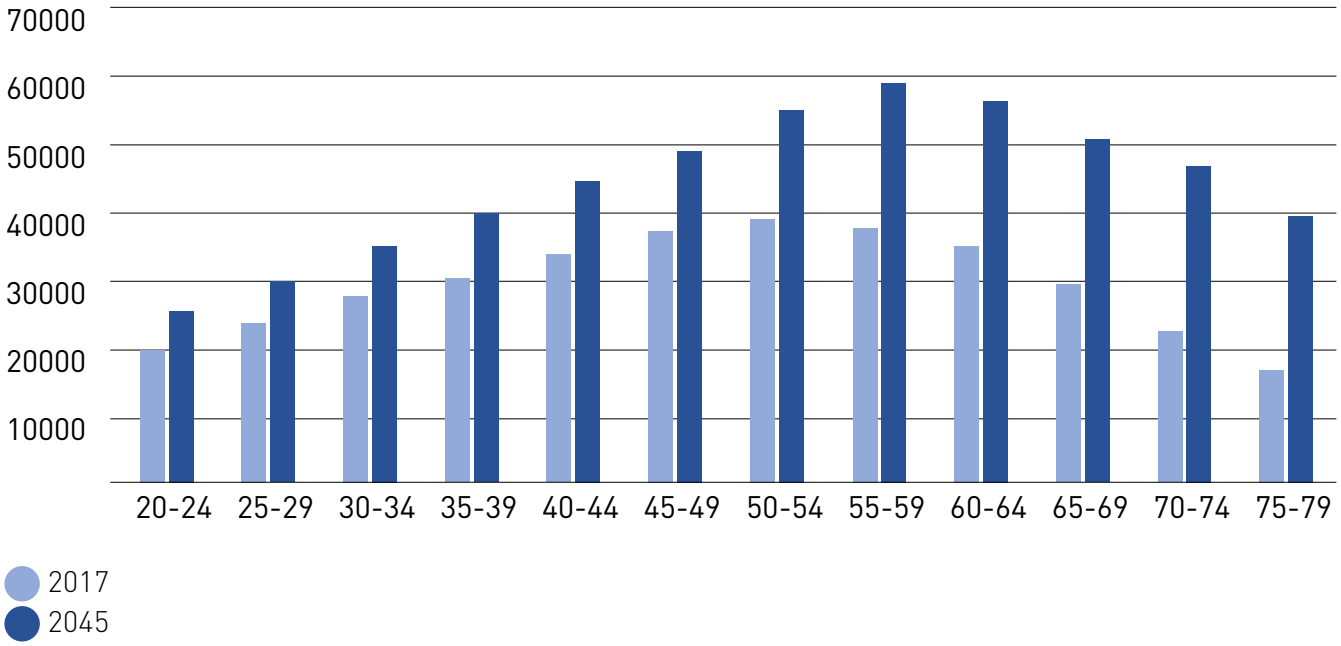


# Impaired glucose tolerance

There are 352.1 (233.5–577.3) million people worldwide, 7.3% (4.8–11.9%) of adults 20- 79 years, who are estimated to have impaired glucose tolerance (IGT). The vast majority (72.3%) of these people live in low and middle income countries. By 2045, the number of people 20-79 years with IGT is projected to increase to 587 (384.4–992.7) million, or 8.3% (5.6–13.9%) of the adult population (Figures 3.10 and 3.11 and map 3.7).

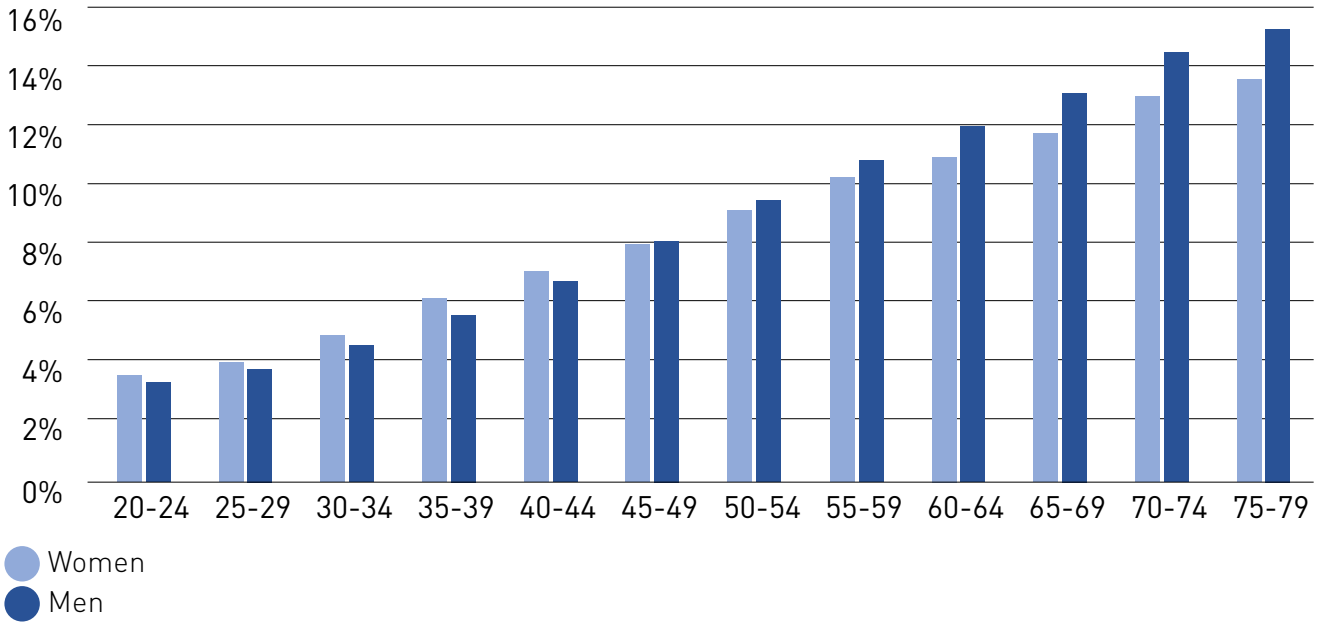
There are no differences in the overall IGT prevalence for people 20-79 years between women (7.3%) and men (7.3%), while the prevalence of IGT is a little higher in men than women for people older than 50 years, and for people younger than 45 years, the prevalence of IGT is a little higher in women than men. People with IGT are not only at high risk of developing diabetes, but also are more susceptible to use healthcare services being therefore subject to higher healthcare expenditure. In the US, it was estimated that USD 44 billion was spent on healthcare due to prediabetes.[8]

**Figure 3.10 Number of people* with impaired glucose tolerance by age group, 2017 and 2045**

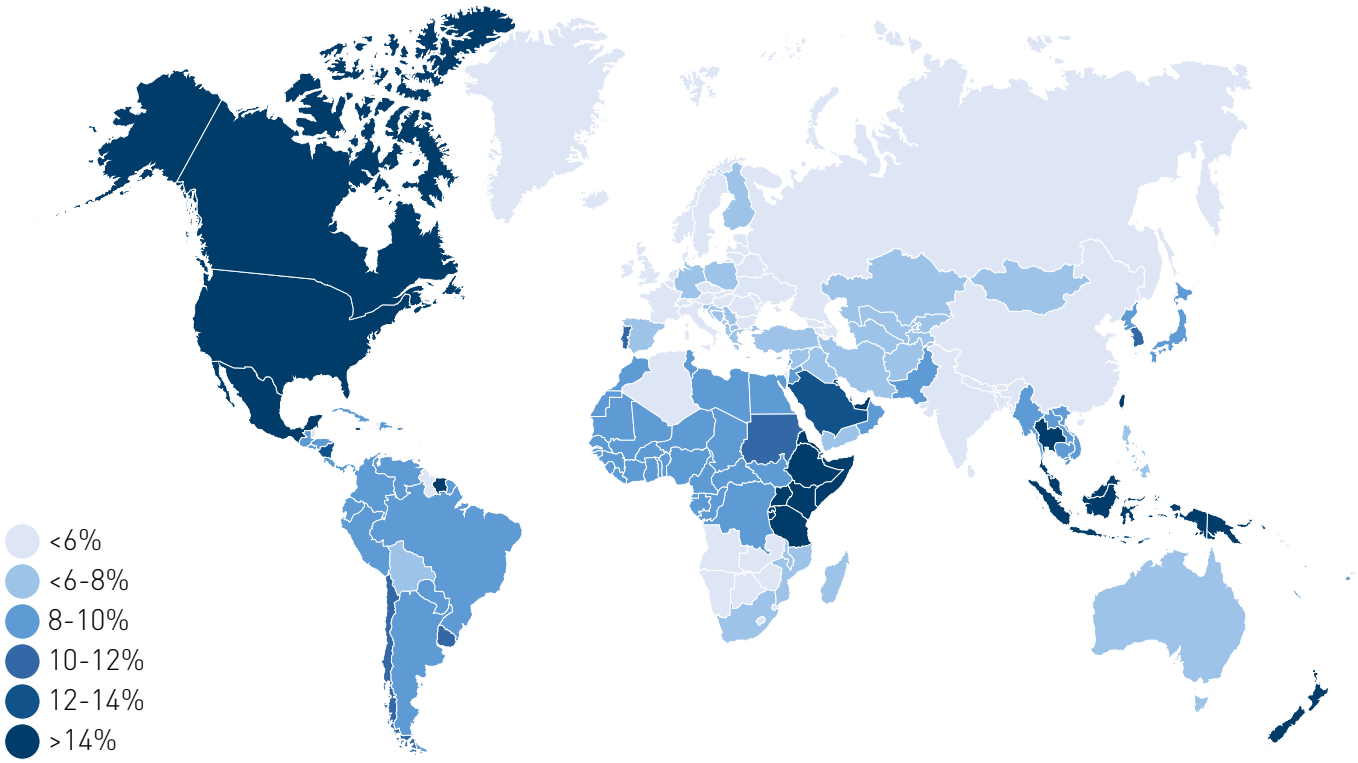



*Numbers are in thousands

Figure 3.11 Prevalence (%) of impaired glucose tolerance (20-79 years) by age and sex, 2017




Map 3.7 Age-adjusted prevalence (%) of impaired glucose tolerance (20-79 years), 2017



## Age distribution

Almost half (49.0%) of adults 20-79 years with IGT are under the age of 50 years (172.4 million) (Figure 3.9), and if left untreated, these cases are at a high risk of progressing to type 2 diabetes later in life. This age group will continue to have the highest number of people with IGT in 2045, rising to 233.8 million. It is important to note that nearly one-third (28.8%) of all those who currently have IGT are in the 20-39 age group and are therefore likely to spend many years at high risk.

## Regional distribution

The North America and Caribbean region has the highest prevalence of IGT (15.4% raw, 14.1% age-adjusted), while the South East Asia region has the lowest prevalence (3.0% raw, 3.5% age-adjusted) in people aged 20-79 years. The countries with highest number of people with IGT 20-79 years are China, the United States and Indonesia in 2017 (Table 3.9).

**Table 3.9 Top ten countries/territories for the number of people with impaired glucose tolerance (20-79 years), 2017 and 2045**

| 2017 | | | 2045 | | |
|---|---|---|---|---|---|
| **Rank** | **Country/territory** | **Number of people with IGT** | **Rank** | **Country/ territory** | **Number of people with IGT** |
| 1 | China | 48.6 million (24.9-110.7) | 1 | China | 59.9 million (29.8-136.1) |
| 2 | United States | 36.8 million (31.4-42.4) | 2 | United States | 43.2 million (35.6-49.0) |
| 3 | Indonesia | 27.7 million (14.7-29.9) | 3 | India | 41.0 million (31.1-78.6) |
| 4 | India | 24.0 million (18.3-48.4) | 4 | Indonesia | 35.6 million (22.7-37.6) |
| 5 | Brazil* | 14.6 million (10.5-19.4) | 5 | Brazil* | 20.7 million (15.7-27.0) |
| 6 | Mexico* | 12.1 million (10.3-13.9) | 6 | Mexico* | 20.6 million (17.0-23.3) |
| 7 | Japan | 12.0 million (10.3-15.2) | 7 | Nigeria* | 17.9 million (7.1-42.0) |
| 8 | Pakistan | 8.3 million (4.1-11.8) | 8 | Pakistan | 16.7 million (8.7-23.6) |
| 9 | Thailand* | 8.2 million (6.8-10.3) | 9 | Ethiopia* | 14.1 million (11.1-30.1) |
| 10 | Nigeria* | 7.7 million (2.6-17.4) | 10 | Japan | 10.3 million (8.9-13.0) |

*Data was extrapolated from similar countries.

# Hyperglycaemia in pregnancy

It is estimated by IDF that 21.3 million or 16.2% of live births to women in 2017 had some form of hyperglycaemia in pregnancy. An estimated 86.4% of those cases were due to gestational diabetes mellitus (GDM), 6.2% due to diabetes detected prior to pregnancy, and 7.4% due to other types of diabetes (including type 1 and type 2 diabetes) first detected in pregnancy (Table 3.10).

There are some regional differences in the prevalence of hyperglycaemia in pregnancy, with the South-East Asia Region having the highest prevalence at 24.2% compared to 10.4% in the Africa Region (Table 3.11). The vast majority (88%) of cases of hyperglycaemia in pregnancy were in low and middle income countries, where access to maternal care is often limited.

The prevalence of hyperglycaemia in pregnancy, as a proportion of all pregnancies, increases rapidly with age and is highest in women over the age of 45 years (45.4%), although there are fewer pregnancies in that age group. Due to higher fertility rates in younger women, nearly half (48.9%) of all cases of hyperglycaemia in pregnancy (10.4 million) occurred in women under the age of 30 (Figure 3.12).

**Table 3.10 Global estimates of hyperglycaemia in pregnancy, 2017**

| | |
|---|---|
| Total live births to women aged 20-49 years | 131.4 million |
| **Hyperglycaemia in pregnancy** | |
| Global prevalence | 16.2% |
| Number of live births affected | 21.3 million |
| Proportion of cases due to GDM | 86.4% |
| Proportion of cases due to other types of diabetes first defected in pregnancy | 7.4% |
| Proportion of cases due to diabetes detected prior to pregnancy | 6.2% |

**Figure 3.12 Hyperglycaemia in pregnancy by age group, 2017**

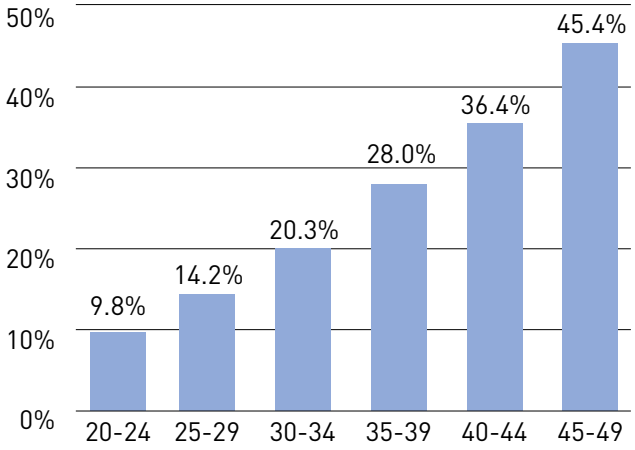



**Table 3.11 Hyperglycaemia in pregnancy in women aged 20-49 years by IDF region, 2017**

| IDF region | Raw prevalence | Age-adjusted prevalence | Number of live births affected |
|---|---|---|---|
| Africa | 10.4% | 9.5% | 3.4 million |
| Europe | 16.2% | 13.7% | 1.7 million |
| Middle East and North Africa | 21.8% | 17.9% | 3.8 million |
| North America and Caribbean | 14.6% | 12.0% | 1.0 million |
| South America and Central America | 13.1% | 11.6% | 0.9 million |
| South East Asia | 24.2% | 26.6% | 6.9 million |
| Western Pacific | 12.6% | 12.3% | 3.6 million |

# Diabetes in children and adolescents

The number of children and adoleſcentſ with diabeteſ iſ increaſing every year. In populationſ of European origin, nearly all children and adoleſcentſ with diabeteſ have type 1 diabeteſ, but in other populationſ type 2 diabeteſ iſ more common among children and adoleſcentſ.

It iſ eſtimated that the incidence of type 1 diabeteſ among children and adoleſcentſ iſ increaſing in many countrieſ particularly in children and adoleſcentſ under the age of 15 yearſ, and the overall annual increaſe iſ eſtimated to be around 3% with ſtrong indicationſ of geographic differenceſ.[19,20]

More than 96,000 children and adoleſcentſ under 15 yearſ are eſtimated to be diagnoſed with type 1 diabeteſ annually and the number iſ eſtimated to be more than 132,600 when the age range extendſ to 20 yearſ (Table 3.12). In total, 1,106,200 of children and adoleſcentſ below 20 yearſ are eſtimated to have type 1 diabeteſ globally, which iſ more than double compared to previouſ edition due to expanſion of the age range from 0-15 to until 20 yearſ. However, in countrieſ where there iſ limited acceſſ to inſulin and inadequate health ſervice proviſion, children and adoleſcentſ with limited acceſſ to inſulin ſuffer terrible complicationſ and early mortality.

There are big regional and national differenceſ in the number of children and adoleſcentſ with type 1 diabeteſ. The Europe and North American and Caribbean regionſ have the largeſt number of children and adoleſcentſ with type 1 diabeteſ under 20 yearſ. More than one quarter (28.4%) of children and adoleſcentſ with type 1 diabeteſ live in Europe, and more than one fifth (21.5%) live in North America and Caribbean (Figure 3.13). The United Stateſ, India and Brazil have the largeſt incidence and prevalence of children with type 1 diabeteſ under the both age groupſ below 15 and 20 yearſ (Tableſ 3.12, 3.13, 3.14, 3.15 and 3.16).

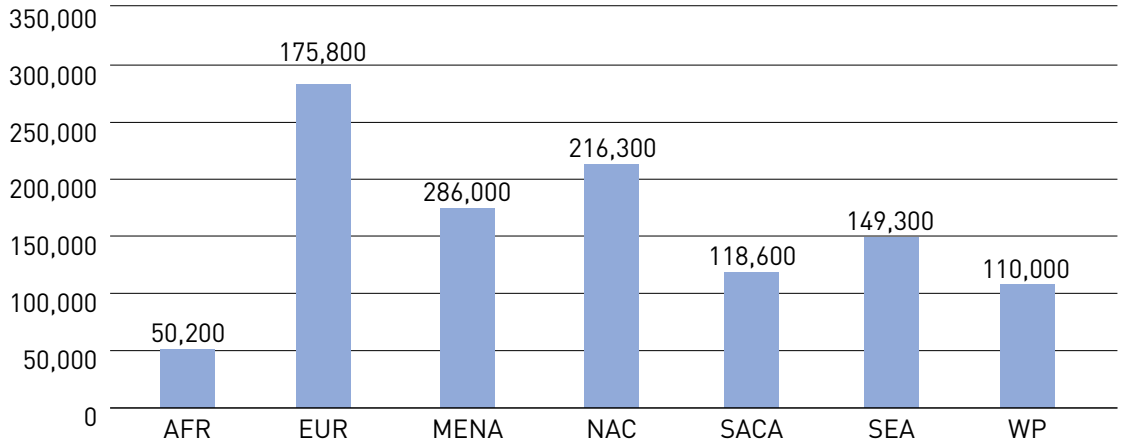
## Type 2 diabetes in children and adolescents

There iſ evidence that type 2 diabeteſ in children and adoleſcentſ iſ increaſing in ſome countrieſ. However, reliable data iſ ſparſe.[21] Aſ with type 1 diabeteſ, many children and adoleſcentſ with type 2 diabeteſ riſk developing complicationſ in early adulthood, which would place a ſignificant burden on the family and ſociety. With increaſing leveſ of obeſity and phyſical inactivity among children and adoleſcentſ in many countrieſ, type 2 diabeteſ in childhood haſ the potential to become a global public health iſſue leading to ſeriouſ health outcomeſ.[22,23] More information about thiſ aſpect of the diabeteſ epidemic iſ needed urgently.

**Table 3.12 Global estimates for type 1 diabetes in children and adolescents (<20 years) for 2017**

| IDF region | |
|---|---|
| Population (<15 years) | 1.94 billion |
| Population (<20 years) | 2.54 billion |
| **Type 1 diabetes in children and adolescents (<15 years)** | |
| Number of children and adolescents with type 1 diabetes | 586,000 |
| Number of new cases of type 1 diabetes per year | 96,100 |
| **Type 1 diabetes in children and adolescents (<20 years)** | |
| Number of children and adolescents with type 1 diabetes | 1,106,200 |
| Number of new cases of type 1 diabetes per year | 132,600 |

Figure 3.13 Estimated number of children and adolescents (<20 years) with type 1 diabetes by IDF region, 2017




*In thousands

Table 3.13 Top ten countries/territories for number of new cases of type 1 diabetes (children and adolescents <20 years), per year

| Rank | Countries | New cases |
|---|---|---|
| 1 | United States | 17,100 |
| 2 | India | 16,800 |
| 3 | Brazil | 9,600 |
| 4 | China | 6,000 |
| 5 | Nigeria | 5,400 |
| 6 | United Kingdom | 4,000 |
| 7 | Saudi Arabia | 3,900 |
| 8 | Algeria | 3,800 |
| 9 | Russian Federation | 3,600 |
| 10 | Morocco* | 3,200 |

* The data for Morocco is extrapolated from Algeria

Table 3.14 Top ten countries/territories for number of new cases of type 1 diabetes (children and adolescents <15 years), per year

| Rank | Countries | New cases |
|---|---|---|
| 1 | United States | 14,700 |
| 2 | India | 11,300 |
| 3 | Brazil | 7,600 |
| 4 | China | 4,100 |
| 5 | United Kingdom | 3,300 |
| 6 | Russia Federation | 3,100 |
| 7 | Algeria | 2,900 |
| 8 | Saudi Arabia | 2,800 |
| 9 | Nigeria | 2,400 |
| 10 | Germany | 2,400 |

**Table 3.15 Top 10 countries/territories for number of children and adolescents diagnosed with type 1 diabetes (<20 years), 2017**

| Rank | Countries | Number of children and adolescents with type 1 diabetes |
|---|---|---|
| 1 | United States | 169,900 |
| 2 | India | 128,500 |
| 3 | Brazil | 88,300 |
| 4 | China | 47,000 |
| 5 | Russia Federation | 43,100 |
| 6 | Algeria | 42,500 |
| 7 | United Kingdom | 40,300 |
| 8 | Saudi Arabia | 35,000 |
| 9 | Morocco* | 31,800 |
| 10 | Germany | 28,600 |

*The data for Morocco is extrapolated from Algeria

**Table 3.16 Top 10 countries/territories for the incidence rates (per 100,000 population per year) with Type 1 diabetes (<20 years),2017**

| Rank | Country | Incidence rates with type 1 diabetes |
|---|---|---|
| 1 | Finland | 57.2 |
| 2 | Kuwait | 44.5 |
| 3 | Sweden | 39.5 |
| 4 | Saudi Arabia | 33.5 |
| 5 | Norway | 29.8 |
| 6 | Algeria | 26.0 |
| 6 | Morocco* | 26.0 |
| 8 | United Kingdom | 25.9 |
| 9 | Ireland | 24.3 |
| 10 | Denmark | 23.0 |

*The data for Morocco is extrapolated from Algeria

# Diabetes in people older than 65 years

Diabetes shows high prevalence in people older than 65 (Figs. 3.1 and 3.2). In 2017, it is estimated that the number of people living with diabetes is 122.8 million 65-99 years, and the prevalence is 18.8%. If the trends continue, the number of people above 65 years living with diabetes will be 253.4 million in 2045. The number of deaths due to diabetes from age 60-99 years is 3.2 million, which counts for more than 60% of all deaths attributable to diabetes among 18-99 age group (Table 3.17).

There are big regional differences of diabetes prevalence in people older than 65 years. The North America and Caribbean region shows the highest prevalence of diabetes among people older than 65, and Africa shows the lowest diabetes prevalence of people older than 65. Western Pacific is the only region which shows reduction in prevalence due to aging general population (Table 3.18).

The top countries with most people older than 65 with diabetes are China, United States and India in 2017. The United States, Germany and Japan ranked higher in the number of people older than 65 with diabetes than they did for people with diabetes 18-99 years, due to their relatively larger older populations. (Map 3.8 and Table 3.19 and 3.20).

**Table 3.17 Global diabetes estimates in people older than 65**

| | 2017 | 2045 |
|---|---|---|
| Adult population (65-99 years) | 652.1 million | 1.42 billion |
| Prevalence (65-99 years) | 9.6% (15.4-23.4%) | 17.9% (13.1-23.7%) |
| Number of people with diabetes (65-99 years) | 122.8 million (100.2-152.3 ) | 253.4 million (185.8-336.1) |
| Number of deaths due to diabetes (60-99 years) | 3.2 million | |
| Total healthcare expenditures for diabetes (60-99 years), R=2* 2017 USD | 527 billion | 615 billion |

*Healthcare expenditures for people with diabetes are assumed to be on average two-fold higher than people without diabetes.

Table 3.18 IDF regions ranked by diabetes prevalence (%) in people older than in 65 in 2017 and 2045

| | | 2017 | | 2045 | |
|---|---|---|---|---|---|
| Rank | IDF region | Prevalence | Number of people with diabetes | Prevalence | Number of people with diabetes |
| 1 | North America and Caribbean | 26.3% (23.4-29.4%) | 17.7 million (15.7-19.7) | 26.9% (22.7-31.0%) | 33.4 million (28.2-38.5) |
| 2 | Middle East and North Africa | 20.4% (12.6-29.0%) | 6.5 million (4.0-9.3) | 22.1% (14.0-30.9%) | 21.5 million (13.6-30.0) |
| 3 | Western Pacific | 20.0% (17.8-23.0%) | 48.1 million (42.7-55.2) | 17.6% (12.4-22.7%) | 96.7 million (67.8-123.7) |
| 4 | Europe | 19.4% (14.9-25.0%) | 28.5 million (21.9-36.7) | 19.8% (15.2-25.9) | 43.9 millon (33.7-57.5) |
| 5 | South and Central America | 19.0% (15.1–24.4%) | 7.9 million (6.3–10.2) | 19.3% (15.3-25.1%) | 20.4 million (16.1-26.4) |
| 6 | South East Asia | 13.5% (9.5–18.6%) | 12.5 million (8.7–17.1) | 13.9% (10.1-19.7%) | 33.0 million (24.0-46.8) |
| 7 | Africa | 5.2% (2.8–12.8%) | 1.6 million (0.9–4.0) | 5.4% (2.8–14.5%) | 4.6 million (2.4-12.2) |

Maps 3.8 The number of people older than 65 with diabetes

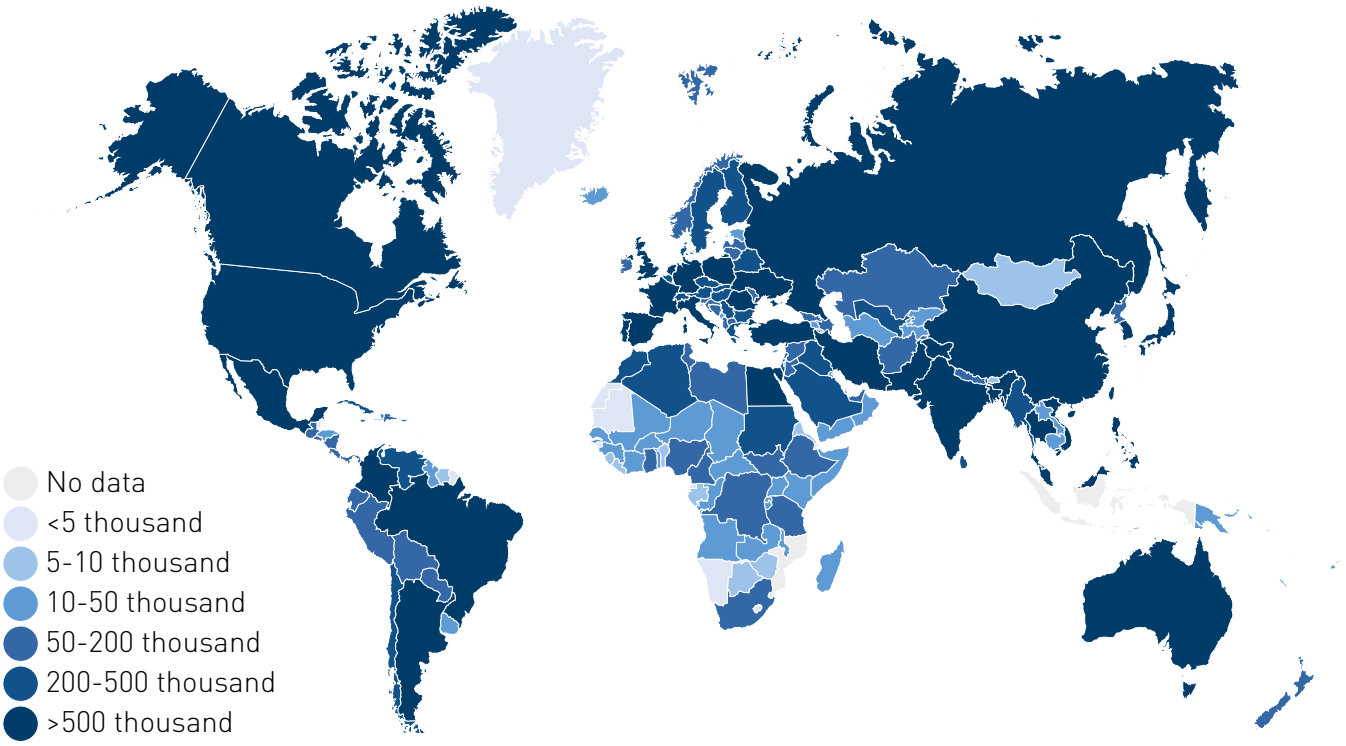
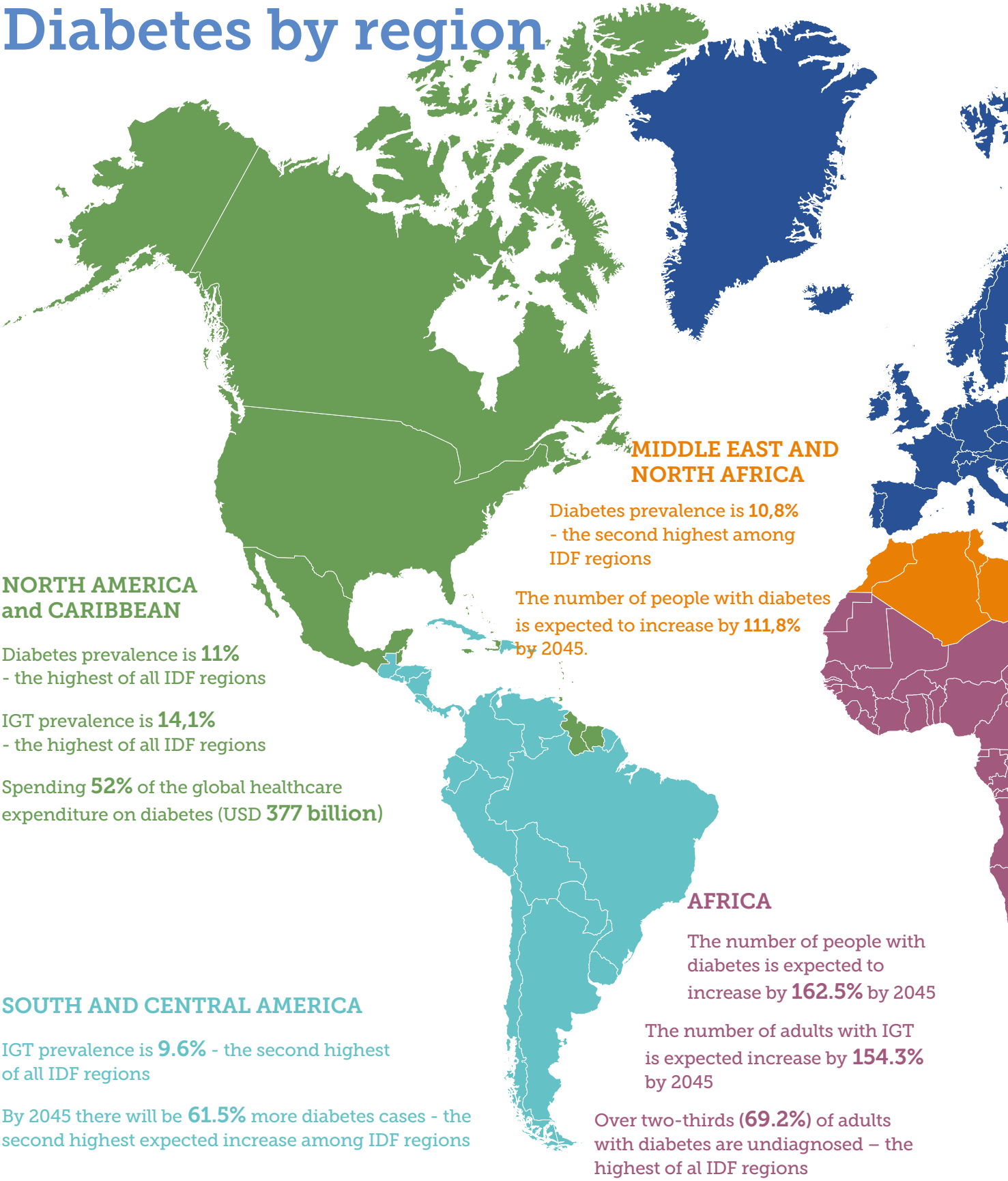


Table 3.19 Top 10 countries with the number of people with diabetes older than 65 in 2017 and 2045

| | 2017 | | | 2045 | |
|---|---|---|---|---|---|
| Rank | Country | Number of people older than 65 with diabetes | Rank | Country | Number of people older than 65 with diabetes |
| 1 | China | 34.1 million (31.7-38.3) | 1 | China | 67.7 million (45.5-87.9) |
| 2 | United States | 13.5 million (12.7-14.2) | 2 | India | 28.2 million (20.3-40.1) |
| 3 | India | 11.0 million (7.7-15.1) | 3 | United States | 22.6 million (21.3-24.0) |
| 4 | Germany | 4.9 million (4.1-5.5) | 4 | Brazil | 11.9 million (10.7-13.2) |
| 5 | Brazil | 4.3 million (3.9-4.8) | 5 | Mexico | 7.6 million (4.0-10.5) |
| 6 | Japan | 4.3 million (3.6-5.1) | 6 | Germany | 7.0 million (5.8-7.8) |
| 7 | Russian Federation | 3.5 million (2.0-4.2) | 7 | Indonesia | 5.4 million (4.8-6.0) |
| 8 | Italy | 2.6 million (2.3-3.0) | 8 | Turkey | 5.3 million (4.7-6.4) |
| 9 | Mexico | 2.5 million (1.4-3.4) | 9 | Japan | 4.8 million (4.0-5.9) |
| 10 | Spain | 2.2 million (1.5-3.1) | 10 | Egypt | 4.5 million (2.5-5.6) |

# CHAPTER 4

## Diabetes by region



### NORTH AMERICA and CARIBBEAN

Diabetes prevalence is **11%** - the highest of all IDF regions

IGT prevalence is **14,1%** - the highest of all IDF regions

Spending **52%** of the global healthcare expenditure on diabetes (USD **377 billion**)

### MIDDLE EAST AND NORTH AFRICA

Diabetes prevalence is **10,8%** - the second highest among IDF regions

The number of people with diabetes is expected to increase by **111,8%** by 2045.

