International Diabetes Federation

537 million

people worldwide have diabetes

IDF Diabetes Atlas

10TH edition

2021

IDF Diabetes Atlas

10TH edition

International
Diabetes
Federation

Table of contents

First edition, 2000
Second edition, 2003
Third edition, 2006
Fourth edition, 2009
Fifth edition, 2011
Sixth edition, 2013
Seventh edition, 2015
Eighth edition, 2017
Ninth edition, 2019

Online version of *IDF Diabetes Atlas*:
www.diabetesatlas.org

ISBN: 978-2-930229-98-0

Unless indicated otherwise all photographs in this edition of the *IDF Diabetes Atlas* were taken by the following Panos Pictures photographers: Australia stills and video – Alana Holmberg, Bangladesh stills and video – GMB Akash, Brazil stills and video – Lalo de Almeida, Lebanon stills and video – Andrew McConnell, South Africa stills and video – Tommy Trenchard, UK stills – Mary Tuner, UK video – Greg Funnell, USA stills and video – Ian Willms

Technical editing and design by Berkeley Communications:
www.berkeleypr.com

Acknowledgements

IDF Diabetes Atlas, 10th Edition Committee
Dianna J Magliano (Co-chair), Edward J Boyko (Co-chair), Beverley Balkau, Noel Barengo, Elizabeth Barr, Abdul Basit, Dominika Bhata, Christian Bommer, Gillian Booth, Bertrand Cariou, Juliana Chan, Hongzhi Chen, Lei Chen, Tawanda Chivese, Dana Dabalea, Hema Divakar, Daisy Duan, Bruce B Duncan, Michael Fang, Ghazal Fazli, Courtney Fischer, Kathryn Foti, Laercio Franco, Edward Gregg, Leonor Guariguata, Akhil Gupta, Anthony Hanley, Jessica L Harding, William H Herman, Cheri Hotu, Cecilia Høgfeldt, Elbert Huang, Adam Hulman, Steven James, Alicia J Jenkins, Seung Jin Han, Calvin Ke, Emma L Klatman, Shihchen Kuo, Jean Lawrence, Dinky Levitt, Xia Li, Lorraine Lipscombe, Paz Lopez-Doriga Ruez, Andrea Luk, Ronald C Ma, Jayanthi Maniam, Louise Maple-Brown, Jean-Claude Mbanya, Natalie McGlynn, Fernando Mijares Diaz, Hiliary Monteith, Ayesha Motala, Estelle Nobecourt, Graham D Ogle, Katherine Ogurstova, Richard Oram, Bige Ozkan, Emily Papadimos, Chris Patterson, Meda Pavkov, Cate Pihoker, Justin Porter, Camille Powe, Ambady Ramachandran, Gojka Roglic, Mary Rooney, Julian Sacre, Elizabeth Selvin, Baiju Shah, Jonathan E Shaw, David Simmons, Caroline Stein, Jannet Svensson, Olive Tang, Justin Echouffo Tcheugui, Jincy Varghese, Amelia Wallace, Pandora L Wander, Donald Warne, Mahmoud Werfalli, Sarah Wild, Jencia Wong, Yuting Xie, Xilin Yang, Lili Yuen, Philip Zeitler, Ping Zhang, Sui Zhang, Xinge Zhang, Zhiguang Zhou

Editorial team
Edward J Boyko, Dianna J Magliano
Suvi Karuranga, Lorenzo Piemonte, Phil Riley
Pouya Saeedi, Hong Sun

Contributors
Mikkel Pape Dysted, Balázs Esztergályos, Sanju Gautam, Bruno Helman, Moritz Pinkepank, Adilson Randi, Agus Salim, Katherine Wallis, Beatriz Yáñez Jiménez, Margaux Ysebaert

GLOBODIAB Research Consortium

Data
The list of studies on which estimates in the *IDF Diabetes Atlas* are based, and those considered but not used, can be found at: www.diabetesatlas.org

Corporate sponsors
The *IDF Diabetes Atlas* 10th edition has been produced thanks to educational grants from Novo Nordisk, Pfizer-MSD Alliance, and Sanofi.

Foreword

The International Diabetes Federation (IDF) is proud to launch the 10th edition of the *IDF Diabetes Atlas*. We have been publishing global estimates of the prevalence of diabetes for just over 20 years. During this time, the publication has established itself as the most cited and trusted source on the global impact of diabetes and an indispensable tool for diabetes advocacy. With each new edition, the popularity of the publication grows. Each edition is freely available online and downloaded more than 250,000 times. The publication of the *IDF Diabetes Atlas* 10th edition is timely, and its evidence and messages are more relevant than ever.

I wish I could report that the past two decades have witnessed decisive action to tackle diabetes and that the rising tide of diabetes has finally turned. I wish I could share news that universal health coverage has given more than half a billion people living with diabetes worldwide access to the care they need and can afford. I wish I could declare that, 100 years after its discovery, therapeutic insulin is now within reach of all those who need it to survive. Alas, I cannot. Rather, I must repeat the message that diabetes is a pandemic of unprecedented magnitude spiralling out of control.

Globally, more than one in 10 adults are now living with diabetes. Moreover, there is a growing list of countries where one-in-five or even more of the adult population has diabetes. Since the first edition in 2000, the estimated prevalence of diabetes in adults aged 20–79 years has more than tripled, from an estimated 151 million (4.6% of the global population at the time) to 537 million (10.5%) today. Without sufficient action to address the situation, we predict 643 million people will have diabetes by 2030 (11.3% of the population). If trends continue, the number will jump to a staggering 783 million (12.2%) by 2045.

The rising number of persons with diabetes is driven by multiple factors – people are living longer and we have higher quality data. However, much of the diabetes burden remains hidden. Almost every time we find new and more accurate data, our estimates have to be revised upwards.

The evidence presented in this edition will not cover the impact of COVID-19 on people living with diabetes. This impact will become clearer in subsequent editions. We do know that the virus has placed an additional burden on many with diabetes. We have seen that people living with diabetes can be more susceptible to the worst complications. There is concern that the current situation may cause a rise in the prevalence of diabetes and its complications over the coming years. We have yet to see the impact of lockdowns, shielding and the potential risk of COVID-induced diabetes on population health.

Diabetes must be taken seriously not only by individuals living with, or at high risk of, the condition but also by healthcare professionals and decision-makers. Diabetes remains a serious and growing challenge to public health and places a huge burden on individuals affected and their families. People living with diabetes are at risk of developing several debilitating and life-threatening complications, leading to an increased need for medical care, reduced quality of life and premature death. Globally, diabetes ranks among the top 10 causes of mortality. Why is not enough being done to prevent diabetes and its complications and provide the best available care to people with the condition?

I believe there are some rays of hope. The centenary of the discovery of insulin has attracted greater attention to the diabetes cause. In April 2021, the World Health Organization launched its Global Diabetes Compact, marking an increased focus on diabetes. We pledged our support to the development and implementation of the Compact through our advocacy and awareness activities. Soon after, a landmark Resolution highlighting the importance of prevention, diagnosis and control of diabetes was agreed by the World Health Assembly. These are important steps towards addressing the continued and rapid rise of diabetes prevalence, particularly in countries that do not have a national diabetes plan or coverage for essential health services.

There remain many countries for which we do not have data or data of sufficient quality to complete the global picture. The *IDF Diabetes Atlas* will continue to encourage the development of high-quality diabetes data in all countries to fill the gaps. More research is required to generate solid evidence to improve understanding of the impact of diabetes and inform national and global health targets. IDF is committed to fostering further epidemiological research in diabetes in collaboration with aligned organisations and partners.

Our sincere hope is that this 10th edition of the *IDF Diabetes Atlas* will help IDF members and the wider diabetes community advocate for more action to identify undiagnosed diabetes, prevent type 2 diabetes in people at risk, and improve care for all people with diabetes. United, the global diabetes community has the numbers, the influence and the determination to bring about meaningful change.

Professor Andrew Boulton
President 2020–2022
International Diabetes Federation

For over two decades, the *IDF Diabetes Atlas* has been a leading source of information on the global impact of diabetes. Its widespread popularity and reach is testament to its value for people with a personal or professional interest in diabetes.

The 10th edition of the *IDF Diabetes Atlas* reports a continued global increase in diabetes prevalence, confirming diabetes as a significant global challenge to the health and wellbeing of individuals, families and countries. It is offered for careful and considered use in the support of continued and enhanced action to improve the lives of people with diabetes and those at risk of developing the condition.

Estimating the global impact of diabetes is challenging as raw data arises from country-specific studies conducted using different methodologies. While some effort has been made to standardise the approach to measuring diabetes prevalence by the introduction of the World Health Organisation (WHO) STEPwise approach, not all countries have adopted it and the diabetes data available remain not always of high quality and can be heterogeneous, even within the same country. This is further complicated by the various diagnostic tests employed for the diagnosis of diabetes, the use of differing diagnostic criteria (WHO vs American Diabetes Association) and a range of diagnostic methodologies (plasma or capillary glucose, hemoglobin A1c (HbA1c), self-report). Other areas of potential divergence are the sampling frames used, response rates achieved, age-groups reported and geographical scope of each study. It should also be noted that the diagnostic criteria for diabetes used for estimations in the *IDF Diabetes Atlas* is epidemiological, which differs from the criteria used for a clinical diagnosis of diabetes that requires two abnormal tests in the absence of signs and symptoms.

Our inability to provide comprehensive coverage of global diabetes prevalence is also due to the sheer lack of data in some parts of the world. In the 9th edition of the *IDF Diabetes Atlas*, only 144 out of 215 countries (67%) had quality data derived from in-country studies. Estimates for the remaining 71 countries were modelled from other countries with similar characteristics, a necessary compromise that allows the *IDF Diabetes Atlas* to present a complete picture of prevalence for each country and territory. For the 10th edition, we have introduced more changes to improve the quality and relevance of our estimates. We have removed the majority of studies published before 2005. This means we now have fewer data sources, but those included are more representative of the current prevalence of diabetes. This loss of data sources is offset somewhat by the inclusion of new data from national population-based diabetes registries. With the recent emergence of big data generally and specifically in the area of diabetes, it was important for the *IDF Diabetes Atlas* to stay abreast of the generation of 'real world, real time' diabetes data and modify our methodology to include it.

Previous editions of the *IDF Diabetes Atlas* have used different sources of raw data, made different assumptions, and focused on different metrics of burden. Therefore, our estimates may vary across editions due to improvements in methodology and data sources. This may lead to unexpected changes in estimates for a country or region that do not reflect a real change. This should be taken into account when comparing estimates from the 10th edition with previous editions.

Forecasting future diabetes prevalence can be challenging and the projections are only as good as the data inputs which inform them. The *IDF Diabetes Atlas* takes the view that simple predictions that only consider changing distributions of age, sex and urban/rural residence are likely to be the most robust. It is acknowledged that other factors such as trends in obesity and overweight are important when predicting diabetes prevalence. We have plans to include these in the next edition.

The COVID-19 pandemic has dominated our lives over the last 18 months, so it would have been remiss of the *IDF Diabetes Atlas* not to address the relationship between COVID-19 and diabetes. We have included a chapter that summarises the data currently available globally and will look to update it in future editions.

The 10th edition of the *IDF Diabetes Atlas* was produced under unique circumstances. The pandemic delayed its start, prohibited face-to-face contact with members of the IDF Executive Office and imposed different and novel ways of working. It would not have been possible without the tireless commitment and efforts of the the Editorial Team and members of the *IDF Diabetes Atlas* Committee, to whom we are extremely grateful.

Professor Dianna Magliano
Chair
IDF Diabetes Atlas Committee
(10th Edition)

Professor Edward Boyko
Chair
IDF Diabetes Atlas Committee
(10th Edition)

Summary

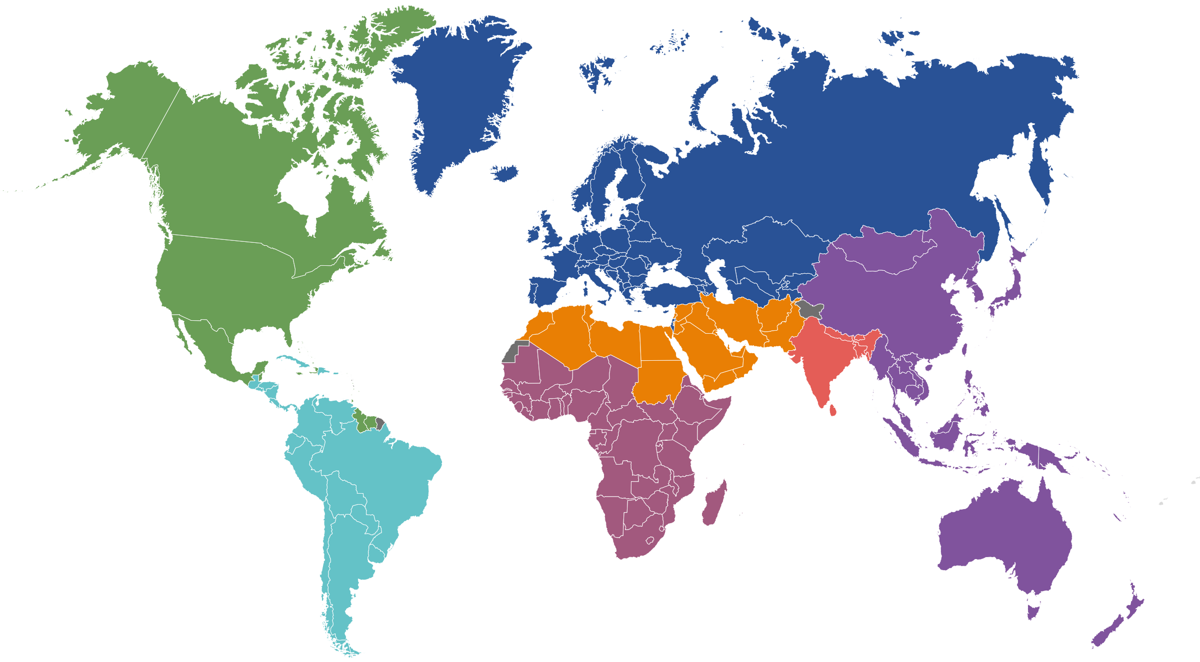
Map 1 Number of people with diabetes worldwide and per IDF Region in 2021–2045 (20–79 years)

World		
2045	783 million	46% increase
2030	643 million	
2021	537 million	

North America & Caribbean (NAC)		
2045	63 million	24% increase
2030	57 million	
2021	51 million	

Europe (EUR)		
2045	69 million	13% increase
2030	67 million	
2021	61 million	

Western Pacific (WP)		
2045	260 million	27% increase
2030	238 million	
2021	206 million	



South & Central America (SACA)		
2045	49 million	50% increase
2030	40 million	
2021	32 million	

Africa (AFR)		
2045	55 million	134% increase
2030	33 million	
2021	24 million	

Middle East & North Africa (MENA)		
2045	136 million	87% increase
2030	95 million	
2021	73 million	

South-East Asia (SEA)		
2045	152 million	68% increase
2030	113 million	
2021	90 million	

The 10^{th} edition confirms that diabetes is one of the fastest growing global health emergencies of the 21st century

Diabetes is a major health issue that has reached alarming levels. Today, more than half a billion people are living with diabetes worldwide.

The *IDF Diabetes Atlas* is an authoritative source of evidence on the prevalence of diabetes, related morbidity and mortality, as well as diabetes-related health expenditures at global, regional and national levels. The *IDF Diabetes Atlas* also introduces readers to the pathophysiology of diabetes, its classification and its diagnostic criteria. It presents the global picture of diabetes for different types of diabetes and populations and provides information on specific actions that can be taken, such as proven measures to prevent type 2 diabetes and best management of all forms of diabetes to avoid subsequent complications.

The credibility of diabetes estimates relies on the rigorous methods used for the selection and analysis of high-quality data sources. For every edition, the *IDF Diabetes Atlas* Committee – composed of thematic experts from each of the seven IDF Regions – reviews the methods underlying the *IDF Diabetes Atlas* estimates and projections and available data sources. The methods have been explained in detail by Guariguata *et al*,[1] and more recently, by Sun *et al*.[2] The majority of the data sources used are population-based studies that have been published in peer-reviewed journals. In this edition, we have also included data from national diabetes registries. With the establishment of electronic records and national registries becoming more common, we anticipate more data like these will be featured in the future. Furthermore, information from national health surveys, including some of the World Health Organization (WHO) STEPwise approach to Surveillance (STEPS), are used where they meet inclusion criteria.

Findings of the current 10^{th} edition confirm that diabetes is one of the fastest growing global health emergencies of the 21st century (see Map 1). In 2021, it is estimated that 537 million people have diabetes, and this number is projected to reach 643 million by 2030, and 783 million by 2045. In addition, 541 million people are estimated to have impaired glucose tolerance in 2021. It is also estimated that over 6.7 million people aged 20–79 will die from diabetes-related causes in 2021. The number of children and adolescents (i.e. up to 19 years old) living with diabetes increases annually. In 2021, over 1.2 million children and adolescents have type 1 diabetes. Direct health expenditures due to diabetes are already close to one trillion USD and will exceed this figure by 2030.

This *IDF Diabetes Atlas* 10^{th} edition also shows that hyperglycaemia in pregnancy (HIP) affects approximately one in six pregnancies. Another cause for alarm is the consistently high percentage (45%) of people with undiagnosed diabetes, which is overwhelmingly type 2. This highlights the urgent need to improve the ability to diagnose people with diabetes, many of whom are unaware they have diabetes, and provide appropriate and timely care for all people with diabetes as early as possible.

References

1. Guariguata L, Whiting D, Weil C, Unwin N. The International Diabetes Federation diabetes atlas methodology for estimating global and national prevalence of diabetes in adults. *Diabetes Res Clin Pract*. 2011 Dec;94(3):322–32.
2. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, *et al*. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diab Res Clin Pract*. 2021 (in press).

Introduction

Key messages

- **The *IDF Diabetes Atlas* has provided essential information on the estimated and projected global prevalence of diabetes for more than two decades**
- **It draws attention to the importance and growing impact of diabetes in all countries and regions**

A proud history of information dissemination and advocacy

Since its first edition, published in 2000, the *IDF Diabetes Atlas* has provided robust estimates of the prevalence of diabetes by country, IDF Region and globally. Since its second edition, published in 2003, it has also projected these estimates into the future. In doing so, it has served as an advocacy tool, not only for the quantification of the impact of diabetes worldwide, but also for reducing that impact through measures aimed at improving the long-term consequences of all types of diabetes, as well as the primary prevention of type 2 diabetes.

In 2000, the global estimate of diabetes prevalence in the 20–79 year-old age group was 151 million, close to the WHO estimate at the time (150 million).[1] The most recent WHO estimate (2014) of 422 million people with diabetes was also very close to the IDF estimate of 415 million people with diabetes in 2015. Since then, IDF estimates have indicated alarming increases in the number of people living with diabetes (see Figure 1), more than tripling the 2000 figure to the current (2021) estimate of 537 million.

For the first time, we are able to present the impact of type 1 and type 2 diabetes in different stages of life

Our vision for the IDF Diabetes Atlas 10th edition

The 10th edition of the *IDF Diabetes Atlas* has two inter-related objectives:

- Advocacy for the continued and more effective use of the *IDF Diabetes Atlas* and its further improvement.
- Innovation and continued development for the 10th edition including the utilisation of new methods and incorporation of new data sources.

Multiple changes have been made to the epidemiological methods used in preparing the 10th edition of the *IDF Diabetes Atlas*. These are summarised in Chapter 2 and are described in detail in a separate publication by Sun *et al*.[2] New data have been accessed and some topics have been introduced for the first time (see 'What's new in the 10th edition?' below). However, the basis on which estimates and projections have been calculated in this edition remain essentially the same as those used in the previous edition. Thus, continuity has been maintained and, with certain caveats, conclusions about time trends in the global progress of diabetes can be made with reasonable confidence.

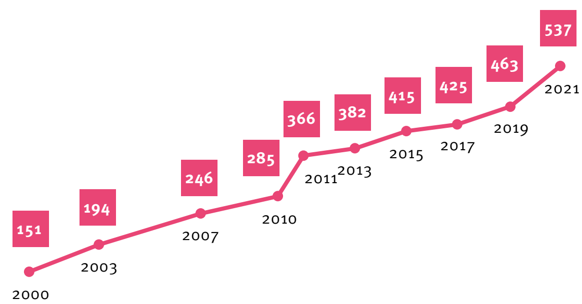
What's new in the 10th edition?