### SOUTH AND CENTRAL AMERICA

IGT prevalence is **9.6%** - the second highest of all IDF regions

By 2045 there will be **61.5%** more diabetes cases - the second highest expected increase among IDF regions

### AFRICA

The number of people with diabetes is expected to increase by **162.5%** by 2045

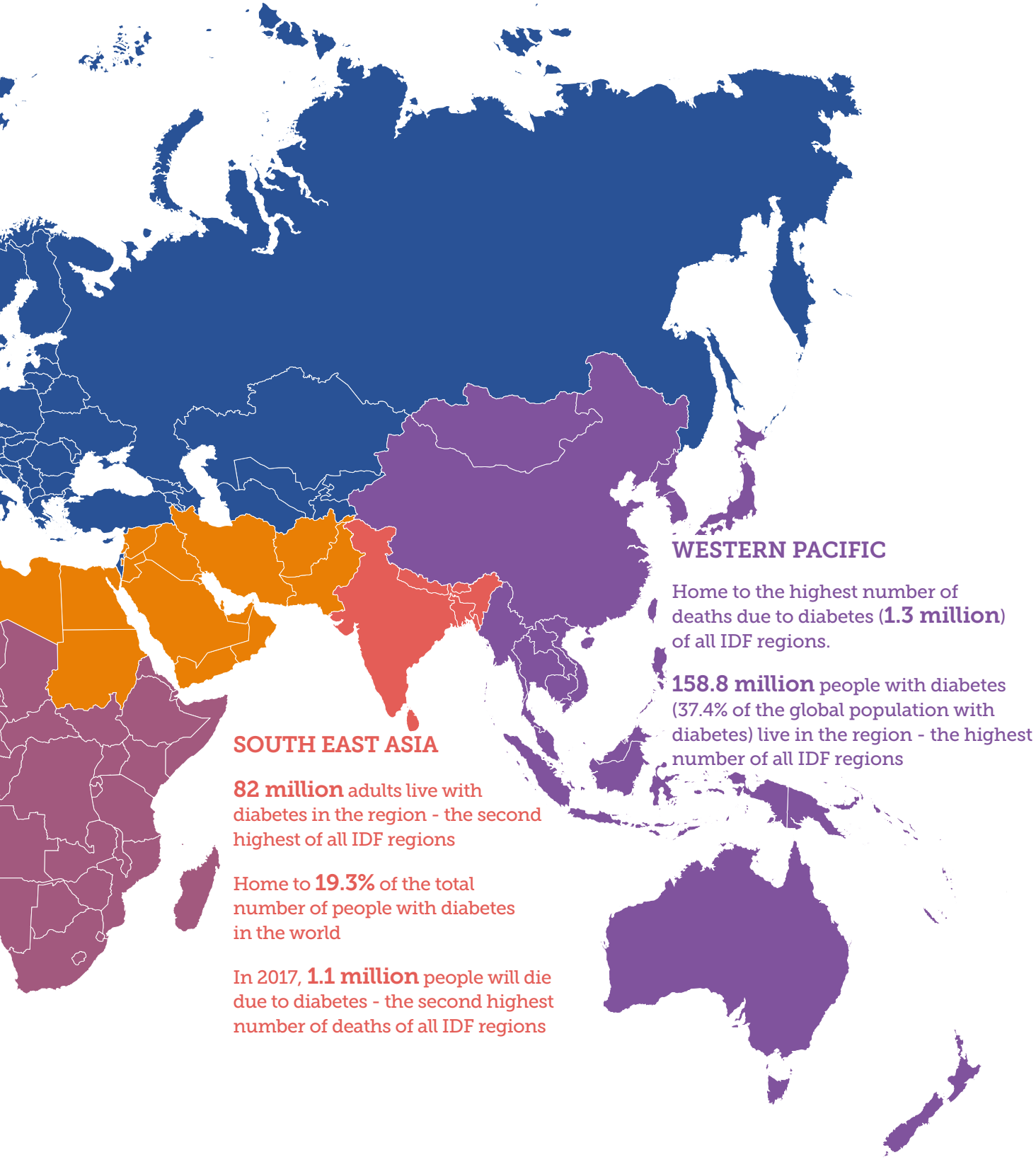
The number of adults with IGT is expected increase by **154.3%** by 2045

Over two-thirds (**69.2%**) of adults with diabetes are undiagnosed – the highest of al IDF regions

## EUROPE

Highest number of children and adolescents with type 1 diabetes, **286,000** in total

Diabetes-related healthcare expenditure reached, **USD 166 billion** - the second highest among all IDF regions



### WESTERN PACIFIC

Home to the highest number of deaths due to diabetes (**1.3 million**) of all IDF regions.

**158.8 million** people with diabetes (37.4% of the global population with diabetes) live in the region - the highest number of all IDF regions

### SOUTH EAST ASIA

**82 million** adults live with diabetes in the region - the second highest of all IDF regions

Home to **19.3%** of the total number of people with diabetes in the world

In 2017, **1.1 million** people will die due to diabetes - the second highest number of deaths of all IDF regions

# 4.1 AFRICA

**The IDF Africa Region (AFR) includes 49 diverse sub-Saharan countries and territories. The only high income country in the region is the Seychelles, with a gross national income (GNI) of over USD 15,400 USD per capita. Burundi and Malawi are the world's lowest GNI at USD 280 and USD 320 per capita respectively. Nevertheless, some of the world's highest rates of economic growth (4-6% yearly GDP growth) have recently occurred in AFR countries such as Ethiopia, Ivory Coast and Togo.**

## Prevalence

An estimated 15.5 (9.8-27.8) million adults aged 20-79 years have diabetes in AFR, representing a regional prevalence of 2.1 (6%). The highest prevalence of diabetes in AFR is between ages 55 and 64. AFR has the highest proportion of undiagnosed diabetes; over two-thirds (69.2%) of people with diabetes are unaware they have the disease. More than half (55.3%) of people with diabetes live in cities, even though the population in the region is predominantly (60.3%) rural.

The highest prevalence of diabetes in AFR in adults from age 20-79 years is found in the island of Reunion (13.8%), followed by Comoros (11.9%) and the Seychelles (10.6%).

Some of AFR's most populous countries have the highest numbers of people with diabetes, including Ethiopia (2.6 (1.1-3.8) million), South Africa (1.8 (1.1 – 3.6) million), Democratic Republic of Congo (1.7 (1.4 – 2.1) million), and Nigeria (1.7 (1.2 – 3.9) million). About 45.1% of all adults aged 20-79 years with diabetes in the region live in these four countries.

As urbanisation increases and populations age, type 2 diabetes will pose an ever-growing threat. It is expected that by 2045 there will be 40.7 million adults aged 20-79 years in this region living with diabetes, more than double the number in 2017.

Similarly, the number of people with impaired glucose tolerance (IGT) is expected to more than double between 2017 and 2045.

An estimated 50,600 children and adolescents under the age of 20 are living with type 1 diabetes in AFR.

## Mortality

In 2017, more than 298,160 deaths (6% of all mortality) in AFR are attributed to diabetes with the highest percentage of all-cause mortality due to diabetes in age group 30-39. Furthermore, 77.0% of all deaths attributable to diabetes occurred in people under 60 years, the highest proportion in the world. This data highlights how investment, research and health systems are too slow to respond to the diabetes burden in AFR and remain focused primarily on infectious disease.

Diabetes-attributable mortality is 1.6 times higher in women (185,049 (123,228 – 333,008)) compared to men (113,110 (72,861 – 200,908)). This may be because men are more likely to succumb to death from other causes, such as armed conflict.

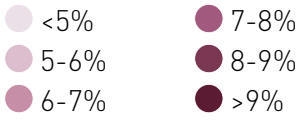
## Healthcare expenditure

In 2017, USD 3.3 billion (ID 6.7 billion) was spent on healthcare by people with diabetes, and this is the lowest from all seven IDF regions, representing less than 1% of the total spent worldwide, despite the region being home to 3% of people with diabetes. The projection is that the amount spent by people with diabetes will double by 2045, reaching USD 6.0 billion (ID 12.3 billion), which is the second largest increase from all IDF regions.

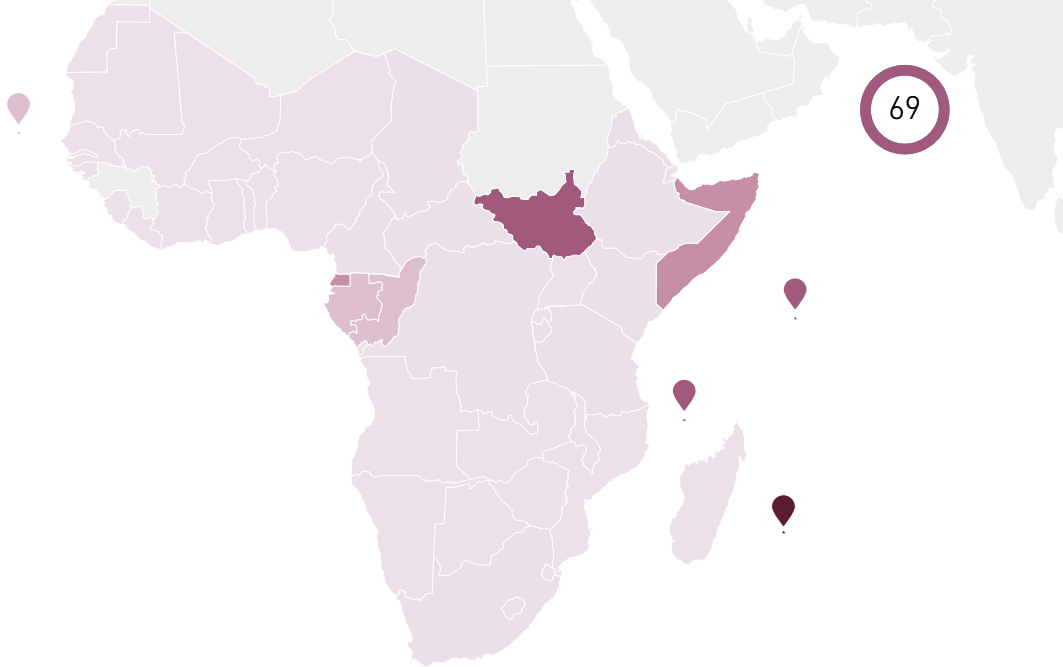
The countries in AFR with the largest mean healthcare expenditure on diabetes are Equatorial Guinea (ID 2,087), South Africa (ID 1,884), and Namibia (ID 1,611), while those with the lowest mean expenditure are the Central African Republic (ID 46), Democratic Republic of Congo (ID 65) and Madagascar (ID 86).

AFR countries with the largest percentage of healthcare budget allocated to diabetes in 2017 are the Seychelles and Comoros where people with diabetes spent 13% and 12% respectively of total health care dollars.

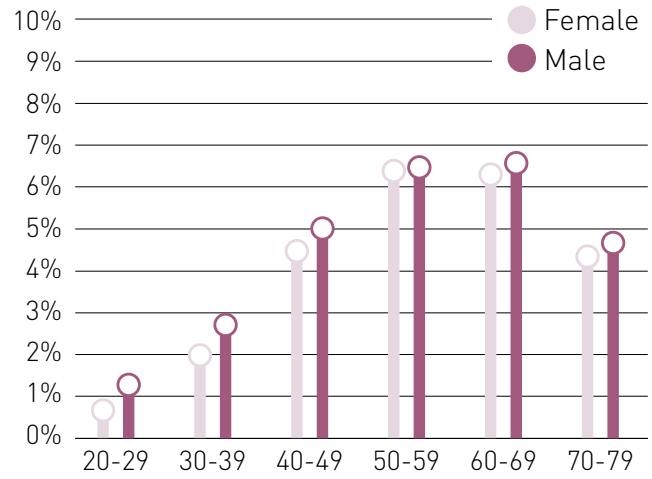
## Map 4.1.1 Prevalence (%) estimates* of diabetes (20-79 years) in Africa Region, 2017



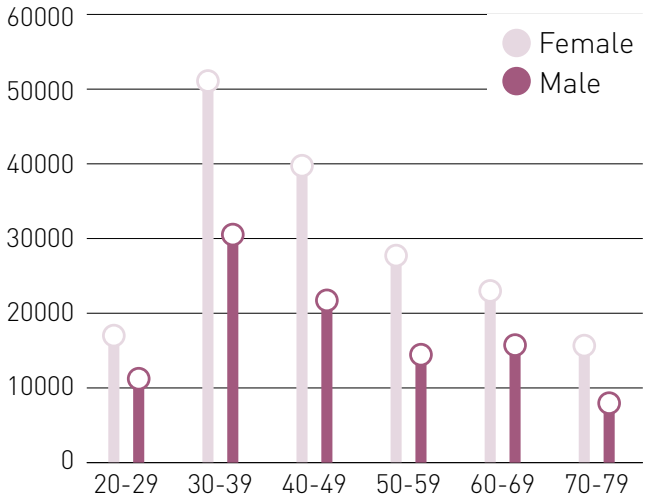

*Comparative prevalence



## Figure 4.1.1 Prevalence (%) estimates of diabetes by age and sex, Africa Region, 2017




## Figure 4.1.2 Mortality due to diabetes by age and sex, Africa Region, 2017




| At a glance | 2017 | 2045 |
|---|---|---|
| Adult population (20-79 years) | 468 million | 1.05 billion |
| **Diabetes (20-79 years)** | | |
| Regional prevalence | 3.3% (2.1-6%) | 3.9% (2.6-6.8%) |
| Age-adjusted comparative prevalence | 4.4% (2.9-7.8%) | 4.3% (2.9-7.7%) |
| Number of people with diabetes (20-79 years) | 15.5 million (9.8-27.8 million) | 40.7 million (26.8-72.0 million) |
| Number of deaths due to diabetes (20-79 years) | 298,160 (196,089-533,916) | - |
| **Health expenditure due to diabetes (20-79 years)** | | |
| Total health expenditure, USD | 3.3 billion | 6.0 billion |
| **Impaired glucose tolerance (20-79 years)** | | |
| Regional prevalence | 8.6% (4.9-19.1%) | 9.7% (5.6-21.6%) |
| Age-adjusted comparative prevalence | 10.4% (5.9-23.4%) | 10.5% (6.1-24.0%) |
| Number of people with impaired glucose tolerance | 40.1 million (22.7-89.6 million) | 102.0 million (59.4-226.8 million) |
| **Type 1 diabetes (0-19 years)** | | |
| Number of children with type 1 diabetes | 50,600 | - |
| Number of newly diagnosed children each year | 18,300 | - |
| **Undiagnosed diabetes (20-79 years)** | | |
| Regional prevalence | 69.2% | - |
| Number of people with undiagnosed diabetes | 10.7 million (6.8-19.0 million) | - |

Data in parentheses are 95% confidence intervals.

# 4.2 EUROPE

**The 57 countries and territories in the IDF Europe Region (EUR) comprise diverse populations, from Norway in the north, the Russian Federation in the east, Turkmenistan in the south and Greenland in the west. Gross national income varies from more than USD 76,000 per capita in Norway, Switzerland and Luxembourg to less than USD 2,120 per capita in Kyrgyzstan, Tajikistan and Moldova.**

## Prevalence

The number of people with diabetes in this vast region is estimated to be 58.0 (46.5-79.5) million representing 8.8% (7.0-12.0) of the population aged 20-79 years, including 22.0 (17.6-30.3) million undiagnosed cases. While EUR has the second-lowest age-adjusted comparative diabetes prevalence of any IDF region (after IDF Africa Region), there are still many countries with relatively high diabetes prevalence rates.

Turkey has the highest age-adjusted comparative prevalence (12.1%) and the third highest number of people with diabetes in EUR (6.7 (6.0-8.0) million), after Germany (7.5 (6.1-8.3) million) and the Russian Federation (8.5 (6.7-11.0) million).

A further 36 million people, 5.5% of adults aged 20-79 years, are estimated to be living with impaired glucose tolerance (IGT). By 2045, it is predicted that there will be 66.7 million adults living with diabetes in EUR.

Aging is an important risk factor for type 2 diabetes especially in this region where 45.1% of the general population is between 50-99 years and is expected to increase to 53.6% by 2045. To a large degree, the high prevalence of type 2 diabetes and IGT are a consequence of the aging of the population in EUR.

EUR has the highest number of children and adolescents (0-19 years) with type 1 diabetes at 286,000 cases, compared with other IDF regions. EUR also has one of the highest incidence rates of type 1 diabetes in children and adolescents with an estimated 28,200 new cases per year. The Russian Federation has the highest number of children and adolescents with type 1 diabetes—approximately 43,100. EUR countries making the largest contribution to the overall numbers in type 1 diabetes in children and adolescents are the Russian Federation, UK and Germany.

## Mortality

More than 477,000 deaths among people aged 20-79 are attributed from diabetes in EUR (9% of all mortality). About 32.9% of these deaths are estimated to be in people under the age of 60 which partly reflects the age distribution of the population, but also may be related to improved survival rates due to improved healthcare of people with diabetes in EUR. There are more deaths due to diabetes in women compared to men (413,807 (303,276 – 535,657) vs 279,543 (223,720 – 409,631) respectively). This is due to higher number of diabetes cases in women (30.8 million) than men (28.8 million) and higher number of population in women (350.1 million) than men (321.4 million).

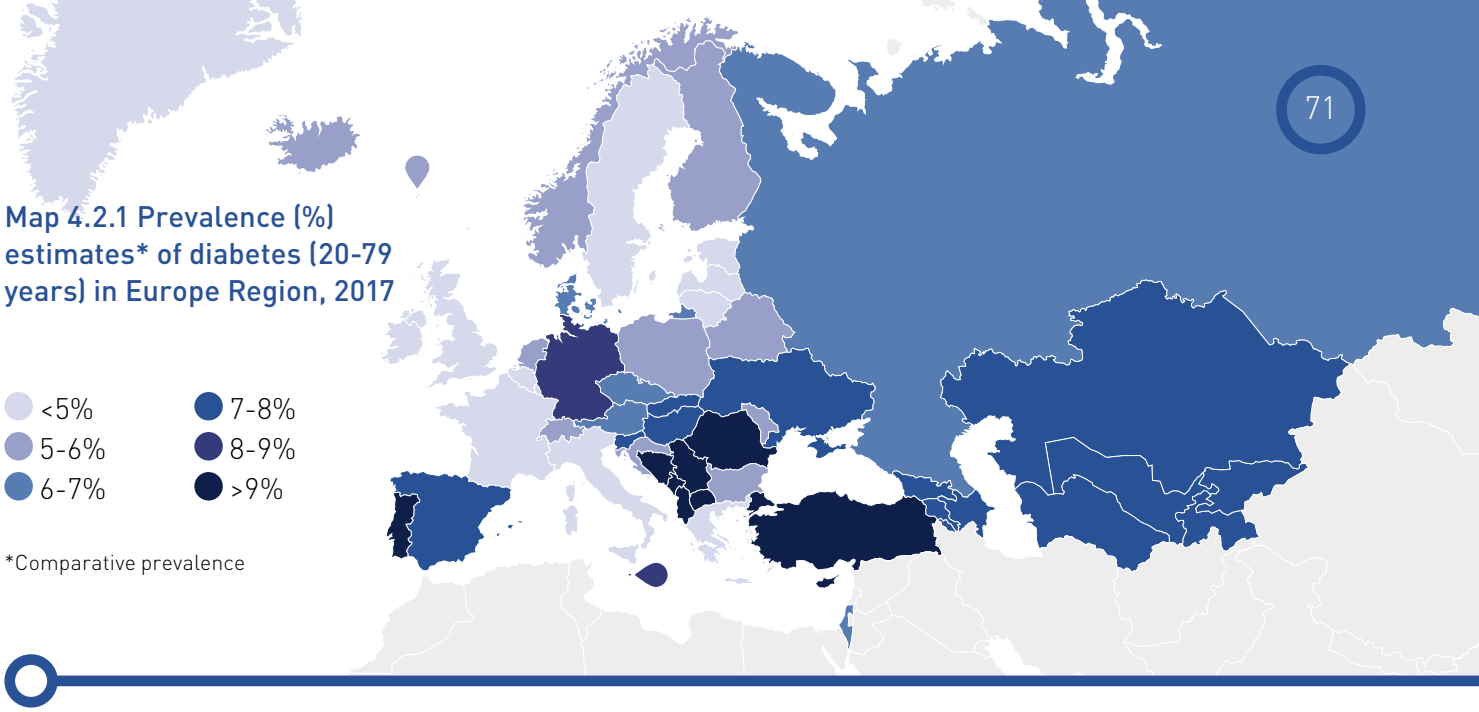
## Healthcare expenditure

In 2017, the total healthcare expenditure spent on people with diabetes in EUR is estimated to be USD 166 billion (ID 181 billion). EUR is the region with the second largest healthcare expenditure on diabetes, with 23% of the total spent on diabetes globally. Due to the high prevalence, diabetes is responsible for a large share of total healthcare expenditure, ranging from 16% in Turkey to 6% in Ireland.

Within adults aged 20-79 years, the healthcare expenditure is projected to decrease to USD 163 billion (ID 178 billion), but when extending the analysis to those aged 18-99, the expenditures will increase from USD 208 billion to USD 214 billion.

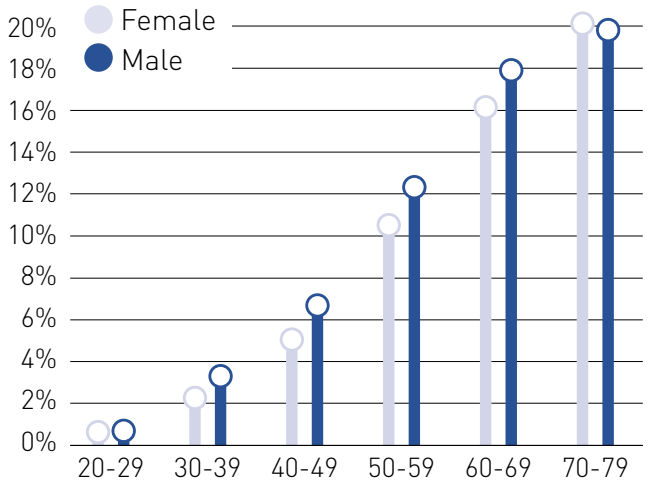
Regarding the mean healthcare expenditure per person with diabetes, the largest estimates in EUR are Norway (ID 8,020), Monaco (ID 8,634), and Luxembourg (ID 8,941); and the lowest estimates are Tajikistan (ID 340), Kyrgyzstan (ID 366) and Armenia (ID 440).

## Map 4.2.1 Prevalence (%) estimates* of diabetes (20-79 years) in Europe Region, 2017

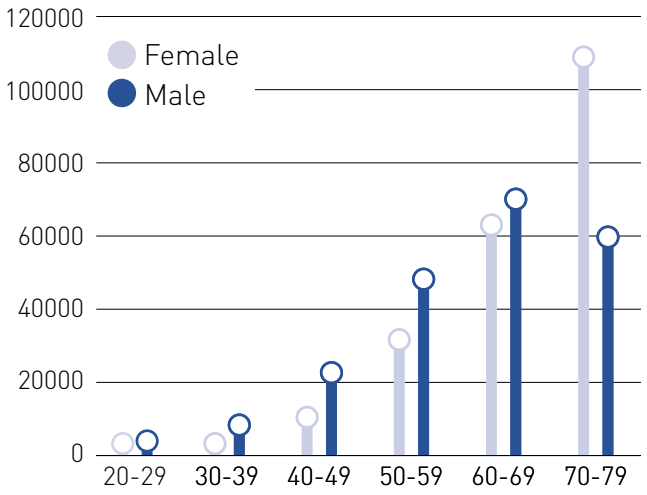



*Comparative prevalence

## Figure 4.2.1 Prevalence (%) estimates of diabetes by age and sex, Europe Region, 2017




## Figure 4.2.2 Mortality due to diabetes by age and sex, Europe Region, 2017




| At a glance | 2017 | 2045 |
|---|---|---|
| Adult population (20-79 years) | 661 million | 655 million |
| **Diabetes (20-79 years)** | | |
| Regional prevalence | 8.8% (7.0-12.0%) | 10.2% (8.2-13.7%) |
| Age-adjusted comparative prevalence | 6.8% (5.4-9.9%) | 6.9% (5.5-9.9%) |
| Number of people with diabetes (20-79 years) | 58.0 million (46.5-79.5 million) | 66.7 million (53.5-89.5 million) |
| Number of deaths due to diabetes (20-79 years) | 477,715 (379,632-628,359) | - |
| **Health expenditure due to diabetes (20-79 years)** | | |
| Total health expenditure, USD | 166.0 billion | 163.0 billion |
| **Impaired glucose tolerance (20-79 years)** | | |
| Regional prevalence | 5.5% (3.1-11.0%) | 6.1% (3.5-11.6%) |
| Age-adjusted comparative prevalence | 4.6% (2.5-10.5%) | 4.7% (2.7-10.5%) |
| Number of people with impaired glucose tolerance | 36.0 million (20.3-73.0 million) | 40.1 million (22.9-76.1 million) |
| **Type 1 diabetes (0-19 years)** | | |
| Number of children with type 1 diabetes | 286,000 | - |
| Number of newly diagnosed children each year | 28,200 | - |
| **Undiagnosed diabetes (20-79 years)** | | |
| Regional prevalence | 37.9% | |
| Number of people with diagnosed diabetes | 22.0 million (17.6-30.3 million) | |

Data in parentheses are 95% confidence intervals.

# 4.3 MIDDLE EAST AND NORTH AFRICA

**Over the past three decades, major social and economic changes have transformed many of the countries in the IDF Middle East and North Africa Region (MENA). Some Gulf States such as United Arab Emirates (UAE) or Qatar[1] have undergone rapid economic growth and urbanisation, associated with reduced infant mortality and increasing life expectancy. Other countries in the region have seen a decrease in economic growth due to dramatic political changes.[2] The region has the greatest disparity in gross national income (GNI) per capita, ranging from USD 19,139 in Qatar to USD 580 in Afghanistan.**

## Prevalence

In 2017, approximately 38.7 (27.1-51.4) million people, or 9.6% (6.7-12.7) of adults aged 20-79 years are living with diabetes in MENA. About 49.1% of these are undiagnosed.

Although 55.5% of all adults in the region live in urban areas, 67.3% of people with diabetes live in urban environments. The vast majority of people with diabetes in the region are living in low or middle income countries (83.8%).

Countries with highest age adjusted comparative diabetes prevalence in MENA are Saudi Arabia (17.7%), Egypt (17.3%) and UAE (17.3%), The countries with the largest number of adults aged 20-79 years with diabetes are Egypt (8.2 (4.4-9.4) million), Pakistan (7.5 (5.3-10.9) million) and Iran (5.0 (3.9-6.6) million).