This year we have included a chapter on COVID-19 infection and diabetes which examines how diabetes influences not only the risk of contracting COVID-19 infection, but also what effects diabetes has on the clinical course of infection, including the need for hospitalisation, ICU care, and mortality (Chapter 4).

For the first time, we are able to present type 1 and type 2 diabetes prevalence in different stages of life. The worrying emergence of type 2 diabetes in children and adolescents has been recognised and is included alongside type 1 diabetes in these age groups (Chapter 3). The number of adults over 20 living with type 1 diabetes has also been presented (Chapter 3).

Figure 1 Estimates and projections of the global prevalence of diabetes in the 20–79 year age group in millions (IDF Diabetes Atlas editions 1st to 10th)

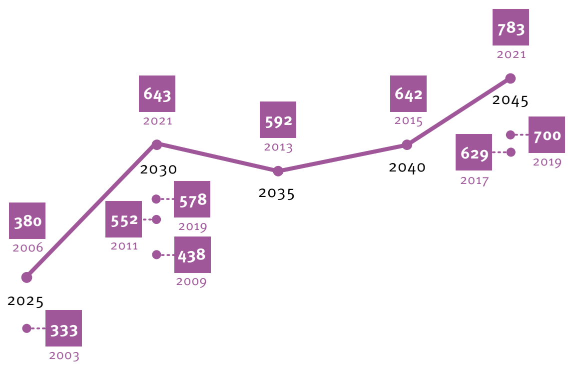
Estimates of the global prevalence of diabetes in the 20–79 year age group (millions)



Key

151 Number of people with diabetes in millions

Projections of the global prevalence of diabetes in the 20–79 year age group (millions)



Key

333 Projection in millions

2003 Year projection made

In each edition of the Atlas, we estimate diabetes prevalence based on the best quality data available at the time of analysis

Increased recognition of pre-diabetes has allowed us to report recent data on its prevalence (Chapter 3).

Estimates of the incidence of diabetes are included, recognising that, given many people with diabetes are living longer, influences on prevalence are complex and the global impact of diabetes is best assessed using incidence as well as prevalence (Chapter 3).

The importance of the advocacy objective of the *IDF Diabetes Atlas* and related materials is given attention. For that purpose, a separate 10 Steps to Data-driven advocacy is also available, serving as a stimulus to the use of the *IDF Diabetes Atlas* data for advocacy purposes to a broader audience.

How to read this edition of the IDF Diabetes Atlas

Although it might be tempting to focus solely on the figures for a given country or IDF Region, other factors should be considered when interpreting the *IDF Diabetes Atlas* estimates and any differences from those given in the previous edition. Possible reasons to account for significant differences between the 9th (2019) and 10th edition (2021) figures are:

- The inclusion of new studies for some countries with in-country data sources in the previous edition.†
- The inclusion of national diabetes registry data with modification. Data on diagnosed diabetes from these sources were adjusted to include both diagnosed and an estimate of undiagnosed diabetes.
- The exclusion of specific WHO STEPS surveys included in the previous edition, as a result of concerns about their validity (see Chapter 2).
- While we may include several studies for one country which all met inclusion criteria, in cases where multiple serial surveys were available, only the latest survey was included.
- The exclusion of studies conducted before 2005, with the exception of cases when no other data source is available. Since older studies probably report a lower prevalence, the exclusion of these studies may result in an estimate of prevalence being higher than previous editions.
- Likewise, updating data sources with better quality studies may result in a lower prevalence than reports from previous years with less robust methodology. Any change in prevalence within individual countries could be due, in part, to these methodological changes.

It must be stressed that any differences between the 9th and 10th edition estimates may be due to updating of studies, rather than to real changes in diabetes prevalence since the 9th edition in 2019. For example, the 2019 estimate for a country might have been based on a study conducted in 2005, but the 2021 estimate was able to include a study published in 2020.

In each edition of the *IDF Diabetes Atlas*, we estimate diabetes prevalence based on the best quality data available at the time of analysis. It is important to highlight that the diabetes figures presented in this document are therefore estimates and thus changes in the magnitude of prevalence of individual countries from edition to edition should be treated with caution.

Limitations

- The definition of diabetes used in the *IDF Diabetes Atlas* is based on an epidemiological definition which requires abnormal blood glucose levels to be detected on only one test compared to a clinical diagnosis of diabetes which requires abnormal blood glucose levels to be detected on two separate tests.
- While we attempted to include only population-based representative studies, all studies have limitations and biases which require careful interpretation. In some countries/territories where territory-wide or population-based registers were included, the estimate of prevalence was adjusted, taking into consideration the proportion of people with undiagnosed diabetes in that country/territory.
- When a country lacked any internal data, diabetes prevalence was extrapolated from a country with similar economy, language and demography. Such extrapolations may represent a source of error.
- The urban and rural classifications are based on how the individual data sources defined urban and rural, rather than defined by the IDF analysis team.

References

1 King H, Aubert RE, Herman WH. Global burden of diabetes, 1995–2025: prevalence, numerical estimates, and projections. *Diabetes Care*. 1998 Sep; 21(9):1414–31.

2 Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, *et al*. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diab Res Clin Pract*. 2021 (in press).

† Data sources used in this edition can be found at the IDF Diabetes Atlas website: www.diabetesatlas.org.

Key messages

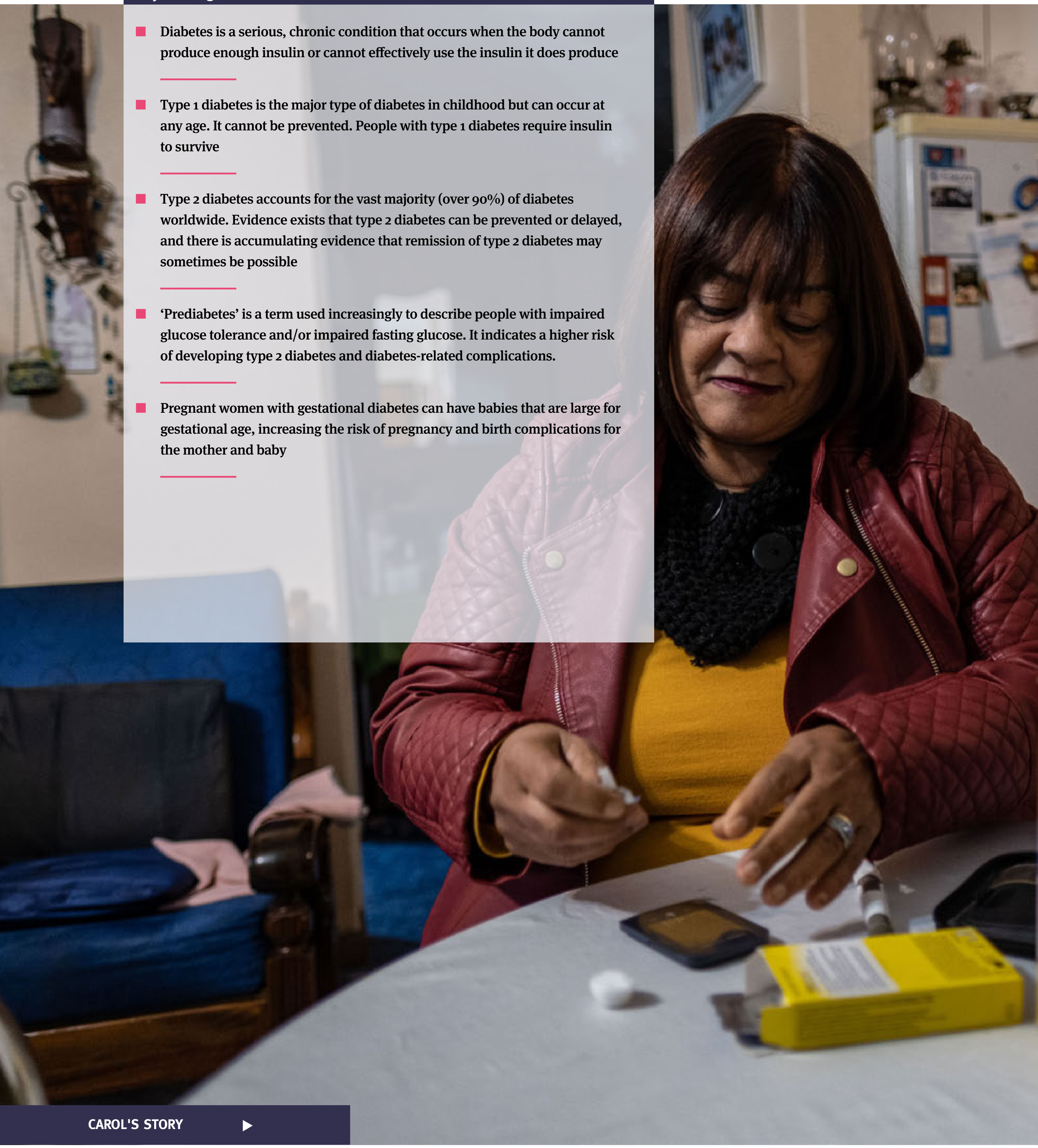
- Diabetes is a serious, chronic condition that occurs when the body cannot produce enough insulin or cannot effectively use the insulin it does produce

- Type 1 diabetes is the major type of diabetes in childhood but can occur at any age. It cannot be prevented. People with type 1 diabetes require insulin to survive

- Type 2 diabetes accounts for the vast majority (over 90%) of diabetes worldwide. Evidence exists that type 2 diabetes can be prevented or delayed, and there is accumulating evidence that remission of type 2 diabetes may sometimes be possible

- 'Prediabetes' is a term used increasingly to describe people with impaired glucose tolerance and/or impaired fasting glucose. It indicates a higher risk of developing type 2 diabetes and diabetes-related complications.

- Pregnant women with gestational diabetes can have babies that are large for gestational age, increasing the risk of pregnancy and birth complications for the mother and baby



CAROL'S STORY ▶

1

What is diabetes?

1 What is diabetes?

Diabetes mellitus, more simply called diabetes, is a serious, long-term (or "chronic") condition that occurs when raised levels of blood glucose occur because the body cannot produce any or enough of the hormone insulin or cannot effectively use the insulin it produces.

Insulin is an essential hormone produced in the pancreas. It allows glucose from the bloodstream to enter the body's cells where it is converted into energy or stored. Insulin is also essential for the metabolism of protein and fat. A lack of insulin, or the inability of cells to respond to it, leads to high levels of blood glucose (hyperglycaemia), which is the clinical indicator of diabetes. The threshold levels for the diagnosis of diabetes can be found in Figure 1.1.

An insulin deficit, if left unchecked over the long term, can cause damage to many of the body's organs, leading to disabling and life-threatening health complications such as cardiovascular diseases (CVD), nerve damage (neuropathy), kidney damage (nephropathy), lower-limb amputation, and eye disease (mainly affecting the retina) resulting in visual loss and even blindness. However, if appropriate management of diabetes is achieved, these serious complications can be delayed or prevented altogether.

Figure 1.1 Modified diagnostic criteria for diabetes[1]

Test	Diabetes Should be diagnosed if ONE OR MORE of the following criteria are met	Impaired Glucose Tolerance (IGT) Should be diagnosed if BOTH of the following criteria are met	Impaired Fasting Glucose (IFG) Should be diagnosed if THE FIRST OR BOTH of the following are met
Fasting plasma glucose	≥7.0 mmol/L (126 mg/dL)	<7.0 mmol/L (126 mg/dL)	6.1 – 6.9 mmol/L (110 – 125 mg/dL)
	or	and	and if measured
Two-hour plasma glucose after 75g oral glucose load (oral glucose tolerance test (OGTT))	≥11.1 mmol/L (200 mg/dL)	≥7.8 and <11.1 mmol/L (140–200 mg/dL)	<7.8 mmol/L (140 mg/dL)
	or		
HbA1c	≥48 mmol/mol (equivalent to 6.5%)		
	or		
Random plasma glucose in the presence of symptoms of hyperglycaemia	≥11.1 mmol/L (200 mg/dL)		

Fasting is defined as no caloric intake for at least eight hours.

The HbA1c test should be performed in a laboratory using a method that is NGSP-certified and standardised to the Diabetes Control and Complications Trial assay.

The two-hour postprandial plasma glucose test should be performed using a glucose load containing the equivalent of 75-g anhydrous glucose dissolved in water.

In the absence of symptoms of hyperglycaemia, two abnormal tests are required for the diagnosis of diabetes mellitus.

The American Diabetes Association (ADA)[2] recommends diagnosing "prediabetes" with HbA1c values between 39 and 47 mmol/mol (5.7–6.4%) and impaired fasting glucose when the fasting plasma glucose is between 5.6 and 6.9mmol/L (100–125mg/dL).

Type 1 diabetes

Type 1 diabetes is caused by an autoimmune process in which the body's immune system attacks the insulin-producing beta-cells of the pancreas. As a result, the body produces very little or no insulin. The causes of this destructive process are not fully understood but a likely explanation is that the combination of genetic susceptibility (conferred by a large number of genes) and an environmental trigger such as a viral infection, initiate the autoimmune reaction.[3,4] The condition can develop at any age, although type 1 diabetes occurs most frequently in children and young adults. Type 1 diabetes is one of the most common chronic diseases in childhood. Type 2 diabetes is also seen in older children and is increasing in some countries as childhood overweight and obesity become more common.

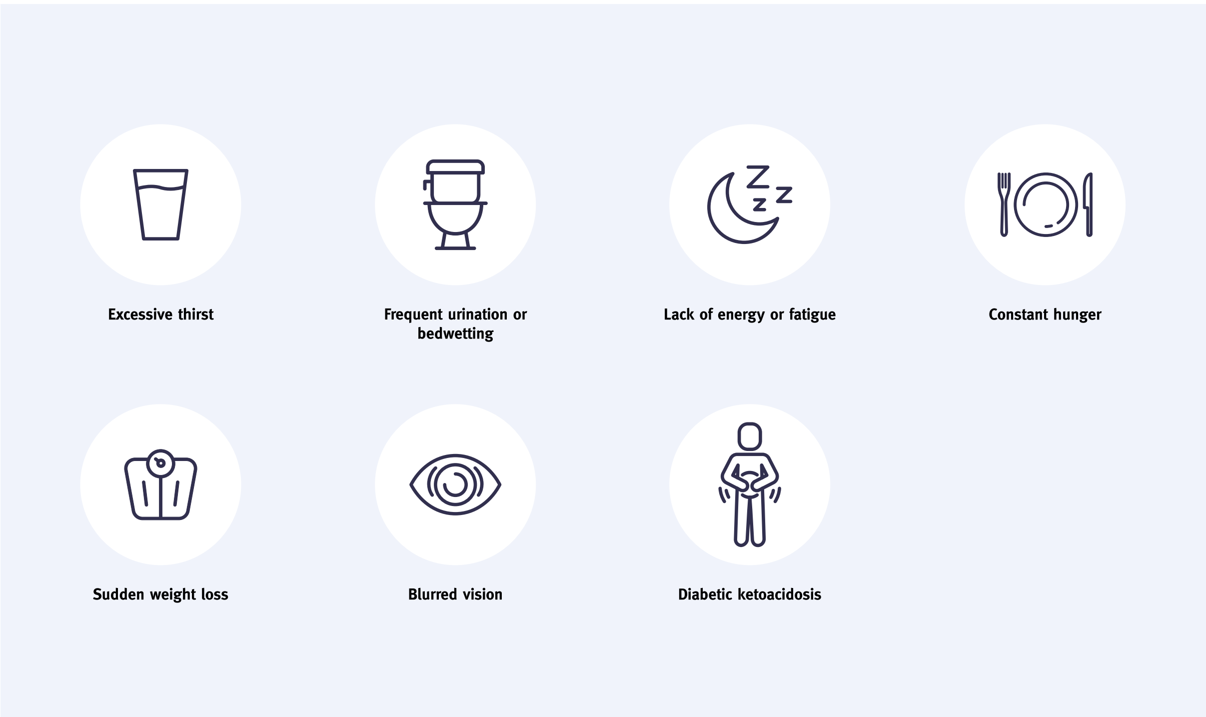
People with type 1 diabetes need daily insulin injections to keep their blood glucose level within an appropriate range. Without insulin, they would not survive. However, with daily insulin treatment, regular blood glucose monitoring, education and support, they can live healthy lives and delay or prevent many of the complications associated with diabetes.

A structured self-management plan comprising insulin use, blood glucose monitoring, physical activity and a healthy diet is especially difficult to follow in early childhood and adolescence. In many countries, especially in economically disadvantaged families, access to insulin and self-care tools, including structured diabetes education, can be limited. This may lead to severe disability and early death from episodes where harmful substances known as 'ketones' build up in the body leading to diabetic ketoacidosis (DKA).

Living with type 1 diabetes remains a challenge for a child and the whole family, even in countries with access to multiple daily injections or an insulin pump, glucose monitoring, structured diabetes education and expert medical care. Besides the acute complications of hypoglycaemia (abnormally low blood glucose) and DKA, suboptimal metabolic control may lead to poor growth and the early onset of circulatory (or 'vascular') complications.

The typical symptoms of type 1 diabetes are listed in Figure 1.2. The classic clinical picture of excessive thirst (polydipsia), frequent urination (polyuria) and weight loss may, however, not be present and the diagnosis delayed or even missed entirely.

Figure 1.2 The typical symptoms of type 1 diabetes



Even in countries with universal health coverage (UHC), diagnosis of type 1 diabetes may be delayed until the first hospital admission for DKA, sometimes with fatal results.

A recent study of DKA rates at diagnosis of type 1 diabetes in 13 high-income countries showed a pooled rate for 2006–2016 of 29.9%.[5] Prevalence ranged from 19.5% to 43.8%, and increased over time in three countries and decreased in one. This situation has prompted campaigns to increase awareness of type 1 diabetes among parents, school teachers and healthcare professionals.[6] The latter include advocacy of 'on-the-spot' blood glucose measurement in an unwell child with no obvious diagnosis. In less-resourced countries, the frequency of misdiagnosis and consequent death from DKA at onset of type 1 diabetes is not known, but is likely to be very substantial in some countries.[7]

Type 1 diabetes is diagnosed by an elevated blood glucose concentration (Figure 1.1) in the presence of some or, rarely, all of the symptoms listed in Figure 1.2. However, diagnosing the type of diabetes is sometimes difficult and additional testing may be required to distinguish between type 1 and type 2 diabetes particularly the monogenic types.

The incidence of type 1 diabetes varies around the world, with some regions having much higher incidences than others.[8] Incidence has been increasing in the great majority of countries studied, although there is now evidence that this increase is tailing off or has ceased in some high-income countries. The reasons for this are unclear but the rapid increase over time is most likely due to environmental changes.[9]

Type 2 diabetes

Type 2 diabetes is the most common type of diabetes, accounting for over 90% of all diabetes worldwide. In type 2 diabetes, hyperglycaemia is the result, initially, of the inability of the body's cells to respond fully to insulin, a condition termed insulin resistance. With the onset of insulin resistance, the hormone is less effective and, in due course, prompts an increase in insulin production. Over time, inadequate production of insulin can develop as a result of failure of the pancreatic beta cells to keep up with demand.

Type 2 diabetes may have symptoms similar to those of type 1 diabetes but, in general, symptoms are much less dramatic and the condition may be completely symptomless. Also, the exact time of the onset of type 2 diabetes is usually impossible to determine. As a result, there is often a long pre-diagnostic period and as many as one-third to one-half of people with type 2 diabetes in the population may be undiagnosed. If the diagnosis is delayed for a prolonged time, complications such as visual impairment, poorly-healing lower-limb ulcers, heart disease or stroke may lead to the diagnosis.[10, 11]

The causes of type 2 diabetes are not completely understood but there is a strong link with overweight, and obesity, increasing age, ethnicity, and family history. As with type 1 diabetes, contributors to type 2 diabetes risk are thought to include polygenic and environmental triggers.

The cornerstone of type 2 diabetes management is promoting a lifestyle that includes a healthy diet, regular physical activity, smoking cessation and maintenance of healthy body weight. As a contribution to improving the management of type 2 diabetes, in 2017 IDF issued the IDF Clinical Practice Recommendations for Managing Type 2 Diabetes in Primary Care.[12] If attempts to change lifestyle are not sufficient to control blood glucose levels, oral medication is usually initiated, with metformin as the first-line medicine.