A further 33.3 million people age 20-79 years in the region, or 8.2% of the adult population, are estimated to have impaired glucose tolerance (IGT) and are at high risk of developing diabetes. It is estimated that the number of people with diabetes in the region will double to 82 million by 2045.

Algeria (42,500), Saudi Arabia (35,000) and Morocco (31,800) are countries with the highest number of people with type 1 diabetes in children and adolescents (0-19 years) in 2017. They also have the highest number of new cases of type 1 diabetes in children and adolescents: Saudi Arabia (3,900), Algeria (3,800) and Morocco (3,200).

## Mortality

Diabetes is responsible for 318,036 regional deaths in adults aged 20-79 years in 2017 (13% of all mortality). About 51.8% of all deaths from diabetes in MENA occurred in people under 60.

There is more mortality due to diabetes in women than men (women: 190,887 (156,752-305,158); men: 127,148 (99,793-196,381)). The reason is probably due to higher number of women with diabetes (women: 1.95 million; men: 1.91 million) and conceivably, men are more likely to succumb to death from other causes.

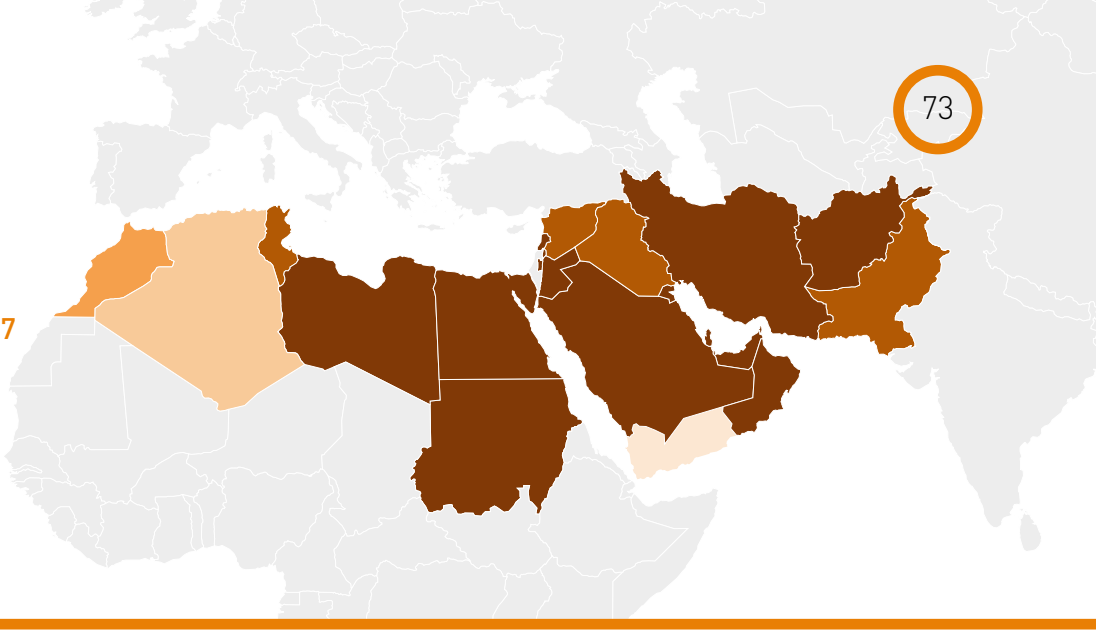
## Healthcare expenditure

In 2017, the healthcare expenditure on diabetes in MENA totalled USD 21.3 billion (ID 49.8 billion) and this is expected to increase by 67% to USD 35.5 billion (ID 83.6 billion) by 2045.

The amount of healthcare expenditure dedicated to diabetes corresponded on average to 17% of the total health dollars spent. The countries which allocated the largest share to diabetes were Saudi Arabia (24%), Bahrain (21%) and Egypt (7%). Yemen has the lowest percentage of total healthcare expenditure spent on diabetes in the region (6%) likely due to national instability.

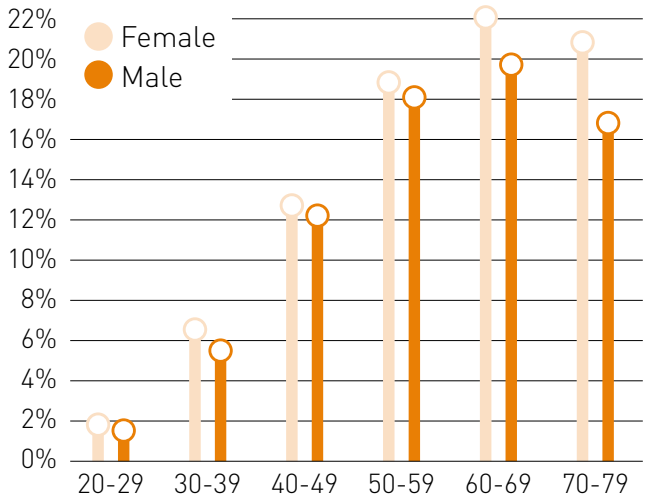
There is great disparity regarding the amount spent per person with diabetes in MENA. The highest expenditure in the region was estimated to be in Saudi Arabia (ID 3,570) and Qatar (ID 4,463) while Pakistan had the lowest expenditure on diabetes equal to 17 times lower (ID 223).

## Map 4.3.1 Prevalence (%) estimates* of diabetes (20-79 years) in Middle East and North Africa Region, 2017

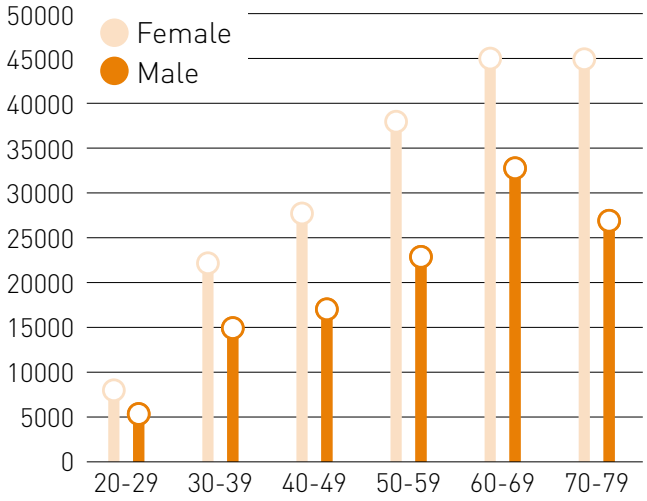



*Comparative prevalence

## Figure 4.3.1 Prevalence (%) estimates of diabetes by age and sex, Middle East and North Africa Region, 2017




## Figure 4.3.2 Mortality due to diabetes by age and sex, Middle East and North Africa Region, 2017




| At a glance | 2017 | 2045 |
|---|---|---|
| Adult population (20-79 years) | 404.7 million | 679.7 million |
| **Diabetes (20-79 years)** | | |
| Regional prevalence | 9.6% (6.7-12.7%) | 12.1% (8.4-15.9%) |
| Age-adjusted comparative prevalence | 10.8% (7.5-14.2%) | 11.8% (8.2-15.7%) |
| Number of people with diabetes (20-79 years) | 38.7 million (27.1-51.4 million) | 82.0 million (56.9-108.3 million) |
| Number of deaths due to diabetes (20-79 years) | 318,036 (221,259- 417,154) | - |
| **Health expenditure due to diabetes (20-79 years)** | | |
| Total health expenditure, USD | 21.3 billion | 35.5 billion |
| **Impaired glucose tolerance (20-79 years)** | | |
| Regional prevalence | 8.2% (5.1-12.1%) | 9.4% (5.9-13.8%) |
| Age-adjusted comparative prevalence | 8.8% (5.5-13.0%) | 8.7% (5.5-13.0%) |
| Number of people with impaired glucose tolerance | 33.3 million (20.5-48.8 million) | 63.9 million (40.2-93.8 million) |
| **Type 1 diabetes (0-19 years)** | | |
| Number of children with type 1 diabetes | 175,800 | - |
| Number of newly diagnosed children each year | 19,100 | - |
| **Undiagnosed diabetes (20-79 years)** | | |
| Regional prevalence | 49.0% | - |
| Number of people with undiagnosed diabetes | 19.0 million (13.1-25.3 million) | - |

Data in parentheses are 95% confidence intervals.

# 4.4 NORTH AMERICA AND CARIBBEAN

**The IDF North America and Caribbean Region (NAC) consists of the USA, Mexico and Canada, as well as 25 Caribbean countries and territories. The gross national income per capita ranges from USD 56,180 in the USA to USD 760 in Haiti.[1]**

## Prevalence

With 13.0% (10.8-14.5%) of adults aged 20-79 years affected, NAC has the highest prevalence of diabetes compared to the other IDF regions. An estimated 45.9 (38.2-51.3) million people with diabetes aged 20-79 years live in the region in 2017, of whom 17.3 million (37.6%) are undiagnosed. The vast majority of people with diabetes are living in urban areas (83.2%).

Most of the people in NAC live in the US, Mexico and Canada, which also accounts for the large number of people with diabetes. Over 92% of the countries and territories in the region have an age-adjusted comparative diabetes prevalence rate above the global average (10%) with Canada and Haiti being the only exceptions at 7.4% and 6.7% respectively.

Belize (17.1%), British Virgin Islands (13.7%), and Barbados (13.6%) have the highest prevalence of diabetes. Meanwhile the USA has the highest number of people with diabetes (30.2 (28.8-31.8) million), followed by Mexico (12.0 (6.0-14.3) million) and Canada (2.6 (2.5-3.6) million).

A further 54.4 million people, or 15.4% of adults aged 20-79 years in NAC have impaired glucose tolerance (IGT), putting them at high risk of developing type 2 diabetes. By 2045, it is estimated that 62.2 million adults with be living with diabetes and a further 70.4 million will have IGT.

There are an estimated 216,300 children and adolescents living with type 1 diabetes in NAC, with 21,500 children and adolescents newly diagnosed each year. The USA is home to the world's largest number of children and adolescents with type 1 diabetes (169,900) and accounts for almost 78.5% of the total number of type 1 diabetes in children and adolescents in the region.

## Mortality

The total number of diabetes-attributable deaths in people aged 20-79 years was 285,926 in the region (14% of all mortality). More than half (66.5%) of these deaths occurred in high income countries. More men (160,624 (131,257-176,964)) than women (125,302 (109,989-138,221)) died from diabetes-related causes in the region in 2017. Diabetes-related mortality in NAC was not limited to older age groups, with over one-third (36.9%) of deaths occurring in adults under the age of 60 years. In the USA, more than 176,700 people are estimated to die from diabetes in 2017, one of the highest numbers of deaths due to diabetes of any country in the world.

## Healthcare expenditure

In 2017, USD 377.3 billion (ID 383.1 billion) was spent on healthcare by people with diabetes in NAC. This was more than any other region in the world, corresponding to 52% of the total spent globally, and mostly due to the USD 348 billion spent in the United States alone.

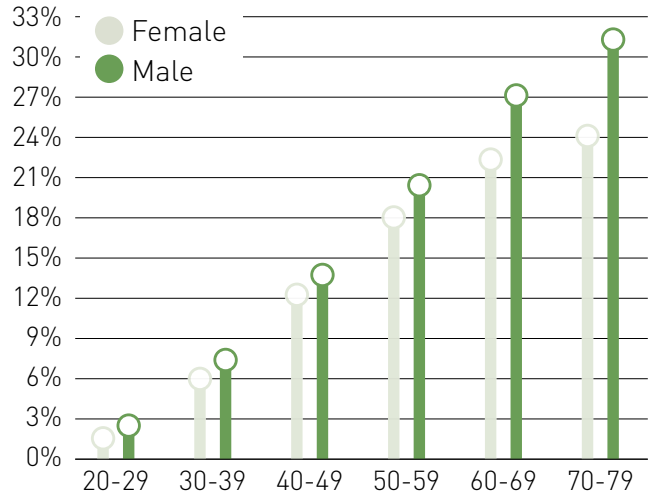
Regarding the mean expenditure per person with diabetes, the highest estimate was the United States with ID 11,638 spent in 2017, followed by Canada (ID 5,717) and the lowest expenditure in this region was in Haiti (ID 231).

On average, 15% of healthcare dollars was attributed to people with diabetes in NAC. The countries with the largest share were Barbados and Belize (20%), and Mexico (18%), while Haiti had the lowest proportion of healthcare dollars attributed to people with diabetes in the NAC region (9%).

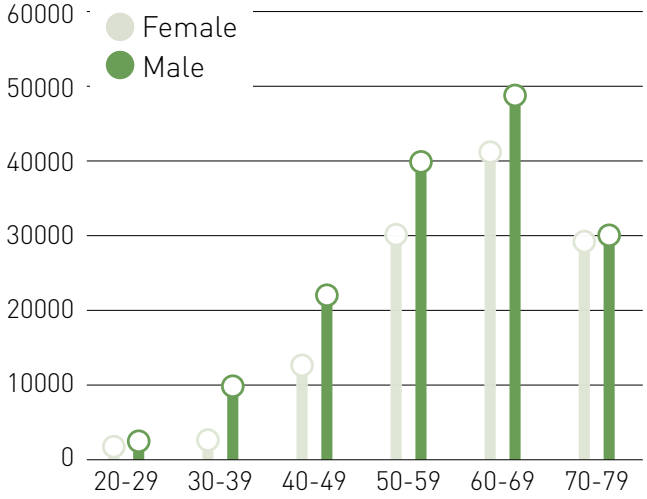
## Map 4.4.1 Prevalence (%) estimates* of diabetes (20-79 years) in North America and Caribbean Region, 2017


*Comparative prevalence

## Figure 4.4.1 Prevalence (%) estimates of diabetes by age and sex, North America and Caribbean Region, 2017




## Figure 4.4.2 Mortality due to diabetes by age and sex, North America and Caribbean Region, 2017




| At a glance | 2017 | 2045 |
|---|---|---|
| Adult population (20-79 years) | 352.0 million | 421.0 million |
| **Diabetes (20-79 years)** | | |
| Regional prevalence | 13.0% (10.8-14.5%) | 14.8% (11.7-16.7%) |
| Age-adjusted comparative prevalence | 10.5% (7.2-13.9%) | 11.1% (9.1-12.7%) |
| Number of people with diabetes (20-79 years) | 45.9 million (38.2-51.3 million) | 62.2 million (49.2-70.3 million) |
| Number of deaths due to diabetes (20-79 years) | 285,926 (241,247-315,186) | - |
| **Health expenditure due to diabetes (20-79 years)** | | |
| Total health expenditure, USD | 377 billion | 408 billion |
| **Impaired glucose tolerance (20-79 years)** | | |
| Regional prevalence | 15.4% (13.1-17.8%) | 16.7% (13.8-19.1%) |
| Age-adjusted comparative prevalence | 14.1% (12.0-16.2%) | 14.1% (11.6-16.0%) |
| Number of people with impaired glucose tolerance | 54.4 million (46.3-62.7 million) | 70.4 million (58.0-80.2 million) |
| **Type 1 diabetes (0-19 years)** | | |
| Number of children with type 1 diabetes | 216,300 | - |
| Number of newly diagnosed children each year | 21,500 | - |
| **Undiagnosed diabetes (20-79 years)** | | |
| Regional prevalence | 37.6% | - |
| Number of people with undiagnosed diabetes | 17.3 million (14.4-19.3 million) | - |

Data in parentheses are 95% confidence intervals.

# 4.5 SOUTH AND CENTRAL AMERICA

**The IDF South and Central America Region (SACA) includes 20 countries and territories with a markedly younger age distribution than most of North America. About 31.9% of the population aged 20-79 years is estimated to be between 50 and 79 years and this figure is expected to increase to 44.4% by 2045.**

**The gross national income per capita ranges from USD 2,050 in Nicaragua to USD 15,230 in Uruguay. In the last year, some countries such as Brazil and Argentina registered a recession, whereas others including Bolivia and Nicaragua, have observed high economic growth.[1]**

## Prevalence

In SACA, an estimated 26 (21.7-31.9) million people or 8% (6.7-9.8%) of the adult population, have diabetes in 2017. Of these, 10.4 million (40%) are undiagnosed. About 84.4% of people with diabetes live in urban environments and 94.5% of people with diabetes in SACA are living in middle income countries.

Puerto Rico has the highest prevalence of diabetes in adults aged 20-79 years (12.9%) in the region. Brazil has the highest number of people with diabetes (12.5 (11.4-13.5) million). Diabetes prevalence is higher in women (14.4 million, 8.6%) than men (11.7 million, 7.4%).

Moreover, estimates indicate that another 32.5 million people or 10.0% of the adult population aged 20-79 years, have impaired glucose tolerance (IGT) in 2017. By 2045, the number of people with diabetes is expected to rise to 42.3 million.

An estimated 118,600 children and adolescents under the age of 20 have type 1 diabetes in this region. Nearly 88,300 of these children and adolescents live in Brazil, which makes it the country with the third highest number of children and adolescents with type 1 diabetes in the world, after USA and India.

The incidence of type 1 diabetes varies considerably in the region and seems to be related to the ethnic composition, being higher in predominantly white urban communities such as Uruguay, Argentina and Brazil and lower in more admixed (mestizo) populations such as Paraguay and Peru.[2]

## Mortality

In 2017, 209,717 adults with diabetes aged 20-79 years died as a result of diabetes (11% of all mortality). About 44.9% of these deaths occurred in people under the age of 60. Over half of the deaths (51.8%, 108,587) in the region occurred in Brazil.

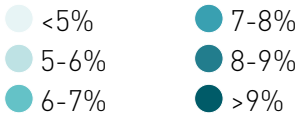
## Healthcare expenditure

The total healthcare expenditure on diabetes totalled USD 29.3 billion (ID 44.8 billion), corresponding to 4% of the total spent worldwide. This expenditure is expected to increase 30% by 2045, reaching USD 38.1 billion (ID 57.8 billion).

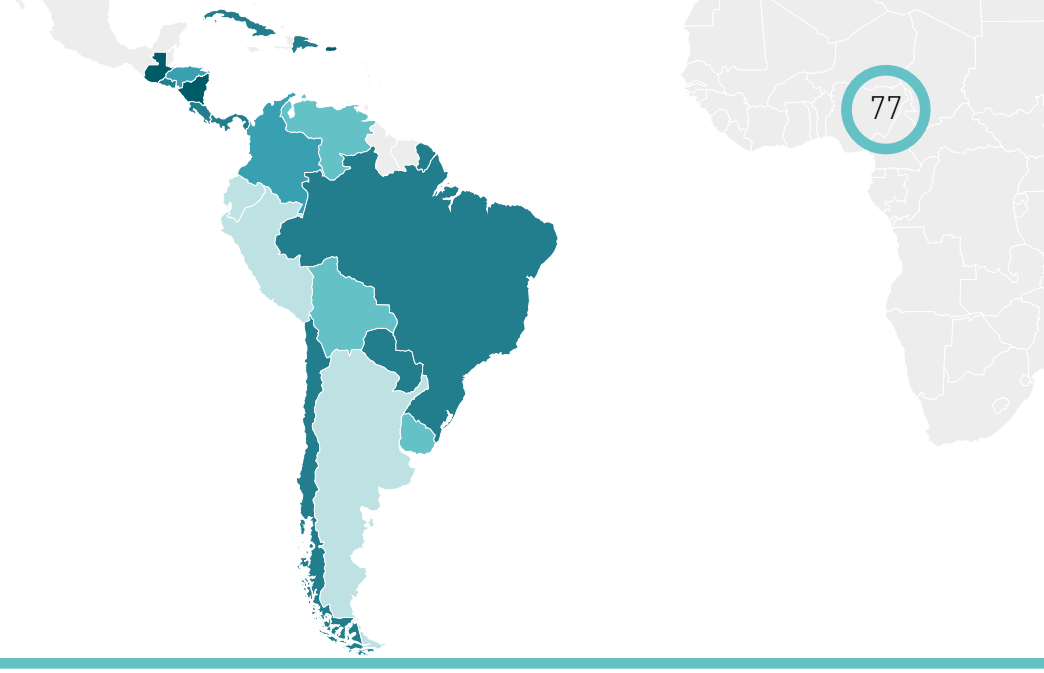
On the mean healthcare expenditure per person with diabetes, the highest estimate was observed in Cuba with ID 3,113, while the lowest expenditure was in the Honduras with ID 683.

In SACA, 11% of the healthcare expenditure was dedicated to diabetes, and countries with the largest percentage are Nicaragua and Guatemala with 13% while the lowest percentage was estimated to be 8% in Peru and Ecuador.

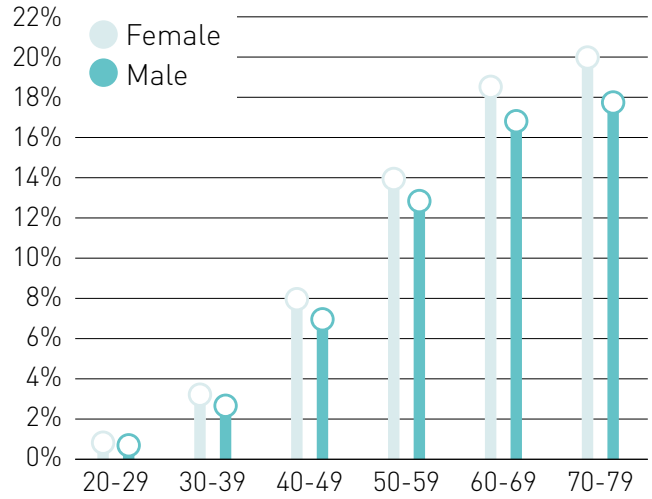
## Map 4.5.1 Prevalence (%) estimates* of diabetes (20-79 years) in South and Central American Region, 2017



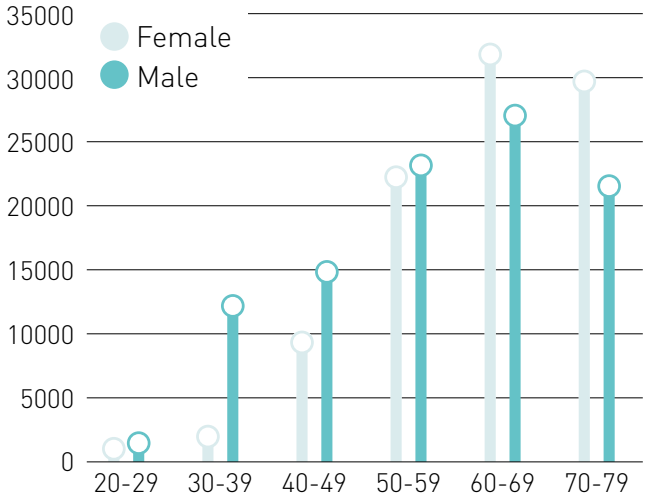

*Comparative prevalence



## Figure 4.5.1 Prevalence (%) estimates of diabetes by age and sex, South and Central America Region, 2017




## Figure 4.5.2 Mortality due to diabetes by age and sex, South and Central America Region, 2017




| At a glance | 2017 | 2045 |
|---|---|---|
| Adult population (20-79 years) | 325.0 million | 419.0 million |
| **Diabetes (20-79 years)** | | |
| Regional prevalence | 8.0% (6.7-9.8%) | 10.1% (8.3-12.4%) |
| Age-adjusted comparative prevalence | 7.6% (6.3-9.5%) | 7.6 (6.2-9.6%) |
| Number of people with diabetes (20-79 years) | 26.0 million (21.7-31.9 million) | 42.3 million (34.9-52.1 million) |
| Number of deaths due to diabetes (20-79 years) | 209,717 (176,057- 251,217) | - |
| **Health expenditure due to diabetes (18-99 years)** | | |
| Total health expenditure, USD | 29.3 billion | 38.1 billion |
| **Impaired glucose tolerance (20-79 years)** | | |
| Regional prevalence | 10.0% (7.2-13.3%) | 11.5% (8.6-15.1%) |
| Age-adjusted comparative prevalence | 9.6% (6.9-12.7%) | 9.5% (7.0-12.7%) |
| Number of people with impaired glucose tolerance | 32.5 million (23.5-43.4 million) | 48.1 million (36.2-63.2 million) |
| **Type 1 diabetes (0-19 years)** | | |
| Number of children with type 1 diabetes | 118,600 | - |
| Number of newly diagnosed children each year | 12,700 | - |
| **Undiagnosed diabetes (20-79 years)** | | |
| Regional prevalence | 40.0% | - |
| Number of people with undiagnosed diabetes | 10.4 million (8.8-12.6 million) | - |

Data in parentheses are 95% confidence intervals.

# 4.6 SOUTH-EAST ASIA

**Although the IDF South-East Asia Region (SEA) comprises only seven countries—India, Bangladesh, Nepal, Sri Lanka, Mauritius, Bhutan and the Maldives—it is the second most populous IDF region after the Western Pacific Region (WP). In 2017, all SEA countries are classified as low- or middle income and have an annual economic growth of over 3-7% during the year.[1] Mauritius has the highest gross national income per capita at USD 9,760 and Nepal the lowest at USD 730.**

**SEA has 962 million adults aged 20-79 years in 2017 and by 2045, the region is predicted to grow to about 1.37 billion adults aged 20-79 years. This region is represented predominantly by India and all other countries are small which leads to heterogeneity in the data.**

## Prevalence

Estimates in 2017 indicate that 8.5% (6.5-10.7%) of the adult population aged 20-79 years has diabetes. This is equivalent to 82.0 (62.6 – 103.2) million people living with diabetes. About 45.8% of these are undiagnosed. Although only one-third (33.3%) of adults in SEA live in urban areas in 2017, nearly half (48.8%) of all adults with diabetes can be found in cities.

Mauritius has the highest adult diabetes prevalence rate in this region (22.0%), followed by Sri Lanka (10.7%) and India (10.4%). India is home to the second largest number of adults living with diabetes worldwide, after China. People with diabetes in India, Bangladesh, and Sri Lanka make up 98.9% of the region's total adult diabetes population. People from age 50-70 have the highest diabetes prevalence among all ages in this region.

A further 29.1 million people aged 20-79 years have impaired glucose tolerance and are at increased risk of developing type 2 diabetes in the future. The number of people with diabetes in the region is predicted to be 151.4 million by 2045 or 11.1% of the adult population aged 20-79 years.

There are an estimated 149,300 children and adolescents under the age of 20 living with type 1 diabetes in SEA. Approximately 19,500 children and adolescents developed type 1 diabetes in the region during 2017. India is home to the second largest number of children and adolescents aged 0-19 years with type 1 diabetes in the world (128,500), after the USA, and accounts for the majority of children and adolescents with diabetes in the SEA.

## Mortality

With 1.1 million deaths in 2017 (14% of all mortality), the region had the second highest number of deaths attributable to diabetes of any of the seven IDF regions, after WP. Nearly half (51.5%) of these deaths occurred in people under 60 years of age. In 2017, India is the largest contributor to the regional mortality, with nearly 1 million estimated deaths attributable to diabetes.

## Healthcare expenditure

The total healthcare expenditure on people with diabetes in 2017 was USD 9.4 billion in 2017 (ID 33.2 billion), which makes SEA the second lowest total healthcare expenditure on diabetes of all seven IDF regions after the African region. However, SEA will experience a large growth in healthcare expenditure on diabetes in the next decades, reaching USD 14.4 billion (ID 50.6 billion) in 2045.

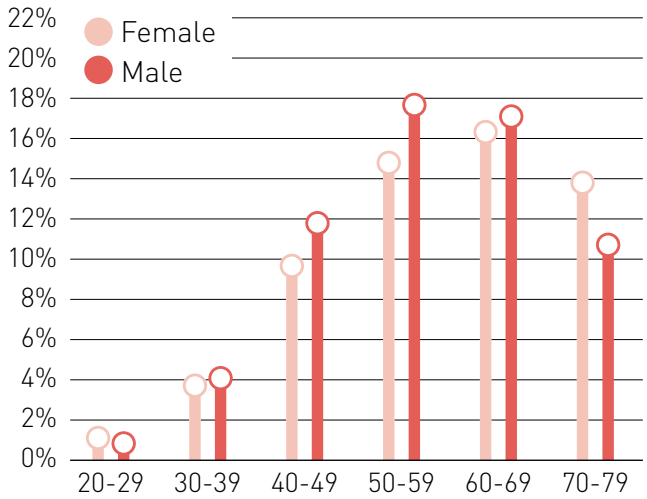
The highest estimate in 2017 for mean expenditure per person with diabetes in the region was ID 3,246 in the Maldives, while the lowest was ID 147 in Bangladesh. Regarding India, which accounts for 90% of diabetes cases in the region, ID 426 was spent per person with diabetes.

Despite the lower numbers presented here, in comparison with other parts of the world, these correspond to significant share of the total resources available. On average 12% of the total expenditures on healthcare was directed to people with diabetes. The highest percentage in the region was Mauritius where one in four healthcare dollars was spent on diabetes, and the lowest was Nepal with only 6% of the total dedicated to diabetes.

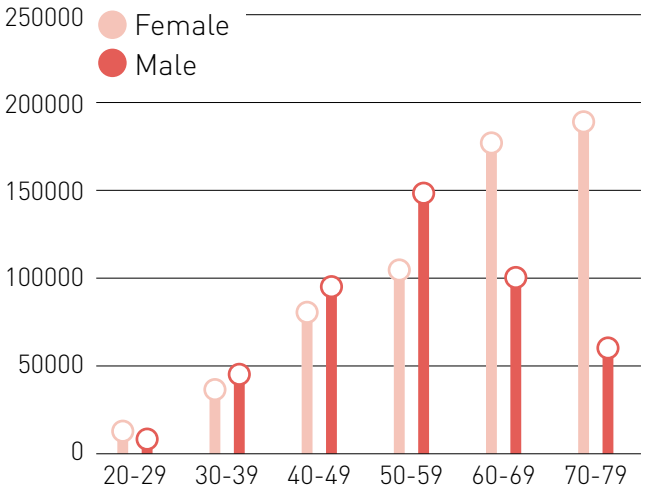
## Map 4.6.1 Prevalence (%) estimates* of diabetes (20-79 years) in South-East Asia Region, 2017


*Comparative prevalence

## Figure 4.6.1 Prevalence (%) estimates of diabetes by age and sex, South-East Asia Region, 2017




## Figure 4.6.2 Mortality due to diabetes by age and sex, South-East Asia Region, 2017




| At a glance | 2017 | 2045 |
|---|---|---|
| Adult population (20-79 years) | 962.0 million | 1.37 billion |
| **Diabetes (20-79 years)** | | |
| Regional prevalence | 8.5% (6.5-10.7%) | 11.1% (8.6-13.9%) |
| Age-adjusted comparative prevalence | 10.1% (7.9-12.8%) | 10.1% (7.9-12.8%) |
| Number of people with diabetes (20-79 years) | 82.0 million (62.6-103.2 million) | 151.4 million (117.1-189.2 million) |
| Number of deaths due to diabetes (20-79 years) | 1.1 million (0.86-1.4 million) | - |
| **Health expenditure due to diabetes (20-79 years)** | | |
| Total health expenditure, USD | 9.5 billion | 14.4 billion |
| **Impaired glucose tolerance (20-79 years)** | | |
| Regional prevalence | 3.0% (2.3-6.0%) | 3.7% (2.7-6.9%) |
| Age-adjusted comparative prevalence | 3.5% (2.6-6.5%) | 3.4% (2.6-6.5%) |
| Number of people with impaired glucose tolerance | 29.1 million (21.8-57.3 million) | 50.0 million (37.5-93.6 million) |
| **Type 1 diabetes (0-19 years)** | | |
| Number of children with type 1 diabetes | 149,300 | - |
| Number of newly diagnosed children each year | 19,500 | - |
| **Undiagnosed diabetes (20-79 years)** | | |
| Regional prevalence | 57.6% | - |
| Number of children with undiagnosed diabetes | 47.2 million (36.0-59.4 million) | - |

Data in parentheses are 95% confidence intervals.

# 4.7 WESTERN PACIFIC

**The IDF Western Pacific Region (WP) has the largest population of any region with 39 countries and territories. WP is home to China, the world's most populous country with 62.2% of adults in the region, and to some of the least populous, such as the Pacific islands of Tokelau and Niue. The economic profiles of countries vary from a gross national income per capita of USD 51,880 in Singapore to less than USD 1,140 in Cambodia.**

## Prevalence

In 2017, 9.5% (8.4-12%) of adults aged 20-79 years are estimated to be living with diabetes. This is equivalent to 158.8 (140.6-200.4) million people. Over half (54%) of these are undiagnosed, 63.8% of people with diabetes live in cities and 90.2% of people with diabetes live in low or middle income countries. WP is home to 37.4% of the total number of people with diabetes in the world.

There is a big difference between the estimates for the prevalence of adult diabetes in WP: from the world's highest in the Pacific Island nation of the Marshall Islands (30.5%) to one of the lowest in Cambodia (4.4%). China has the highest number of people with diabetes (114.4 (104.1-146.3) million) in the world.

There are also 126.7 million adults aged 20-79 years with impaired glucose tolerance (IGT) in the region who are at increased risk of future diabetes. By year 2045, it is predicted that there will be 193.3 million adults with diabetes (20-79 years) in the region equivalent to 10.3% of the adult population.

An estimated 110,000 children and adolescents under the age of 20 in the region have type 1 diabetes with approximately 13,300 newly diagnosed in 2017. Over 46,900 of these children and adolescents are in China likely due to the large proportion of this age group in China rather than a high incidence rate.

## Mortality

With 1.3 million deaths among adults (11% of all mortality), WP had the highest number of deaths due to diabetes of all the IDF regions. Over 38.0% of diabetes deaths occurred in people under the age of 60. China alone had 842,993 deaths due to diabetes in 2017 with 33.8% of the total occurring in people under 60.

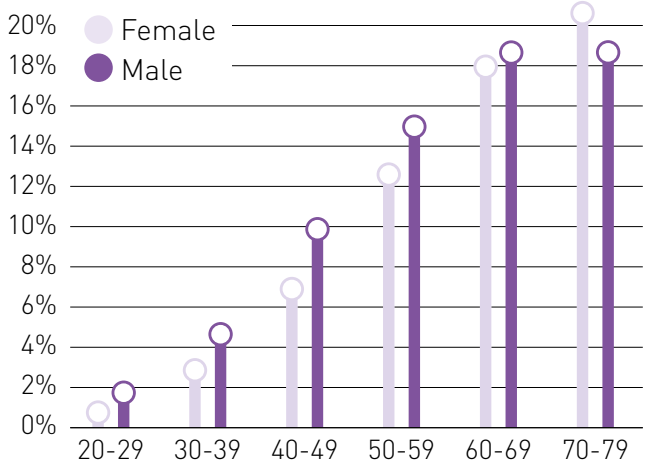
## Healthcare expenditure

In WP, USD 120.3 billion (ID 178.7 billion) was spent on healthcare by people with diabetes in 2017. Due to a projected decrease in the total number of people with diabetes in some of the WP countries (Japan and Taiwan) and significant changes in the population structure of other countries (China and the Republic of Korea), a small reduction in total amount spent on healthcare by people with diabetes is projected in 2045 (USD 111.6 billion (ID 167.3 billion)). Even so, it is important to highlight that this projection does not consider prevalence growth or increase in healthcare costs, being exclusively based on demographic changes.

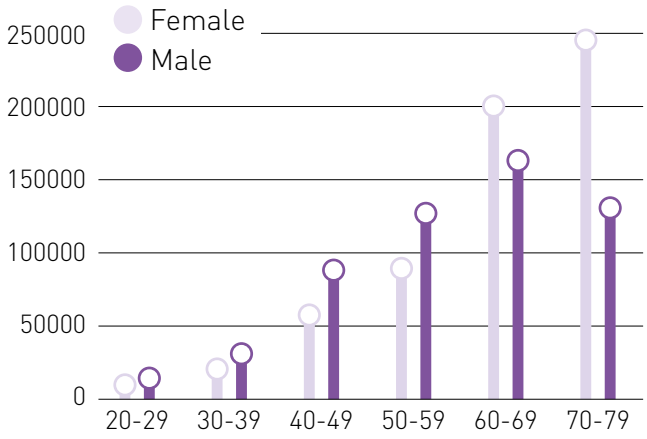
China spent the most on diabetes in the region for a total of ID 109.8 billion, corresponding to 52% of the total spent in the region. The highest mean expenditure estimate per person with diabetes was in Australia with ID 5,650 spent in 2017, while the lowest value was in Papua New Guinea with ID 172.

On average 10% of healthcare dollars was spent on diabetes. The country with the highest percentage of healthcare expenditure dedicated to diabetes was Tuvalu with 31%, while the lowest was Cambodia with only 4%.

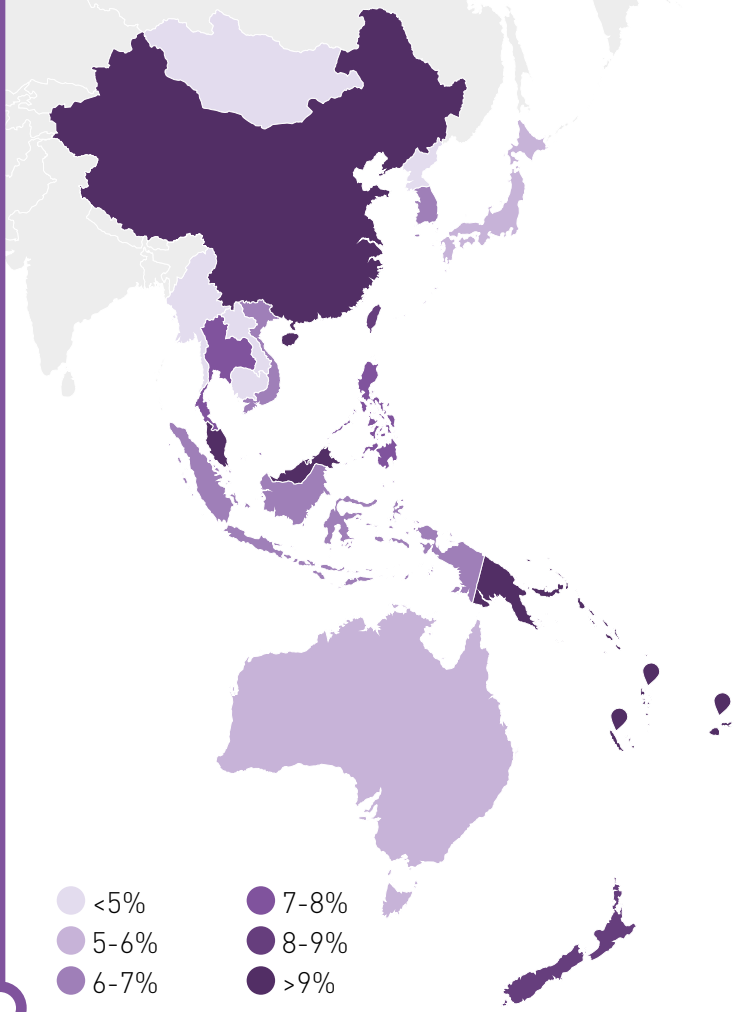
## Figure 4.7.1 Prevalence (%) estimates of diabetes by age and sex, Western Pacific Region, 2017




## Figure 4.7.2 Mortality due to diabetes by age and sex, Western Pacific Region, 2017




## Map 4.7.1 Prevalence (%) estimates* of diabetes (20-79 years) in Western Pacific Region, 2017




*Comparative prevalence

| At a glance | 2017 | 2045 |
|---|---|---|
| Adult population (20-79 years) | 1.7 billion | 1.8 billion |
| **Diabetes (20-79 years)** | | |
| Regional prevalence | 9.5% (8.4-12.0%) | 10.3% (7.8-12.8%) |
| Age-adjusted comparative prevalence | 8.6% (7.6-11.0%) | 7.4% (5.8-9.2%) |
| Number of people with diabetes (20-79 years) | 158.8 million (140.6-200.4 million) | 183.3 million (138.6-227.4 million) |
| Number of deaths due to diabetes (20-79 years) | 1.3 million (1.1-1.5 million) | - |
| **Health expenditure due to diabetes (20-79 years)** | | |
| Total health expenditure, USD | 120.3 billion | 111.6 billion |
| **Impaired glucose tolerance (20-79 years)** | | |
| Regional prevalence | 7.6% (4.7-12.1%) | 8.8% (5.6%-14.1%) |
| Age-adjusted comparative prevalence | 7.1% (4.3-11.5%) | 7.5% (4.5-11.6%) |
| Number of people with impaired glucose tolerance | 126.7 million (78.4-202.5 million) | 157 million (99.6-250.1 million) |
| **Type 1 diabetes (0-19 years)** | | |
| Number of children with type 1 diabetes | 110,000 | - |
| Number of newly diagnosed children each year | 13,300 | - |
| **Undiagnosed diabetes (20-79 years)** | | |
| Regional prevalence | 54.1% | |
| Number of people with undiagnosed diabetes | 85.9 million (76.1-108.0) | |

Data in parentheses are 95% confidence intervals.

# CHAPTER 5

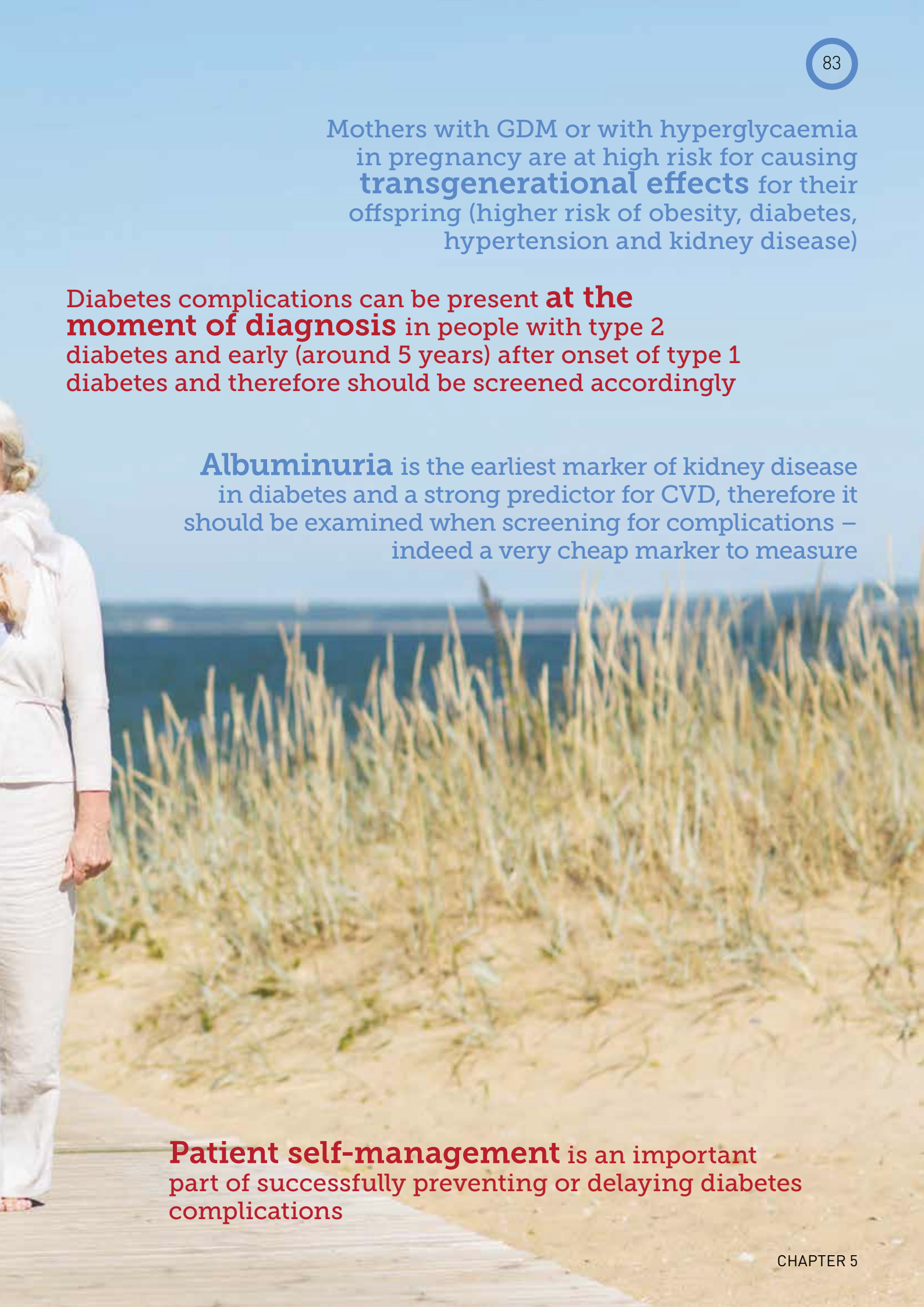
## Diabetes Complications

Cardiovascular and renal complications are the **main cause of death** in people with diabetes around the world and this can be avoided by **appropriate treatment**

Mothers with GDM or with hyperglycaemia in pregnancy are at high risk for causing **transgenerational effects** for their offspring (higher risk of obesity, diabetes, hypertension and kidney disease)

Diabetes complications can be present **at the moment of diagnosis** in people with type 2 diabetes and early (around 5 years) after onset of type 1 diabetes and therefore should be screened accordingly

**Albuminuria** is the earliest marker of kidney disease in diabetes and a strong predictor for CVD, therefore it should be examined when screening for complications – indeed a very cheap marker to measure



**Patient self-management** is an important part of successfully preventing or delaying diabetes complications

# Diabetes complications

When not well managed, all types of diabetes can lead to complications in many parts of the body, resulting in frequent hospitalisations and early death. People with diabetes have an increased risk of developing a number of serious life-threatening health problems increasing medical care costs and lowering quality of life.

Persistently high blood glucose levels cause generalized vascular damage affecting the heart, eyes, kidneys and nerves. Diabetes is one of the leading causes of cardiovascular disease (CVD), blindness, kidney failure and lower-limb amputation. In pregnancy, poorly controlled diabetes increases the risk of maternal and fetal complications. There are no detailed global estimates of diabetes-related complications, but where data are available – mainly from high income countries – prevalence and incidence vary hugely between countries.[1,2]

Diabetes complications can be divided into acute and chronic complications. Acute complications include hypoglycaemia, diabetic ketoacidosis (DKA), hyperglycaemic hyperosmolar state (HHS), hyperglycaemic diabetic coma, seizures or loss of consciousness and infections. Chronic microvascular complications are nephropathy, neuropathy and retinopathy, whereas chronic macrovascular complications are coronary artery disease (CAD) leading to angina or myocardial infarction, peripheral artery disease (PAD) contributing to stroke, diabetic encephalopathy and diabetic foot. In addition, diabetes has also been associated with increased rates of cancer, physical and cognitive disability,[3-5] tuberculosis[6,7] and depression.[8]

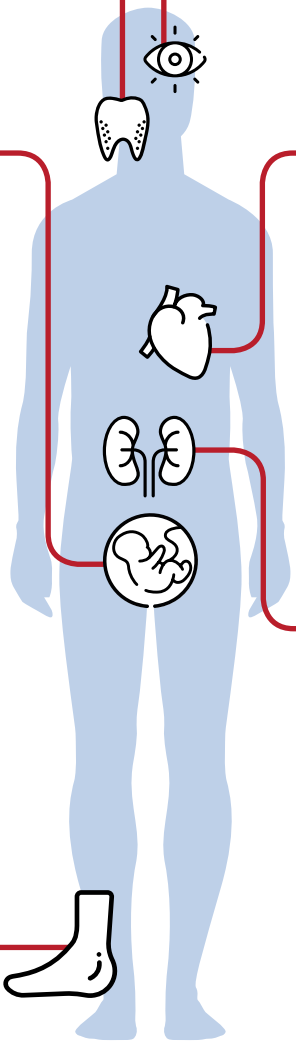
People with diabetes should be regularly screened for potential complications and provided with close monitoring by healthcare professionals. A majority of people with diabetes are unaware of having diabetes complications.[9] However, most complications can be detected in their early stages by screening programmes, allowing for early treatments and prevention of disease progression. Diabetes requires a comprehensive management plan where patients are educated to make informed decisions about diet, exercise, and weight; effectively monitor their blood glucose, lipids, blood pressure and cholesterol; access and correctly use medications; and regularly attend screening for complications.

The International Diabetes Federation (IDF) runs a series of initiatives around the globe to advance treatment, services and education to improve outcomes for people with diabetes and also promotes prevention of diabetes and its complications. (See Chapter 6). However, more needs to be done and therefore, IDF calls for epidemiologic studies in all parts of the world to gain a more comprehensive global picture on diabetes complications and their extent.

A majority of people with diabetes are **unaware** of having diabetes complications. However, most complications **can be detected in their early stages** by screening programmes

People with diabetes are at **higher risk** of developing periodontal disease

Diabetic retinopathy affects over **one-third** of all people with diabetes and is the leading cause of vision loss in working-age adults.



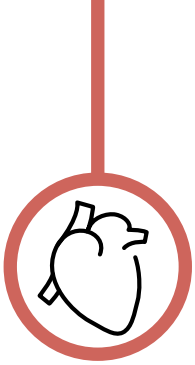
Pregnant woman with diabetes or at high risk for GDM should manage their glycaemia throughout their pregnancy to avoid long-term consequences for themselves and their children, and **trasgenerational effects** (higher risk of obesity, diabetes, hypertension and kidney disease in the offspring)

People with diabetes are **2 to 3 times** more likely to have cardiovascular disease (CVD)

The prevalence of end-stage renal disease (ESRD) is up to **10 times higher** in people with diabetes

Every **30 seconds** a lower limb or part of a lower limb is lost to amputation somewhere in the world as a consequence of diabetes

# Cardiovascular disease



People with diabetes are at increased risk of cardiovascular disease (CVD). High levels of blood glucose can make the blood coagulation system more active, increasing the risk of blood clots. Diabetes is also associated with high blood pressure and cholesterol levels, which lead to increased risk of cardiovascular complications such as angina, coronary artery diseases (CADs), myocardial infarction, stroke, peripheral artery disease (PAD), and congestive heart failure. A comprehensive report about epidemiology related to diabetes and CVD has been published by IDF in 2016.[10]

## Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels and they include:

- **Coronary heart disease:** disease of the blood vessels supplying the heart muscle;
- **Cerebrovascular disease:** disease of the blood vessels supplying the brain;
- **Peripheral arterial disease:** disease of blood vessels supplying the arms and legs;
- **Rheumatic heart disease:** damage to the heart muscle and heart valves from rheumatic fever, caused by streptococcal bacteria;
- **Congenital heart disease**: malformations of heart structure existing at birth; deep vein thrombosis and pulmonary embolism – blood clots in the leg veins, which can dislodge and move to the heart and lungs.

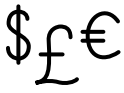
Overall, it is estimated that every year 14 to 47 per 1,000 middle-aged people with diabetes (50-69 years) living in high and middle income countries have a CVD event.[11-16] Among these, 2-26 per 1,000 are coronary artery disease events,[17-22] and 2-18 per 1,000 are strokes.[11-13,15,19,20,23-29]

People with diabetes are two to three times more likely to have cardiovascular disease (CVD) than people without diabetes.[30, 31] The incidence of CVD increases with age and there is variation between countries with higher rates being observed in low and middle income settings compared to high income countries.[31]

Based on studies conducted among younger people with type 1 diabetes (28-44 years) living in high and middle income countries, up to 16% had a history of CVD,[32-36] up to 2% had a history of stroke[37] and up to 1% had a history of heart attack.[38] The prevalence of CAD (including angina pectoris and heart attack) among similar age groups with type 1 diabetes (25-43 years) in high and middle income countries ranged from 0.5% to 20%.[39-42] Whereas, among older people (51-69 years) with type 1 and type 2 diabetes, the prevalence of coronary artery disease ranged from 12% to 31.7%.[11,39,42-52]

CVD is a major cause of death and disability in people with diabetes. In young people with type 1 diabetes (8-43 years), up to five people out of 1,000 die from CVD each year,[35,36,53-56] while among middle-aged people with type 2 diabetes living in high and middle income countries, up to 27 people out of 1,000 die from CVD each year; a third of them die from stroke, and a quarter die from coronary artery disease.[11,13,14,16,24,27,43,45,58-65]

### Economic burden of diabetes and CVD



CVD consumes a significant part of diabetes resources nationally.[66] Based on US data, 20 % of all inpatient days and 15 % of physician office visits are due to this chronic complication of diabetes. Moreover, CVD related care represents the largest proportion of diabetes health expenditures: one out of four diabetes inpatient costs are a consequence of CVD, and 15 % of costs of physician office visits are related to CVD. At the same time diabetes is responsible for more than a quarter of all CVD expenditure.[67]

On average, people with diagnosed diabetes have medical expenditures approximately two-fold higher than what expenditures would be in the absence of diabetes. For the cost categories analysed, care for people with diagnosed diabetes accounts for more than one in five healthcare dollars in the US, and more than half of that expenditure is directly attributable to diabetes. Indirect costs include increased absenteeism (USD 5 billion) and reduced productivity while at work (USD 20.8 billion) for the employed population, reduced productivity for those not in the labour force (USD 2.7 billion), inability to work as a result of disease-related disability (USD 21.6 billion), and lost productive capacity due to early mortality (USD 18.5 billion).[67,68]

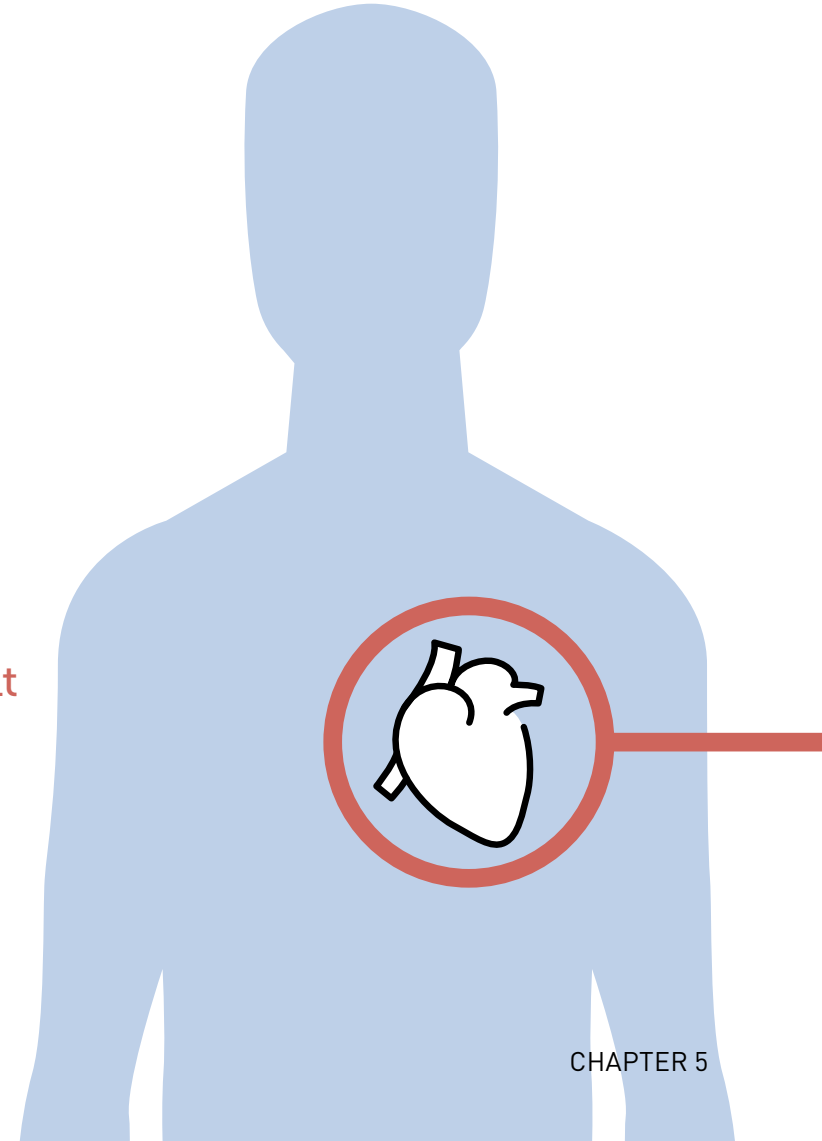
Although often forgotten, the burden of diabetes and CVD is also a problem in low and middle income countries. Based on a global study which included 23 low and middle income countries, it was estimated that USD 84 billion of gross domestic product (GDP) was lost due to CVD and diabetes from 2005 to 2015. Half of this GDP loss came from three countries: China, India, and the Russian Federation.[69]

Furthermore based on a recently published article, the average global costs of diabetes (direct and indirect ) for 2015 was USD 1.3 trillion or 1.8% of global gross domestic product (GDP). North America was the most affected region relative to GDP and also the largest contributor to global absolute costs. However, on average, the economic burden as percentage of GDP was larger in middle income countries than in high income countries.[70]

**1 out of 4** diabetes inpatient costs are a consequence of cardiovascular complications

**Prevention and management of CVD**

Preventing cardiovascular events in high risk populations can reduce mortality as well as decrease the economic burden from heart attack and stroke. Long term follow-up has showed a 57% reduction of major cardiovascular events among people with type 1 diabetes,[71] and a 53% reduction of CVD of death from cardiovascular causes, nonfatal myocardial infarction, nonfatal stroke, revascularization and amputation among people with type 2 diabetes.[72] Blood glucose self-management must be accompanied by the adoption of healthy lifestyle, characterized by reduced intake of sugar, salt and fat; improved fruit and vegetable intake; increased physical activity; smoking cessation; and avoidance of excessive alcohol. Furthermore, medications are needed for tight control of the metabolic parameters including glucose lowering drugs, antihypertensives, statins and aspirin in those patients with very high risk.[73-75]



# Diabetic eye disease

Diabetic eye disease (DED) occurs as a direct result of chronic high blood glucose levels causing damage to the retinal capillaries, leading to capillary leakage and capillary blockage. It may lead to loss of vision and eventually, blindness. The spectrum of DED comprises diabetic retinopathy (DR), diabetic macular edema (DME), cataract, glaucoma, loss of focusing ability, and double vision. DME is a further complication of retinopathy, which can occur at any stage. It is characterized by a swelling of the macula due to ischemia.[76] The risk for retinopathy is increased among people with type 1 diabetes, people with longer duration of diabetes, and possibly among people of lower socioeconomic status.[77]

DR is the leading cause of vision loss in working-age adults (20 to 65 years) and approximately one in three people living with diabetes have some degree of DR and one in ten will develop a vision threatening form of the disease. As per the estimates of the International Association on the Prevention of Blindness (IAPB), 145 million people had some form of DR and 45 million people suffered from vision threatening DR in 2015.[78-80] The prevalence of any retinopathy in persons with diabetes is 35% while proliferative (vision-threatening) retinopathy is 7%.[77]

20% of adults surveyed across 41 countries were diagnosed with DED in the IDF DR Barometer. The prevalence of DED was 41% in the South-East Asia region, 20% in the European region, 19% in the Region of the Americas, 19% in the Western Pacific region, 18% in the Eastern Mediterranean region, and 12% in the Africa region. Globally, 7.6% of patients surveyed had been diagnosed with DME.[81]

The prevalence of DME was 6.4% in the Region of the Americas, 6.3% in the South-East Asia region, and 5.6% in the Western Pacific region. The rates in the European and Eastern Mediterranean region are slightly higher at 8.9% and 11% respectively.[81]

The proportion of moderate and severe vision impairment attributable to DR was 1.3% in 1990 worldwide and this increased to 1.9% in 2010. Southern Latin America had the largest proportion, namely 4.0% in 2010. The proportion of blindness cases attributable to DR increased from 2.1% in 1990 to 2.6% in 2010. Once again, Southern Latin America had the largest proportion of blindness cases due to diabetes from all regions analysed worldwide, which was 5.5% in 2010.[82]

### Economic burden of DED

Diabetic eye disease has a significant impact on people's quality of life and was associated with deterioration in physical wellbeing. Globally,64% of people with DME and 58% with DED experience limitations on performing daily activities compared to 37% of those without DED.[81] Moreover, those with these conditions rated their health as fair or poor in greater proportion compared to those without DED, reporting higher frequency of physically unhealthy days and restricted daily activities. [77]

Besides the burden for people with diabetes, DED is also responsible for significant healthcare expenditure. In a study conducted in Sweden, DR alone consumed 10 million euros in healthcare expenditures.[83]

Evidence from other countries suggests a similarly high economic burden of DED. In Spain, the cost of DR grew from EUR 200 in 2007, to EUR 233 in 2014; while the mean cost of DME went from EUR 705 in 2007 to EUR 4,200 in 2014.[84] In Canada, the mean six-month cost of mild DME was CAD 2,092, and for severe DME was CAD 3,007.[85] On top of the medical expenditures, the costs associated with DED include productivity losses due to absence from labour force and opportunity costs associated to the support of informal care givers.[86] Based on research from Australia, these types of costs, totalled AUD 2 billion due to DME only.[87]

### Prevention and management of DED

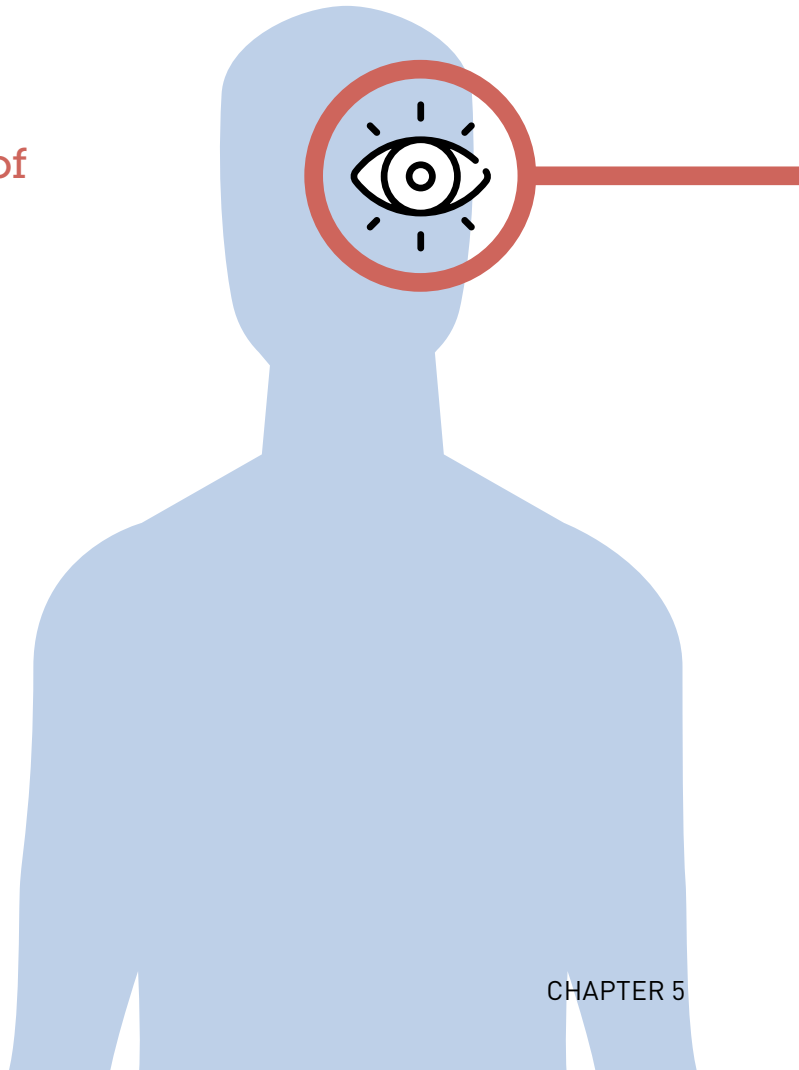
Since DED is largely asymptomatic in the early stages, it is essential that people with diabetes have retinal screening on a regular basis in order to detect DR and DME. The methods for DR diagnosis include ophthalmoscopy, optical coherence tomography, retinal photography and fluorescein angiography. The non-mydriatic retinal photography is recommended as the preferred screening method. It provides a permanent record and can be carried out using telemedicine. Screening for retinopathy should be done regularly since diagnosis of diabetes.[88]

The primary prevention intervention for DED is good diabetes management. This can be achieved through intensive blood glucose self-management via diet with medication if required which can prevent the onset of DR by 76% and its progression by 54% for insulin treated patients.[89] Moreover, for people with type 2 diabetes more intensive blood glucose control can improve eye health outcomes by 13% compared to regular care.[90]

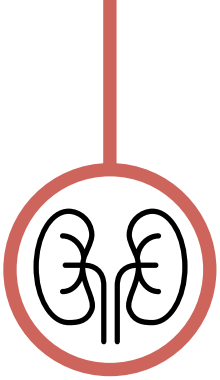
The effective treatments available include laser coagulation treatment, intravitreal anti-VEGF drugs, intravitreal steroid injections, and vitrectomy. These treatments can prevent vision loss, stabilize vision and in some cases, improve vision if provided early. Unfortunately, in many low and middle income countries, there is a lack of available screening and treatment for DR.[81]

It is also essential that people with diabetes are educated about the importance of regular retinal screening and given efficient and timely access to those services. Furthermore, people with diabetes should implement personal management strategies such as healthy lifestyle choices regarding nutrition and exercise, and have proper support and education for tight blood glucose and blood pressure management as these efforts play an important role in reducing the risk of the development and progression of DR.[81]

Intensive blood glucose control through diet with medication (if required) can prevent the onset of diabetic retinopathy by **76%**



# Kidney disease in diabetes (nephropathy)

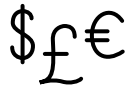


Chronic kidney disease (CKD) among patients with diabetes can be true diabetic nephropathy, but can also be caused indirectly by diabetes due mostly to hypertension, but also polyneuropathic bladder dysfunction, increased incidence of relapsing urinary tract infections or macrovascular angiopathy.