If treatment with a single antidiabetic medication is not sufficient, a range of combination therapy options are now available (e.g. sulphonylureas, alpha glucosidase inhibitors, thiazolidinediones, dipeptidyl peptidase 4 [DPP-4] inhibitors, glucagon-like peptide 1 [GLP-1] agonists and sodium glucose co-transporter 2 inhibitors). Insulin injections may be necessary to control hyperglycaemia to recommended levels if non-insulin medications fail to achieve glycaemic control.

Beyond controlling blood glucose levels, it is critically important to manage blood pressure (BP) and blood cholesterol (LDL-c) levels and to assess control of these risk factors on a regular basis (at least annually). Regular screening for the development of early diabetic complications, such as kidney disease, retinopathy, neuropathy, peripheral artery disease and foot ulceration, will allow preventive treatments where available to prevent the development and progression of these complications. With regular check-ups and effective lifestyle management, as well as medication if required, people with type 2 diabetes can lead long and healthy lives.

Globally, the prevalence of type 2 diabetes is high and rising across all regions. This rise is driven by population ageing, economic development and increasing urbanisation, leading to more sedentary lifestyles and greater consumption of unhealthy foods linked with obesity.[13] However, the beneficial results of early detection, more effective treatment and the resulting longer survival are also contributing to the rise in prevalence.

As previously mentioned, type 2 diabetes has also become a concern in children and young people as a result of an increasing prevalence of obesity. Unfortunately, population-based studies in this area are scarce. Furthermore, there are differences in the methodologies used and the general quality of published observations.[14]

Nevertheless, it is clear that type 2 diabetes is particularly prevalent in some groups such as Pima and Navajo Native Americans, Aboriginal and Torres Strait Islander people in Australia and Canadian First Nation people, as well as those of Asian and Afro-American descent. In these groups, and among American-Hispanic, Japanese and Chinese children, type 2 diabetes appears to be on the increase, whereas no increase is seen in non-Hispanic white children.[15, 16]

Impaired glucose tolerance and impaired fasting glucose

Impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) are conditions of raised blood glucose levels above the normal range and below the diabetes diagnostic threshold (see Figure 1.1). The terms ‘prediabetes’, ‘non-diabetic hyperglycaemia’,[17] and ‘intermediate hyperglycaemia’[18] are in use as alternatives. The importance of IGT and IFG is three-fold: first, they signify a higher risk of the future development of type 2 diabetes;[19–21] second, IGT and IFG indicate an already heightened risk of CVD;[22, 23] and third, their detection opens the door to interventions that can lead to the prevention of type 2 diabetes.[24] However, current evidence on prevention relates to isolated IGT and combined IGT and IFG but not, as yet, to isolated IFG.[25]

Progression from IGT and IFG to type 2 diabetes is linked to glucose levels (judged by the extent of hyperglycaemia) along with risk factors such as age and weight.[26] The cumulative incidence of type 2 diabetes progression five years after diagnosis of IGT or IFG is estimated to be 26% and 50%, respectively.[20]

Diagnostic criteria for diabetes

Most guidelines use the standard diagnostic criteria proposed by IDF and the World Health Organization (WHO) in Figure 1.1. The footnote in Figure 1.1 mentions the American Diabetes Association (ADA) inclusion of HbA1c as part of the diagnostic criteria of diabetes

Type 2 diabetes is the most common type of diabetes, accounting for over 90% of all diabetes worldwide

and prediabetes. WHO supports the use of HbA1c ≥ 6.5% for diabetes diagnosis but not for intermediate hyperglycaemia, on the grounds that quality-assured HbA1c measurement is not available on a global scale.[27]

Currently, WHO and IDF recommend the use of 75-gram oral glucose tolerance test (OGTT) with measurement of both fasting and two-hour plasma glucose to detect IGT and IFG. However, there is accumulating evidence favouring use of the one-hour 75-gram OGTT, which may be a more sensitive method capable of identifying intermediate hyperglycaemia.[28]

For type 2 diabetes, in the presence of symptoms (e.g. polyuria, polydipsia and unexplained weight loss) the diagnosis can be made based on: a random venous plasma glucose concentration ≥ 11.1 mmol/l or in the absence of symptoms by a fasting plasma glucose concentration ≥ 7.0 mmol/l (whole blood ≥ 6.1 mmol/l or HbA1c ≥ 6.5%). If elevated values are detected in asymptomatic people, repeat testing, preferably with the same test, is recommended as soon as practical on a subsequent day to confirm the diagnosis.

Hyperglycaemia in pregnancy

According to WHO and the International Federation of Gynaecology and Obstetrics (FIGO), hyperglycaemia in pregnancy (HIP) can be classified as either pre-gestational diabetes, gestational diabetes mellitus (GDM) or diabetes in pregnancy (DIP).[29, 30] Pre-gestational diabetes includes women with known type 1, type 2 or rarer forms of diabetes before pregnancy. GDM may occur at anytime during the antenatal period and is not expected to persist postpartum.[31] DIP applies to pregnant women with hyperglycaemia that were first diagnosed during pregnancy and meet WHO criteria of diabetes in the non-pregnant state. DIP is best detected during the first trimester.[32] It has been estimated that most (75%–90%) cases of HIP are GDM.[33]

Overt symptoms of hyperglycaemia during pregnancy are rare and may be difficult to distinguish from normal pregnancy symptoms. As a result, an OGTT is

Table 1.1 Diagnostic criteria in studies used for estimating hyperglycaemia in pregnancy[37]

Criteria	Fasting		1-hour		2-hour		3-hour	
	mg/dL	mmol/L	mg/dL	mmol/L	mg/dL	mmol/L	mg/dL	mmol/L
NDDG (USA)*	105	5.9	190	10.6	165	9.2	145	8.1
Carpenter Coustan (USA)*	95	5.3	180	10.0	155	8.6	140	7.8
CDA	95	5.3	191	10.6	160	9.0	–	–
WHO 1985	140	7.8	–	–	140	7.8	–	–
WHO 1999	126	7.0	–	–	140	7.8	–	–
IADPSG/ADA WHO/FIGO	92	5.1	180	10	153	8.5	–	–
(DIPSI non-fasting)	–	–	–	–	–	7.8	–	–
NICE (UK)	–	5.6	–	–	–	7.8	–	–

ADA = American Diabetes Association; NDDG = National Diabetes Data Group; CDA = Canadian Diabetes Association; DIPSI = Diabetes in Pregnancy Society of India; WHO = World Health Organization; IADPSG = International Association of the Diabetes and Pregnancy Study Groups. NICE = National Institute for Clinical Excellence; FIGO = International Federation of Gynaecology and Obstetrics

* after 50g glucose challenge test-if positive, uses 100g glucose load, at least two need to be positive

recommended for the screening for GDM for all women between the 24th and 28th week of pregnancy, but for high-risk women, screening should be conducted earlier in pregnancy.[34] The diagnostic criteria for GDM vary and remain controversial, complicating the comparison of research data. There has been a move towards the diagnostic criteria advocated by the International Association of the Diabetes and Pregnancy Study Groups (IADPSG)/WHO[35, 36] and this has resulted in a general increase in the overall prevalence of GDM.[37] Typically, an OGTT is performed by measuring the plasma glucose concentration while fasting and one and two hours after ingesting 75-grams of glucose. For diagnosing GDM, the criteria currently recommended across the world are summarised in Table 1.1.

Besides those women with hyperglycaemia early in pregnancy, GDM arises in women with insufficient insulin secretory capacity to overcome the diminished action of insulin (insulin resistance) due to hormone production by the placenta as pregnancy progresses.[29] Risk factors for GDM include older age, overweight and obesity, previous GDM, excessive weight gain during pregnancy, a family history of diabetes, polycystic ovary syndrome, habitual smoking and a history of stillbirth or giving birth to an infant with a congenital abnormality. GDM is more common in some ethnic groups.

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. In addition, the relative risk of developing type 2 diabetes is particularly high at three–six years after GDM and can occur under 40 years of age. The risks remain markedly elevated thereafter.[37] Considering the high risk of early onset type 2 diabetes and the fact that prior GDM increases the risk of cardiovascular disease (CVD), with or without type 2 diabetes, any lifestyle intervention should be started within three years after the pregnancy in order to achieve the maximum benefit for the prevention of diabetes.[37, 38] Babies born to mothers with GDM also have a higher lifetime risk of obesity and developing type 2 diabetes.[39]

Women with hyperglycaemia detected during pregnancy are at greater risk of adverse pregnancy outcomes. These include high blood pressure (including pre-eclampsia) and a large baby for gestational age (termed ‘macrosomia’), which can make a normal birth difficult and hazardous, with the baby more prone to fractures and nerve damage. Identification of hyperglycaemia in pregnancy, combined with good control of blood glucose during pregnancy can reduce these risks. Women of child-bearing age who are known to have diabetes prior to pregnancy should receive pre-conception advice, higher dose folic acid treatment, a medication review, intensive diabetes management and a planned approach to pregnancy.

All women who have HIP – be it GDM, previously undiagnosed DIP or existing and known diabetes – require optimal antenatal care and appropriate assistance with postnatal management. Women with hyperglycaemia during pregnancy may be able to control their blood glucose levels through a healthy diet, weight management, moderate exercise and blood glucose monitoring. Interaction with healthcare professionals is important to support their self-management and also to identify when medical (e.g. prescription of insulin and/or oral medications) or obstetric intervention is needed.

Other types of diabetes

The recently published WHO report on the classification of diabetes mellitus[40] lists a number of 'other specific types' of diabetes, including monogenic diabetes and what was once termed 'secondary diabetes'.

Monogenic diabetes, as the name implies, results from a single gene rather than the contribution of multiple genes and environmental factors, as seen in type 1 and type 2 diabetes. Monogenic diabetes is much less common and represents 1.5–2% of all cases, though this may well be an underestimate as it is often misdiagnosed as either type 1 or type 2 diabetes.[41]

These monogenic forms present a broad spectrum, from neonatal diabetes mellitus (sometimes called 'monogenic diabetes of infancy'), maturity onset diabetes of the young (MODY) and rare diabetes-associated syndromic diseases.[42] Although rare, these can serve as 'human knockout models', providing insight into diabetes pathogenesis.[43]

From a clinical perspective, the exact diagnosis of the monogenic forms of diabetes is important because, in some instances, therapy can be tailored to the specific genetic defect.[41] Further distinction between the 14 different sub-types of MODY leads not only to differences in clinical management but different predictions of complication risk. In recent years, with the accumulation of genome-wide association studies, an increasing number of monogenic forms of diabetes are being discovered.[42–44] Thus the true prevalence of these types may be underestimated.

Diabetes can also arise as a consequence of other conditions. These other specific types of diabetes are listed below, according to the most recent WHO diabetes classification.[40]

Figure 1.3. Other specific types of diabetes[40]

- Diabetes caused by diseases of the pancreas, such as pancreatitis, trauma, infection, pancreatic cancer and pancreatectomy
- Diabetes due to endocrine disorders that cause excess secretion of hormones that antagonise insulin (e.g. Cushing's syndrome)
- Drug and chemical-induced diabetes from drugs that disrupt insulin secretion or insulin action
- Infection-related diabetes that is caused by viral infection associated with beta cell destruction
- Uncommon specific forms of immune-mediated diabetes (e.g. immunological disorders other than those that cause type 1 diabetes)
- Other genetic syndromes sometime associated with diabetes (i.e. Prader-Willi syndrome, Down's syndrome, Friedreich's ataxia)

Newly diagnosed diabetes cases that are not able to be classified in any of the categories that were described in this chapter, are designated as "unclassified diabetes".

References

1 *IDF Clinical Practice Recommendations for Managing Type 2 Diabetes in Primary Care*. [Internet]. International Diabetes Federation; 2019. Available from: https://www.idf.org/e-library/guidelines/128-idf-clinical-practice-recommendations-for-managing-type-2-diabetes-in-primary-care.html

2 American Diabetes Association. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2018. *Diabetes Care*. 2018;41(Suppl 1):S13–27

3 Atkinson MA, Eisenbarth GS, Michels AW. Type 1 diabetes. *Lancet*. 2014 Jan 4;383(9911):69–82

4 Craig ME, Jefferies C, Dabelea D, Balde N, Seth A, Donaghue KC. Definition, epidemiology, and classification of diabetes in children and adolescents. *Pediatr Diabetes* 2014; 19(Suppl 27):7–19

5 Cherubini V, Grimsmann JM, Åkesson K, Birkebæk NH, Cinek O, Dovč K, *et al*. Temporal trends in diabetic ketoacidosis at diagnosis of paediatric type 1 diabetes between 2006 and 2016: results from 13 countries in three continents. *Diabetologia*. 2020 Aug;63(8):1530-1541. doi: 10.1007/s00125-020-05152-1

6 Deylami R, Townson J, Mann M, Gregory JW. Systematic review of publicity interventions to increase awareness amongst healthcare professionals and the public to promote earlier diagnosis of type 1 diabetes in children and young people. *Pediatr Diabetes*. 2018;19(3):566–73

7 Ogle GD, Middlehurst AC, Silink M. The IDF Life for a Child Program Index of diabetes care for children and youth. *Pediatr Diabetes*. 2016;17(5):374–84

8 Ogle GD, James S, Dabelea D, Pihoker C, Svennson J, Maniam J, Patterson CC. Global estimates of incidence of type 1 diabetes in children and adolescents; Results from the International Diabetes Federation Atlas, 10th Edition. *Diabetes Res Clin Pract* 2021 (in press)

9 Tuomilehto J, Ogle GD, Lund-Blix N, Stene LC. Update on worldwide trends in occurrence of childhood Type 1 Diabetes in 2020. *Pediatr Endocrinol Rev* 2020;17(Suppl 1):198–209

10 Gregg EW, Li Y, Wang J, Burrows NR, Ali MK, Rolka D, *et al*. Changes in diabetes-related complications in the United States, 1990–2010. *N Engl J Med*. 2014 Apr 17;370(16):1514–23.

11 King P, Peacock I, Donnelly R. The UK prospective diabetes study (UKPDS): clinical and therapeutic implications for type 2 diabetes. *Br J Clin Pharmacol*. 1999 Nov;48(5):643–8

12 *IDF Clinical Practice Recommendations for Managing Type 2 Diabetes in Primary Care*. [Internet]. International Diabetes Federation; 2019. Available from: https://www.idf.org/e-library/guidelines/128-idf-clinical-practice-recommendations-for-managing-type-2-diabetes-in-primary-care.html

13 Basu S, Yoffe P, Hills N, Lustig RH. The relationship of sugar to population-level diabetes prevalence: an econometric analysis of repeated cross-sectional data. *PLoS ONE*. 2013;8(2):e57873

14 Fazeli Farsani S, van der Aa MP, van der Vorst MMJ, Knibbe C a. J, de Boer A. Global trends in the incidence and prevalence of type 2 diabetes in children and adolescents: a systematic review and evaluation of methodological approaches. *Diabetologia*. 2013 Jul;56(7):1471–88

15 Mayer-Davis EJ, Lawrence JM, Dabelea D, Divers J, Isom S, Dolan L, *et al*. Incidence Trends of Type 1 and Type 2 Diabetes among Youths, 2002–2012. *N Engl J Med*. 2017 13;376(15):1419–29

16 Urakami T, Miyata M, Yoshida K, Mine Y, Kuwabara R, Aoki M, *et al*. Changes in annual incidence of school children with type 2 diabetes in the Tokyo Metropolitan Area during 1975–2015. *Pediatr Diabetes*. 2018;19(8):1385–92

17 National Cardiovascular Intelligence Network (NCVIN)/NHS Diabetes Prevention Programme (NHS DPP). *Nondiabetic hyperglycaemia*. London: Public Health England;2015. Available at: https://www.england.nhs.uk/diabetes/diabetes-prevention/

18 World Health Organization and International Diabetes Federation. *Definition and diagnosis of diabetes mellitus and intermediate hyperglycaemia*. Report of a WHO/IDF Consultation. Geneva; 2016. Available at: https://www.who. int/diabetes/publications/diagnosis_diabetes2006/en/

19 Heianza Y, Hara S, Arase Y, Saito K, Fujiwara K, Tsuji H, *et al*. HbA1c 5·7-6·4% and impaired fasting plasma glucose for diagnosis of prediabetes and risk of progression to diabetes in Japan (TOPICS 3): a longitudinal cohort study. *Lancet*. 2011 Jul 9;378(9786):147–55; DOI:10.1016/S0140-6736(11)60472-8

20 Richter B, Hemmingsen B, Metzendorf M-I, Takwoingi Y. Development of type 2 diabetes mellitus in people with intermediate hyperglycaemia. *Cochrane Database Syst Rev*. 2018 Oct 29;10:CD012661; DOI:10.1002/14651858.CD012661. pub2

21 Tabák AG, Herder C, Rathmann W, Brunner EJ, Kivimäki M. Prediabetes: a high-risk state for diabetes development. *Lancet*. 2012 Jun 16;379(9833):2279–90; DOI:10.1016/S0140-6736(12)60283-9

22 Huang Y, Cai X, Mai W, Li M, Hu Y. Association between prediabetes and risk of cardiovascular disease and all-cause mortality: systematic review and meta-analysis. *BMJ*. 2016 Nov 23;355:i5953; DOI:10.1136/bmj.i5953

23 Yeboah J, Bertoni AG, Herrington DM, Post WS, Burke GL. Impaired fasting glucose and the risk of incident diabetes mellitus and cardiovascular events in an adult population: MESA (Multi-Ethnic Study of Atherosclerosis). *J Am Coll Cardiol*. 2011 Jul 5;58(2):140–6. DOI:10.1016/j.jacc.2011.03.025

24 Diabetes Prevention Program Research Group, Knowler WC, Fowler SE, Hamman RF, Christophi CA, Hoffman HJ, *et al*. 10-year follow-up of diabetes incidence and weight loss in the Diabetes Prevention Program Outcomes Study. *Lancet*. 2009 Nov 14;374(9702):1677–86; DOI:10.1016/S0140-6736(09)61457-4

25 Cefalu WT, Buse JB, Tuomilehto J, Fleming GA, Ferrannini E, Gerstein HC, *et al*. Update and next steps for real-world translation of interventions for Type 2 diabetes prevention: reflections from a Diabetes Care Editors' Expert Forum. *Diabetes Care*. 2016;39(7):1186–201; DOI; 10.2337/dc16-0873

26 Howells L, Musaddaq B, McKay AJ, Majeed A. Clinical impact of lifestyle interventions for the prevention of diabetes: an overview of systematic reviews. *BMJ Open*. 2016 21;6(12):e013806; DOI; 10.1136/bmjopen-2016-013806

27 World Health Organization IDF. *Definition and diagnosis of diabetes mellitus and intermediate hyperglycaemia : report of a WHO/IDF consultation* [Internet]. Geneva: World Health Organization; 2006. Available from: http://www.who.int/iris/handle/10665/43588

28 Bergman M, Manco M, Sesti G, Dankner R, Pareek M, Jagannathan R, *et al*. Petition to replace current OGTT criteria for diagnosing prediabetes with the 1-hour post-load plasma glucose ≥ 155 mg/dl (8.6 mmol/L). *Diabetes Res Clin Pract*. 2018 Dec;146:18–33

29 World Health Organization. *Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy*. Geneva: World Health Organization; 2013. Available from: http://apps.who.int/iris/bitstream/10665/85975/1/WHO_NMH_MND_13.2_eng.pdf

30 Hod M, Kapur A, Sacks DA, Hadar E, Agarwal M, Di Renzo GC, *et al*. The International Federation of Gynecology and Obstetrics (FIGO) initiative on gestational diabetes mellitus: A pragmatic guide for diagnosis, management, and care. *Int J Gynaecol Obstet*. 2015 Oct;131 Suppl 3:S173–211

31 Immanuel J, Simmons D. Screening and treatment for early-onset gestational diabetes mellitus: A systematic review and meta-analysis. *Curr Diab Rep*. 2017 Oct 2;17(11):115

32 Guariguata L, Linnenkamp U, Beagley J, Whiting DR, Cho NH. Global estimates of the prevalence of hyperglycaemia in pregnancy. *Diabetes Res Clin Pract*. 2014 Feb;103(2):176–85

33 American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care*. 2014 Jan;37 Suppl 1:S81–90

34 Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy: a World Health Organization Guideline. *Diabetes Res Clin Pract*. 2014 Mar;103(3):341–63