Based on data from the UK, one-fifth of people with diabetes[90] and based on data from the US, 40% of people with diabetes will develop chronic kidney disease, whereas 19% show signs of stage 3 or higher.[91] Pooled data from 54 countries reveal that more than 80% of end-stage renal disease (ESRD) cases are caused by diabetes, hypertension or a combination both. The proportion of ESRD attributable to diabetes only varies between 12 to 55%. The prevalence of ESRD is also up to 10 times higher in people with diabetes as those without.[1]

Diabetes, hypertension and kidney failure are highly interlinked. On the one hand, type 2 diabetes is among the leading causes of kidney failure which is a risk for hypertension and on the other hand, hypertension can often precede CKD and contribute to progression of kidney disease.[92] Hyperglycaemia induces hyperfiltration, a predictor of progressive kidney disease, and morphologic changes in the kidneys that ultimately lead to podocyte damage and loss of filtration surface.[93]

### Economic burden of kidney disease



Likewise, with the other diabetes related complications, kidney disease is associated with significant additional health expenditure for people with diabetes. Depending on the severity of kidney disease in diabetes, the costs also vary. Based on a US study conducted between 1999 and 2002 people with diabetes but no nephropathy incurred a mean annual medical cost of USD 4,573, while patients with clinical nephropathy experienced mean annual costs 49% higher (USD 6,826). Moreover, when nephropathy progresses to end stage renal disease (ESRD) the associated health expenditures increase exponentially. Among patients with ESRD those not on dialysis experienced annual mean costs of USD 10,322, while for those on dialysis this increased 2.8 times.[94]

In order to reduce this economic burden, the most effective strategy is to prevent diabetes in the first place, and among those with diabetes to diagnose and treat kidney disease early on. Based on a UK study, starting early therapy can lead to important cost savings when compared with a later start of the same intervention. As per the results of this study, GBP 2310 (± 327) can be saved over lifetime.[95]

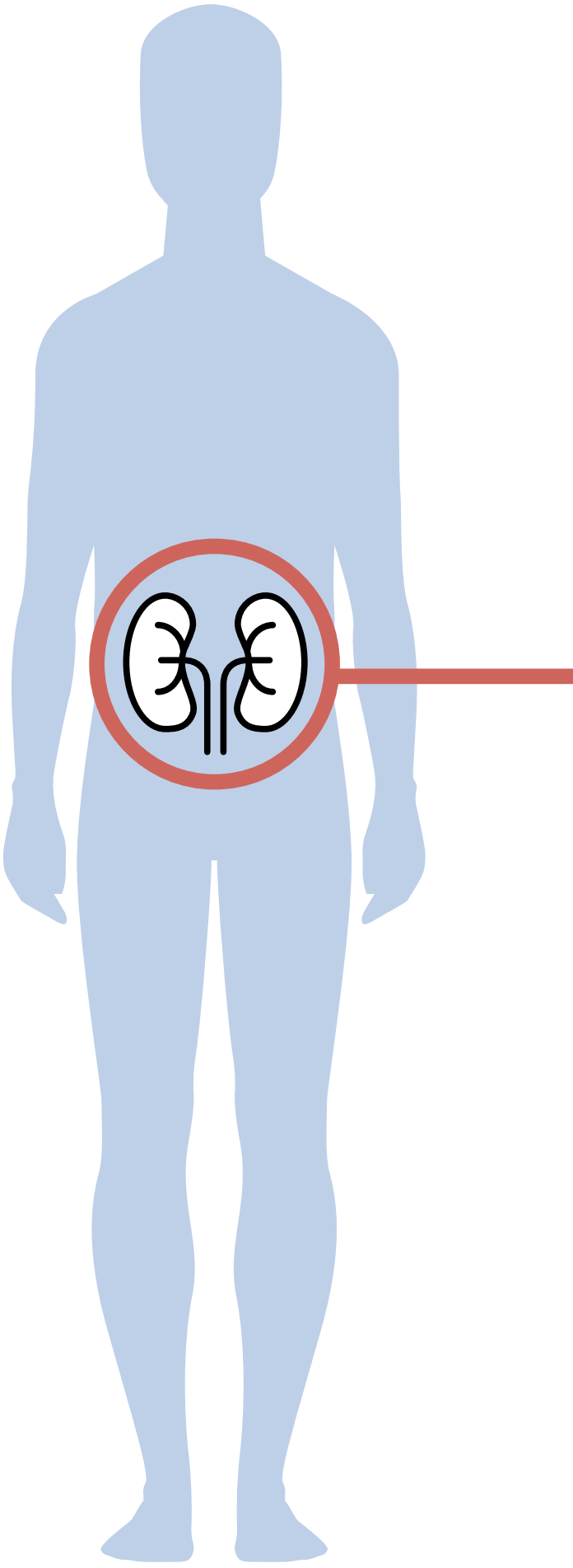
Another study, conducted in Thailand has obtained similar health economic results, with ACE inhibitors used as therapy for the delay of ESRD among patients with albuminuria, producing savings of USD 120,000 per 100 people with diabetes.[96]

### Prevention and management of kidney disease

Both diabetes and chronic kidney disease (CKD) are strongly associated with CVD and therefore, the major component in their management is control of cardiovascular risk factors such as hypertension and hyperglycaemia. It is important to control blood glucose and blood pressure in order to reduce the risk of nephropathy. Screening for abnormal quantities of albumin in the urine (albuminuria) and starting treatment with drugs that reduce the activity of the renin-angiotensin-aldosterone system when albuminuria is persistently found, even in the absence of hypertension, is very effective to prevent the development and progression of CKD in people with diabetes.

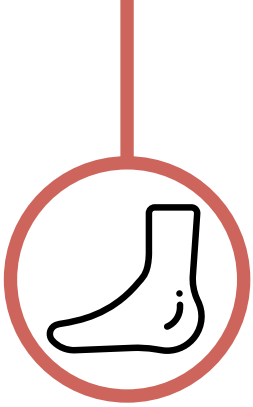
Screening for albuminuria should be done every year since diagnosis in people with type 2 diabetes and the same after the first five years in people with type 1 diabetes.[97]

The fundamental care for CKD is to avoid progression to kidney failure requiring dialysis and/or transplant. This can be achieved by tight management of blood glucose and blood pressure and also a healthy lifestyle. When CKD has advanced to stage 3 special considerations may be needed regarding selection and dosage of glucose lowering drugs and other medications. Once the disease has advanced to stage 4 and 5, the patient requires the care of specialist renal teams for planning of renal replacement therapy including dialysis, and monitoring and management of the metabolic consequences such as anaemia and lack of potassium or phosphate. In some cases, consideration of pancreas and kidney transplant should take place. Currently, only a minority of people have access to dialysis and renal replacement therapy on a global scale.[98]



**People with diabetes and clinical nephropathy experience 50% higher health expenditures compared to those with diabetes but without clinical nephropathy**

# Nerve damage (neuropathy) and diabetic foot



High blood glucose can cause damage to the nerves throughout the body. Neuropathy is a frequently encountered complication of diabetes. Nerve damage can be quite significant and allow injuries to go unnoticed, leading to ulceration, serious infections and in some cases amputations. Diabetic neuropathy is an impairment of normal activities of the nerves throughout the body and can alter autonomic, motor and sensory functions. Peripheral neuropathy is the most common form of diabetic neuropathy which affects the distal nerves of the limbs, particularly those of the feet. It alters mainly the sensory function symmetrically causing abnormal feelings and progressive numbness which facilitates the development of ulcers (diabetic foot) because of external trauma and/or abnormal distribution of the internal bone pressure. Neuropathy can also lead to erectile dysfunction, as well as digestive and urinary problems, and some other problems such as cardiac autonomic dysfunction.

Diabetic foot is a severe chronic complication, and it consists of lesions in the deep tissues associated with neurological disorders and PVD in the lower limbs. The reported prevalence of diabetic peripheral neuropathy ranges from 16% to as high as 66%.[99,100] Amputation in people with diabetes is 10 to 20 times more common compared to those of non-diabetic people.[101] Every 30 seconds a lower limb or part of a lower limb is lost to amputation somewhere in the world as a consequence of diabetes.[102] The incidence of diabetic foot is increasing due to the increased prevalence of diabetes and the prolonged life expectancy of diabetic patients.

In high income countries, the annual incidence of foot ulceration among people with diabetes is about 2%, being the most common cause of non-traumatic amputation, approximately 1% of people with diabetes suffer lower-limb amputation. In low and middle income countries foot ulcers, and amputation are more common.[103,104] With comprehensive management, a large proportion of amputations related to diabetes can be prevented. Even when amputation takes place, the remaining leg and the person's life can be saved by good follow-up care from a multidisciplinary foot team.[105]

Global prevalence of diabetic foot varies between 3% in Oceania to 13% in North America, with a global average of 6.4%. The prevalence of diabetic foot is higher for men than for women. Also, the prevalence of diabetic foot is higher among people with type 2 diabetes, compared to people with type 1 diabetes.[106]

The characteristics of people with diabetic foot often include older age, longer diabetic duration, hypertension, diabetic retinopathy and smoking history.

### Economic burden of diabetic foot

$£€

Foot complications are among the most serious and costly complications of diabetes. In 2007, one-third of diabetes costs were estimated to be linked to foot ulcers. Compared to people with diabetes without foot ulcers, the cost of care for people with diabetes and with foot ulcers is 5.4 times higher in the year of the first episode and 2.6 times higher in the year of the second episode. Moreover, among patients with foot ulcers, costs for treating those with the highest grade ulcers were eight times higher compared to treatment of the lowest grade foot ulcers.[107]

### Prevention and management of diabetic foot

Similar to other diabetes related complications, the preventive strategy for diabetic foot is adequate diabetes management, characterized by glycaemic control. Intensive blood glucose management ($HbA_{1c}$<7%) can lead to a 35%

risk reduction of amputation compared to less intensive glycaemic management. Moreover, intensive management is also associated with slower decline in sensory vibration threshold.[108] People with diabetes should regularly examine their feet, use appropriate footwear and treat any non-ulcerative pathology correctly.

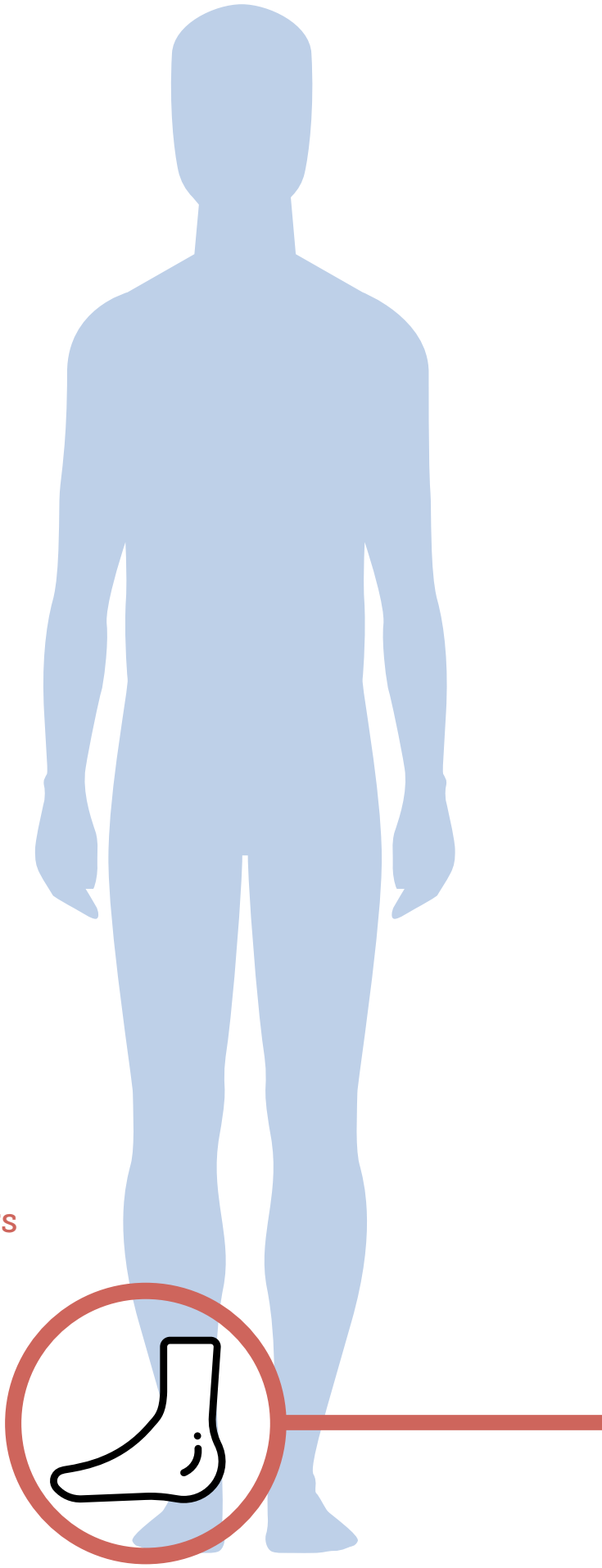
Regarding management of diabetic foot, two strategies should be prioritized:

1. increase awareness and knowledge among healthcare professionals on management and treatment of diabetic foot; and
2. conduct periodical screening and risk stratification for at-risk feet.

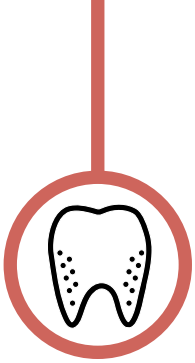
Less than one-third of physicians recognize the manifestations of diabetic peripheral neuropathy, even when symptomatic.[109] Moreover, there is a lack of understanding of the comprehensive management and treatment of diabetic foot amongst healthcare professionals.[110]

All people with diabetes should be screened for risk and placed in the appropriate risk stratification which is the clinical pathway for treatment and prevention. Comprehensive diabetic foot risk assessments and foot care based on prevention, education and a multi-disciplinary team approach will reduce foot complications and amputations by up to 85%. To address this, IDF has developed Clinical Practice Recommendation on the Diabetic Foot.[111]

People with diabetes with foot ulcers experience health expenditures **5 times higher** than those without foot ulcers



# Oral health



People with diabetes have increased risk of inflammation of the gums (periodontitis) or gingival hyperplasia if blood glucose is not properly managed. Periodontitis is a major cause of tooth loss and is associated with an increased risk of CVD. Other diabetes-related oral conditions include dental decay, candidiasis, lichen planus, neurosensory disorders (burning mouth syndrome), salivary dysfunction and xerostomia, and taste impairment.

Those with diabetes have a higher risk of developing periodontal disease compared to those without diabetes.[112-114] The prevalence of periodontal disease is more common among people with diabetes (92.6%) than those without the disease (83%).[115] Diabetes is associated with a greater prevalence of lichen planus,[116] fissured tongue, traumatic ulcers, irritation fibroma,[117] recurrent aphthous stomatitis[118] and oral fungal infections.[117] These complications might be caused by chronic immunosuppression, delayed healing or salivary hypofunction.[119]

### Economic burden of oral complications $£€

An American study based on insurance claims the number of hospitalizations of people with diabetes receiving periodontal treatment was 39 % lower compared with people with diabetes who have not received periodontal care. This difference was associated with a significantly lower cost; the mean annual medical costs per subject were USD 2,840 lower for those receiving care, which represented a 40 % cost reduction.[120] Another study also for the US has estimated that oral healthcare can potentially generate savings ranging between USD 39-53 billion among people with diabetes.[121]

Despite the presented evidence here, studies from other parts of the world, particularly from low- and middle-income countries, are needed in order to get a better global picture.

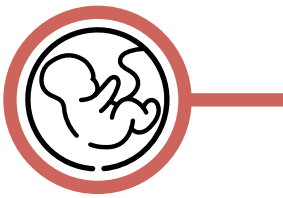
### Prevention and management of oral complications

The use of an electric toothbrush and a strict dental maintenance schedule are important in long-term oral health and for the prevention of complications. Regular oral check-ups should be established to ensure early diagnosis especially among previously undiagnosed diabetes patients and prompt management of any oral complications among patients with diabetes. Annual visits are recommended for symptoms of gum disease such as bleeding when brushing teeth or swollen and red gums.[122]

To improve oral health, salivary function must be maintained. Common dry or burning sensation in the mouth among people with diabetes can be a side effect of medication use which can be managed by modifying drug scheduling, dose adjustment, changing medications or simply by chewing sugar-free gum. A high fluid intake should be encouraged. Patients should avoid bulky, spicy or acidic foods, alcoholic and carbonated beverages, and tobacco use. The use of mouthwashes, that are specific to the treatment of dry mouth and alcohol free may also alleviate the oral discomfort. Also, therapy with immunologically active saliva substitutes can be helpful for reducing bacterial plaque, gingivitis and positive oral yeast counts.[123]

**Oral healthcare can potentially generate between USD 39-53 billion saving in people with diabetes**

# Pregnancy-related complications



Pregnant women with any type of diabetes are at risk for many devastating consequences for both mother and child. High blood glucose levels increase the risk for foetal loss, congenital malformations, stillbirth, perinatal death, pre-eclampsia, eclampsia, obstetric complications and maternal morbidity and pregnancy related mortality. High blood glucose can cause both macrosomia and low birth weight, shoulder dystocia and thus lead to problems during delivery, injuries to the child and mother, and lower blood glucose in the child after birth. The child might be born with low blood sugar, breathing problems and jaundice. Those exposed to a diabetic intrauterine environment are at higher risk of developing type 2 diabetes earlier in life than those without this exposure.[124,125]

### Economic burden of pregnancy complications

Hyperglycaemia in pregnancy is associated with average additional costs of USD 15,593 per pregnant woman of which consists mostly of complications for the mother (USD 11,794) and neonatal complications in the macrosomic child (USD 3799). The translation of costs per case-pregnancy and delivery only- to a system's level has an annual budget impact of more than USD 1.8 billion in the US alone.[126] Another study from the US also shows the costs of diabetes resulting in additional USD 4,560 when compared to pregnancies without diabetes, which represents an increase of 30 %.[124]

### Prevention and management of pregnancy complications

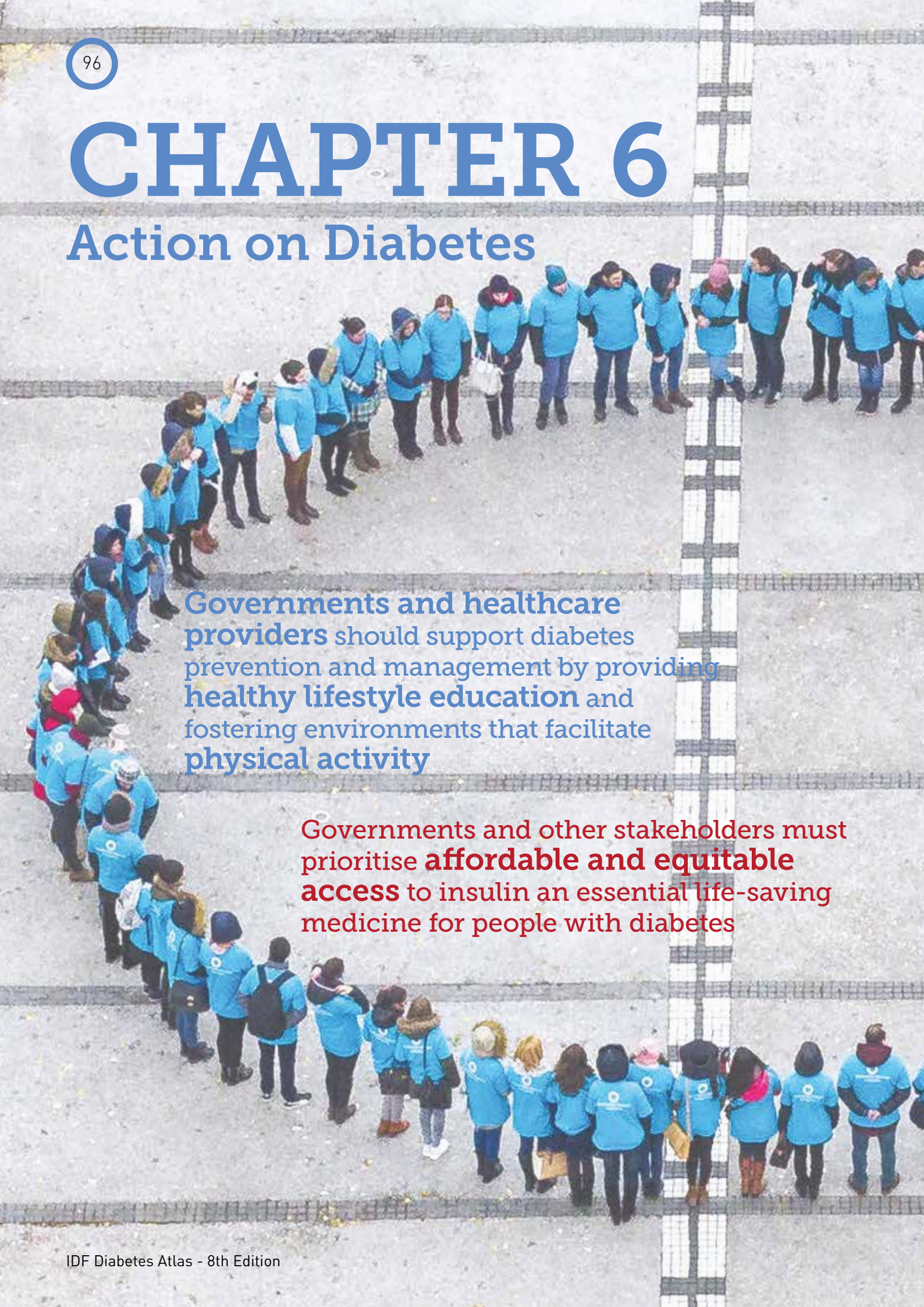
It is important for women with diabetes in pregnancy or gestational diabetes (GDM) to carefully control and monitor their blood glucose levels to reduce the risk of adverse pregnancy outcomes with the assistance of the healthcare provider. Medical nutrition therapy with 33 % to 40 % intake of carbohydrate with a preference for complex carbohydrate and regular physical activity helps better manage glucose levels and achieve optimal weight during pregnancy, based on the maternal body mass index (BMI).[127-130]

The oral glucose tolerance test (OGTT) is typically used for the diagnosis and monitoring of hyperglycaemia in pregnancy.[131] It measures the body's ability to use glucose. Special testing and monitoring of the baby may include foetal movement counting, ultrasound to view internal organs or to detect macrosomia or disproportional foetal growth, nonstress testing to measure the baby's heart rate in response to movements, biophysical profile to check foetal movements, heart rate, and amniotic fluid, and Doppler flow studies to measure blood flow. In the collaboration between the mother and healthcare team, the timing and mode of delivery should be determined based on gestational age, glucose control, and estimated foetal weight.[131]

Hyperglycaemia in pregnancy is associated with additional costs of **USD 16,000** per pregnant woman

# CHAPTER 6

## Action on Diabetes



**Governments and healthcare providers** should support diabetes prevention and management by providing **healthy lifestyle education** and fostering environments that facilitate **physical activity**

Governments and other stakeholders must prioritise **affordable and equitable access** to insulin an essential life-saving medicine for people with diabetes

IDF education and prevention initiatives aim to supports the development of health professionals so they are equipped to deliver **high-quality, diabetes care** and promote specific models of care to achieves **optimal management** of all types of diabetes

There are **cost-effective and evidence-based** solutions to reverse the global type 2 diabetes epidemic

Diabetes is not only a health issue - it causes are multi-dimensional, so **multisectoral response** is required

### The International Diabetes Federation

The International Diabetes Federation (IDF) is an umbrella organisation of over 230 national diabetes associations in more than 165 countries and territories. It represents the interests of the growing number of people with diabetes or those at risk, and has been leading the global diabetes community since 1950.

The mission of IDF is to promote diabetes care, prevention and a cure worldwide. Its activities aim to influence policy, increase public awareness and encourage improvements in health.

In addition, IDF promotes the knowledge sharing of high-quality information about diabetes and the prevention of type 2 diabetes, and provides resources to support education for people with or at risk of diabetes and their healthcare providers.

IDF is the legitimate voice of the global diabetes community. Through its global initiatives and activities, the Federation aims to be the leading, authoritative global voice for people with diabetes and those at risk. IDF is in partnernship with the World Health Organization (WHO).

## IDF global presence

The world is awakening to the diabetes epidemic and the urgent need for action to mitigate it. Over the last few years, IDF has made significant progress in pushing for heightened political commitment regarding noncommunicable diseases (NCDs). The 2011 UN High-Level Summit on NCDs built global determination to stem the tide of diabetes and related NCDs. The Summit was followed by the 2013 WHO voluntary targets on NCDs, which were unanimously adopted by UN Member States, including the target on 0% increase in diabetes and obesity prevalence by 2025. The Sustainable Development Goals (SDGs), adopted by the UN in September 2015, aim to achieve, through national commitments, a reduction in premature mortality from NCDs by one-third to ensure access to quality essential healthcare services and to provide safe, effective, quality and affordable essential medicines for all by 2030. IDF is building on this momentum.

With its Members and partners, IDF also continues to implement the three priority objectives set out in the IDF Global Diabetes Plan 2011-2021:

1. To improve health outcomes for people with diabetes.
2. To prevent the development of type 2 diabetes.
3. To prevent discrimination against people with diabetes.

IDF's attention has now turned to 2018. This will be a key year for people with diabetes when the Third UN High Level Review on NCDs (planned for September 2018) will determine the required future actions needed to achieve the 2025 targets. The 2018 High Level Review will assess the progress achieved towards the global NCD targets and the implementation of the four time-bound commitments agreed at the 2014 UN High Level Review on NCDs. In preparation for this, IDF will work with its network of partners and stakeholders to explore strategies and solutions to ensure commitments are held and objectives met by the 2025/2030 milestones.

# Recommendations

In the context of an overall integrated approach to NCDs and in line with the Global Diabetes Plan 2011-2021, a series of actions can be taken to reduce the impact of diabetes locally, regionally and globally, as established in this *IDF Diabetes Atlas* 8th edition:

1. **Promote high-quality research on diabetes epidemiology.**
   Accurate diabetes estimates depend on availability and quality of up-to-date diabetes studies. IDF recommends strengthening national screening surveys and regular surveillance systems to all countries.

2. **Prioritization of diabetes care and control.**
   Scaling-up action for diabetes prevention and management requires high-level national and international political commitment, resources and effective governance and advocacy. To improve accessibility and outcomes of diabetes prevention and care, IDF recommends building the capacity of primary care professionals (PCPs) and strengthening interdisciplinary collaboration through training, mentoring, technical support, clinical leadership, policy and protocols.

3. **Implement National Plans and Strategies to reduce diabetes burden.**
   National Diabetes Programmes are a tried and tested strategy for mounting an effective and coherent approach to improving outcomes of diabetes prevention and care. IDF recommends a universal approach to improving public health services as an investment in the long-term health and well-being of the population, which is both of intrinsic value as well as a major component of economic productivity.

4. **Extend health promotion to reduce diabetes and its complications.**
   Unhealthy lifestyle including overweight or obesity, insufficient physical activity, smoking and unhealthy dietary practices increase the occurrence of type 2 diabetes, related complications and other NCDs. IDF encourages using research evidence strategically and adopting an ethical and effective whole-of-society approach in public-private partnership to promote the intake of healthy diet and physical activity through education and local adaptations of comprehensive lifestyle programmes.

# IDF in action

## Advocating for action at high-level political meetings

Through coordinated advocacy at the global level and at the national level in collaboration with our Member Associations, IDF is working to make change for the millions of people living with diabetes. IDF produces diverse advocacy tools and resources to empower diabetes advocates. In 2016 and 2017, IDF increased social media campaigns as an advocacy opportunity during major international meetings to urge global leaders to act on diabetes.

In 2016, IDF prepared tailored country messages for the G7 and G20 Leaders' Summits focused on the need to improve access to diabetes medicines and supplies and on the cost-effectiveness of type 2 diabetes prevention. These briefings were handed to G20 countries high-level officers during the 69th World Health Assembly, requesting that diabetes be prioritised in the international agenda.

In 2017, IDF conducted a communications campaign during the BRICS summit to promote policy recommendations to improve access to diabetes care in Brazil, Russia, India, China and South Africa. These were developed together with the IDF Members in those countries along with IDFs Blue Circle Voices (BCV) network.

## Young Leaders in Diabetes – young minds, fresh ideas, real change

The IDF Young Leaders in Diabetes (YLD) programme aims to enhance the lives of young people living with diabetes and create leaders within the diabetes community. It is open to people with diabetes between the ages of 18 to 30. The programme is committed to raising awareness of diabetes by being a powerful voice for prevention, education, access to quality care, improved quality of life and ultimately ending diabetes discrimination.

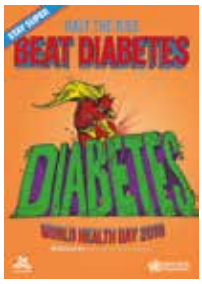
More information: **https://www.idf.org/our-network/young-leaders/meet-the-young-leaders**

## Blue Circle Voices – representing the global voice of diabetes

Blue Circle Voices (BCV) is an IDF initiative that aims to represent the interests of people of all ages living with or affected by diabetes, through a worldwide network of members and other stakeholders. The BCV network draws upon the experiences of people with diabetes and acts as their global voice.

Consulting with BCVs will help foster better understanding of the issues and challenges that people with diabetes encounter in our world today to inform the strategies necessary to meet the varying needs of people with diabetes worldwide. The network will also strengthen IDFs presence in global forums and bring both better awareness and credibility to diabetes prevention, care, access and rights issues.

More information: **https://www.idf.org/our-network/blue-circle-voices.html**




### World Health Day 2016: Beat diabetes

World Health Day is a WHO-led awareness campaign that each 7 April focuses on a different health-related topic. As both a result of the successful collaboration between IDF and WHO and the need for global attention on the diabetes health crisis,

World Health Day 2016 focused on diabetes with the theme "Beat diabetes". IDF joined forces with WHO in making World Health Day 2016 a great success for the global diabetes community.

# Uniting the global diabetes community

### IDF Congress

The IDF Congress is one of the world's largest health-related congresses for the dissemination and promotion of leading scientific advances and knowledge on practical aspects related to diabetes research, care, education and advocacy. The event targets health professionals and congress participants include physicians, scientists, nurses and educators.

More information: **www.idf.org/congress**

### World Diabetes Day (WDD)

World Diabetes Day (WDD) is celebrated every year on November 14. It was established in 1991 by IDF and WHO in response to growing concerns about the escalating health threat posed by diabetes. World Diabetes Day became an official United Nations Day in 2006.

WDD is the world's largest diabetes awareness campaign, reaching a global audience of over one billion people in 165 countries. The campaign draws attention to issues of paramount importance to the diabetes world and keeps diabetes firmly in the public and political spotlight.

In 2015, World Diabetes Day became a year-long campaign to reflect the realities of people living with diabetes. The campaign focused on healthy eating as one of the key factors in managing type 1 diabetes and preventing type 2 diabetes. The theme of World Diabetes Day 2016 was "Eyes on Diabetes". The 2017 theme is "Women and diabetes: our right to a healthy future."

More information: **www.worlddiabetesday.org**

# IDF training materials

The increasing global prevalence of chronic diseases is placing enormous and growing demands and responsibilities on health systems. Healthcare professionals play a critical role in improving access to and the quality of healthcare for people with diabetes. Preparing the worldwide healthcare workforce to respond to the associated challenges is a crucial objective for IDF.

## IDF School of Diabetes

IDF School of Diabetes courses were launched in 2017 with a vision to deliver high standard, evidence-based diabetes education for health professionals, people with diabetes and caregivers worldwide.

The IDF School is a one-stop portal giving access to the best in-class information on recent advances in diabetes prevention, management and care. Features of the IDF School include online certificate courses, discussion forums, opinion polls and lecture videos on diabetes, expert opinions, and daily news updates. IDF certified courses include curricula for diabetes educators, primary care physicians/general practitioners and specialists. More information: **www.idfdiabeteschool.org**

## Diabetes Education Network for Health Professionals (D-NET)

The Diabetes Education Network for Health Professionals (D-NET) is the first international forum for health professionals aimed at enhancing diabetes education and management. The online platform offers diabetes professionals worldwide the opportunity to connect with and share, learn and discuss the latest developments in diabetes care and education.

D-NET was launched by IDF in 2010. Since then, D-NET has grown into an online network of more than 11,000 members. D-NET provides its members with regular discussions led by international experts, an interactive library and a global event calendar.
More information: **https://d-net.idf.org/en/**

## Kids and Diabetes in Schools (KiDS)

The Kids and Diabetes in Schools (KiDS) project is designed to support the rights of children with diabetes, to ensure school days are happy days by encouraging healthy behaviour among school-aged children and reducing discrimination. It was co-designed by IDF and the International Society for Paediatric and Adolescent Diabetes (ISPAD).

KiDS is an educational programme designed for school staff, school students and parents. The KiDS information pack is available in nine languages (Arabic, Chinese, English, French, Greek, Hindi, Portuguese, Russian, and Spanish) from the IDF website. An app in eight languages is also available for tablet computers. Currently, more than 33 countries are engaged with the KiDS project. More information:
**https://kids.idf.org/**

# IDF Guidelines and protocols – setting the global standard for care

Guidelines are an essential component of achieving quality care for all people with diabetes. Guideline recommendations define standards for care and use evidence-based interventions to achieve those standards in order to guide health professionals, people affected by diabetes, policy-makers and administrators.

IDF guidelines and position statements have been prepared to assist countries, organisations and individuals who wish to develop their own national and regional guidelines, and to draw on the experience of experts in each of the IDF Regions.

These documents are available at: **http://www.idf.org/**


## IDF Clinical Practice Recommendations for Managing Type 2 Diabetes in Primary Care 2017

The IDF Guidelines Task Force assessed how surveyed primary care physicians (PCPs) responded to the most common questions that address daily care of people with type 2 diabetes. After identifying common ground in terms of type 2 diabetes diagnosis, management, goal-setting and different levels of prevention, their work resulted in IDF Clinical Practice Recommendations for Managing Type 2 Diabetes in Primary Care. Approximately 78 practical and applicable recommendations are offered for PCPs and their healthcare teams covering all the fields of diabetes management.

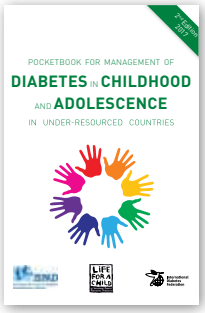
More information: **https://www.idf.org/e-library/guidelines/128-idf-clinical-practice-recommendations-for-managing-type-2-diabetes-in-primary-care.html**


## IDF Clinical Practice Recommendations on the Diabetic Foot 2017

The IDF Clinical Practice Recommendations on the Diabetic Foot are simplified, easy to understand guidelines for the healthcare practitioner to prioritize early intervention of the diabetic foot with a sense of urgency through education. The main aims of the guidelines are to promote early detection and intervention; provide the criteria for time-adequate referral to second or third level centres; and serve as a tool to educate people with diabetes about the importance of prevention of this pathology.

An abbreviated version of these guidelines, "Diabetes Foot Screening Pocket Chart", has also been produced for PCPs, nurses, registered dietitians and nutritionists, and other health professionals.

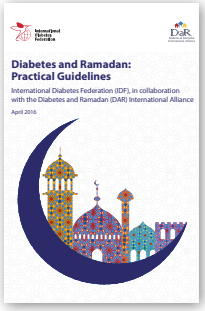
More information: **www.idf.org/our-activities/care-prevention/diabetic-foot.html**




## Pocketbook for Management of Diabetes in Childhood and Adolescence in Under-resourced Countries, 2nd edition, 2017

The IDF Life for a Child Programme and ISPAD developed a shortened version of these guidelines aimed to be of practical use in emergency situations and in clinics that are developing expertise in managing diabetes in children. The Pocketbook for Management of Diabetes in Childhood and Adolescence in Under-resourced Countries provides basic background on diabetes in children and clear advice for initial management of diabetic ketoacidosis, initiation of maintenance insulin therapy, complications screening and other key components of care.

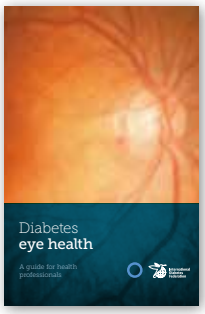
More information: **https://www.idf.org/e-library/guidelines/89-pocketbook-for-management-of-diabetes-in-childhood-and-adolescence-in-under-resourced-countries-2nd-edition.html**




## Diabetes and Ramadan: Practical Guidelines 2016

Ensuring the optimal care of the many people with diabetes who fast during Ramadan is crucial. IDF and the Diabetes and Ramadan (DAR) International Alliance have come together to deliver comprehensive guidance on this subject. The IDF-DAR Practical Guidelines provide healthcare professionals with relevant background information and practical recommendations to enable them to help people with diabetes participate in fasting during Ramadan while minimising the risk of complications.

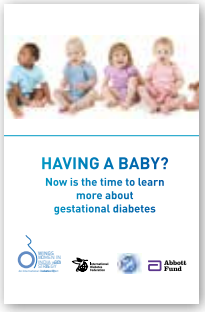
More information: **www.idf.org/e-library/guidelines/87-diabetes-and-ramadan-practical-25.html**




## Diabetes Eye Health: A Guide for Health Professionals 2016

The Diabetes Eye Health guide was developed by IDF and the Fred Hollows Foundation, and builds upon the ICO Guidelines for Diabetic Eye Care. The guide encourages and facilitates good diabetes management, early diagnosis and treatment of diabetic eye disease, and encourages integration and cooperation across the health system. The primary audience for this document is the broad suite of health professionals who work with people with diabetes.

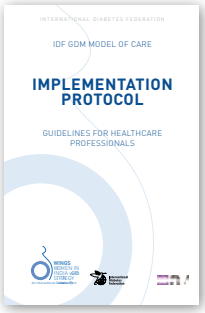
More information: **https://www.idf.org/e-library/guidelines/76-diabetes-eye-health-a-guide-for-health-professionals-en.html**




## Having a Baby? Now is the Time to Learn More about Gestational Diabetes 2015

This brochure is an educational manual with advice for the pregnant woman on having a healthy baby.

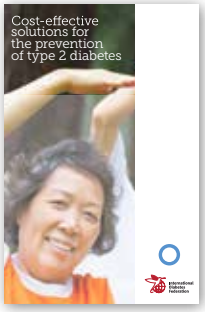
More information: **https://www.idf.org/e-library/guidelines/97-having-a-baby-now-is-the-time-to-learn-more-about-gestational-diabetes.html**




## IDF GDM Model of Care 2015

The IDF GDM Model of Care is an implementation protocol written for healthcare professionals. It was piloted in seven (urban and rural) collaborating health centres in Tamil Nadu State (South India), from June 2012 to December 2015. The IDF GDM Model Approach to Care has been developed using best practice of care and established clinical guidelines.

More information: **https://www.idf.org/e-library/guidelines/77-idf-gdm-model-of-care-implementation-protocol-guidelines-for-healthcare-professionals.html**




## Cost-effective Solutions for Diabetes Prevention

The Cost-effective Solutions for Diabetes Prevention report provides policy makers and diabetes advocates with an accessible and comprehensive summary of current data on the clinical effects of primary prevention programmes, the costs associated with their delivery, and the resulting benefits for society. Evidence on actionable solutions is also included to inform policy development.

More information: **https://www.idf.org/our-activities/care-prevention/prevention.html**


## TEST2PREVENT

IDF developed an online type 2 diabetes risk assessment, which aims to predict an individual's risk of developing type 2 diabetes within ten years. The test is based on the Finnish Diabetes Risk Score (FINDRISC) developed and designed by the National Institute for Health and Welfare, Helsinki, Finland.

The risk assessment is available at: **http://www.idf.org/type-2-diabetes-risk-assessment**


## BRIDGES 2

BRIDGES (Bringing Research in Diabetes to Global Environments and Systems) was developed by IDF to provide strategies and solutions to support translational research efforts worldwide. IDF BRIDGES 2 will fund and replicate a selection of projects from BRIDGES with emphasis on the secondary prevention of diabetes and a strong involvement of local public health authorities. The aim is to translate evidence-based approaches from the first round of BRIDGES to other contexts and countries to improve the lives of people living with diabetes.

More information: **https://www.idf.org/our-activities/epidemiology-research/bridges.html**

# IDF Humanitarian response

Access to essential medicines and technologies during humanitarian crisis appears to be the main obstacle to diabetes management, especially in low and middle income countries. In many countries, lack of access to affordable insulin and care remains in emergency situation a key impediment to successful treatment and results in complications, morbidity and early death. IDF works with governments and non-governmental organizations to improve the situation.

## IDF Life for a Child

IDF Life for a Child was set up in 2000 to provide sufficient insulin and syringes, blood glucose monitoring equipment, appropriate clinical care and diabetes education for children living with diabetes, together with technical support for health professionals. Life for a Child currently helps over 18,000 children and young people living with diabetes in 42 countries.

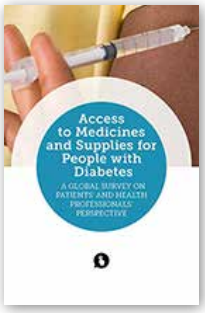
The focus of Life for a Child extends beyond keeping children and young adults alive by improving clinical outcomes and quality of life. A wide range of initiatives have been developed in patient and family education, health professional training, mentoring and relevant clinical research.

More information: **www.lifeforachild.org**

# Improving access to medicine

One of the six building blocks of the health system strengthening framework is to ensure equitable access to essential medicines of assured quality, safety, efficacy and cost-effectiveness, and that they are utilised in a scientifically sound and cost-effective way.[1]

Scaling up access to insulin and other diabetes medicines is critical to global efforts to ameliorate the burden of diabetes such as the objectives and voluntary global targets set forward in the Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013-2020 and also in achieving the Sustainable Development Goals. Governments, in collaboration with the private sector, should take leadership in including efficient procurement and distribution of medicines in countries, establishment or the provision of viable financing options, generic promotion policies and the development and use of evidence based guidelines for the treatment of diabetes. The selection of medicines not included on WHO EML and National EMLs should be rationalised. Improved procurement and distribution practices are also critically needed.




## Global Survey on Access to Medicines and Supplies for People with Diabetes

The IDF Access to Medicines and Supplies for People with Diabetes report (2017) is first effort to analyse the patient and health professionals' perspective on main barriers on access to insulin and diabetes medicine. The report introduces diabetes and related medicines; and provides an assessment of availability, accessibility and pricing of medicines and supplies from around the world. The report found that, the various types of insulins were always available at the service delivery point between 81%-84% of high income countries, while only 10-13% in low income countries.

Diabetes medication, such as metformin and sylfonurea had availability varying between 84-88% of high income countries and between 11-20% in low income countries. The availability of supplies varied between 71-81% in high income countries to 10-14% in low income countries. It was concluded that country-level initiatives and international initiatives can improve health systems and complement the governmental efforts to implement high-impact, affordable interventions to provide access to insulin and diabetes medicine and supplies.

The Access to Medicines and Supplies for People with Diabetes is calling for all parties in the public and private sector to come together and develop sustainable strategies to reduce price of medicine, improve education, improve evidence, improve availability, invest in health systems and health insurance schemes.

More information: **www.idf.org/accesstomedicine**

**Table 6.1 Number of countries with availability of insulin, diabetes drugs and supplies, in access survey by countries' income group**

| | High income countries | Middle income countries | Low income countries |
|---|---|---|---|
| Short-acting insulin | 81% | 46% | 0% |
| Intermediate acting insulin | 84% | 44% | 10% |
| Rapid-acting insulin | 84% | 29% | 13% |
| Long-acting insulin | 81% | 35% | 0% |
| Glucagon | 71% | 38% | 14% |
| Metformin | 88% | 64% | 20% |
| Sylfonurea | 84% | 53% | 11% |
| DPP4 inhibitor | 86% | 27% | 25% |
| GLP1 analogue | 77% | 17% | 33% |
| SGLT2 inhibitor | 83% | 22% | 17% |
| Moglitinide | 88% | 22% | 17% |
| Alpha glucosidase inhibitor | 85% | 20% | 14% |
| Syringes and needles | 81% | 50% | 13% |
| Insulin pens | 81% | 36% | 13% |
| Blood glucose meters and test strips | 78% | 44% | 10% |

# APPENDIX

# Country summary table

## Africa

| Country/territory | Adults with diabetes (20-79) in 1,000s [Confidence interval] | Diabetes (20-79) national prevalence (%) [Confidence interval] | Diabetes age-adjusted (20-79) comparative prevalence (%) [Confidence interval] |
|---|---|---|---|
| WORLD | 424,877.1 [346,391.7-545,447.8] | 8.8 [7.2-11.3] | 8.7 [6.6-12.1] |
| AFRICA | 15,503.0 [9,821.3-27,843.9] | 3.3 [2.1-6.0] | 4.4 [2.9-7.8] |
| Angola | 350.8 [213.8-549.1] | 3.1 [1.9-4.9] | 3.9 [2.4-6.0] |
| Benin | 41.0 [28.8-148.1] | 0.7 [0.5-2.7] | 1.0 [0.6-3.3] |
| Botswana | 52.5 [31.5-86.0] | 3.8 [2.3-6.2] | 4.8 [2.9-7.6] |
| Burkina Faso | 152.4 [106.0-323.9] | 1.8 [1.2-3.8] | 2.4 [1.9-5.9] |
| Burundi | 132.9 [99.7-250.5] | 2.4 [1.8-4.6] | 6.0 [4.6-9.5] |
| Cameroon | 680.3[567.3-834.0] | 5.9 [4.9-7.2] | 7.2 [6.0-8.8] |
| Cape Verde | 6.3 [4.9-15.9] | 1.9 [1.5-5.0] | 2.4 [1.8-5.5] |
| Central African Republic | 120.2 [100.1-147.5] | 4.7 [3.9-5.8] | 6.1 [5.1-7.5] |
| Chad | 235.3 [195.9-288.6] | 3.8 [3.2-4.7] | 6.1 [5.1-7.5] |
| Comoros | 31.2 [21.7-47.1] | 7.6 [5.3-11.6] | 11.9 [8.0-18.1] |
| Democratic Republic of the Congo | 1,706.7 [1,424.4-2,089.6] | 4.8 [4.0-5.8] | 6.1 [5.1-7.5] |
| Republic of Congo | 148.9 [124.5-182.0] | 6.5 [5.4-8.0] | 7.2 [6.0-8.8] |
| Côte d'Ivoire | 217.3 [162.7-513.8] | 2.0 [1.4-4.6] | 2.4 [1.8-5.5] |
| Djibouti | 39.5[30.3-58.2] | 7.5 [5.8-11.1] | 6.0 [4.6-9.5] |
| Equatorial Guinea | 31.8 [26.8-38.4] | 7.0 [5.9-8.5] | 7.8 [6.5-9.5] |
| Eritrea | 83.5 [62.9-144.9] | 3.2 [2.4-5.6] | 6.0 [4.6-9.5] |
| Ethiopia | 2,567.9 [1,094.0-3,795.4] | 5.2 [2.2-07.7] | 7.5 [4.1-11.3] |
| Gabon | 66.0 [54.9-81.0] | 7.0 [5.8-8.6] | 7.2 [6.0-8.8] |
| Gambia | 14.4 [14.0-44.7] | 1.6 [1.5-4.9] | 1.9 [1.9-6.1] |
| Ghana | 518.4 [140.5-830.3] | 3.6 [1.0-5.7] | 5.0 [1.3-7.3] |
| Guinea | 122.2 [88.6-271.4] | 2.0 [1.4-4.4] | 2.4 [1.9-5.9] |
| Guinea-Bissau | 18.4 [14.3-44.8] | 2.0 [1.5-4.8] | 2.4 [1.9-5.9] |
| Kenya | 458.9 [163.6-1,631.1] | 2.0 [0.7-7.0] | 2.9 [1.0-11.0] |
| Lesotho | 30.3 [18.0-50.9] | 2.7 [1.6-4.5] | 3.9 [2.4-6.0] |

**Quality of data sources**

No data  Low  High and Medium

| Adults with Undiagnosed diabetes (20-79) in 1,000s [Confidence interval] | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, USD) | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, ID) | Diabetes related deaths (20-79 years) [Confidence interval] | Number of children with type 1diabetes (0-19 years) in 1,000s |
|---|---|---|---|---|
| **224,242.9 [182,378.7 - 291,876.4]** | **1,316.36** | **1,733.23** | **3,990,420.6 [321,708-5,031,522]** | **1,106.2** |
| 10,724.78 [6,777.91-18,954.94] | 222.57 | 454.35 | 298,160.5 [196,089.8-533,916.7] | 50 600 |
| 174.3 [106.2-272.8] | 377 | 502 | 5,961.1 [3,663.3-9,070.5] | 0.13 |
| 31.3 [21.9-113.0] | 78 | 176 | 676.4 [440.9-2,249.5] | 0.78 |
| 26.1 [15.6-42.8] | 653 | 1,476 | 1,250.9 [756.0-2,279.2] | 0.09 |
| 116.3 [80.9-247.3] | 74 | 173 | 3,326.6 [2,315.7-7,148.6] | 1.54 |
| 101.4 [76.1-191.2] | 44 | 119 | 2,822.3 [2,139.3-5,221.3] | 0.48 |
| 338.1 [281.9-414.5] | 110 | 230 | 15,757.9 [13,313.4-19,020.6] | 2.00 |
| 3.1 [2.4-7.9] | 299 | 535 | 55.7 [42.9-156.8] | 0.07 |
| 91.7 [76.4-112.6] | 29 | 46 | 3,281.3 [2,775.6-3,950.0] | 0.08 |
| 179.6 [149.6-220.3] | 77 | 164 | 5,792.1 [4,881.9-7,008.8] | 0.32 |
| 16.0 [11.1-24.2] | 100 | 178 | 339.7 [226.1-505.4] | 0.03 |
| 1,302.9 [1,087.4-1,595.2] | 178 | 376 | 28,550.0 [23,703.7-35,157.1] | 0.89 |
| 74.0 [61.9-90.5] | 38 | 65 | 2,706.4 [2,288.3-3,269.6] | 1.51 |
| 107.99 [80.8-255.3] | 315 | 558 | 4,962.0 [3,763.7-11,471.1] | 0.26 |
| 19.6 [15.1-28.9] | 1,190 | 2,087 | 541.6 [417.4-765.5] | 0.04 |
| 15.79 [13.3-19.1] | 50 | 101 | 536.5 [457.6-640.1] | 0.10 |
| 63.7 [48.0-110.6] | 49 | 134 | 1,283.1 [971.8-2,241.7] | 2.28 |
| 1,960.3 [835.1-2,897.4] | 551 | 1,028 | 30,972.2 [14,754.9-50,476.6] | 0.28 |
| 32.7 [27.3-40.3] | 64 | 247 | 919.0 [758.0-1,145.2] | 0.28 |
| 11.0 [10.7-34.1] | 107 | 268 | 189.4 [184.6-637.6] | 3.74 |
| 257.6 [69.8-412.6] | 61 | 138 | 9,778.5 [2,378.6-14,925.5] | 0.91 |
| 93.28 [67.6-207.2] | 73 | 179 | 2,004.0 [1,446.4-4,476.6] | 0.14 |
| 14.0 [10.9-34.2] | 154 | 334 | 360.9 [276.6-893.6] | 2.47 |
| 165.2 [58.9-587.2] | 198 | 521 | 7,864.7 [2,950.0-26,999.7] | 0.03 |
| 15.0 [9.0-25.3] | 92 | 196 | 1,394.2 [853.0-2,182.5] | 0.50 |

# Africa

| Country/territory | Adults with diabetes (20-79) in 1,000s [Confidence interval] | Diabetes (20-79) national prevalence (%) [Confidence interval] | Diabetes age-adjusted (20-79) comparative prevalence (%) [Confidence interval] |
|---|---|---|---|
| Liberia | 44.1 [34.2-105.9] | 2.0 [1.5-4.7] | 2.4 [1.9-5.9] |
| Madagascar | 372.8 [249.6-601.8] | 3.0 [2.1-5.0] | 3.9 [2.7-6.1] |
| Malawi | 195.7 [123.9-343.0] | 2.4 [1.5-4.3] | 3.9 [2.7-6.1] |
| Mali | 143.4 [105.4-327.6] | 1.8 [1.4-4.2] | 2.4 [1.9-5.9] |
| Mauritania | 42.9 [32.8-103.6] | 2.0 [1.5-4.9] | 2.4 [1.8-5.5] |
| Mozambique | 292.7 [199.3-513.7] | 2.3 [1.6-4.0] | 3.3 [2.3-5.5] |
| Namibia | 45.5 [27.9-70.4] | 3.4 [2.1-5.2] | 3.9 [2.4-6.0] |
| Niger | 167.8 [110.9-318.3] | 2.0 [1.3-3.8] | 2.4 [1.9-5.9] |
| Nigeria | 1,702.9 [1,239.5-3,875.8] | 2.0 [1.4-4.4] | 2.4 [1.8-5.5] |
| Réunion | 109.7 [82.8-127.5] | 18.8 [14.2-21.8] | 13.8 [10.2-16.2] |
| Rwanda | 203.3 [123.1-321.3] | 3.4 [2.1-5.4] | 4.3 [2.8-7.4] |
| Sao Tome and Principe | 1.8 [1.4-4.4] | 1.9 [1.5-4.7] | 2.4 [1.8-5.5] |
| Senegal | 135.6 [96.2-304.4] | 1.9 [1.3-4.2] | 2.4 [1.8-5.5] |
| Seychelles | 7.5 [5.8-10.2] | 11.3 [8.7-15.4] | 10.6 [7.9-14.5] |
| Sierra Leone | 59.9 [44.1-135.2] | 1.9 [1.4-4.3] | 2.4 [1.9-5.9] |
| Somalia | 216.3 [164.0-349.8] | 4.5 [3.4-7.3] | 6.0 [4.6-9.5] |
| South Africa | 1,826.1 [1,071.3-3,638.5] | 5.4 [3.2-10.8] | 5.5 [3.2-10.6] |
| South Sudan | 431.4 [324.7-562.0] | 7.0 [5.3-9.1] | 10.4 [7.9-13.4] |
| Swaziland | 17.0 [10.2-29.3] | 2.5 [1.5-4.3] | 3.9 [2.4-6.0] |
| United Republic of Tanzania | 897.0 [578.5-1,960.6] | 3.6 [2.3-7.8] | 5.8 [3.8-10.7] |
| Togo | 172.1 [50.7-270.2] | 4.7[1.4-7.4] | 6.2 [1.9-9.7] |
| Uganda | 259.1 [149.7-568.2] | 1.5 [0.9-3.3] | 2.5 [1.3-6.5] |
| Western Sahara | 9.6 [8.7-25.2] | 2.4 [2.2-6.3] | 2.4 [1.9-5.9] |
| Zambia | 222.0 [133.5-354.3] | 3.0 [1.8-4.8] | 3.9 [2.4-6.0] |
| Zimbabwe | 99.4 [64.6-455.2] | 1.3 [0.8-5.8] | 1.8 [1.3-7.6] |

**Quality of data sources**

No data  Low  High and Medium

| Adults with Undiagnosed diabetes (20-79) in 1,000s [Confidence interval] | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, USD) | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, ID) | Diabetes related deaths (20-79 years) [Confidence interval] | Number of children with type 1diabetes (0-19 years) in 1,000s |
|---|---|---|---|---|
| 33.6 [26.1-80.8] | 27 | 86 | 749.7 [576.6-1,857.2] | 1.84 |
| 284.6 [190.5-459.4] | 60 | 194 | 4,685.6 [3,063.2-7,424.9] | 0.80 |
| 149.4 [94.6-261.9] | 102 | 231 | 6,819.4 [4,440.5-11,156.1] | 0.77 |
| 109.5 [80.5-250.1] | 95 | 287 | 2,531.7 [1,836.8-5,971.0] | 0.33 |
| 21.3 [16.3-51.5] | 87 | 165 | 566.5 [430.6-1,425.9] | 0.80 |
| 253.7 [172.8-445.4] | 925 | 1,611 | 9,258.9 [6,523.5-15,103.1] | 0.12 |
| 22.6 [13.9-35.0] | 53 | 117 | 933.3 [574.9-1,385.9] | 2.75 |
| 128.1 [84.7-243.0] | 240 | 444 | 3,028.4 [1,991.1-5,832.6] | 7.50 |
| 846.2 [616.0-1,926.1] | 302 | 603 | 40,329.0 [29,479.6-91,715.5] | 0.24 |
| 38.95 [29.4-45.3] | - | - | - | 0.04 |
| 155.2 [94.0-245.3] | 102 | 242 | 3,876.9 [2,434.9-5,811.2] | 0.74 |
| 0.87 [0.7-2.2] | 331 | 599 | 19.6 [15.1-54.5] | 0.04 |
| 103.5 [73.4-232.4] | 100 | 217 | 1,856.3 [1,310.8-4,324.6] | 3.01 |
| 3.4 [2.6-4.7] | 669 | 1,143 | 67.5 [49.3-87.7] | 0.00 |
| 45.7 [33.7-103.2] | 174 | 452 | 1,652.9 [1,193.0-3,769.5] | 0.11 |
| 165.1 [125.2-267.1] | - | - | 3,957.3 [2,998.9-6,314.0] | 0.03 |
| 1,548.5 [908.4-3,085.5] | 935 | 1,884 | 42,621.4 [25,683.8-75,467.0] | 1.89 |
| 329.3 [247.9-429.1] | - | - | 6,434.4 [4,931.9-8,063.1] | 2.88 |
| 8.4 [5.1-14.6] | 475 | 1,124 | 970.2 [591.4-1,562.7] | 0.05 |
| 714.9 [461.1-1562.7] | 63 | 141 | 17,724.6 [11,333.2-35,366.0] | 0.81 |
| 158.3 [46.6-248.6] | 112 | 285 | 2,646.9 [864.6-4,154.4] | 2.73 |
| 197.8 [114.3-433.8] | 104 | 277 | 6,153.7 [3,719.8-13,288.5] | 2.47 |
| 7.3 [6.6-19.2] | - | - | - | 0.36 |
| 110.3 [66.3-176.1] | 179 | 406 | 7,192.4 [4,409.6-10,823.6] | 0.74 |
| 75.8 [49.3-347.5] | 117 | 233 | 2,757.3 [1,876.8-11,064.5] | 0.58 |