35 International Association of Diabetes and Pregnancy Study Groups Consensus Panel. Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, *et al*. International Association of Diabetes and Pregnancy Study Groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. *Diabetes Care*. 2010 Mar;33(3):676–82

36 Saeedi M, Cao Y, Fadl H, Gustafson H, Simmons D. Increasing prevalence of gestational diabetes mellitus when implementing the IADPSG criteria: A systematic review and meta-analysis. *Diabetes Res Clin Pract*. 2021;172:108642

37 Song C, Lyu Y, Li C, Liu P, Li J, Ma RC, *et al*. Long-term risk of diabetes in women at varying durations after gestational diabetes: a systematic review and meta-analysis with more than 2 million women. *Obes Rev*. 2018;19(3):421–9

38 Bellamy L, Casas J-P, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: A systematic review and meta-analysis. *Lancet*. 2009 May 23;373(9677):1773–9

39 Fetita L-S, Sobngwi E, Serradas P, Calvo F, Gautier J-F. Consequences of fetal exposure to maternal diabetes in offspring. *J Clin Endocrinol Metab*. 2006 Oct;91(10):3718–24

40 World Health Organization. *Classification of diabetes mellitus* [Internet]. World Health Organization; 2019 [cited 2019 Jul 16]. Available from: https://apps.who.int/iris/handle/10665/325182

41 Hattersley AT, Greeley SAW, POLAK M, Rubio-Cabezas O *et al*. ISPAD Clinical Practice Consensus Guidelines 2018: The diagnosis and management of monogenic diabetes in children and adolescents. *Pediatr Diabetes* 2018;19(Suppl 27):47-63. Doi: 10.1111/pedi.12722

42 Vaxillaire M, Bonnefond A, Froguel P. The lessons of early-onset monogenic diabetes for the understanding of diabetes pathogenesis. *Best Pract Res Clin Endocrinol Metab*. 2012 Apr;26(2):171–87

43 Cnop M, Toivonen S, Igoillo-Esteve M, Salpea P. Endoplasmic reticulum stress and eIF2α phosphorylation: The Achilles heel of pancreatic β cells. *Mol Metab*. 2017;6(9):1024–39

44 Flannick J, Johansson S, Njølstad PR. Common and rare forms of diabetes mellitus: towards a continuum of diabetes subtypes. *Nat Rev Endocrinol*. 2016;12(7):394–406

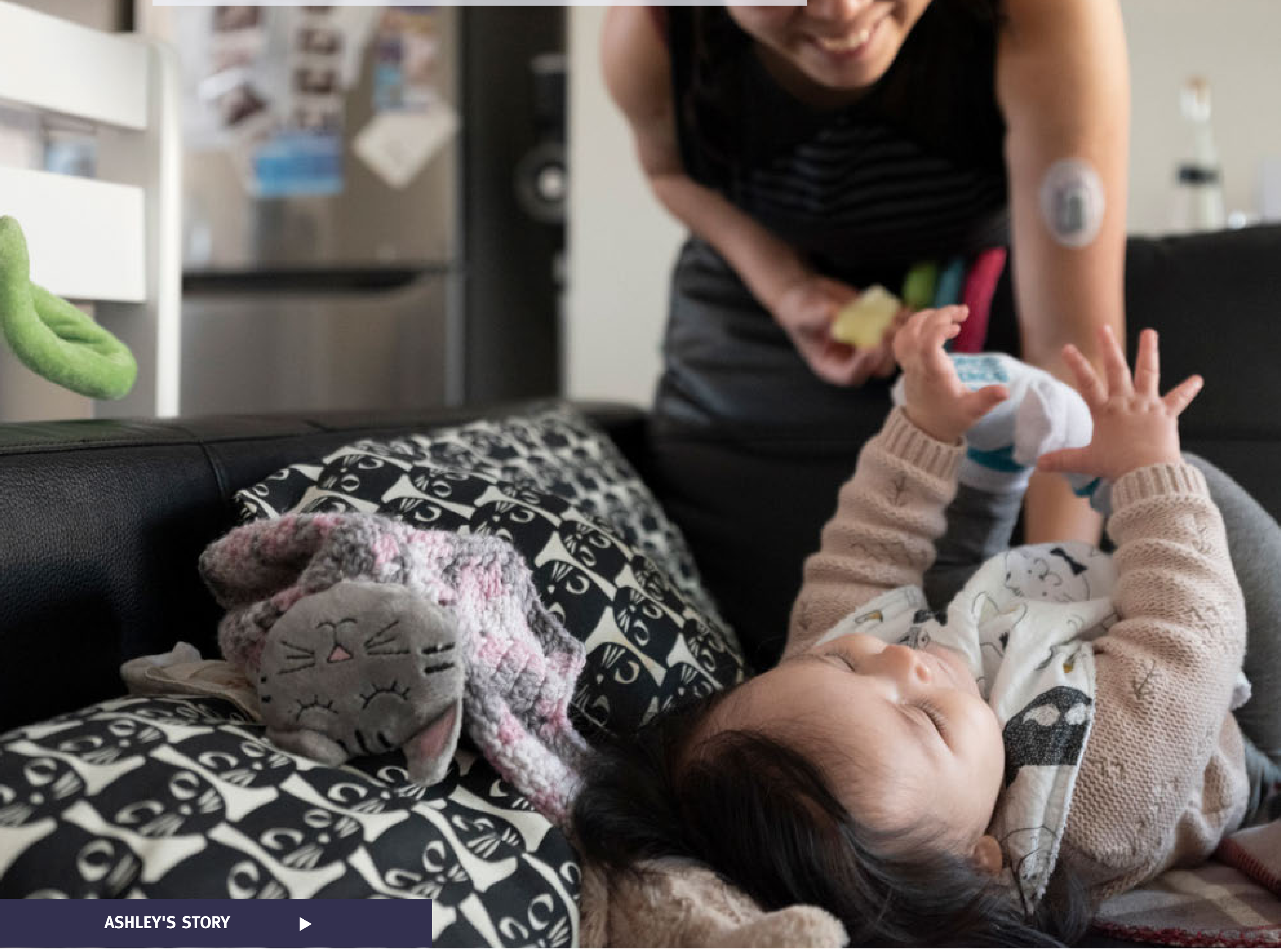
Key messages

- 219 data sources from 144 countries were selected to estimate diabetes prevalence for the current *IDF Diabetes Atlas*

- Data sources come from countries which comprise over 93% of the global population

- Other sources, such as registries, have also been included, but only after rigorous scrutiny of their quality, just as for the peer-reviewed publications

- Future projections have been calculated using the United Nations population predictions and degree of urbanisation. These predictions only take into account changes in the distribution of age, sex and urban/rural residence ratio



ASHLEY'S STORY ▶

2

Methods

Methods

Interpretation of estimates

Monitoring prevalence (the number of people with diabetes at any one time divided by total population) and incidence (new cases of diabetes over a period of time divided by the total population from which cases arise) are important indices of disease burden and useful for monitoring the impact of preventive interventions.

In each edition of the *IDF Diabetes Atlas*, we estimate diabetes prevalence based on the best quality data available at the time of analysis as judged by the international diabetes experts who comprise the *IDF Diabetes Atlas* Committee. It is important to highlight that the diabetes estimates presented in this edition have varying degrees of uncertainty. Thus, these estimates must be interpreted along with their confidence intervals (CI) where the true estimate may lie anywhere between the upper and lower bounds. A wide CI indicates an imprecise estimate while a narrow interval reflects more precision.

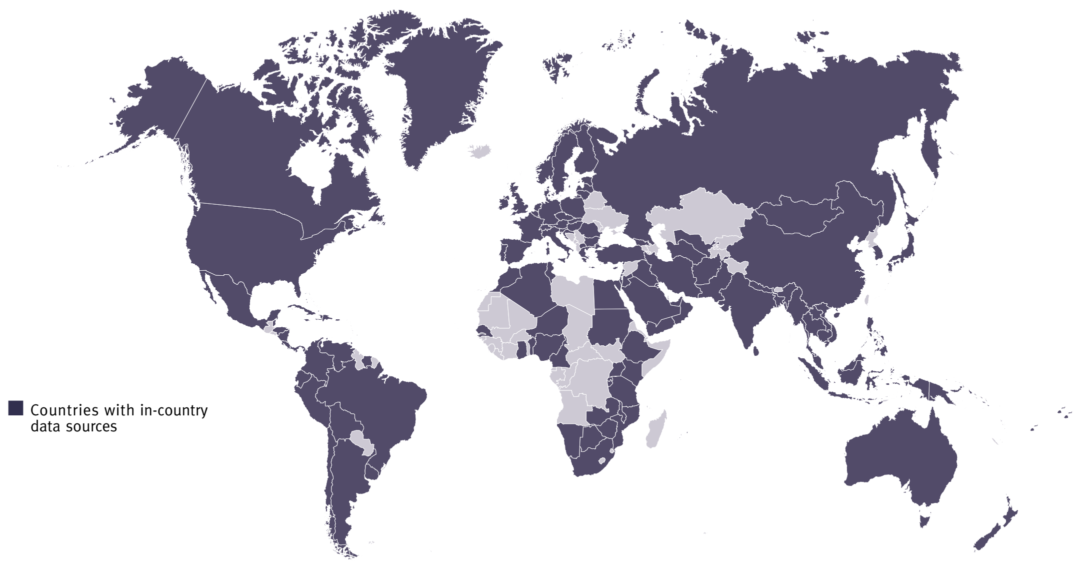
Depending on study design, sample size, type of measurements performed, definitions and analysis methods, these estimates can vary markedly between studies and between countries as well as over time. Therefore, changes in the magnitude of prevalence of individual countries from edition to edition and comparisons between countries should be treated with caution. Additionally, predicted estimates for the future are based only on projected changes in age, sex and rural-urban residence location as defined by the UN.

Gathering and selecting data sources

The data used for the estimation of diabetes prevalence in this edition of the *IDF Diabetes Atlas* were obtained from a variety of sources. The vast majority were extracted from peer-reviewed publications and national health surveys including selected WHO STEPwise approach to surveillance (WHO STEPS) studies.[1] Data from other official sources such as registries and reports from health regulatory bodies were also used, provided there was sufficient information to assess their quality. Data sources with sufficient methodological information on key areas of interest such as method of diagnosis and representativeness of the sample were also included. Given the importance of age as a major determinant for diabetes prevalence, only studies with at least three age-specific estimates were included. Data sources published before 2005 were excluded, except when a country lacked a more recent study.

In total, 41 WHO STEPS were included as data sources, of which 13 were included for the 10th edition of the *IDF Diabetes Atlas* for the first time. WHO STEPS studies that have been recently shown to overestimate diabetes prevalence[2] were excluded from this edition of the *IDF Diabetes Atlas*. Furthermore, territories that had a population less than 50,000 were excluded. As a result, this edition presents data for 215 countries and territories compared to the previous edition, which had 211. The territories added in this edition are American Samoa, Holy See, Isle of Man, Mayotte and the Northern Mariana Islands.

Map 2.1 Countries and territories with in-country data sources on diabetes



In addition, data sources published between January 2019 and December 2020 were screened and added to the existing database if they met the inclusion criteria mentioned below. This added 81 data sources from 67 countries to the existing database (Map 2.1).

To evaluate the quality of available data, each data source was scored, as in previous *IDF Diabetes Atlas* editions, using an analytical hierarchy process (AHP)[3] taking into account the criteria mentioned in Figure 2.1. In this table, the classification possibilities for each of the criteria are presented, arranged from highest to the lowest degree of preference. In total, 219 out of 860 included data sources (25.5%) published since 2005 met the rigorous inclusion criteria or were included by expert consensus for this 10th edition.

Figure 2.1 Classification of diabetes data sources

Method of diabetes diagnosis
- Oral glucose tolerance test (OGTT)
- Fasting blood glucose (FBG)
- Haemoglobin A1c (HbA1c)
- Self-reported diabetes
- Medical record or clinical diagnosis

Sample size
- Equal to or greater than 5,000 people
- 1,500 to 4,999 people
- 700 to 1,499 people
- Less than 700 people

Representativeness of study sample
- Nationally representative
- Regionally representative
- Locally representative
- Ethnic (or other) specific group representative

Age of the data source
(i.e. time since study conducted)
- Less than 5 years
- 5 to 9 years
- 10 to 19 years
- 20 or more years

Type of publication
- Peer-reviewed publication
- National health survey
- Other official report or publication by a health regulatory body
- Unpublished study

The final score of a data source is the summary of all scores on the five criteria mentioned in Figure 2.1. Data sources that received a score over a certain threshold (agreed in consensus with members of the *IDF Diabetes Atlas* Committee) were used to generate the estimates and projections. Preference was given to data sources that were nationally representative, conducted in the past five years, published in peer-reviewed journals and were based on the objective measurement of diabetes status (rather than self-reported).†

Estimating diabetes prevalence and projections for the future

After the selection of data sources, the reported age- and sex-specific data in each data source were smoothed using a logistic regression model. If more than one data source was available for an individual country, the country level diabetes estimates were derived using an average of prevalence estimated from various data sources, with each weighted by the quality score based on the AHP scoring. This permitted the higher quality studies to contribute more to the final country estimate. The details of the logistic regression model are described in a previous publication[4] and any changes and development of the methods are summarised more recently by Sun *et al.*[5]

For each country, the age- sex- and urban/rural-specific diabetes estimates were generated. For studies that did not present results stratified by urban and rural area, the estimated ratio of urban to rural prevalence of disease from the original data or United Nations Population Division (UNPD)[6] approximation was used to distribute the results by urban and rural prevalence. Prevalence estimates were then aggregated to produce estimates for the seven IDF Regions and countries in the four World Bank income classification categories.

The 2021 population data from the UNPD were used in estimating the number of people with diabetes for each nation. In order to project diabetes estimates forward to the years 2030 and 2045, population projections for 2030 and 2045 from the UNPD for each nation were used. The 2030 and 2045 diabetes projections assume that diabetes prevalence does not change for each age group, but take into account the changes in population age structure and degrees of urbanisation.[7] This approach is likely to underestimate future diabetes prevalence as it does not take into account changes in prevalence of obesity and other risk factors that might result in a higher diabetes incidence.

† Data sources used in this edition can be found at the IDF Diabetes Atlas website: www.diabetesatlas.org.

However, estimating diabetes projections for 2030 and 2045 in this way allows comparison with projections made, for the same years, in previous editions of the *IDF Diabetes Atlas*. Increases or decreases in diabetes prevalence in specific countries in this edition compared to the previous editions of the *IDF Diabetes Atlas* may be the result of updates or changes in data sources and may not be a complete or precise reflection of actual changes in diabetes prevalence occurring in that country.

Extrapolating data

One third of countries or territories with more than 50,000 habitants (71 countries out of 215 countries or territories, 33%) do not have in-country data sources on diabetes prevalence that fulfil the *IDF Diabetes Atlas* inclusion criteria. Under such circumstances, estimates were generated by extrapolation using diabetes prevalence data from countries that are similar in terms of ethnicity[8], language[9], World Bank income classification[10] and geographic location.

Extrapolated estimates are less reliable than estimates based on national data sources and should therefore be interpreted with caution. Countries with extrapolated estimates are designated in the country summary table (Appendices) and Map 2.1. The necessity of extrapolation emphasises the importance of conducting high quality studies worldwide that help to address gaps in diabetes prevalence information.

Estimating confidence intervals

Confidence intervals are provided to indicate the degree of uncertainty around each of the estimates. In order to calculate these, two separate analyses were performed: a jack-knife analysis of the sensitivity of the global prevalence estimate to the study selection process and a simulation study to access raw data uncertainty.

The confidence interval for each age group, sex and country was constructed based on combining the minimum and maximum for simulation analyses and the study selection jackknife analyses. These procedures are described more fully elsewhere.[5]

Standardisation of estimates

It is important to appreciate that the *IDF Diabetes Atlas* data is standardised to two different populations and both types of standardised estimates are referred to in the forthcoming chapters.

The total numbers of persons with diabetes, IGT and IFG for each country were calculated by applying the calculated age-, sex- and urbanisation- specific prevalence rates to that country's 2021 age-, sex- and urban/rural setting distribution as estimated by the United Nations Population Prospects 2019 Revision.[6, 11]

This provides a prevalence estimate standardised to the national population, as indicated in the table and figure footnotes: 'standardised to each national population'. This method was used to produce individual country standardised diabetes prevalence estimates. However, to permit comparison of diabetes prevalence between countries, additional 'comparative' estimates were also calculated.

These were produced by standardising 2021 prevalence estimates from each country to the age structure of an estimated UN world population. They are referred to as 'comparative prevalence' and indicated with a footnote: 'standardised to world population'. This latter standardisation approach removes the effect of differences in the age structure between countries. The comparative diabetes prevalence in 2030 and 2045 was calculated using the UN projected global age structures for 2030 and 2045, respectively.[6]

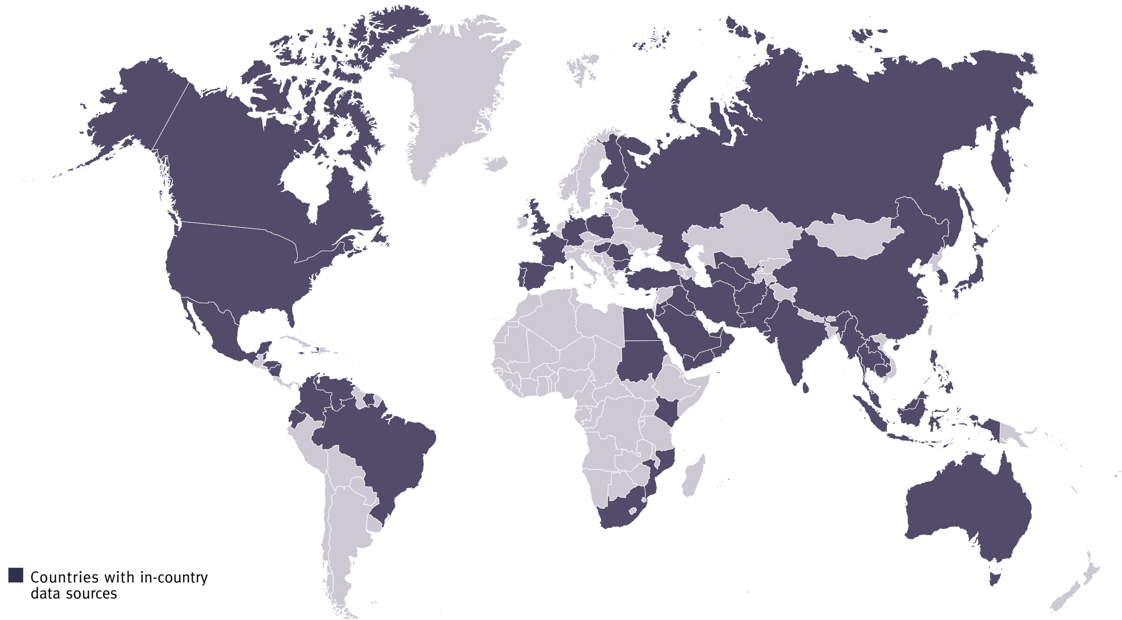
Estimating undiagnosed diabetes prevalence

The early detection of diabetes and initiation of treatment is extremely important in the management of diabetes and prevention of complications. The longer a person has diabetes but remains undiagnosed, the greater the risk of developing complications. People are defined as having undiagnosed diabetes when their blood glucose levels would satisfy the diagnostic criteria for diabetes, but the diagnosis has not been confirmed by a doctor.

Population-based scientific studies allow us to estimate the prevalence of undiagnosed diabetes worldwide. A sample of the population is surveyed to assess how many people have diabetes. Those who say they do not have diabetes are then tested. This helps establish the total prevalence of people already diagnosed with diabetes, and those who tested positive for diabetes in this population sample. The number of undiagnosed people as a proportion of the total number of people living with diabetes is then extrapolated to calculate country-level estimates for undiagnosed diabetes. The proportion of undiagnosed diabetes may differ greatly across countries with different access to healthcare, with less access likely related to a higher proportion with this undiagnosed condition.

It is important to keep in mind that diagnostic tests are based on different biochemical processes and often yield different results.[12] Common tests, such as an oral glucose

Map 2.2 Countries and territories with data sources on the proportion of adults (20–79 years) with previously undiagnosed diabetes



tolerance test (OGTT), fasting blood glucose (FBG) or a haemoglobin A1c (HbA1c) test detect different subgroups of people with diabetes and those groups only partially overlap. While this means studies may report different proportions of undiagnosed people, any diagnostic method for diabetes even if it is not able to detect all cases, can be useful in detecting diabetes earlier.

For this edition of the *IDF Diabetes Atlas*, we have assembled all published studies reporting undiagnosed diabetes that met defined selection criteria, regardless of the way diabetes was detected. The average of the estimates was calculated for countries that reported data on estimates of undiagnosed diabetes. However, in countries without in-country data sources, the undiagnosed proportion was approximated by the average of the estimates from countries with data sources within the same IDF Regions and World Bank Income Group (Map 2.2). Further details of this methodology can be found in previous IDF publications.[13]

Estimating the incidence and prevalence of type 1 diabetes in children and adolescents

The incidence and prevalence estimates of type 1 diabetes in children and adolescents (0–14 and 0–19 years of age) were produced by the 10th Edition of the *IDF Diabetes Atlas* Type 1 Diabetes in Children and Adolescents Special Interest Group, using methodology from the 9th Edition of the *IDF Diabetes Atlas* as previously described[14], along with published prevalence data, when available.

The scientific literature was searched, without language restrictions, for data sources that contained population-based studies on the incidence of type 1 diabetes (new cases each year) or prevalence (existing total cases) in children and adolescents aged up to 20 years. If more than one study was available for a country, the following criteria were applied to select the most suitable study: recent, population-based studies, high (≥90%) ascertainment level, covering a large part of the country, providing age- and sex-specific rates, and including the age ranges 0–14 and 15–19 years. For some countries where two or more studies met these criteria to an equal extent, results were combined by averaging age- and sex-specific rates.

If a country did not have any information available, the incidence rate for ages under 15 years was estimated using data from a similar country, based on geographical proximity, income and ethnicity. For ages 15–19 years, the incidence rate was estimated using the average regional ratio of incidence rates in the 0–14 and 15–19 years age groups.

Prevalence estimates were then derived from these incidence rates, and both were applied to UN population estimates for respective countries to obtain estimates of the numbers of incident and prevalent cases. However, there was a need to adjust prevalence estimates derived from the incidence rates to allow for case fatality, particularly in low-income countries. A mortality-adjusted prevalence was calculated for each country, based on a standardised mortality ratio for people with type 1 diabetes predicted from the country's infant mortality rate (IMR) using a relationship derived in a systematic review of mortality studies in children with type 1 diabetes.[14,15] IMR data were obtained from the WHO Global Health Observatory data repository.[16] For countries not included in the repository, the Central Intelligence Agency World Factbook[17], UN country profile[18] or IndexMundi[19] were used.

A search was also made for type 1 diabetes prevalence studies in children and adolescents. Studies were required to have no data older than the year 2000, have sound, clearly-defined methodology where prevalence was measured rather than imputed from incidence, be country-wide or from a representative part of a country, have ascertainment estimated at ≥90%, and be within five years of the dates of an incidence study.

Publications from 12 countries were found and these published prevalence results were used in place of the calculated prevalence method for these countries.

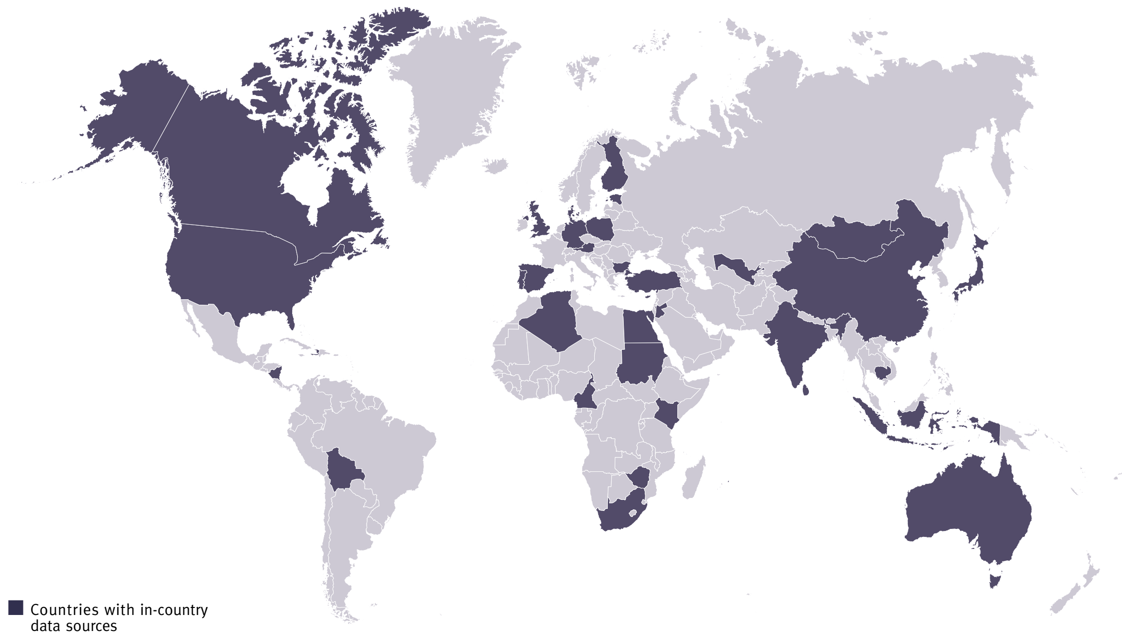
Estimating the incidence and prevalence of youth-onset type 2 diabetes

Youth-onset type 2 diabetes, broadly defined as type 2 diabetes when diagnosed under 20 years of age, is increasingly recognised as an emerging chronic disease in children and adolescents. However, nationally representative epidemiologic data to monitor the occurrence of youth-onset type 2 diabetes are lacking in many regions – most notably in sub-Saharan Africa.

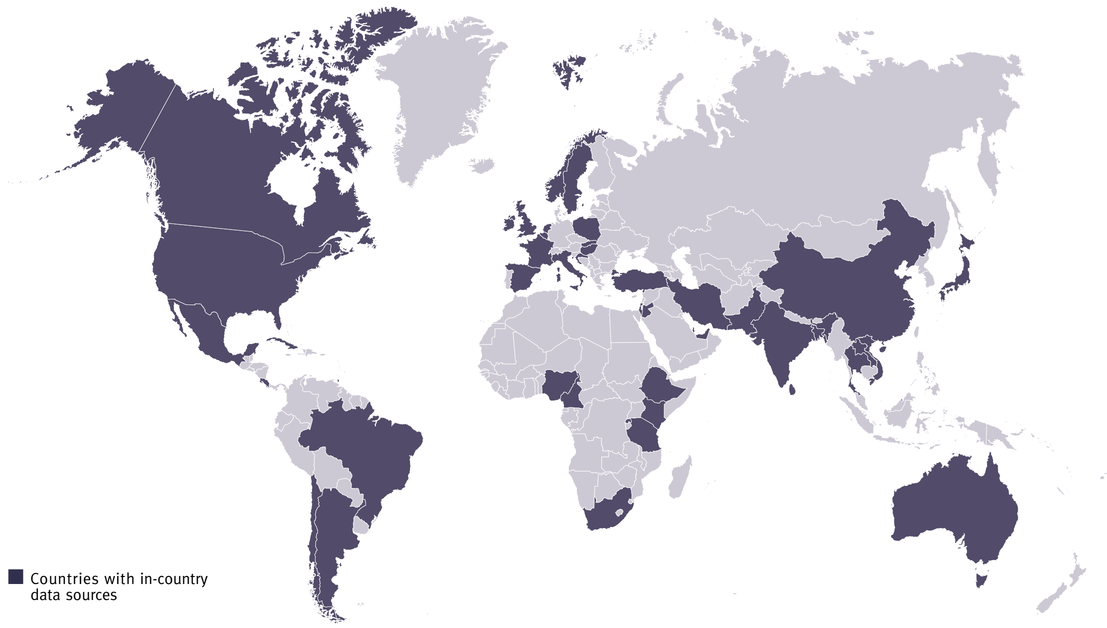
There are many challenges to collecting good quality data on youth-onset type 2 diabetes, in particular the categorisation of diabetes types, given the overlap in clinical presentations of type 2 diabetes, type 1 diabetes and monogenic diabetes.

The comparison of youth-onset type 2 diabetes incidence and prevalence within and across countries and by time period is difficult due to differences in methods of case ascertainment and completeness, variation of age ranges reported as youth-onset, and varying quality of information. The proportion of youth with undiagnosed type 2 diabetes across different regions may also impact the overall epidemiology of youth-onset type 2 diabetes.

Map 2.3 Countries and territories with data sources on impaired glucose tolerance in adults (20–79 years)



Map 2.4 Countries and territories with selected data sources on hyperglycaemia in pregnancy (adults 20–49 years), 2021



Estimating the prevalence of impaired glucose tolerance and impaired fasting glucose

Data sources for impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) prevalence were identified and selected according to criteria previously described (See Chapter 1). The urban and rural IGT and IFG prevalence ratios were calculated according to the weighted average of the ratios reported in various data sources from seven IDF Regions and the World Bank country classifications by income.

A logistic regression model was used to estimate the prevalence of IGT and IFG by country. The number of studies that satisfied the selection criteria was limited to 57 studies (from 48 countries) for IGT and to 49 studies (from 44 countries) for IFG. The prevalence estimates for the remaining countries were extrapolated from countries deemed to be similar, as for total diabetes prevalence (Map 2.3).

Estimating the prevalence of hyperglycaemia in pregnancy

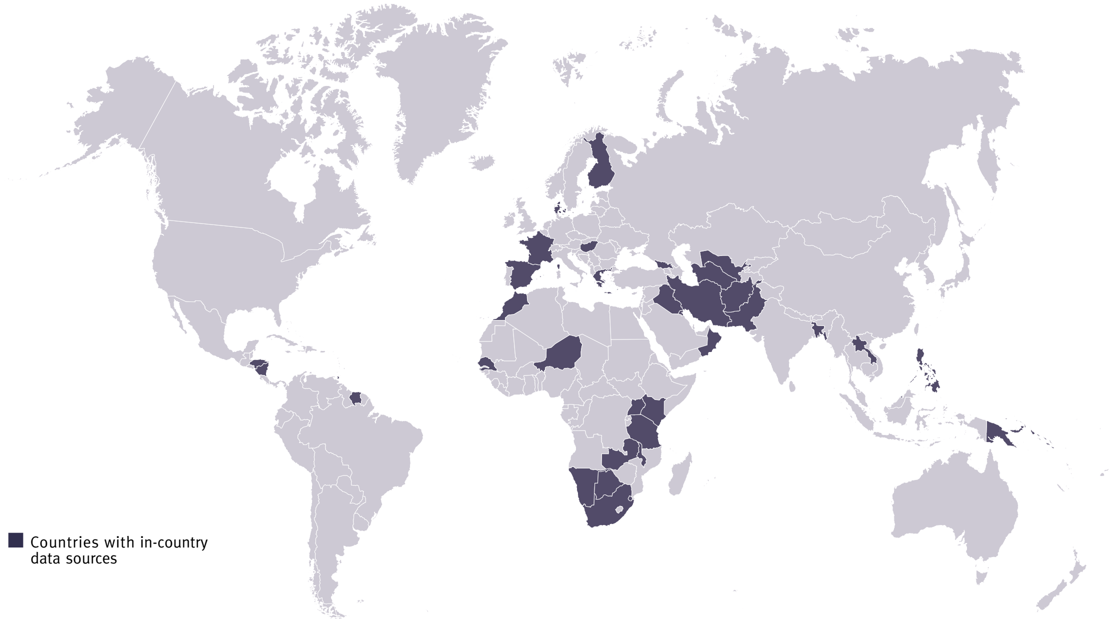
Data sources reporting age-specific prevalence of gestational diabetes mellitus (GDM) and diabetes first detected in pregnancy were searched[20] and selected according to the criteria described previously.[21] UN fertility projections[22] and IDF estimates of diabetes were used to calculate the total percentage of live births affected by hyperglycaemia in pregnancy (HIP).

All studies were scored according to the diagnostic criteria used, the year the study was carried out, study design, the representativeness of the sample and the screening approach. Studies which met our pre-defined threshold were then selected to calculate country-level estimates. For this edition of the *IDF Diabetes Atlas*, 58 studies from 47 countries were used to estimate country-level, age-specific prevalence of HIP using a generalised linear regression model (Map 2.4). The detailed methods for estimation of prevalence of HIP have been described previously.[21]

It should be noted that the method for selecting data sources was updated in the 9th edition of the *IDF Diabetes Atlas*. Thus, any comparison of the prevalence estimates from the 9th and 10th editions with those of previous editions must be viewed with caution. The changes in the selection of data sources include:

- International Association of Diabetes and Pregnancy Study Group (IADPSG) diagnostic criteria have been given more weight in this edition compared to previous editions.
- A new criterion, termed "screening approach", has been added that includes the following options: universal one step, selective, two or more steps, and selective two or more steps.

Map 2.5 Countries and areas with data sources on impaired fasting glucose in adults (20–79 years), 2021



Estimating diabetes-related mortality

The total number of deaths attributable to diabetes by country was calculated by combining information on the number of annual deaths from all-causes stratified by age and sex[23], age- and sex-specific mortality relative risks in people with diabetes compared to those without diabetes, and country-specific diabetes prevalence by age and sex for the year 2021. Relative risks attributable to diabetes are derived from cohort studies comparing death rates in those with and without diabetes.[24, 25] This method of estimating diabetes-related mortality is described in more detail elsewhere.[26–28]

Estimating the economic impact of diabetes

The direct cost estimates in this edition of the *IDF Diabetes Atlas* were calculated using an attributable fraction method, which relies on the following inputs:

- *IDF Diabetes Atlas* estimates of diagnosed and undiagnosed diabetes prevalence for each country and for each age and sex sub-group, stratified by rural and urban setting.
- UN population estimates for 2021 and UN population projections for 2030 and 2045.
- WHO global health expenditures per capita for 2018 (latest available data).
- The ratios of health expenditures for people with diabetes compared to people without diabetes, stratified by age, sex, rural versus urban setting, diagnosed and undiagnosed diabetes, and income per IDF Region.

The WHO definition of health expenditure includes 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 services. The definition includes health expenditures from both public and private sources.[29] The same method was used as in the previous editions to distribute the total health expenditure in a given country into expenditure by age and sex.[30]

Another critical component of the analyses is the ratio of health expenditures for people with diabetes (diagnosed or undiagnosed) compared to those without diabetes. Since the publication of the *IDF Diabetes Atlas* 8th edition, these ratios have been refined by the work of Bommer *et al*. (2017)[31], providing estimates for this ratio with much more specificity in relation to age, sex, rural versus urban setting, whether diabetes is diagnosed, region, and income levels of countries.

The diabetes-related health expenditure estimates are presented in US dollars (USD), and in international dollars (ID), as well as a percentage of total health expenditures and of gross domestic product (GDP). IDs account for local purchasing power and facilitate direct cross-country comparisons of health expenditures. Health expenditures for diabetes as a percentage of total health expenditures and of GDP reflect the direct economic burden of diabetes to a national economy.

1 World Health Organization. *STEPS: A framework for surveillance*. Geneva; 2003

2 Lin S, Rocha VM, Taylor R. Artefactual inflation of type 2 diabetes prevalence in WHO STEP surveys. *Trop Med Int Health*;2019 Feb 1

3 Saaty TL. Relative measurement and its generalization in decision making why pairwise comparisons are central in mathematics for the measurement of intangible factors the analytic hierarchy/network process. *Revista de la Real Academia de Ciencias Exactas, Fisicas y Naturales Serie A Matematicas*. 2008 Sep;102(2):251–318

4 Guariguata L, Whiting D, Weil C, Unwin N. The International Diabetes Federation diabetes atlas methodology for estimating global and national prevalence of diabetes in adults. *Diabetes Res Clin Pract*. 2011 Dec;94(3):322–32

5 Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, *et al*. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diab Res Clin Pract*. 2021 (in press)

6 United Nations. *World Population Prospects: The 2017 Revision*. New York; 2017

7 United Nations. *2018 Revision of World Urbanization Prospects*. New York; 2018

8 Central Intelligence Agency. *The World Factbook, Ethnic groups*. Washington, DC; 2015

9 Central Intelligence Agency. *The World Factbook, Languages*. Washington, DC; Languages; 2015

10 The World Bank. *World Bank Country and Lending Groups*; 2015.

11 Ahmad OB, Boschi-Pinto C, Lopez AD, Murray CJ, Lozano R, Inoue M. *Age Standardization of Rates: A new WHO Standard*. :14

12 Galaviz KI, Narayan KMV, Lobelo F, Weber MB. Lifestyle and the Prevention of Type 2 Diabetes: A Status Report. *Am J Lifestyle Med*. 2015;12(1):4-20. Published 2015 Nov 24. doi:10.1177/1559827615619159

13 Beagley J, Guariguata L, Weil C, Motala AA. Global estimates of undiagnosed diabetes in adults. *Diabetes Res Clin Pract* 2014;103:150–60. https://doi.org/10.1016/j.diabres.2013.11.001.

14 Patterson CC, Karuranga S, Salpea P, Saeedi P, Dahlquist G, Soltesz G, Ogle GD. Worldwide estimates of incidence, prevalence and mortality of Type 1 Diabetes in children and adolescents: Results from the International Diabetes Federation Diabetes Atlas. *Diabetes Res Clin Pract* 2019; 157:107842

15 Morgan E, Cardwell CR, Black CJ, McCance DR, Patterson CC. Excess mortality in Type 1 diabetes diagnosed in childhood and adolescence: a systematic review of population-based cohorts. *Acta Diabetol*. 2015 Aug;52(4):801–7

16 World Health Organization. *Global Health Observatory data repository, Life tables* by country WHO. [Internet]. 2019. Available from: http://apps.who.int/gho/data/node.main.LIFECOUNTRY?lang=en

17 Central Intelligence Agency (CIA). *The World Factbook* [Internet]. Available from: https://www.cia.gov/the-world-factbook/

18 United Nations. UNdata Country Profile. New York 2019. Available from: http://data.un.org/en/index.html

19 IndexMundi – Country facts (2019). Available from: http://www.indexmundi.com

20 Yuen L, Saeedi P, Riaz M, *et al*. Projections of the prevalence of hyperglycaemia in pregnancy in 2019 and beyond: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Res Clin Pract*. 2019 Nov;157:107841. DOI: 10.1016/j.diabres.2019.107841. Epub 2019 Sep 10

21 Linnenkamp U, Guariguata L, Beagley J, *et al*. The IDF Diabetes Atlas methodology for estimating global prevalence of hyperglycaemia in pregnancy. *Diabetes Res Clin Pract*. 2014 Feb;103(2):186–96. DOI:10.1016/j. diabres.2013.11.004

22 United Nations. *World population prospects* (2017 revision). New York; 2017

23 World Health Organization. *Global Health Estimates 2019 Summary Tables* [Internet]. Geneva; 2019 [cited 2021 Jun 21]. Available from: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death

24 Bracco PA, Gregg EW, Rolka DB, Schmidt MI, Barreto SM, Lotufo PA, *et al*. A nationwide analysis of the excess death attributable to diabetes in Brazil. *J Glob Health*. 2020 Jun;10(1):010401. doi: 10.7189/jogh.10.010401. PMID: 32257151; PMCID: PMC7101024

25 Bragg F, Holmes MV, Iona A, Guo Y, Du H, Chen Y, *et al*. Association Between Diabetes and Cause-Specific Mortality in Rural and Urban Areas of China. *JAMA*. 2017 Jan 17;317(3):280-289. doi: 10.1001/jama.2016.19720. PMID: 28114552; PMCID: PMC6520233

26 Saeedi P, Salpea P, Karuranga S Petersohn I, Malanda B, Gregg EW, *et al*. Mortality attributable to diabetes in 20–79 years old adults, 2019 estimates: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Res Clin Pract*. 2020 Apr;162:108086. doi: 10.1016/j.diabres.2020.108086. Epub 2020 Feb 15

27 Roglic G, Unwin N. *Mortality attributable to diabetes*: estimates for the year 2010. Diabetes Res Clin Pract. 2010 Jan;87(1):15–9

28 IDF *Diabetes Atlas* Group. *Update of mortality attributable to diabetes for the IDF Diabetes Atlas*: Estimates for the year 2011. Diabetes Research and Clinical Practice. 2013 May;100(2):277–9

29 World Health Organization. *Global Health Expenditure database*. [Internet]. 2021. Available from: https://apps.who.int/nha/database

30 Williams R, Karuranga S, Malanda B, *et al*. Global and regional estimates and projections of diabetes-related health expenditure: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Res Clin Pract*. 2020;162:108072.