# Europe

| Country/territory | Adults with diabetes (20-79) in 1,000s [Confidence interval] | Diabetes (20-79) national prevalence (%) [Confidence interval] | Diabetes age-adjusted (20-79) comparative prevalence (%) [Confidence interval] |
|---|---|---|---|
| **EUROPE** | **57,968.03 [46,459.531 - 79,473.59]** | **8.8 [7 - 12]** | **6.8 [5.4 -9.9]** |
| Albania | 249.0 [217.1-282.1] | 12.0 [10.5-13.6] | 10.1 [8.7-11.5] |
| Andorra | 6.0 [5.2-7.8] | 11.8 [10.2-15.2] | 8.0 [6.8-10.8] |
| Armenia | 168.4 [114.9-269.8] | 7.6 [5.2-12.3] | 7.1 [4.9-11.1] |
| Austria | 592.0 [518.6-748.8] | 9.1 [8.0-11.5] | 6.4 [5.5-8.3] |
| Azerbaijan | 484.6 [330.7-758.7] | 7.0 [4.8-11.0] | 7.1 [4.9-11.1] |
| Belarus | 482.5 [412.2-1,010.8] | 6.8 [5.8-14.3] | 5.2 [4.4-13.4] |
| Belgium | 500.8 [444.4-656.9] | 6.1 [5.4-8.0] | 4.3 [3.6-5.7] |
| Bosnia and Herzegovina | 366.9 [321.6-413.7] | 12.5 [10.9-14.1] | 10.1 [8.7-11.5] |
| Bulgaria | 424.3 [340.3-559.4] | 7.9 [6.3-10.4] | 5.8 [4.6-8.3] |
| Channel Islands | 7.0 [6.3-9.1] | 5.6 [5.0-7.3] | 4.3 [3.8-5.9] |
| Croatia | 219.0 [165.6-452.1] | 7.0 [5.3-14.4] | 5.6 [4.3-10.7] |
| Cyprus | 93.2 [63.8-153.9] | 10.5 [7.2-17.4] | 9.2 [6.3-15.4] |
| Czech Republic | 767.8 [568.3-996.2] | 9.5 [7.1-12.4] | 6.8 [5.1-9.2] |
| Denmark | 386.7 [335.7-436.7] | 9.3 [8.0-10.5] | 6.4 [5.6-7.2] |
| Estonia | 55.3 [39.2-106.8] | 5.7 [4.1-11.1] | 4.0 [2.9-8.7] |
| Faroe Islands | 2.5 [2.0-3.0] | 7.1 [5.6-8.5] | 5.3 [4.1-6.6] |
| Finland | 370.3 [256.9-449.8] | 9.2 [6.4-11.1] | 5.8 [3.9-7.3] |
| France | 3,276.4 [2,725.6-4,004.8] | 7.3 [6.0-8.9] | 4.8 [3.9-6.2] |
| Georgia | 232.6 [163.5-368.6] | 8.1 [5.7-12.8] | 7.1 [4.9-11.1] |
| Germany | 7,476.8 [6,066.4-8,281.2] | 12.2 [9.9-13.5] | 8.3 [6.6-9.3] |
| Greece | 578.3 [467.6-1,289.1] | 7.2 [5.8-16.0] | 4.5 [3.7-11.2] |
| Greenland | 0.9 [0.8-2.4] | 2.5 [2.2-6.9] | 2.2 [1.9-5.6] |
| Hungary | 706.8 [540.5-1,241.9] | 9.5 [7.3-16.7] | 7.5 [5.9-14.1] |
| Iceland | 18.0 [12.5-22.2] | 7.7 [5.4-9.5] | 5.3 [4.1-6.6] |
| Ireland | 141.5 [111.1-196.5] | 4.3 [3.4-6.0] | 3.3 [2.5-4.8] |
| Israel | 415.8 [333.6-696.4] | 8.1 [6.5-13.6] | 6.7 [5.3-11.2] |
| Italy | 3,402.3 [3,084.9-3,964.1] | 7.6 [6.9-8.9] | 4.8 [4.3-5.8] |

**Quality of data sources** No data Low High and Medium

| Adults with Undiagnosed diabetes (20-79) in 1,000s [Confidence interval] | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, USD) | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, ID) | Diabetes related deaths (20-79 years) [Confidence interval] | Number of children with type 1diabetes (0-19 years) in 1,000s |
|---|---|---|---|---|
| 21,952.81 [17,585.36-30,301.16] | 2,870.52 | 3,130.95 | 477,715.0 [379,632.2-628,359.3] | 286,000 |
| 101.2 [88.2-114.6] | 355 | 801 | 2,458.3 [2,209.5-2,709.7] | 0.41 |
| 2.2 [1.9-2.8] | 4,159 | 4,743 | 32.5 [28.5-39.5] | 0.02 |
| 68.4 [46.7-109.6] | 214 | 480 | 2,012.4 [1,465.4-3,347.3] | 0.13 |
| 211.7 [185.4-267.7] | 6,554 | 5,918 | 2,860.8 [2,550.7-3,444.7] | 0.47 |
| 196.9 [134.4-308.3] | 697 | 1,549 | 4,877.4 [3,561.6-7,809.7] | 2.59 |
| 196.1 [167.5-410.7] | 593 | 1,357 | 7,540.2 [6,484.1-11,515.2] | 2.02 |
| 179.1 [158.9-234.9] | 6,150 | 5,530 | 2,805.8 [2,531.1-3,586.5] | 1.22 |
| 149.1 [130.7-168.1] | 554 | 1,144 | 3,690.8 [3,341.4-4,047.3] | 3.73 |
| 137.8 [110.6-181.7] | 798 | 1,687 | 5,982.3 [5,008.9-7,289.2] | 0.50 |
| 2.5 [2.2-3.2] | - | - | - | 1.13 |
| 92.0 [69.6-189.9] | 1,266 | 1,992 | 1,628.3 [1,240.2-3,243.3] | 0.08 |
| 34.1 [23.4-56.3] | 2,192 | 2,485 | 394.7 [285.8-576.7] | 1.29 |
| 274.5 [203.2-356.2] | 1,627 | 2,533 | 5,626.8 [4,243.8-7,045.7] | 0.35 |
| 253.6 [220.2-286.5] | 7,769 | 5,748 | 2,209.9 [1,943.5-2,464.3] | 3.91 |
| 19.8 [14.0-38.2] | 1,573 | 2,102 | 544.4 [378.7-940.7] | 2.64 |
| 0.9 [0.7-1.1] | - | - | - | 0.50 |
| 224.4 [155.6-272.5] | 5,379 | 4,316 | 2,062.5 [1,483.5-2,410.1] | 0.03 |
| 1,228.3 [1,021.8-1,501.3] | 6,124 | 5,567 | 18,305.0 [15,543.7-21,718.0] | 7.29 |
| 94.5 [66.4-149.8] | 386 | 800 | 2,764.3 [2,020.1-4,427.7] | 17.89 |
| 2,555.4 [2,073.4-2,830.4] | 5,891 | 5,642 | 40,198.3 [33,727.5-43,743.5] | 0.45 |
| 206.7 [167.2-460.9] | 2,056 | 2,475 | 3,068.6 [2,527.6-5,732.1] | 28.58 |
| 0.3 [0.3-0.9] | - | - | - | 2.06 |
| 117.8 [90.1-207.0] | 1,224 | 2,157 | 8,584.4 [63,65.7-12,682.5] | 3.17 |
| 6.4 [4.5-7.9] | 6,130 | 5,105 | 70.2 [51.4-82.3] | 0.13 |
| 50.6 [39.7-70.2] | 5,975 | 5,358 | 703.8 [581.0-887.3] | 3.43 |
| 148.7 [119.3-249.0] | 4,162 | 3,717 | 1,887.7 [1,544.0-2,828.0] | 4.54 |
| 1,216.4 [1,102.9-1,417.3] | 3,701 | 3,679 | 14,549.4 [13,330.1-16,463.3] | 11.58 |

# Europe

| Country/territory | Adults with diabetes (20-79) in 1,000s [Confidence interval] | Diabetes (20-79) national prevalence (%) [Confidence interval] | Diabetes age-adjusted (20-79) comparative prevalence (%) [Confidence interval] |
|---|---|---|---|
| Kazakhstan | 818.2 [563.3-1,289.3] | 7.0 [4.8-11.0] | 7.1 [4.9-11.1] |
| Kyrgyzstan | 220.8 [155.2-330.4] | 6.1 [4.3-9.2] | 7.1 [4.9-11.1] |
| Latvia | 102.0 [82.4-127.9] | 7.0 [5.6-8.7] | 4.9 [3.8-6.4] |
| Liechtenstein | 2.8 [2.4-3.1] | 10.2 [8.6-11.0] | 7.8 [6.5-8.4] |
| Lithuania | 108.7 [95.9-156.9] | 5.2 [4.5-7.4] | 3.7 [3.2-5.4] |
| Luxembourg | 24.6 [16.7-42.7] | 5.7 [3.9 -9.9] | 4.4 [3.0-8.1] |
| Macedonia | 188.8 [164.6-213.8] | 12.2 [10.6-13.8] | 10.1 [8.7-11.5] |
| Malta | 42.3 [24.2-52.1] | 13.2 [7.6-16.3] | 8.8 [4.8-11.4] |
| Moldova | 190.0 [157.6-262.7] | 6.1 [5.1-8.5] | 5.7 [4.7-7.9] |
| Monaco | 2.2 [1.8-2.6] | 7.9 [6.6-9.4] | 5.5 [4.6-6.6] |
| Montenegro | 57.9 [50.4-65.5] | 12.8 [11.2-14.5] | 10.1 [8.7-11.5] |
| Netherlands | 969.8 [729.3-1,293.6] | 7.8 [5.8-10.4] | 5.3 [3.2-8.3] |
| Norway | 298.0 [214.0-364.4] | 7.8 [5.6-9.5] | 5.3 [4.1-6.6] |
| Poland | 2,235.8 [1,648.2-6,308.5] | 7.6 [5.6-21.6] | 5.9 [4.2-22.0] |
| Portugal | 1,065.0 [784.5-1,320.5] | 13.9 [10.2-17.2] | 9.8 [6.9-13.2] |
| Romania | 1,785.3 [1,147.6-2,225.3] | 12.4 [8.0-15.5] | 9.7 [6.0-12.4] |
| Russian Federation | 8,455.3 [,6699.7-1,1016.0] | 7.9 [6.3-10.3] | 6.2 [5.2-8.5] |
| San Marino | 2.1 [1.8-2.4] | 8.7 [7.5-10.0] | 5.6 [4.8-6.7] |
| Serbia | 858.9 [751.2-969.4] | 13.3 [11.6-15.0] | 10.1 [8.7-11.5] |
| Slovakia | 405.8 [254.5- 475.3] | 9.7 [6.1-11.4] | 7.3 [4.7-8.8] |
| Slovenia | 161.6 [108.5-208.1] | 10.4 [7.0-13.4] | 7.3 [5.2-9.6] |
| Spain | 3,584.5 [2,821.7-5,012.0] | 10.4 [8.2-14.6] | 7.2 [5.7-10.4] |
| Sweden | 499.3 [426.7-655.3] | 7.0 [6.0-9.1] | 4.8 [4.1-6.6] |
| Switzerland | 469.4 [463.5-686.4] | 7.4 [7.3-10.8] | 5.6 [5.5-8.0] |
| Tajikistan | 267.5 [188.4-391.4] | 5.5 [3.9-8.1] | 7.1 [4.9-11.1] |
| Turkey | 6,694.4 [6,002.3-7,963.1] | 12.8 [11.5-15.2] | 12.1 [10.8-14.6] |
| Turkmenistan | 210.5 [142.0-330.4] | 6.1 [4.1-9.6] | 7.1 [4.9-11.1] |
| Ukraine | 2,836.3 [1,932.2-4,732.4] | 8.4 [5.7-14.0] | 7.1 [4.9-11.1] |
| United Kingdom | 2,747.7 [2,461.2-3,585.1] | 5.9 [5.2-7.6] | 4.3 [3.8-5.9] |
| Uzbekistan | 1,236.4 [718.5-2,004.3] | 6.5 [3.8-10.5] | 7.6 [4.6-12.5] |

**Quality of data sources** No data Low High and Medium

| Adults with Undiagnosed diabetes (20-79) in 1,000s [Confidence interval] | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, USD) | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, ID) | Diabetes related deaths (20-79 years) [Confidence interval] | Number of children with type 1diabetes (0-19 years) in 1,000s |
|---|---|---|---|---|
| 332.5 [228.9-523.9] | 833 | 1,651 | 10,471.0 [7,576.6-16,230.4] | 1.76 |
| 89.7 [63.1-134.3] | 139 | 366 | 2,482.9 [1,855.3-3,649.8] | 0.67 |
| 36.5 [29.4-45.7] | 1,135 | 1,159 | 1,050.6 [882.4-1,275.5] | 0.27 |
| 1.0 [0.9-1.1] | - | - | 11.6 [10.0-12.3] | 0.01 |
| 38.9 [34.3-56.1] | 1,350 | 2,181 | 1,275.4 [1,134.3-1,807.2] | 0.73 |
| 8.8 [6.0-15.3] | 10,680 | 8,941 | 117.9 [80.5-181.4] | 0.21 |
| 76.7 [66.9-86.9] | 452 | 1,088 | 1,963.8 [1,770.5-2,153.3] | 0.26 |
| 15.1 [8.6-18.6] | 2,778 | 3,454 | 197.3 [123.3-228.3] | 0.17 |
| 77.2 [64.0-106.8] | 318 | 715 | 2,337.3 [2,020.9-3,376.5] | 0.59 |
| 0.8 [0.7-0.9] | 9,635 | 8,634 | 11.4 [9.9-13.2] | 0.01 |
| 23.5 [20.5-26.6] | - | - | 657.3 [592.0-721.3] | 0.26 |
| 346.7 [260.7-462.5] | 7,039 | 6,430 | 4,771.3 [3,774.4-5,718.4] | 6.70 |
| 106.5 [76.5-130.3] | 12,033 | 8,020 | 1,349.3 [1,009.7-1,576.2] | 3.67 |
| 1,008.1 [743.2-2,844.5] | 1,154 | 1,990 | 18,096.5 [13,670.8-30,755.5] | 14.54 |
| 464.2 [342.0-575.6] | 2,230 | 2,861 | 5,788.0 [4,342.7-6,737.9] | 2.20 |
| 369.6 [237.5-460.6] | 649 | 1,259 | 20,585.2 [14,380.0-24,644.8] | 2.62 |
| 4,540.5 [3,597.7-5,915.6] | 1,176 | 2,417 | 115,985.4 [87,700.2-147,916.0] | 43.08 |
| 0.7 [0.6-0.9] | 3,991 | 3,912 | 9.2 [8.1-10.2] | 0.01 |
| 349.0 [305.3-393.9] | 761 | 1,577 | 10,045.0 [9,062.4-11,010.9] | 2.04 |
| 98.5 [61.8-115.4] | 1,836 | 2,750 | 3,828.0 [2,429.2-4,274.7] | 1.40 |
| 57.8 [38.8-74.4] | 2,520 | 3,147 | 945.6 [651.4-1,168.5] | 0.55 |
| 1,017.6 [801.1-1,422.9] | 3,045 | 3,397 | 15,557.2 [12,458.7-20,449.0] | 15.77 |
| 178.5 [152.5-234.3] | 8,356 | 6,406 | 2,221.4 [1,911.4-2,728.0] | 9.06 |
| 167.8 [165.7-245.4] | 11,825 | 7,907 | 1,754.0 [1,741.5-2,534.8] | 2.06 |
| 108.7 [76.6-159.1] | 140 | 340 | 2,614.3 [2,009.8-3,701.1] | 0.91 |
| 2,558.8 [2,294.2-3,043.7] | 814 | 1,486 | 46,270.3 [42,316.6-53,110.4] | 25.67 |
| 85.6 [57.7-134.2] | 307 | 526 | 2,952.5 [2,121.4-4,495.7] | 0.39 |
| 1,152.6 [785.2-1,923.1] | 249 | 718 | 41,504.8 [29,371.6-70,208.2] | 7.47 |
| 508.3 [455.3-663.2] | 4,989 | 4,281 | 14,592.6 [13,234.1-17,817.1] | 40.34 |
| 362.8 [210.8-588.1] | 202 | 552 | 13,409.2 [8,935.0-20,818.3] | 2.55 |

# Middle East and North Africa

| Country/territory | Adults with diabetes (20-79) in 1,000s [Confidence interval] | Diabetes (20-79) national prevalence (%) [Confidence interval] | Diabetes age-adjusted (20-79) comparative prevalence (%) [Confidence interval] |
|---|---|---|---|
| MENA | 38,671.4 [27,139.0 - 51,371.0] | 9.6% (6.7 - 12.7%) | 10.8% ( 7.5 - 14.2%) |
| Afghanistan | 1,032.6 [830.8-1,450.3] | 6.7 [5.4-9.4] | 9.6 [7.5-14.2] |
| Algeria | 1,782.3 [1,250.5-2,452.0] | 6.9 [4.9-9.5] | 6.7 [4.7-9.2] |
| Bahrain | 165.3 [151.8-182.3] | 16.2 [14.8-17.8] | 16.5 [15.1-18.1] |
| Egypt | 8,222.6 [4,409.2-9,389.4] | 15.1 [8.1-17.2] | 17.3 [9.5-19.8] |
| Islamic Republic of Iran | 4,985.5 [3,885.4-6,587.6] | 8.9 [7.0-11.8] | 9.6 [7.5-12.4] |
| Iraq | 1,411.5 [1,004.2-1,887.0] | 7.5 [5.4-10.1] | 8.8 [6.5-11.6] |
| Jordan | 408.1 [335.9-682.8] | 9.5 [7.8-15.9] | 11.8 [8.7-16.7] |
| Kuwait | 441.0 [389.6-508.1] | 15.1 [13.3-17.4] | 15.8 [13.9-18.4] |
| Lebanon | 585.4 [475.8-718.7] | 14.6 [11.9-18.0] | 12.7 [10.3-15.5] |
| Libya | 442.5 [333.0-578.1] | 11.2 [8.4-14.6] | 10.4 [7.9-13.4] |
| Morocco | 1,641.9 [1,299.7-2,609.0] | 7.3 [5.8-11.6] | 7.1 [5.7-11.3] |
| State of Palestine | 168.8 [109.1-347.4] | 7.0 [4.5-14.4] | 10.6 [7.2-19.0] |
| Oman | 367.7 [259.8-449.3] | 10.7 [7.5-13.0] | 12.6 [9.3-15.3] |
| Pakistan | 7,474.0 [5,276.8-10,854.3] | 6.9 [4.9-10.1] | 8.3 [5.9-12.0] |
| Qatar | 259.2 [239.1-287.7] | 14.1 [13.0-15.6] | 16.5 [15.1-18.1] |
| Saudi Arabia | 3,852.0 [3,108.4-4,316.2] | 18.5 [15.0-20.8] | 17.7 [14.5-19.8] |
| Sudan | 2,247.0 [1,151.7-3,656.7] | 10.9 [5.6-17.7] | 15.7 [7.8-22.8] |
| Syrian Arab Republic | 705.7 [557.3-945.1] | 7.1 [5.6-9.5] | 8.2 [6.5-10.8] |
| Tunisia | 762.2 [605.8-1,129.6] | 9.8 [7.8-14.5] | 8.5 [6.7-13.1] |
| United Arab Emirates | 1,185.5 [1,055.0-1,377.9] | 15.6 [13.9-18.1] | 17.3 [14.9-20.1] |
| Yemen | 530.5 [410.2-961.4] | 3.8 [3.0-6.9] | 5.4 [4.2-9.7] |

**Quality of data sources**

No data  Low  High and Medium

| Adults with Undiagnosed diabetes (20-79) in 1,000s [Confidence interval] | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, USD) | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, ID) | Diabetes related deaths (20-79 years) [Confidence interval] | Number of children with type 1diabetes (0-19 years) in 1,000s |
|---|---|---|---|---|
| 18,963.4 [13,143.3-25,263.7] | 552.31 | 1291.10 | 318,036.1 [221,259.3-417,154.1] | 175,800 |
| 718.7 [578.2-1,009.4] | 112 | 330 | 19,147.2 [15,554.2-25,750.2] | 1.18 |
| 1,171.9 [822.2-1,612.2] | 562 | 1,448 | 12,525.8 [7,759.0-16,260.1] | 42.55 |
| 62.9 [57.8-69.4] | 1,770 | 3237 | 559.8 [521.3-607.7] | 0.10 |
| 4,367.0 [2,341.7-4,986.7] | 268 | 897 | 71,292.9 [41,123.1-79,789.0] | 14.18 |
| 1,748.5 [1,362.7-2,310.4] | 544 | 1,242 | 32,414.7 [24,104.2-41,568.1] | 7.18 |
| 664.1 [472.5-887.8] | 533 | 1,643 | 15,641.0 [10,939.0-20,891.7] | 9.01 |
| 156.3 [128.7-261.6] | 619 | 1,376 | 2,838.0 [2,383.8-4,325.7] | 1.08 |
| 74.1 [65.5-85.4] | 1,960 | 3,281 | 1,218.9 [1,098.0-1,363.7] | 5.50 |
| 251.4 [204.4-308.7] | 774 | 1,343 | 5,529.9 [4,802.9-6,373.5] | 0.51 |
| 190.1 [143.0-248.3] | 579 | 1,255 | 3,120.8 [2,471.4-3,822.9] | 1.87 |
| 705.2 [558.2-1,120.6] | 295 | 692 | 9,977.1 [8,041.4-14,944.5] | 31.84 |
| 42.3 [27.4-87.2] | - | - | - | 0.35 |
| 161.0 [113.8-196.8] | 1,035 | 2,211 | 1,204.8 [902.7-1,424.1] | 1.87 |
| 4,594.3 [3,243.6-6,672.2] | 62 | 223 | 79,354.0 [57,306.7-112,612.2] | 0.59 |
| 98.7 [91.0-109.5] | 3,062 | 4,464 | 513.3 [481.7-561.3] | 34.98 |
| 1,516.5 [1,223.7-1,699.2] | 1,661 | 3,571 | 14,664.5 [12,431.7-15,966.5] | 0.78 |
| 965.2 [494.7-1,570.6] | 225 | 488 | 27,614.6 [15,153.2-40,817.9] | 13.77 |
| 303.1 [239.4-405.9] | 122 | 690 | 7,051.9 [5,580.4-9,154.3] | 2.38 |
| 571.6 [454.3-847.2] | 444 | 1143 | 5,303.4 [4,249.6-7,180.1] | 2.41 |
| 482.5 [429.4-560.8] | 2,269 | 3,389 | 2,159.6 [1,951.2-2,436.0] | 0.43 |
| 118.0 [91.3-213.9] | 156 | 396 | 5,903.8 [4,403.7-11,304.6] | 3.21 |

# North America and Caribbean

| Country/territory | Adults with diabetes (20-79) in 1,000s [Confidence interval] | Diabetes (20-79) national prevalence (%) [Confidence interval] | Diabetes age-adjusted (20-79) comparative prevalence (%) [Confidence interval] |
|---|---|---|---|
| NAC | 45,917.89 [38,167.84 - 51,265.18] | 13 [10.8 - 14.5] | 11 [9.2 - 12.5] |
| Anguilla | 1.3 [1.0-1.5] | 13.3 [10.8-16.0] | 12.6 [10.3-15.3] |
| Antigua and Barbuda | 8.5 [7.8-9.7] | 13.6 [12.5-15.6] | 13.2 [12.0-15.3] |
| Aruba | 11.3 [9.4-14.0] | 14.7 [12.3-18.3] | 11.6 [9.6-15.1] |
| Bahamas | 37.9 [34.2-44.1] | 13.5 [12.2-15.8] | 13.2 [12.0-15.3] |
| Barbados | 35.6 [31.7-41.3] | 17.6 [15.6-20.4] | 13.6 [12.0-16.2] |
| Belize | 31.5 [27.5-36.4] | 14.7 [12.8-16.9] | 17.1 [14.9-19.6] |
| Bermuda | 6.6 [5.7-7.8] | 15.2 [13.0-17.8] | 13.0 [10.9-15.6] |
| British Virgin Islands | 2.8 [2.1-3.8] | 14.0 [10.3-18.5] | 13.7 [10.0-18.0] |
| Canada | 2,603.2 [2,486.8-3,611.6] | 9.6 [9.2-13.3] | 7.4 [7.0-10.8] |
| Cayman Islands | 5.4 [4.9-6.4] | 13.6 [12.2-15.9] | 13.2 [11.9-15.5] |
| Curaçao | 18.7 [14.8-22.3] | 12.7 [10.5-15.8] | 11.6 [9.6-15.1] |
| Dominica | 6.0 [5.0-7.5] | 9.5 [7.5-12.7] | 11.6 [9.8-15.1] |
| Grenada | 6.5 [5.1-8.7] | 16.7 [13.6-19.8] | 10.7 [8.5-14.2] |
| Guadeloupe | 53.5 [43.5-63.4] | 11.3 [9.7-15.2] | 11.6 [9.8-15.1] |
| Guyana | 52.4 [44.9-70.3] | 5.7 [3.8-9.4] | 11.6 [9.8-15.1] |
| Haiti | 351.4 [233.5-576.7] | 11.4 [9.2-14.4] | 6.6 [4.5-10.5] |
| Jamaica | 209.3 [169.1-264.9] | 18.2 [14.2-21.5] | 11.3 [9.2-14.4] |
| Martinique | 51.3 [40.0-60.5] | 14.8 [7.4-17.6] | 11.6 [9.6-15.1] |
| Mexico | 12,030.1 [6,007.8-14,347.1] | 13.6 [9.9-18.6] | 13.1 [7.3-16.1] |
| Montserrat | 0.5 [0.4-0.5] | 11.3 [9.7-15.3] | 13.2 [12.0-15.3] |
| Sint Maarten | 3.6 [3.2-4.1] | 11.6 [9.8-15.1] | 13.2 [11.9-15.5] |
| St Kitts and Nevis | 5.0 [3.6-6.9] | 13.0 [8.9-25.9] | 12.8 [9.2-17.9] |
| St Lucia | 14.2 [12.2-19.2] | 12.0 [9.9-16.1] | 11.6 [9.8-15.1] |
| St Vincent and the Grenadines | 8.4 [7.1-11.0] | 13.0 [12.4-13.7] | 11.6 [9.8-15.1] |
| Suriname | 45.7 [31.2-91.1] | 16.5 [13.8-19.2] | 12.5 [8.5-25.2] |
| Trinidad and Tobago | 117.4 [96.6-157.2] | 13.6 [12.2-15.9] | 11 [9.0-15.0] |
| United States of America | 30,187.5 [28,828.5-31,762.8] | 16.4 [12.9-19.5] | 10.8 [10.3-11.4] |
| US Virgin Islands | 12.3 [10.3-14.3] | 13.9 [12.7-15.8] | 12.3 [10.2-14.4] |

**Quality of data sources** No data Low High and Medium

| Adults with Undiagnosed diabetes (20-79) in 1,000s [Confidence interval] | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, USD) | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, ID) | Diabetes related deaths (20-79 years) [Confidence interval] | Number of children with type 1diabetes (0-19 years) in 1,000s |
|---|---|---|---|---|
| 17,284.7 [14,361.1-19,270.2] | 8,246.94 | 8,366.81 | 285,926.5 [241,247.1-315,186.3] | 216,300 |
| 0.5 [0.4-0.5] | - | - | - | 0.00 |
| 2.6 [2.4-3.0] | 1,086 | 1,696 | 72.4 [67.3-79.8] | 0.01 |
| 3.4 [2.9-4.3] | - | - | - | 0.00 |
| 11.5 [10.4-13.4] | 2,320 | 2,453 | 319.7 [294.8-357.8] | 0.11 |
| 9.3 [8.3-10.8] | 1,364 | 1,207 | 294.4 [266.4-327.2] | 0.03 |
| 13.0 [11.3-15.0] | 443 | 778 | 318.5 [281.6-356.7] | 0.09 |
| 2.0 [1.7-2.4] | - | - | - | 0.00 |
| 0.9 [0.6-1.1] | - | - | - | 0.01 |
| 793.6 [758.1-1,101.0] | 6,519 | 5,718 | 11,303.3 [10,878.0-14,447.9] | 18.93 |
| 1.7 [1.5-1.9] | - | - | - | 0.00 |
| 5.7 [4.5-6.8] | 571 | 822 | - | 0.00 |
| 2.1 [1.8-2.7] | 767 | 1,104 | 63.9 [53.4-73.6] | 0.01 |
| 2.3 [1.8-3.1] | - | - | 102.6 [82.4-130.9] | 0.02 |
| 18.9 [15.4-22.4] | 356 | 609 | - | 0.08 |
| 18.5 [15.9-24.9] | 109 | 231 | 885.8 [772.0-1,089.3] | 0.00 |
| 217.9 [144.8-357.6] | 379 | 677 | 5,561.2 [3,910.9-8,322.3] | 0.11 |
| 51.2 [41.3-64.8] | - | - | 2,129.7 [1,738.3-2,531.7] | 0.16 |
| 15.6 [12.2-18.4] | 957 | 1,586 | - | 0.04 |
| 4,504.1 [2,249.3-5,371.6] | - | - | 85,931.8 [50,630.4-100,455.2] | 26.60 |
| 0.1 [0.1-0.2] | 1,068 | 1,597 | - | 0.00 |
| 1.1 [1.0-1.3] | 703 | 983 | - | 0.01 |
| 1.5 [1.1-2.1] | 834 | 1,329 | 60.9 [45.6-79.5] | 0.01 |
| 5.0 [4.3-6.8] | 842 | 1,399 | 145.8 [126.6-174.7] | 0.03 |
| 3.0 [2.5-3.9] | 1,536 | 2,455 | 117.0 [99.7-139.2] | 0.02 |
| 16.1 [11.0-32.2] | 11,638 | 11,638 | 544.2 [407.6-808.7] | 0.00 |
| 35.8 [29.5-47.9] | 1,580 | 2,524 | 1,334.8 [1,125.1-1,728.6] | 0.17 |
| 11,543.8 [11,024.1-12,146.2] | 12,135 | 12,135 | 176,740.5 [170,467.1-184,083.2] | 169.86 |
| 3.4 [2.9-4.0] | - | - | - | 0.04 |