31 Bommer C, Heesemann E, Sagalova V, Manne-Goehler J, Atun R, Bärnighausen T, *et al*. The global economic burden of diabetes in adults aged 20–79 years: a cost-of-illness study. *Lancet Diabetes Endocrinol*. 2017;5(6):423–30

Key messages

- An estimated 537 million adults aged 20–79 years are currently living with diabetes. This represents 10.5% of the world's population in this age group
- The total number is predicted to rise to 643 million (11.3%) by 2030 and to 783 million (12.2%) by 2045
- An estimated 240 million people are living with undiagnosed diabetes worldwide, meaning almost one-in-two adults with diabetes are unaware they have the condition
- Almost 90% of people with undiagnosed diabetes live in low- and middle-income countries
- In Africa, South-East Asia and the Western Pacific more than half of people with diabetes are undiagnosed
- Over 1.2 million children and adolescents have type 1 diabetes. Over half (54%) are under 15 years of age
- The incidence of diabetes was stable or declined in the period from 2006 to 2017 in over 70% of mainly high-income populations, according to a systematic review of the literature
- Over 80% of countries reported declining or stable diabetes incidence since 2010

CYRINE'S STORY ▶

3

Global picture

3 Global picture

In this 10th edition of the *IDF Diabetes Atlas*, the prevalence of diabetes is estimated for the year 2021 and projected to the years 2030 and 2045. The diabetes estimates are for adults aged 20–79 years, and include both type 1 and type 2 diabetes, as well as diagnosed and undiagnosed diabetes.

An estimated 537 million adults aged 20–79 years worldwide (10.5% of all adults in this age group) have diabetes. By 2030, 643 million, and by 2045, 783 million adults aged 20–79 years are projected to be living with diabetes. Thus, while the world's population is estimated to grow 20% over this period, the number with diabetes is estimated to increase by 46% (Map 3.1, Table 3.1, Map 3.2).

Map 3.1 Estimated total number of adults (20–79 years) with diabetes in 2021

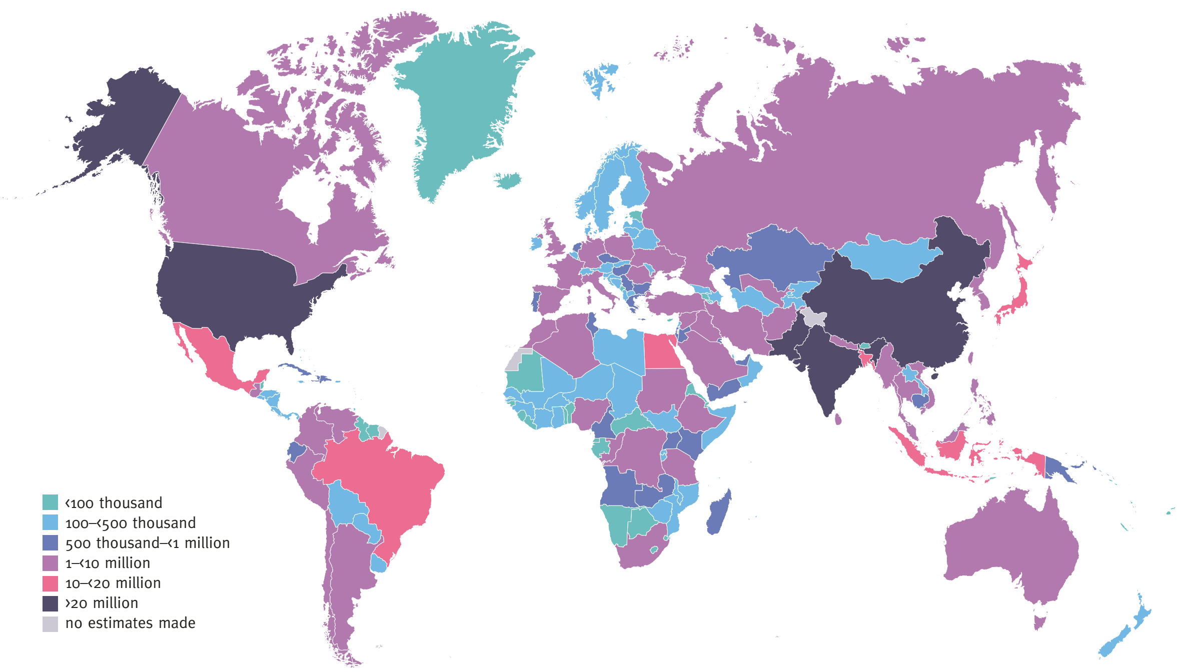
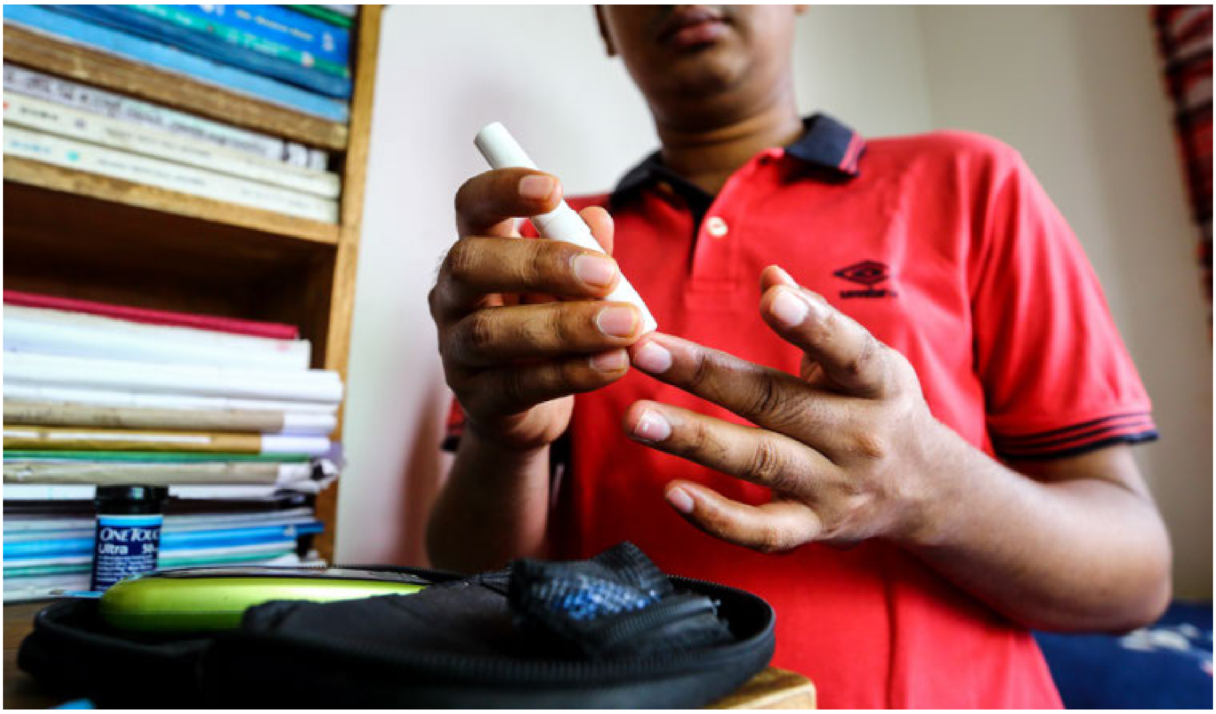


Table 3.1 Estimated total number of adults (20–79 years) with diabetes in 2021, 2030 and 2045

At a glance	2021	2030	2045
Total world population	7.9 billion	8.6 billion	9.5 billion
Adult population (20–79 years)	5.1 billion	5.7 billion	6.4 billion
Diabetes (20–79 years)			
Prevalence[i]	10.5%	11.3%	12.2%
Number of people with diabetes	536.6 million	642.7 million	783.2 million
Number of deaths due to diabetes	6.7 million	–	–
Total health expenditure due to diabetes[ii] (2021 USD)	USD 966 billion	USD 1,028 billion	USD 1,054 billion
Hyperglycaemia in pregnancy (20–49 years)			
Proportion of live births affected[iii]	16.7%	–	–
Number of live births affected	21.1 million	–	–
Impaired glucose tolerance (20–79 years)			
Prevalence[i]	10.6%	11.0%	11.4%
Number of people with impaired glucose tolerance	541.0 million	622.7 million	730.3 million
Impaired fasting glucose (20–79 years)			
Prevalence[i]	6.2%	6.5%	6.9%
Number of people with impaired glucose tolerance	319.0 million	369.7 million	440.8 million
Type 1 diabetes (0–19 years)			
Number of children and adolescents with type 1 diabetes	1.2 million	–	–
Number of newly diagnosed cases each year	184,100	–	–

i Prevalence is standardised to each national population for the respective year
ii Health expenditure for people with diabetes is assumed to be on average two-fold higher than people without diabetes
iii Prevalence is standardised to world population for the respective year



Diabetes prevalence in 2021 and projections to 2030 and 2045 (20–79 years)

The estimates in this 10th edition of the *IDF Diabetes Atlas* are provided for 215 countries and territories, grouped into the 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). In total, 219 data sources from 144 countries were included in the analysis.[1]

Our projections show a growth of 16% in the expected prevalence of diabetes due to ageing of the population. The greatest percentage increase from 2021 to 2045 in comparative prevalence is estimated to occur in middle-income countries due to their ageing populations.

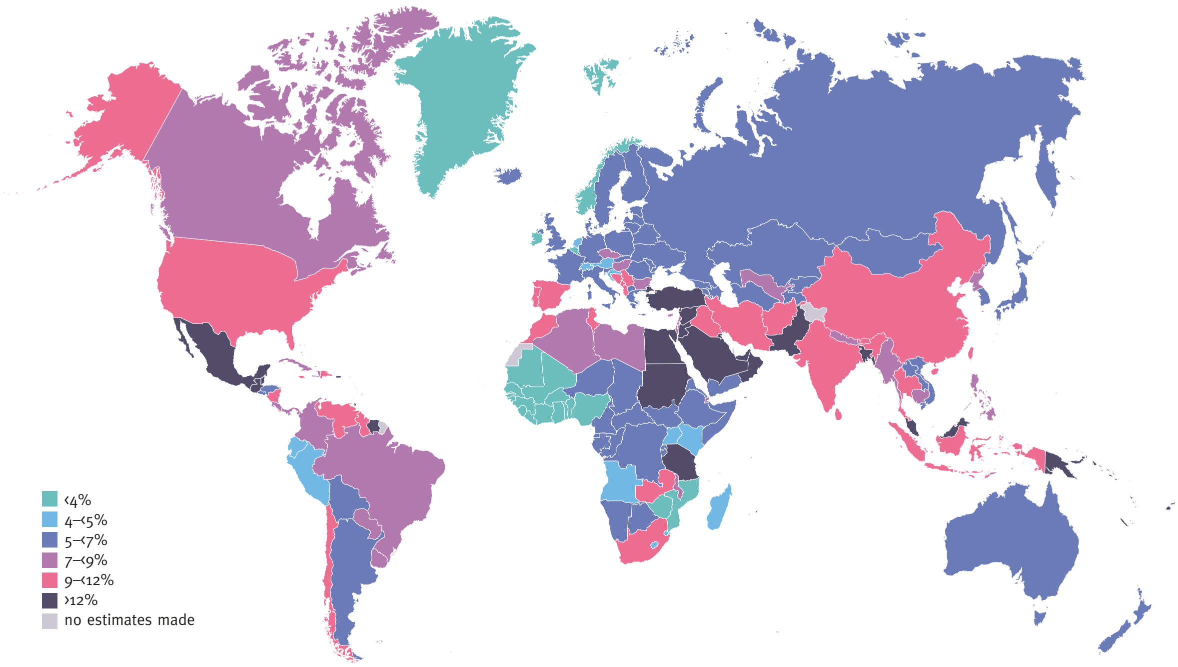
On the other hand, it is estimated that 94% of the increase in the number of people with diabetes by 2045 will occur in low and middle-income countries, where population growth is expected to be greater (Table 3.2).

Table 3.2 Number of adults (20–79 years) with diabetes per World Bank income classification in 2021 and 2045

At a glance	2021			2045		
World Bank income classification	**Number of people with diabetes (millions)**	**Diabetes prevalence[i] (%)**	**Comparative diabetes prevalence[ii] (%)**	**Number of people with diabetes (millions)**	**Diabetes prevalence[i] (%)**	**Comparative diabetes prevalence[ii] (%)**
World	**536.6**	**10.5%**	**9.8**	**783.2**	**12.2%**	**11.2**
High-income countries	103.9	11.1%	8.4	117.7	12.4%	10.3
Middle-income countries	414.0	10.8%	10.5	623.3	13.1%	12.0
Low-income countries	18.7	5.5%	6.7	42.2	6.1%	7.0
Number of deaths due to diabetes	6.7 million		–		–	

i Prevalence is standardised to each national population for the respective year
ii Prevalence is standardised to world population for the respective year

Map 3.2 Estimated age-adjusted comparative prevalence of diabetes in adults (20–79 years) in 2021



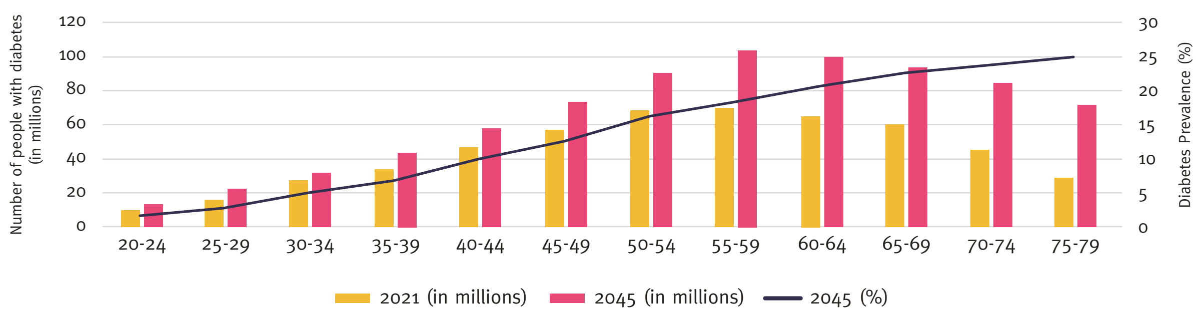
Age distribution

Diabetes estimates for 2021 show increasing prevalence of diabetes by age. Similar trends are predicted for 2045. Prevalence is lowest among adults aged 20–24 years (2.2% in 2021) (Figure 3.1). Among adults aged 75–79 years diabetes prevalence is estimated to be 24.0% in 2021 and predicted to rise to 24.7% in 2045. The aging of the world's population will produce an increasing proportion of those with diabetes being over the age of 60 years.

Gender distribution

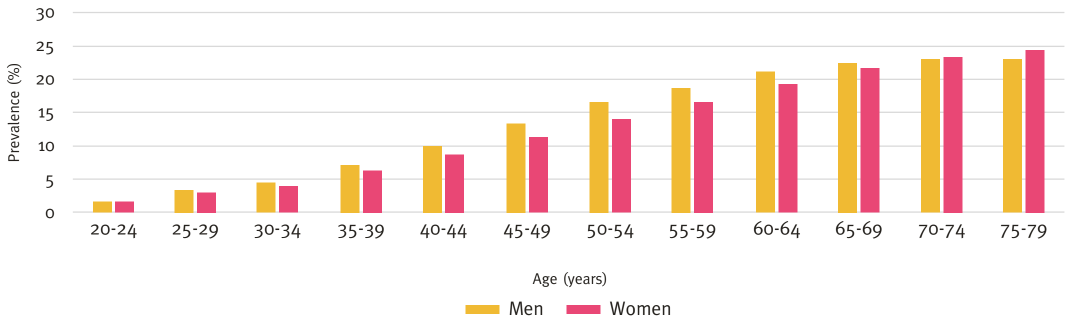
The estimated prevalence of diabetes in women aged 20–79 years is slightly lower than in men (10.2% vs 10.8%). In 2021, there are 17.7 million more men than women living with diabetes. (Figure 3.2).

Figure 3.1 Number of people with diabetes in adults (20–79 years) by age group in 2021 (columns) and estimated prevalence[i] across age groups in 2045 (black line)



i Prevalence is standardised to each national population

Figure 3.2 Prevalence[i] of diabetes among men and women (20–79 years), 2021



i Prevalence is standardised to each national population

Urban and rural distribution

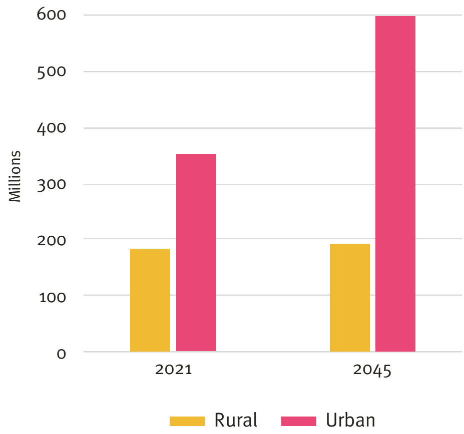
In 2021, more people with diabetes live in urban (360.0 million) than in rural (176.6 million) areas – the prevalence in urban areas being 12.1% and in rural areas 8.3%. The number of people with diabetes living in urban areas is expected to increase to 596.5 million in 2045 (Figure 3.3), as a result of global urbanisation. By 2045, the predicted prevalence of diabetes in urban areas is estimated to increase to 13.9%, due to population ageing.

Regional distribution

As explained in Chapter 2, age is a major determinant of diabetes risk. Thus, comparative prevalence estimates and projections have been used to allow comparisons at IDF regional and country levels. The MENA Region has the highest comparative prevalence of diabetes (18.1%) in people aged 20–79 years in 2021. This estimate is expected to increase, with the MENA Region continuing to have the highest comparative prevalence in 2045 (20.4%).

The AFR Region currently has the lowest comparative prevalence (5.3%), which can be partially attributed to low levels of urbanisation and low prevalence of overweight and obesity. Its prevalence is estimated to rise from 4.5% in 2021 to 5.2% in 2045, an increase of smaller magnitude than in other IDF regions (Table 3.3). This is likely to be an underestimate given the rapid urbanisation and expected changes in lifestyles and ecosystems in this region.

Figure 3.3 Number of people with diabetes in adults (20–79 years) living in urban and rural areas in 2021 and 2045



Country distribution

The countries with the largest numbers of adults with diabetes aged 20–79 years in 2021 are China, India and Pakistan. They are anticipated to remain so in 2045 (Table 3.4). The countries that have the highest number of people with diabetes do not necessarily have the highest prevalence.

The highest comparative diabetes prevalence rates in 2021 are reported in Pakistan (30.8%), French Polynesia (25.2%) and Kuwait (24.9%) (Table 3.5). These countries are also expected to have the highest overall comparative diabetes prevalence in 2045, with figures in Pakistan reaching 33.6%, Kuwait 29.8% and French Polynesia 28.2%.

Table 3.3 Prevalence of diabetes in adults (20–79 years) in IDF Regions in 2021 and 2045, ranked by 2021 age-adjusted comparative diabetes prevalence

		2021			2045		
Rank	**IDF Region**	**Number of people with diabetes (millions)**	**Diabetes prevalence[i] (%)**	**Comparative diabetes prevalence[ii] (%)**	**Number of people with diabetes (millions)**	**Diabetes prevalence[i] (%)**	**Comparative diabetes prevalence[ii] (%)**
	World	**536.6**	**10.5**	**9.8**	**783.2**	**12.2**	**11.2**
1	MENA	72.7	16.2	18.1	135.7	19.3	20.4
2	NAC	50.5	14.0	11.9	62.8	15.2	14.2
3	SEA	90.2	8.7	10.0	151.5	11.3	11.3
4	WP	205.6	11.9	9.9	260.2	14.4	11.5
5	SACA	32.5	9.5	8.2	48.9	11.9	9.8
6	EUR	61.4	9.2	7.0	69.2	10.4	8.7
7	AFR	23.6	4.5	5.3	54.9	5.2	5.6

IDF: International Diabetes Federation; AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific

i Prevalence is standardised to each national population for the respective year
ii Prevalence is standardised to world population for the respective year

Table 3.4 Top 10 countries or territories for number of adults (20–79 years) with diabetes in 2021 and 2045

2021			2045		
Rank	**Country or territory**	**Number of people with diabetes (millions)**	**Rank**	**Country or territory**	**Number of people with diabetes (millions)**
1	China	140.9	1	China	174.4
2	India	74.2	2	India	124.9
3	Pakistan	33.0	3	Pakistan	62.2
4	United States of America	32.2	4	United States of America	36.3
5	Indonesia	19.5	5	Indonesia	28.6
6	Brazil	15.7	6	Brazil	23.2
7	Mexico	14.1	7	Bangladesh	22.3
8	Bangladesh	13.1	8	Mexico	21.2
9	Japan	11.0	9	Egypt	20.0
10	Egypt	10.9	10	Turkey	13.4

Table 3.5 Top 10 countries or territories with age-adjusted comparative diabetes prevalence in adults (20–79 years) in 2021 and 2045

2021			2045		
Rank	**Country or territory**	**Comparative diabetes prevalence[i] (%)**	**Rank**	**Country or territory**	**Comparative diabetes prevalence[i] (%)**
1	Pakistan	30.8	1	Pakistan	33.6
2	French Polynesia	25.2	2	Kuwait	29.8
3	Kuwait	24.9	3	French Polynesia	28.2
4	New Caledonia[ii]	23.4	4	Mauritius	26.6
5	Northern Mariana Islands[ii]	23.4	5	New Caledonia[ii]	26.2
6	Nauru[ii]	23.4	6	Northern Mariana Islands[ii]	26.2
7	Marshall Islands	23.0	7	Nauru[ii]	26.2
8	Mauritius	22.6	8	Marshall Islands	26.0
9	Kiribati	22.1	9	Kiribati	24.1
10	Egypt	20.9	10	Egypt	23.4

i Prevalence is standardised to world population for the respective year
ii Countries without in-country data sources. Estimates are extrapolated

Undiagnosed diabetes

There were 111 available data sources on the prevalence of undiagnosed diabetes, representing 68 countries. For countries with either low-quality or no in-country data on undiagnosed diabetes (147 countries, 68.4%), the prevalence of undiagnosed diabetes was estimated (see Chapter 2).

In 2021, almost one-in-two (44.7%; 239.7 million) adults living with diabetes (20–79 years old) were found to be unaware of their status. It is fundamental for people with diabetes to be diagnosed as early as possible to prevent or delay complications, avoid a premature death and improve quality of life. A serious concern is that people with diabetes diagnosed later, rather than earlier, are likely to use more healthcare services due to greater likelihood of diabetes complications, placing an added burden on healthcare systems already under pressure.[2]

Low rates of clinical diagnosis of diabetes are often a result of insufficient access to healthcare and lower capacity in existing health systems.[3] Inexpensive screening strategies using validated diabetes risk scores, combined with diagnostic tests[4] are, therefore, urgently needed to identify people with diabetes earlier and to expand coverage of preventive counselling, diagnosis and clinical care.

Regional disparities in undiagnosed diabetes

Globally, 87.5% of all undiagnosed cases of diabetes are in low and middle-income countries, with low-income countries having the highest proportion undiagnosed (50.5%). However, even in high-income countries, almost a third (28.8%) of people with diabetes have not been diagnosed (Table 3.6).

Table 3.6 Adults (20–79 years) with undiagnosed diabetes by World Bank income classification in 2021

World Bank income classification	Proportion undiagnosed (%)	Number of people with undiagnosed diabetes (million)
High-income countries	28.8	29.9
Middle-income countries	48.4	200.4
Low-income countries	50.5	9.5

Large regional differences exist in the proportion of diabetes that was undiagnosed. The highest proportions were in Africa (53.6%), the Western Pacific (52.8%) and South-East Asia (51.3%), respectively (Table 3.7). These parts of the world include significant rural areas that may result in difficulty in identifying undiagnosed diabetes due to limited resources, poor access to healthcare services and the prioritisation of other health issues. The lowest proportion of undiagnosed diabetes was found in the North America and Caribbean Region (24.2%) (Table 3.7).

The number of people with undiagnosed diabetes varies by country (Map 3.3). However, the countries with the highest number of people with undiagnosed diabetes are those with the largest number of people with diabetes: China, India and Indonesia (Table 3.8). Among countries that have conducted their own surveys, Mozambique, Uzbekistan, Indonesia and Afghanistan have the highest proportion of undiagnosed diabetes.

Table 3.7 Adults (20–79 years) with undiagnosed diabetes in IDF Regions in 2021, ranked by proportion undiagnosed

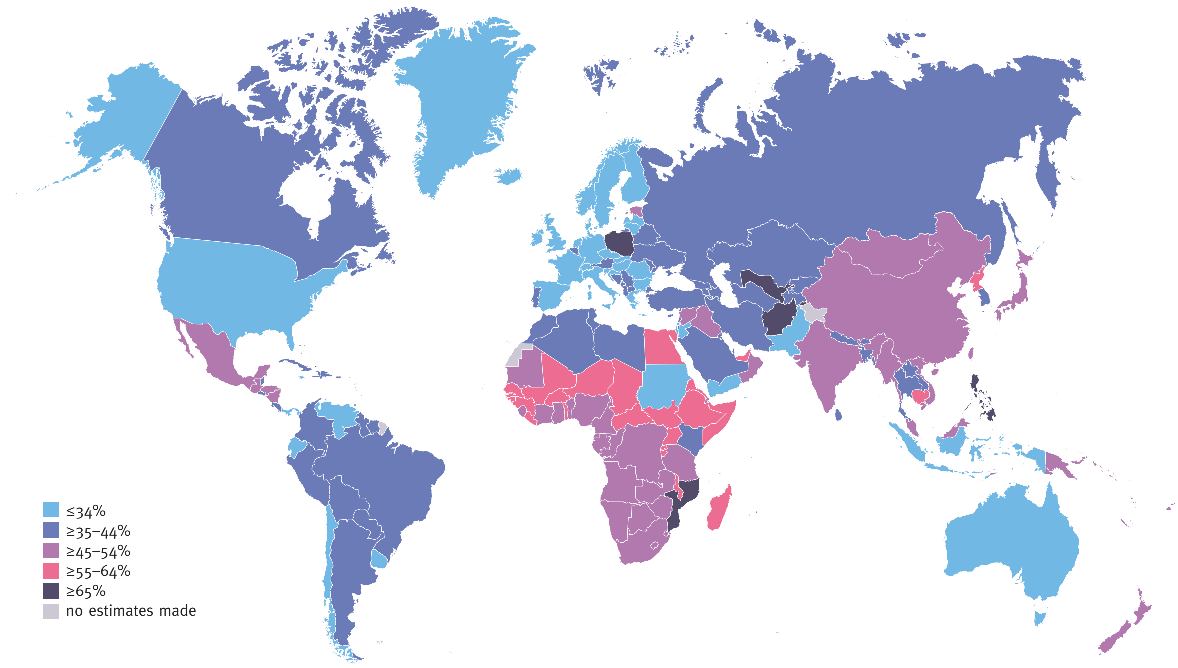
Rank	IDF Region	Proportion undiagnosed (%)	Number of people with undiagnosed diabetes (million)
	World	**44.7**	**239.7**
1	AFR	53.6	12.7
2	WP	52.8	108.7
3	SEA	51.3	46.2
4	MENA	37.6	27.3
5	EUR	35.7	21.9
6	SACA	32.8	10.7
7	NAC	24.2	12.2

IDF: International Diabetes Federation; AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific

Table 3.8 Top 10 countries or territories for the number of adults (20–79 years) with undiagnosed diabetes in 2021

Rank	Country or territory	Number of people with undiagnosed diabetes, (millions)	Proportion undiagnosed (%)
1	China	72.8	51.7
2	India	39.4	53.1
3	Indonesia	14.3	73.7
4	Pakistan	8.9	26.9
5	Egypt	6.8	62.0
6	Mexico	6.7	47.5
7	Bangladesh	5.7	43.5
8	Brazil	5.0	31.9
9	Japan	5.0	45.5
10	United States of America	4.0	12.5

Map 3.3 Proportion of adults (20–79 years) with undiagnosed diabetes by country in 2021



Variation in diagnosed diabetes among countries is often linked to several factors, including genetics, social and economic conditions, performance of the local health system, and general awareness about diabetes among the public and health professionals. In total, only 68 of the 215 countries and territories with estimates in the Atlas had reliable in-country data. A greater number of high-quality population-based studies that include diabetes measured by blood test are urgently needed to improve estimates and allocate resources toward diagnosis.

Almost one in two adults with diabetes are unaware they have the condition. Globally, an estimated 240 million people are living with undiagnosed diabetes. There is a clear need to detect diabetes early and initiate action to prevent complications. Healthcare systems everywhere need to provide the quality of care necessary to support the person beyond diagnosis. Unfortunately, continuous and affordable access to treatment and education remains a major problem in many areas, especially in low and middle-income countries.

Almost 1 in 2 adults with diabetes are unaware they have diabetes

Diabetes incidence

The main focus of the *IDF Diabetes Atlas* has been to track the global impact of diabetes using prevalence. However, increasing prevalence does not always mean that the risk of developing diabetes is rising. Prevalence can increase simply because people with diabetes receive better medical care and live longer. Therefore, it is also important to look at incidence — the rate at which new cases of diabetes are occurring. Unfortunately, while incidence has been the standard reporting metric for type 1 diabetes, the number of published studies reporting the incidence of type 2 diabetes is relatively small.

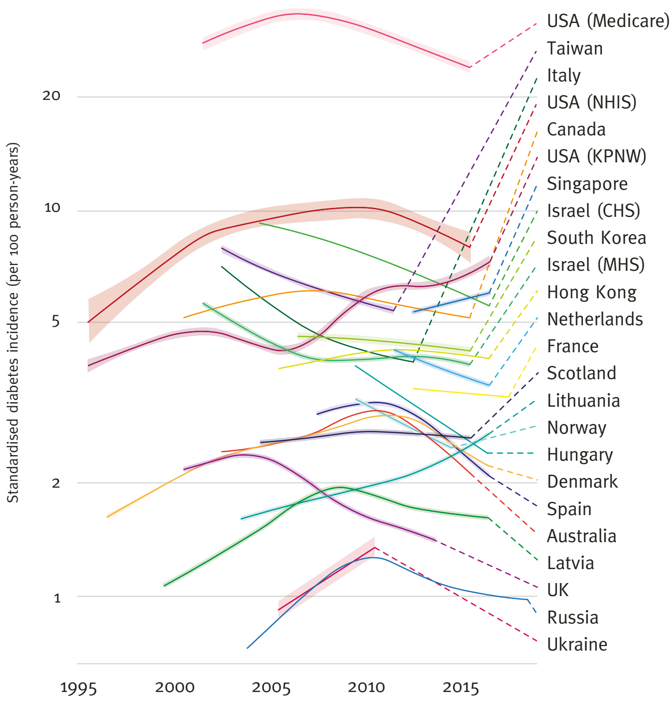
Two significant reports on the global incidence of diabetes have been published recently. The first is a systematic review which searched the literature for studies reporting trends in diabetes incidence up until December 2017.[5] The majority of studies reported that diabetes incidence increased from the 1990s to the mid-2000s, but over the period 2006–2014, incidence was either stable or decreasing in 66% of the populations. This systematic review has now been extended to August 2020, to include nine additional publications. Of the 45 populations reporting incidence trends over 2006–2017, 71% showed declining or stable incidences.

The second study is a multi-country analysis of diabetes incidence trends from high and middle-income settings.[6] Diabetes incidence data were assembled from diabetes registries, administrative data, health insurance and one health survey: 24 data sources across 21 countries. Data were then aggregated by five-year age groups and sex, and analysed using age-period-cohort models with smooth age effects, standardised to the 2010 EU standard population (Figure 3.4). Among the 24 data sources, Ukraine, Singapore, and Lithuania showed increasing incidence across their entire reporting period. Israel (Maccabi Healthcare Services) showed a small rise in some of the more recent years, having shown decreasing incidence in earlier years.

The data from Kaiser Permanente Northwest showed incidence increasing, followed by a fall until 2006 and then increasing until the end of the reporting period. All of the remaining data sources showed decreasing or stable incidence from around 2010 onwards. Annual changes in incidence before and after 2010 for each data source are shown in figure 3.5. Among those data sources reporting a fall in incidence after 2010, the annual reduction in incidence ranged from 1.1% to 10.8%. Among the data sources reporting a rise after 2010, the annual rise in incidence ranged from 0.9% to 5.6%. Since these data are mainly from administrative sources, the findings are only for diagnosed diabetes and thus incidence trends in undiagnosed diabetes remain uncertain. Further, there was significant heterogeneity in the way the centres diagnosed diabetes. Lastly, there were no data from low-income countries and thus the findings inform us about trends in diabetes incidence in some high and middle-income countries only.

In conclusion, the incidence of type 2 diabetes may be falling or stable in many high-income countries. While these findings may hint at the success of prevention strategies implemented in many countries, other factors, such as changes in diabetes screening over time and the introduction of HbA1c for diabetes diagnosis, may have played a role.

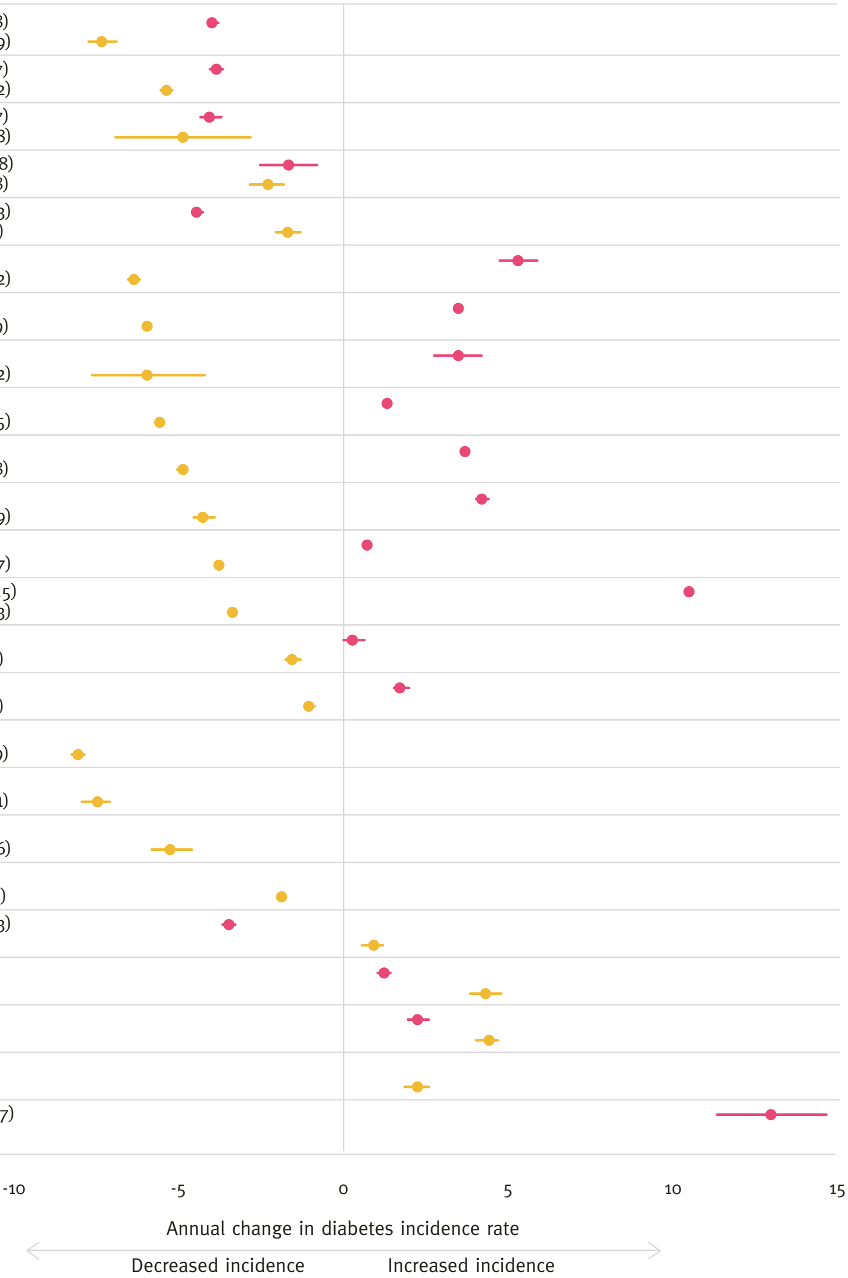
Figure 3.4 Trends in annual incidence of diagnosed diabetes, adapted from Magliano *et al*[6]



Age- and sex-standardised incidence rates of diagnosed diabetes per 1,000 person-years (EU standard population 2010, with equal weights for men and women). Standardisation is based on annual age-specific incidence rates from age-period-cohort models fitted separately for each data source and sex. Shaded areas represent 95% confidence intervals around incidence trends. CHS=Clalit Health Services. KPNW=Kaiser Permanente Northwest. MHS=Maccabi Healthcare Services. NHIS=National Health Interview Survey, US

Figure 3.5 Estimated annual change in the incidence of diagnosed total or type 2 diabetes before and after 2010

Country	Annual change (%,95% CI)
UK	-4.0 (-4.1, -3.8) -7.4 (-7.8, -6.9)
Israel (CHS)	-3.9 (-4.1, -3.7) -5.4 (-5.6, -5.2)
Taiwan	-4.1 (-4.4, -3.7) -4.9 (-7.0, -2.8)
South Korea	-1.7, (-2.6, -0.8) -2.3 (-2.9, -1.8)
Italy	-4.5 (-4.6, -4.3) -1.7 (-2.1, -1.3)
Spain	5.3 (4.7, 5.9) -6.4 (-6.6, -6.2)
Australia	3.5 (3.4, 3.6) -6.0 (-6.1, -5.9)
USA (NHIS)	3.5 (2.7, 4.2) -6.0 (-7.7, -4.2)
USA (Medicare)	1.3 (1.2, 1.3) -5.6 (-5.6, -5.5)
Denmark	3.7 (3.6, 3.8) -4.9 (-5.1, -4.8)
Latvia	4.2 (4.0, 4.4) -4.3 (-4.6, -3.9)
Canada	0.7 (0.7, 0.8) -3.8 (-3.8, -3.7)
Russia	10.5 (10.4, 10.5) -3.4 (-3.4, -3.3)
Scotland	0.3 (0.0, 0.6) -1.6 (-1.8, -1.3)
Hong Kong	1.7 (1.5, 2.0) -1.1 (-1.2, -0.9)
Hungary	NA -8.1 (-8.3, -7.9)
Norway	NA -7.5 (-8.0, -7.1)
Netherlands	NA -5.3 (-5.9, -4.6)
France	NA -1.9 (-2.0, -1.8)
Israel (MHS)	-3.5 (-3.7, -3.3) 0.9 (0.5, 1.2)
USA (KPNW)	1.2 (1.0, 1.4) 4.3 (3.8, 4.8)
Lithuania	2.2 (1.9, 2.6) 4.4 (4.0, 4.7)
Singapore	NA 2.2 (1.8, 2.6)
Ukraine	13.0 (11.3, 14.7) NA



Pre-2010
Post-2010

Diabetes incidence and prevalence in children and adolescents

Type 1 diabetes is the most common form of diabetes in children and adolescents in the majority of countries, but other forms of diabetes also occur, including type 2 diabetes and monogenic diabetes. Type 1 diabetes is a complex condition to manage. Insulin injections are needed for survival and good outcomes can only be achieved with multiple daily injections or the use of an insulin pump. Successful insulin therapy requires self-monitoring of blood glucose, comprehensive diabetes education and the support of skilled health professionals.

Numbers of new (incident) and existing (prevalent) type 1 diabetes cases are increasing each year due to rising incidence in many countries[7] and reductions in mortality. In total, 1,211,900 children and adolescents younger than 20 years are estimated to have type 1 diabetes globally. It is estimated that around 108,200 children and adolescents under 15 years are diagnosed each year. This number rises to 149,500 when the age range extends to those under 20 years (Table 3.9).