# South and Central America

| Country/territory | Adults with diabetes (20-79) in 1,000s [Confidence interval] | Diabetes (20-79) national prevalence (%) [Confidence interval] | Diabetes age-adjusted (20-79) comparative prevalence (%) [Confidence interval] |
|---|---|---|---|
| SACA | 26,044.6 [21,692.0 - 31,885.2] | 8% [6.7 - 9.8 %] | 7.6 [6.3-9.5] |
| Argentina | 1,757.5 [1,234.0-2,512.0] | 6.2 [4.3-8.8] | 5.5 [4.0-8.2] |
| Bolivia | 391.0 [321.0-604.2] | 6.2 [5.1-9.6] | 6.9 [5.6-10.4] |
| Brazil | 12,465.8 [11,439.3-13,471.4] | 8.7 [8.0-9.4] | 8.1 [7.4-8.8] |
| Chile | 1,199.8 [1,020.2-1,478.6] | 9.3 [7.9-11.5] | 8.5 [7.2-10.5] |
| Colombia | 2,671.4 [1,873.0-3,627.6] | 8.1 [5.7-11.1] | 7.4 [5.1-10.6] |
| Costa Rica | 319.1 [279.4-370.7] | 9.5 [8.3-11.0] | 8.8 [7.7-10.2] |
| Cuba | 897.6 [827.3-967.4] | 10.6 [9.8-11.4] | 8.3 [7.6-9.1] |
| Dominican Republic | 520.8 [330.8-712.5] | 8.1 [5.1-11.0] | 8.2 [5.3-11.2] |
| Ecuador | 554.5 [351.1-861.3] | 5.5 [3.5-8.5] | 5.6 [3.6-8.9] |
| El Salvador | 332.7 [290.9-428.0] | 8.7 [7.6-11.2] | 8.9 [7.8-11.4] |
| French Guiana | 13.1 [12.0-14.1] | 8.1 [7.5-8.8] | 8.3 [7.6-9.1] |
| Guatemala | 752.7 [492.6-1,120.0] | 8.4 [5.5-12.6] | 10.2 [6.8-14.9] |
| Honduras | 285.8 [200.2-472.4] | 6.0 [4.2-9.9] | 7.2 [5.0-11.8] |
| Nicaragua | 373.4 [245.6-510.8] | 10.0 [6.6-13.7] | 11.5 [7.5-15.7] |
| Panama | 215.9 [175.2-267.3] | 8.5 [6.9-10.5] | 8.3 [6.8-10.3] |
| Paraguay | 298.0 [271.5-327.1] | 7.4 [6.7-8.1] | 8.3 [7.6-9.1] |
| Peru | 1,130.8 [846.6-1,663.9] | 5.6 [4.2-8.3] | 5.9 [4.3-9.1] |
| Puerto Rico | 400.6 [334.1-477.6] | 15.4 [12.9-18.4] | 12.9 [10.7-15.5] |
| Uruguay | 152.8 [128.2-193.2] | 6.6 [5.5-8.3] | 6.9 [5.9-8.6] |
| Venezuela | 1,311.4 [1,018.9-1,805.1] | 6.6 [5.1-9.1] | 6.5 [5.0-9.0] |

**Quality of data sources**

No data  Low  High and Medium

| Adults with Undiagnosed diabetes (20-79) in 1,000s [Confidence interval] | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, USD) | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, ID) | Diabetes related deaths (20-79 years) [Confidence interval] | Number of children with type 1diabetes (0-19 years) in 1,000s |
|---|---|---|---|---|
| 10,416.9 [8,776.8-12,571.4] | 1,144.09 | 1,748.15 | 209,717.8 [176,057.6-251,217.2] | 118,600 |
| 629.8 [442.2-900.2] | 907 | 1,704 | 15,545.5 [10281.6-21,795.3] | 8.88 |
| 108.6 [89.2-167.9] | 348 | 713 | 4,403.9 [3,622.7-6287.1] | 0.18 |
| 5,734.3 [5,262.1-6,196.9] | 1,406 | 1,956 | 108,587.4 [100,323.2-116,927.6] | 88.30 |
| 258.1 [219.4-318.0] | 1,555 | 2,392 | 7,103.1 [6,219.3-8,317.3] | 5.70 |
| 957.3 [671.2-1299.9] | 854 | 1,443 | 17,037.9 [12,259.3-22,379.5] | 1.74 |
| 114.4 [100.1-132.8] | 1,390 | 1991 | 1,711.9 [1,536.8-1,922.8] | 0.16 |
| 321.7 [296.5-346.7] | 1,027 | 3,113 | 7,060.7 [6,554.9-7,547.9] | 0.47 |
| 186.6 [118.6-255.3] | 434 | 936 | 6,541.3 [4,153.0-8,704.7] | 0.20 |
| 198.7 [125.8-308.7] | 931 | 1,672 | 3,907.3 [2,367.8-6,102.6] | 0.74 |
| 119.2 [104.3-153.4] | 423 | 854 | 2,926.6 [2,559.1-3,678.4] | 1.19 |
| 4.7 [4.3-5.0] | - | - | - | 0.00 |
| 269.7 [176.5-401.4] | 399 | 810 | 7,709.2 [5,129.1-10,655.6] | 4.66 |
| 102.4 [71.7-169.3] | 363 | 683 | 1,818.2 [1,259.9-2,914.4] | 1.85 |
| 133.8 [88.0-183.0] | 273 | 684 | 2,925.2 [1,970.9-3,871.3] | 1.39 |
| 77.4 [62.8-95.8] | 1,467 | 2,566 | 1,318.3 [1,076.7-1,609.8] | 0.17 |
| 106.8 [97.3-117.2] | 778 | 1,462 | 2,654.1 [2,455.1-2,860.3] | 0.21 |
| 452.3 [338.6-665.5] | 566 | 1,035 | 7,129.5 [5,331.4-10,556.8] | 0.50 |
| 124.0 [103.4-147.8] | - | - | - | 1.30 |
| 47.3 [39.7-59.8] | 1,962 | 2,438 | 1,095.8 [915.7-1,378.5] | 0.76 |
| 469.9 [365.1-646.8] | 1418 | 1498 | 10,241.8 [8,041.3-13,707.4] | 0.16 |

# South East Asia

| Country/territory | Adults with diabetes (20-79) in 1,000s [Confidence interval] | Diabetes (20-79) national prevalence (%) [Confidence interval] | Diabetes age-adjusted (20-79) comparative prevalence (%) [Confidence interval] |
|---|---|---|---|
| SEA | 82,014.4 [62,553.207-103,207.03] | 8.5% (6.5 - 10.7%) | 10.1% ( 7.9 - 12.8%) |
| Bangladesh | 6,926.3 [5,628.9-9,513.4] | 6.9 [5.6-9.5] | 8.4 [6.8-11.6] |
| Bhutan | 40.21 [35.5-47.4] | 7.9 [7.0-9.3] | 9.8 [8.6-11.3] |
| India | 72,946.4 [55,473.0-90,198.1] | 8.8 [6.7-10.9] | 10.4 [8.0-12.9] |
| Maldives | 18.4 [16.3-43.5] | 7.7 [6.8-18.2] | 9.2 [8.1-22.1] |
| Mauritius | 227.8 [91.8-262.8] | 24.6 [9.9-28.4] | 22.0 [9.1-25.7] |
| Nepal | 657.2 [455.0-1,324.8] | 4.0 [2.7-8.0] | 7.3 [5.5-11.5] |
| Sri Lanka | 1,198.1 [852.7-1,817.1] | 8.6 [6.1-13.0] | 10.7 [8.1-15.2] |

**Quality of data sources** No data Low High and Medium

# Western Pacific

| Country/territory | Adults with diabetes (20-79) in 1,000s [Confidence interval] | Diabetes (20-79) national prevalence (%) [Confidence interval] | Diabetes age-adjusted (20-79) comparative prevalence (%) [Confidence interval] |
|---|---|---|---|
| Western Pacific | 158757.82 [140558.6-200401.8] | 9.5 [8.4 - 12] | 8.6 (7.6 - 11] |
| Australia | 1,133.0 [878.4-1,361.2] | 6.5 [5.0-7.8] | 5.1 [4.0-6.1] |
| Brunei Darussalam | 41.1 [34.8-50.0] | 13.8 [11.7-16.8] | 12.8 [10.9-15.3] |
| Cambodia | 246.2 [236.2-269.6] | 2.6 [2.5-2.9] | 4.0 [3.8-4.4] |
| China | 114,394.8 [104,108.8-146,293.2] | 10.9 [9.9-14.0] | 9.7 [8.8-12.5] |
| Hong Kong China | 636.0 [561.4-742.2] | 6.2 [9.7-12.8] | 8.3 [7.3-9.9] |
| Macau China | 45.0 [39.8-53.0] | 9.3 [8.2-10.9] | 8.3 [7.3-9.9] |
| Cook Islands | 1.5 [1.1-2.4] | 11.8 [8.6-18.8] | 12.0 [9.1-17.9] |
| Fiji | 81.7 [62.0-167.3] | 14.5 [11.0-29.7] | 14.5 [10.8-29.0] |
| French Polynesia | 45.4 [38.0-53.1] | 22.9 [19.2-26.8] | 22.6 [19.0-26.4] |
| Guam | 26.1 [22.0-31.7] | 23.1 [19.5-28.0] | 21.5 [17.8-26.9] |
| Indonesia | 10,276.1 [8,884.3-11,109.2] | 6.7 [5.3-6.7] | 6.3 [5.5-6.8] |

**Quality of data sources** No data Low High and Medium

| Adults with Undiagnosed diabetes (20-79) in 1,000s [Confidence interval] | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, USD) | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, ID) | Diabetes related deaths (20-79 years) [Confidence interval] | Number of children with type 1diabetes (0-19 years) in 1,000s |
|---|---|---|---|---|
| 47,202.7 [36,002.0-59,432.3] | 115.92 | 404.96 | 1,125,696.2 [864,450.2-1367,694.4] | 149300 |
| 3,878.7 [3,152.2-5,327.5] | 51 | 147 | 97,641.4 [80,804.8-123,773.2] | 17.06 |
| 21.8 [19.3-25.8] | 143 | 452 | 304.15 [276.2-340.1] | 0.04 |
| 42,210.3 [32,099.3-52,193.0] | 119 | 426 | 997,802.8 [763,170.6-1,198,284.3] | 128.53 |
| 10.0 [8.8-23.6] | 1,895 | 3,246 | 111.7 [102.4-234.2] | 0.05 |
| 121.1 [48.8-139.7] | 535 | 994 | 2,609.3 [1,285.6-2,907.4] | 0.04 |
| 532.1 [368.4-1,072.6] | 71 | 244 | 11,693.1 [8341.4-19,875.1] | 1.63 |
| 428.7 [305.1-650.2] | 185 | 536 | 15,533.8 [10,469.3-22,280.2] | 1.96 |

| Adults with Undiagnosed diabetes (20-79) in 1,000s [Confidence interval] | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, USD) | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, ID) | Diabetes related deaths (20-79 years) [Confidence interval] | Number of children with type 1diabetes (0-19 years) in 1,000s |
|---|---|---|---|---|
| 85,869.29 [76,145.39-105,026.7] | 775.14 | 1,153.20 | 1,275,168.4 [1,138,347.2 -1,517,994.3] | 110,000 |
| 403.8 [313.1-485.2] | 7,821 | 5,650 | 4,575.62 [3,581.2-5,394.3] | 13.21 |
| 19.9 [16.9-24.2] | 1,338 | 2,483 | 277.51 [249.6-314.8] | 0.01 |
| 154.3 [148.1-169.0] | 112 | 334 | 5,030.0 [4,847.6-5,600.0] | 0.39 |
| 61,294.0 [55,782.6-78,385.5] | 549 | 956 | 842,993.74 [775,488.8-1,006,504.3] | 46.96 |
| 409.8 [361.7-478.2] | - | - | - | 5.55 |
| 21.8 [19.3-25.7] | - | - | - | 0.00 |
| 0.7 [0.5-1.2] | 703 | 800 | 6.81 [5.2-10.3] | 1.90 |
| 43.5 [33.0-89.0] | 299 | 533 | 842.7 [645.6-1,369.6] | 0.01 |
| 22.0 [18.4-25.7] | - | - | - | 0.00 |
| 12.6 [10.7-15.4] | - | - | - | 0.28 |
| 7,571.4 [65,46.0-8,185.3] | - | - | 114,069.2 [101,084.8-122,868.3] | 4.44 |

# Western Pacific

| Country/territory | Adults with diabetes (20-79) in 1,000s [Confidence interval] | Diabetes (20-79) national prevalence (%) [Confidence interval] | Diabetes age-adjusted (20-79) comparative prevalence (%) [Confidence interval] |
|---|---|---|---|
| Japan | 7,234.2 [6,155.2-9,489.8] | 7.7 [6.6-10.1] | 5.7 [4.7-8.6] |
| Kiribati | 13.0 [6.4-17.9] | 20.4 [10.0-28.1] | 22.7 [11.2-31.1] |
| Democratic People's Republic of Korea | 842.0 [808.8-934.7] | 4.7 [4.5-5.2] | 4.0 [3.8-4.4] |
| Republic of Korea | 3,465.4 [2,631.3-4,349.9] | 8.8 [6.7-11.1] | 6.8 [5.3-8.7] |
| Lao People's Democratic Republic | 115.2 [110.5-126.2] | 3.0 [2.9-3.3] | 4.0 [3.8-4.4] |
| Malaysia | 3,492.6 [3,124.2-4,024.6] | 16.9 [15.1-19.4] | 16.7 [14.9-19.3] |
| Marshall Islands | 10.6 [7.2-14.0] | 32.9 [22.3-43.6] | 30.5 [19.0-40.4] |
| Federated States of Micronesia | 6.1 [4.6-8.8] | 10.6 [8.0-15.4] | 12.0 [9.3-19.1] |
| Mongolia | 97.8 [32.6-174.7] | 5.1 [1.7-9.0] | 4.8 [1.7-8.7] |
| Myanmar | 1,399.0 [1,047.5-2,192.5] | 4.0 [3.0-6.3] | 4.6 [3.4-7.5] |
| Nauru | 1.5 [1.1-1.9] | 24.0 [18.3-30.3] | 24.1 [18.2-30.5] |
| New Caledonia | 46.2 [36.4-56.5] | 24.9 [19.7-30.5] | 23.4 [19.2-27.9] |
| New Zealand | 326.1 [250.5-405.2] | 10.1 [7.8-12.6] | 8.1 [6.3-10.1] |
| Niue | 0.3 [0.2-0.3] | 26.2 [16.3-32.6] | 27.3 [16.6-34.2] |
| Palau | 2.4 [1.7-5.0] | 17.9 [13.1-38.1] | 15.9 [11.6-30.7] |
| Papua New Guinea | 639.8 [280.3-874.5] | 15.3 [6.7-21.0] | 17.7 [7.3-24.8] |
| Philippines | 3,721.9 [2,980.4-4,695.2] | 6.3 [4.9-7.8] | 7.1 [5.6-8.9] |
| Samoa | 7.4 [5.3-16.2] | 7.3 [5.3-16.1] | 9.2 [6.7-18.8] |
| Singapore | 606.0 [527.9-682.2] | 13.7 [12.0-15.5] | 11.0 [9.5-12.5] |
| Solomon Islands | 43.0 [23.8-63.4] | 14.2 [7.8-20.9] | 18.7 [9.4-27.2] |
| Taiwan | 1,958.0 [1,467.1-2,524.2] | 10.9 [8.1-14.0] | 8.8 [6.5-11.6] |
| Thailand | 4,208.6 [3,235.1-4,838.8] | 8.3 [6.4-9.5] | 7.0 [5.5-8.2] |
| Timor L'Este | 32.9 [28.7-37.4] | 5.8 [5.1-6.6] | 6.9 [6.0-7.8] |
| Tokelau | 0.2 [0.1-0.3] | 26.7 [14.6-33.9] | 27.0 [14.8-34.3] |
| Tonga | 7.3 [4.9-11.2] | 13.0 [8.8-20.1] | 15.4 [10.0-23.5] |
| Tuvalu | 1.8 [1.0-2.2] | 29.6 [17.5-37.1] | 27.3 [16.6-34.2] |
| Vanuatu | 16.2 [12.5-23.9] | 10.9 [8.4-16.0] | 12.0 [9.3-19.1] |
| Viet Nam | 3,535.7 [2,906.5-4,697.2] | 5.5 [4.5-7.2] | 6.0 [4.9-8.0] |

**Quality of data sources** No data Low High and Medium

| Adults with Undiagnosed diabetes (20-79) in 1,000s [Confidence interval] | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, USD) | Mean diabetes-related expenditure per person (20-79) with diabetes (R=2, ID) | Diabetes related deaths (20-79 years) [Confidence interval] | Number of children with type 1diabetes (0-19 years) in 1,000s |
|---|---|---|---|---|
| 3,368.6 [2,866.1-4,418.9] | 166 | 499 | 70,346.6 [62,089.0-80,978.1] | 0.00 |
| 7.0 [3.4-9.6] | 3,925 | 3,951 | 107.5 [63.4-134.3] | 0.14 |
| 674.0 [647.4-748.2] | 225 | 267 | 17,064.4 [16,492.9-19,665.2] | 0.00 |
| 1,319.8 [1,002.1-1,656.6] | 62 | 186 | 33,564.3 [25,016.3-39,515.6] | 2.55 |
| 61.5 [59.0-67.4] | - | - | 2,548.12 [2,456.6-2,819.9] | 0.03 |
| 1,766.8 [1,580.4-2,035.9] | 625 | 1427 | 22,321.2 [20,477.9-24,787.8] | 0.59 |
| 5.6 [3.8-7.5] | 750 | 815 | 161.19 [122.5-190.7] | 0.00 |
| 3.2 [2.4-4.7] | 308 | 892 | 58.1 [46.2-76.4] | 0.03 |
| 69.3 [23.1-123.8] | 35 | 180 | 1,244.90 [434.1-2,064.6] | 0.18 |
| 747.0 [559.3-1,170.7] | 683 | 677 | 34,205.3 [25,416.5-53,597.9] | 0.93 |
| 0.7 [0.5-0.9] | - | - | 15.36 [12.5-18.0] | 0.00 |
| 22.4 [17.7-27.4] | 6,090 | 4,998 | - | 0.01 |
| 83.8 [64.4-104.2] | - | - | 1,373.90 [1,079.3-1,657.1] | 1.97 |
| 0.1 [0.1-0.2] | 1,631 | 2,026 | 0.72 [0.5-0.9] | 0.00 |
| 1.3 [0.9-2.7] | 145 | 172 | 15.64 [12.0-26.1] | 0.00 |
| 341.6 [149.7-467.0] | 234 | 569 | 6,462.72 [3,527.1-8,636.8] | 0.03 |
| 2,481.4 [1,987.0-3,130.3] | 2,582 | 3,172 | 39,386.6 [32,037.3-47,439.2] | 25.54 |
| 3.6 [2.6-7.8] | 543 | 753 | 82.21 [57.5-146.5] | 0.01 |
| 327.1 [285.0-368.2] | 3,268 | 4,805 | 4,386.53 [3,940.9-4,786.5] | 0.26 |
| 23.0 [12.7-33.9] | 168 | 177 | 335.0 [182.7-427.3] | 0.00 |
| 838.0 [627.9-1,080.3] | | | | 2.25 |
| 1,849.4 [1,421.6-2,126.3] | 310 | 817 | 44,044.7 [34,736.8-49,890.0] | 0.90 |
| 17.6 [15.3-20.0] | 113 | 201 | 370.50 [327.1-411.8] | 0.04 |
| 0.1 [0.1-0.1] | - | - | - | 0.00 |
| 5.0 [3.4-7.7] | 340 | 431 | 68.26 [46.1-94.8] | 0.00 |
| 0.9 [0.6-1.2] | 762 | 704 | 15.16 [10.6-17.7] | 0.00 |
| 8.6[6.7-12.8] | 264 | 252 | 125.74 [100.1-171.2] | 0.01 |
| 1,887.9 [1,551.9-2,508.1] | 217 | 594 | 29,068.0 [23,758.5-38,333.5] | 1.79 |

# Abbreviations and acronyms

## A

**AFR**
IDF Africa Region

**AUD**
Australian Dollars

## B

**BCV**
Blue Circle Voices

**BMI**
body mass index

**BRIDGES**
Bringing Research in Diabetes to Global Environments and Systems

## C

**CAD**
coronary artery disease

**CKD**
chronic kidney disease

**CVD**
cardiovascular disease

## D

**DAR**
diabetes and Ramadan

**DED**
diabetic eye disease

**DIAMOND**
Diabetes Mondiale study

**DKA**
diabetic ketoacidosis

**DM**
diabetes mellitus

**DME**
diabetic macular edema

**D-NET**
Diabetes Education Network for Health Professionals

**DPP-4 inhibitors**
inhibitors of dipeptidyl peptidase 4

**DR**
diabetic retinopathy

## E

**eGFR**
estimated glomerular function

**ESRD**
end-stage renal disease

**EUR**
IDF Europe Region

## F

**FBG**
fasting blood glucose

**FINDRISC**
Finnish Diabetes Risk Score

## G

**G7**
Group of 7 countries: Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.

**G20**
Group of 20 countries: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, United Kingdom, the United States, and the European Union

**GBP**
The British Pound

**GDM**
gestational diabetes mellitus

**GDP**
gross domestic product

**GLP-1 receptor agonists**
glucagon-like peptide-1 receptor agonists

**GNI**
gross national income

## H

**HbA1c**
glycosylated haemoglobin A1c

**HHS**
hyperglycaemic hyperosmolar state

**HIV/AIDS**
human immunodeficiency virus infection and acquired immune deficiency syndrome

## I

**IAPB**
International Association on the Prevention of Blindness

**ICO**
International Council of Ophthalmology

**ID**
international dollars

**IDF**
International Diabetes Federation

**IFG**
impaired fasting glucose

**IGT**
impaired glucose tolerance

**ISPAD**
International Society for Pediatric and Adolescent Diabetes

## K

**KiDS**
IDF Kids and Diabetes in Schools project

## L

**LFAC**
Life for a Child

## M

**MENA**
IDF Middle East and North Africa Region

**mg/dl**
milligrams per decilitre

**mmol/L**
millimoles per litre

**mmol/mol**
millimoles per mole

**MODY**
maturity-onset diabetes of the young

## N

**NAC**
IDF North America and Caribbean Region

**NCDs**
noncommunicable diseases

**NEML**
National Essential Medicines List

**OGTT**
oral glucose tolerance test

## P

**PAD**
peripheral artery disease

**PCP**
primary care physician

**PVD**
peripheral vascular disease

## R

**R** (from health expenditure estimates)
diabetes cost ratio

## S

**SACA**
IDF South and Central America Region

**SDGs**
United Nations Sustainable Development Goals

**SEA**
IDF South-East Asia Region

**SGLT2 inhibitors**
sodium-glucose co-transporter-2 inhibitors

**STEP**
the WHO STEPwise approach to Surveillance

## T

**T1D**
type 1 diabetes

**T2D**
type 2 diabetes

**TB**
tuberculosis

## U

**UAE**
United Arab Emirates

**UK**
United Kingdom

**UN**
United Nations

**UNPD**
United Nations Population Division

**US**
United States

**USD**
United States dollars

## V

**VEGF**
vascular endothelial growth factor

## W

**WDD**
World Diabetes Day

**WHD**
World Health Day

**WHO**
World Health Organization

**WINGS**
Women in India with GDM Strategy

**WP**
IDF Western Pacific region

## Y

**YLD**
IDF Young Leaders in Diabetes

# Glossary

## A

**Age-adjusted comparative prevalence**
Also simply called comparative prevalence. The age-adjusted comparative prevalence in the *IDF Diabetes Atlas* has been calculated by assuming that every country and region has the same age profile (the age profile of the world population in 2001 has been used). This reduces the effect of the differences of age between countries and regions, and makes this estimate appropriate for making comparisons. The comparative prevalence estimate should not be used for calculating the number of people within a country or region who have diabetes. See Chapter 2 for more details.

## B

**Beta cells**
Beta cells are found in the pancreas that produce, store and release insulin.

## C

**Cardiovascular disease (CVD)**
Diseases and injuries of the circulatory system: the heart, the blood vessels of the heart and the system of blood vessels throughout the body and to (and in) the brain. Generally refers to conditions that involve narrowed or blocked blood vessels.

**Comparative prevalence**
See Age-adjusted comparative prevalence.

## D

**Diabetes complications**
Acute and chronic conditions caused by diabetes. Acute complications include diabetic ketoacidosis (DKA), hyperglycaemic hyperosmolar syndrome (HHS), hyperglycaemic diabetic coma, seizures or loss of consciousness and infections. Chronic microvascular complications include retinopathy (eye disease), nephropathy (kidney disease), neuropathy (nerve disease) and periodontitis (inflammation of the tissue surrounding the tooth), whereas chronic macrovascular complications are cardiovascular disease (disease of the circulatory system), diabetic encephalopathy (brain dysfunction) and diabetic foot (foot ulceration and amputation). See Chapter 5 for more details.

**Diabetes (mellitus)**
A condition that arises when the pancreas does not produce enough insulin or when the body cannot effectively use insulin. The three most common forms of diabetes are: type 1, type 2, and gestational. See Chapter 1 for more details.

**Diabetic foot**
A foot that exhibits any disease that results directly from diabetes or a complication of diabetes.

## E

**Epidemiology**
The study of the occurrence, distribution and patterns of disease in large populations, including factors that influence disease and the application of this knowledge to improve public health.

## G

**G7**
A governmental political forum that currently includes Canada, France, Germany, Italy, Japan, United Kingdom, United States and the European Union.

**G20**
The G20 is an international forum for the governments and central bank governors from 20 major economies: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, United Kingdom, the United States, and the European Union.

**Gestational diabetes mellitus (GDM)**
Hyperglycaemia (high blood glucose level) that is first detected during pregnancy is classified as either gestational diabetes mellitus (GDM) or diabetes mellitus in pregnancy. Women with slightly elevated blood glucose levels are classified as having GDM and women with substantially elevated blood glucose levels are classified as women with diabetes in pregnancy. See Chapter 1 for more details.

**Glucagon**
A hormone produced in the pancreas. If blood glucose levels decrease, it triggers the body to release stored glucose into the blood stream. See Chapter 1 for more details.

**Glucose**
Also called dextrose or blood sugar. The main sugar the body produces to store energy from proteins, fats and carbohydrates. Glucose is the major source of energy for living cells and is carried to each cell through the bloodstream. However, the cells cannot use glucose without the help of insulin. See Chapter 1 for more details.

**Glycogen**
A form of glucose that is used for storing energy in the liver and muscles. If blood glucose levels decrease, the hormone glucagon triggers the body to convert glycogen to glucose and release it into the blood stream. See Chapter 1 for more details.

**Glycosylated haemoglobin $A_{1c}$ ($HbA_{1c}$)**
Haemoglobin to which glucose is bound. Glycosylated haemoglobin is tested to determine the average level of blood glucose over the past two to three months.

**Gross domestic product (GDP)**
A measure of the size of a country's economy. It is the sum of the products produced within a country's borders, including products produced by foreign-owned enterprises.

**Gross national income (GNI)**
A measure of the size of a country's economy. It is the sum of the products produced by enterprises owned by a country's citizens, excluding products produced by foreign-owned enterprises.

## H

**High income country**
A country defined by the World Bank to have a gross national income per capita of USD 12,736 or more in 2015.

**Hyperglycaemia**
A raised level of glucose in the blood. It occurs when the body does not have enough insulin or cannot use the insulin it does have to turn glucose into energy. Signs of hyperglycaemia include great thirst, dry mouth and need to urinate often.

**Hypoglycaemia**
A lowered level of glucose in the blood. This occurs when a person with diabetes has injected too much insulin, eaten too little food, or has exercised without extra food. A person with hypoglycaemia may feel nervous, shaky, weak, or sweaty, and have a headache, blurred vision and hunger.

## I

**Impaired fasting glucose (IFG)**
Blood glucose that is higher than normal blood glucose, but below the diagnostic threshold for diabetes after fasting (typically after an overnight fast). See Chapter 1 for more details.

**Impaired glucose tolerance (IGT)**
Blood glucose that is higher than normal blood glucose, but below the diagnostic threshold for diabetes after ingesting a standard amount of glucose during an oral glucose tolerance test. See Chapter 1 for more details.

**Incidence**
The number of new cases of a disease among a certain group of people for a certain period of time. For example, the number of new cases of type 1 diabetes in children under 20 in one year.

**Insulin**
A hormone produced in the pancreas. If blood glucose levels increase, insulin triggers cells to take up glucose from the blood stream and convert it to energy, and the liver to take up glucose from the blood stream and store it as glycogen. See Chapter 1 for more details.

**International Dollar (ID)**
A hypothetical unit of currency that has the same purchasing power in every country. Conversions from local currencies to international dollars are calculated using tables of purchasing power parities, which are taken from studies of prices for the same basket of goods and services in different countries. Internationals Dollars can be used to compare expenditures between different countries or regions

## L

**Liver**
A vital organ located below the diaphragm. It has a wide range of functions, including storing glucose as glycogen when triggered by insulin, and releasing glucose into the blood when triggered by glucagon.

**Low income country**
A country defined by the World Bank to have a gross national income per capita of USD 1,045 or less in 2015.

## M

**Middle income country**
A country defined by the World Bank to have a gross national income per capita of more than USD 1,045 and less than USD 12,736 in 2015.

**Monogenic diabetes**
A less common type of diabetes, which arises as a result of a genetic mutation. Examples include Maturity-Onset Diabetes of the Young (MODY) and Neonatal Diabetes Mellitus.

## N

**National prevalence**
Indicates the percentage of each country's population that has diabetes. It is appropriate for assessing the burden of diabetes for each country.

**Nephropathy**
Damage, disease, or dysfunction of the kidney, which can cause the kidneys to be less efficient or to fail.

**Neuropathy**
Damage, disease, or dysfunction of the peripheral nerves, which can cause numbness or weakness.

## P

**Pancreas**
An organ situated behind the stomach, which produces several important hormones, including insulin and glucagon.

**Periodontitis**
Also known as gum disease. Inflammatory diseases that affect the tissues that surround and support the teeth.

**Prevalence**
The proportion or number of individuals in a population that has a disease or condition at a particular time (be it a point in time or time period). For example, the proportion of adults aged 20-79 with diabetes in 2017. Prevalence is a proportion or number and not a rate.

## R

**R** (from health expenditure estimates)
The diabetes cost ratio, which is the ratio of health expenditures for persons with diabetes to health expenditures for age- and sex-matched persons who do not have diabetes. By comparing the total costs of matched persons with and without diabetes, the costs that diabetes causes can be isolated. The R=2 estimates assume that health care expenditures for people with diabetes are on average two-fold higher than people without diabetes, and the R=3 estimates assume that health care expenditures for people with diabetes are on average three-fold higher than people without diabetes. See Chapter 2 for more details.

**Raw prevalence**
Also called country, national or regional prevalence.
The number of percentage of each country's or region's population that has diabetes. It is appropriate for assessing the impact of diabetes for each country or region. See Chapter 2 for more details.

**Regional prevalence**
Indicates the percentage of each region's population that has diabetes. It is appropriate for assessing the burden of diabetes for each region.

**Retinopathy**
A disease of the retina of the eye, which may cause visual impairment and blindness.

## S

**Secondary diabetes**
A less common type of diabetes, which arises as a complication of other diseases (e.g. hormone disturbances or diseases of the pancreas).

**Stroke**
A sudden loss of function in part of the brain as a result of the interruption of its blood supply by a blocked or burst artery.

## T

**Type 1 diabetes**
People with type 1 diabetes cannot produce insulin. The disease can affect people of any age, but onset usually occurs in children or young adults. See Chapter 1 for more details.

**Type 2 diabetes**
People with type 2 diabetes cannot use insulin to turn glucose into energy. Type 2 diabetes mellitus is much more common than type 1, and occurs mainly in adults although it is now also increasingly found in children and young adults. See Chapter 1 for more details.

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## Chapter 6

1. World Health Organization. Everybody's business. Streghtening health systems to improve health outcomes. WHO's framework for action. World Health Organization, 2007.

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