A complementary publication[8] provides the incidence data estimated for all countries. Incidence rates are highest in populations of Northern European origin, as well as in an increasing number of countries in the Middle East and North Africa. Of the ten countries with the highest incidence, four are now from non-European populations (Table 3.10). A recent report from Eritrea demonstrating a high incidence, particularly in the 15–24-year age group, confirms observations among migrant populations from this area in Africa.[9]

Of the 215 countries and territories covered by the *IDF Diabetes Atlas*, only 97 have their own incidence data. For most, this is limited to children and adolescents under 15-years of age. Among the countries without data for under 20-year-olds are some very populous nations, such as Nigeria, Indonesia, the Philippines, Vietnam, and South Africa. For these countries data are extrapolated from a nearby country with similar characteristics. However there are various reasons why such data may not be accurate. The African Region is the least complete. However, new data from Gabon,[10] Mali[11] and Eritrea,[9] as well as updated data from Tanzania,[12] have helped fill some of the gaps.

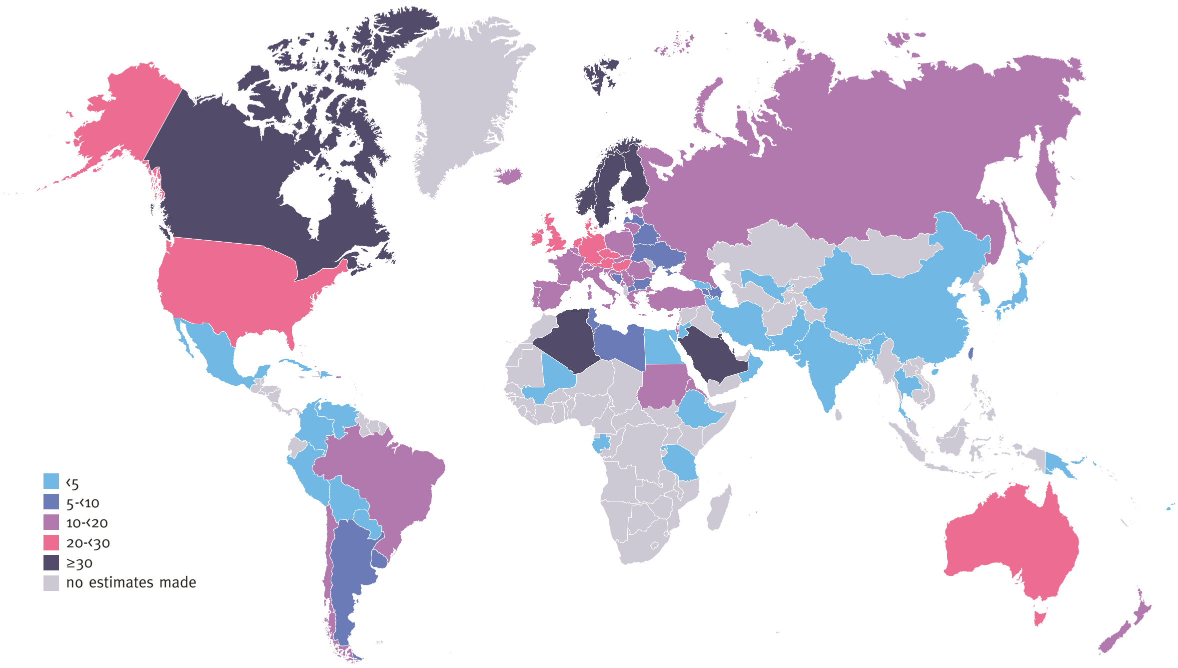
Compared with the 9th Edition of the *IDF Diabetes Atlas* in 2019, the number of new cases has increased sharply in the AFR and MENA regions due to revisions resulting from recent incidence studies.

Table 3.9 Global estimates for type 1 diabetes in children and adolescents (0–14 years and 0–19 years) in 2021.

Global population (0–14 years)	1.99 billion
Global population (0–19 years)	2.61 billion
Type 1 diabetes in children and adolescents (0–14 years)	
Number of prevalent (existing) cases of type 1 diabetes	651,700
Number of incident (new) cases of type 1 diabetes per year	108,300
Type 1 diabetes in children and adolescents (0–19 years)	
Number of prevalent (existing) cases of type 1 diabetes	1,211,900
Number of incident (new) cases of type 1 diabetes per year	149,500

Incidence is a key element in tracking the progress of epidemics of chronic diseases such as diabetes

Map 3.4 Age-sex standardised incidence rates (per 100,000 population per annum) of type 1 diabetes in children and adolescents aged 0–14 years



Comparable measured prevalence data are only available for 12 countries. Due to the paucity of prevalence data, estimation for all countries was not possible and data from these reports was used to estimate prevalence by region. Rapid changes in mortality, diagnosed incidence, and differences between regions within countries may explain larger discrepancies for Mali,[11] Maldives,[13] and Canada.[14, 15] The EUR and NAC regions have the highest number of prevalent cases due to high incidence rates. Numbers of people under 20 years of age with type 1 diabetes in AFR have more than doubled since 2019 due to the availability of new data. Figures 3.6 and 3.7 show the breakdown of prevalent and incident cases per IDF Region. By country, India now has the highest estimated number of prevalent type 1 diabetes cases in people under 20 years of age (229,400), followed by USA (157,900) and Brazil 92,300 (Table 3.10).

The *IDF Diabetes Atlas* Committee encourages all countries to ascertain their current rates of new and existing cases of type 1 diabetes for children and adolescents. The IDF Guide for Diabetes Epidemiological Studies[16], provides useful and practical information on how to plan, conduct, and report such studies.

Figure 3.6 Estimated number of children and adolescents (0–19 years) with prevalent (existing) type 1 diabetes by IDF Region in 2021 (adjusted for mortality)

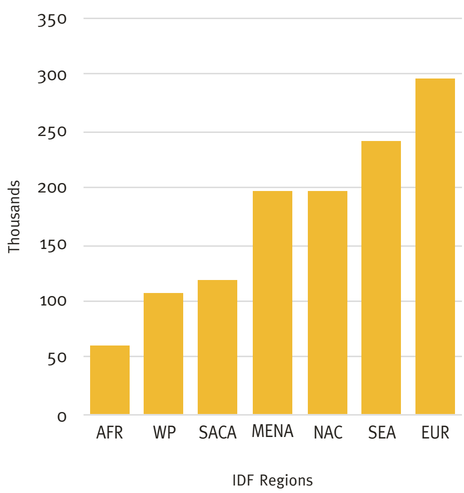


Figure 3.7 Estimated annual incident (new) cases of type 1 diabetes in children and adolescents (0–19 years) by IDF Region in 2021

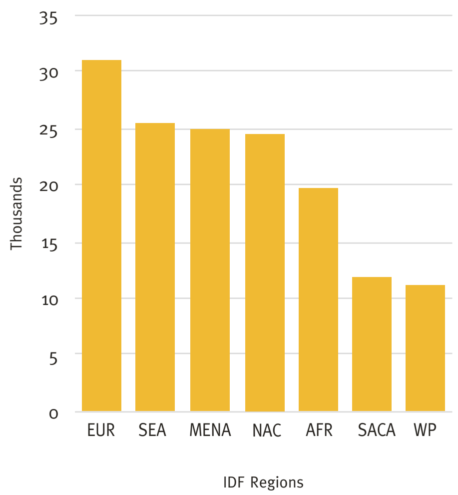


Table 3.10 Top 10 countries or territories for estimated number of incident (new) cases of type 1 diabetes in children and adolescents (0–19 years) per annum

Rank	Country or territory	Number of incident (new) cases (0–19 years) in thousands
1	India	24.0
2	United States of America	18.2
3	Brazil	8.9
4	Algeria	6.5
5	China	6.1
6	Morocco[i]	5.1
7	Russian Federation	4.0
8	Nigeria	3.8
9	Saudi Arabia	3.8
10	Germany	3.6

i The figure for Morocco uses incidence rates extrapolated from Algeria

Table 3.11 Top 10 countries or territories for estimated number of prevalent (existing) cases of type 1 diabetes in children and adolescents (0–19 years) per annum

Rank	Country or territory	Number of children and adolescents with type 1 diabetes (0–19 years) in thousands
1	India	229.4
2	United States of America	157.9
3	Brazil	92.3
4	China	56.0
5	Algeria	50.8
6	Morocco[i]	43.3
7	Russian Federation	38.1
8	Germany	35.1
9	United Kingdom	31.6
10	Saudi Arabia	28.9

i The figure for Morocco uses incidence rates extrapolated from Algeria

Table 3.12 Top 10 countries or territories for incidence rates (per 100,000 population per annum) of type 1 diabetes in children (0–14 years)

Rank	Country or territory	Incidence rates (per 100,000 population per year) 0–14 years
1	Finland	52.2
2	Sweden	44.1
3	Kuwait	41.7
4	Qatar	38.1
5	Canada	37.9
6	Algeria	34.8
7	Norway	33.6
8	Saudi Arabia	31.4
9	United Kingdom	28.1
10	Ireland	27.5

Incidence and prevalence of youth-onset type 2 diabetes

The incidence and prevalence of youth-onset type 2 diabetes vary by ethnicity and other factors. Populations with high incidence and prevalence of type 2 diabetes in youth also have higher risk of type 2 diabetes among adults. The highest incidence rates of type 2 diabetes in youth have been reported from Canadian First Nations, American Indian and Navajo nation, Australian Aboriginal and Torres Strait Islander, and African American populations (31–94 per 100,000 per year), [17–20] whereas youth from non-Hispanic Caucasian populations, such as those in Europe and the US had the lowest incidence rates (0.1-0.8 per 100,000 per year) (Figure 3.8).[21, 22]

Prevalence estimates were the highest in youth from Brazil and Mexico, as well as indigenous populations in the US and Canada, and among Black populations in the Americas (160–3,300 per 100,000),[23–25] and the lowest in populations in Europe (0.6 to 2.7 per 100,000)[26–27] (Figure 3.9).

Obesity is an important modifiable risk factor for type 2 diabetes. However, some populations that have a low prevalence of childhood obesity, such as East Asians, report higher incidence rates of youth-onset type 2 diabetes than populations with a greater burden of childhood obesity.[28–29] Genetic predisposition, disparities in socio-economic status, access to healthcare and cultural practices across people of different ethnic backgrounds or countries may also contribute to differences in the risk of youth-onset type 2 diabetes.[30–31]

In countries with trend data for type 2 diabetes, a growth in incidence of type 2 diabetes is observed, with the increase usually greater in non-Caucasian populations.[17, 19–21] The reasons for these increases in incidence are multifactorial, including the rising burden of childhood obesity, changes in diet and physical activity, maternal obesity and diabetes, and other as yet unknown factors.[28]

Figure 3.8 Reported prevalence of type 2 diabetes in youth ranked by region and ethnicity

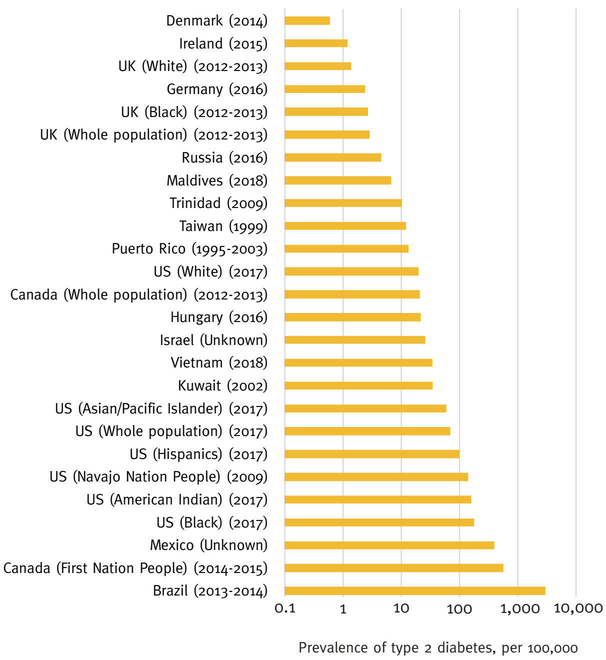
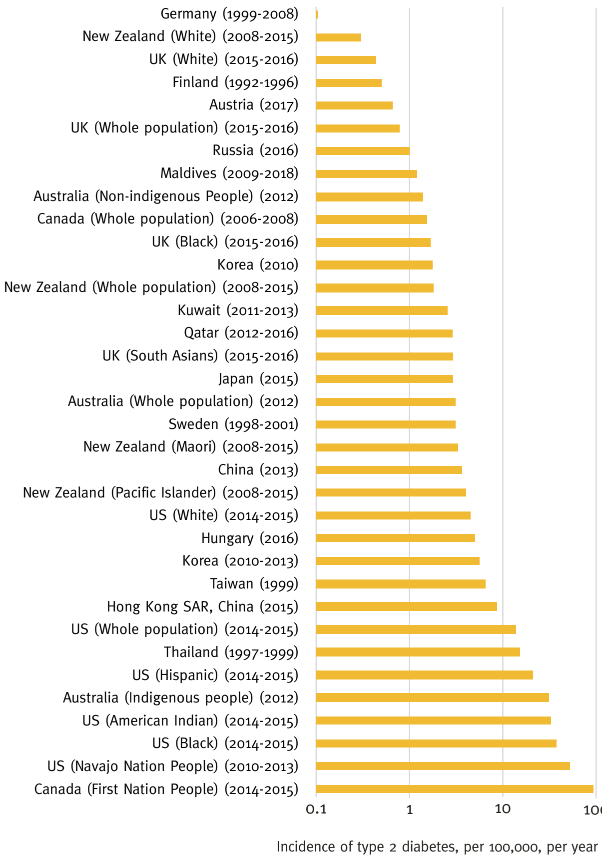


Figure 3.9 Reported incidence of type 2 diabetes in youth ranked by region and ethnicity



The incidence of type 2 diabetes is extremely low among pre-pubertal children but rises gradually at puberty, likely due to hormonal changes and insulin resistance associated with puberty. Incidence rates are higher in girls than boys, a sex difference that is not present in adults; this is not well understood but may be due to differential sex-hormone effects or known differences in weight gain and lifestyle habits during and after puberty.[19, 21]

Complications in youth-onset type 2 diabetes

Youth-onset type 2 diabetes has a unique phenotype and physiology characterised by poorer glycaemic trajectory, higher metformin monotherapy failure rates, and more rapid beta cell functional decline than that seen in adults with type 2 diabetes.[32] As compared with type 1 diabetes, youth with type 2 diabetes are more likely to have or develop other cardiometabolic risk factors, such as high blood pressure, elevated triglycerides and central obesity.[33]

The prevalence of some microvascular complications is two-to-three-fold higher in youth with type 2 diabetes than those with type 1 diabetes of a similar age.[34] Evidence of preclinical cardiovascular disease has also been found in youth with type 2 diabetes,[35, 36] and emerging data suggest mortality in excess of type 1 diabetes counterparts and youth from the same populations without diabetes.[37]

The presence of advanced complications during the most productive time of life is more likely to occur given the early onset of type 2 diabetes. This has significant impact on individuals, families and communities, and places an additional strain on healthcare systems.

Furthermore, the development of type 2 diabetes during reproductive years may amplify intergenerational risk for early onset type 2 diabetes. While multi-nation surveillance of type 1 diabetes is already well established, surveillance of youth-onset type 2 diabetes is not. Therefore, a strong call must be made for the collection of trend data to assess the global burden of type 2 diabetes in youth.

The incidence of type 2 diabetes is extremely low among pre-pubertal children but rises gradually at puberty, likely due to hormonal changes and insulin resistance associated with puberty

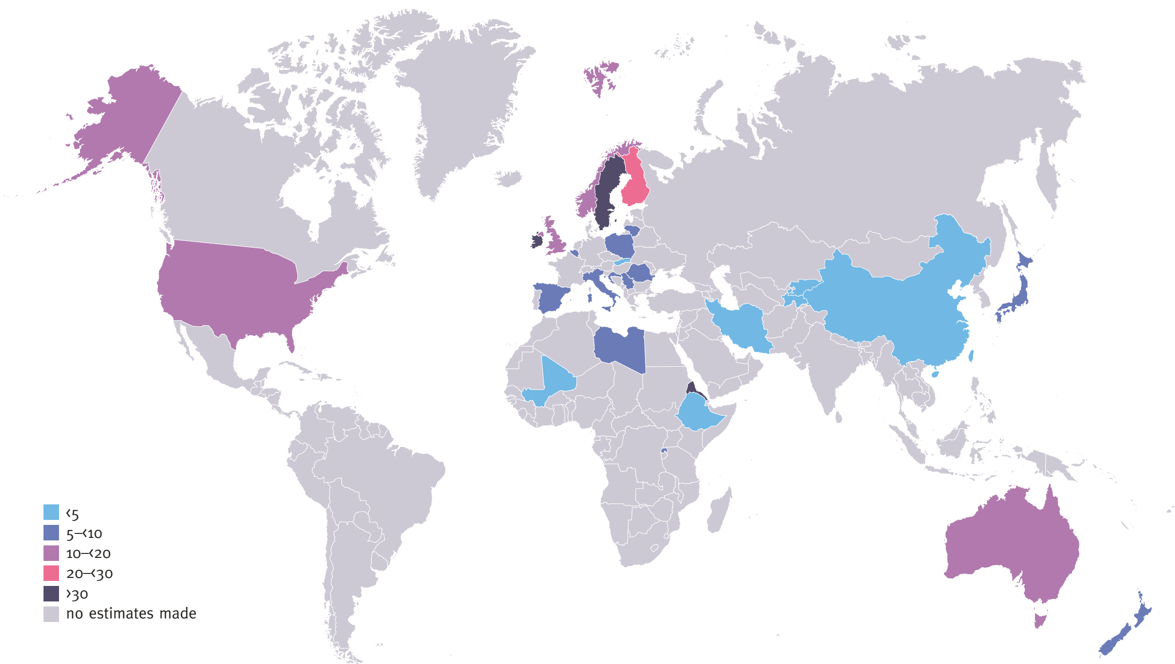
Adult-onset type 1 diabetes

It is traditionally thought that type 1 diabetes presents commonly in childhood or adolescence but infrequently in adulthood. Consequently, a large number of studies report on the incidence of type 1 diabetes among children and adolescents, while comparatively fewer studies report data for the incidence of type 1 diabetes in adults.

Despite this, there is increasing recognition of the contribution of type 1 diabetes to the overall burden of diabetes in adults and the need for care provision and related planning for those with adult-onset type 1 diabetes. However, type 1 diabetes is more challenging to diagnose in adults due to various factors and can be misdiagnosed as type 2 diabetes, leading to an underestimation of the burden of adult-onset type 1 diabetes. In order to evaluate the burden of adult-onset type 1 diabetes, a systematic review was recently conducted.[38] Among the 46 studies identified, incidence of adult-onset (≥20 years) type 1 diabetes was available for 32 countries and regions reporting estimates between 1973 and 2019.

The incidence of adult-onset type 1 diabetes is, in general, higher among men than women. There is a more than 30-fold variation in the annual incidence of adult-onset type 1 diabetes, with rates varying from less than one per 100,000 in China to more than 30 per 100,000 in parts of Northern Europe and Eastern Africa. In general, the variation in incidence of adult-onset type 1 diabetes mirrors the geographical variation in childhood-onset type 1 diabetes, whereby countries with high rates in children and adolescents also tend to have higher rates in adulthood (Table 3.13). Though type 1 diabetes is typically considered to present in childhood and adolescence, the relationship between T1D incidence and age of onset is not clear. In our review, in countries with available data, the incidence of adult-onset T1D did not decline with increasing age, and remained substantial across the life course.

Map 3.5 Incidence of adult-onset type 1 diabetes in adults 20–40 years



Annual incidence of type 1 diabetes (per 100,000 per year) among adults aged 20–40 years (men and women) per country/region (estimated from studies between 1973 and 2020)

Table 3.13 Countries with the highest incidence of adult-onset type 1 diabetes

Rank	Country	Study year	Incidence (per 100,000)
1	Eritrea	2019	46.2
2	Sweden	2009	30.6
3	Ireland	2011–2016	30.6
4	Finland	2017	24.0
5	United Kingdom	2009–2013	17.8
6	Norway	1978–1982	16.7
7	United States	2017	16.5
8	Australia	2020	16.4
9	Libya	1981–1990	9.9
10	Spain	1987–1990	9.9

Most studies reporting the incidence of adult-onset type 1 diabetes rely on a clinical diagnosis, usually defined as physician-diagnosed type 1 diabetes, plus the need for insulin therapy within 12 months of diagnosis.

However, there are several challenges in establishing a diagnosis of type 1 diabetes in adults. This includes the absence of classical symptoms such as Ketoacidosis (KCA) in some cases, as well as slower disease progression, and potential delay in the initiation of insulin treatment. These may lead to cases being misdiagnosed and mismanaged as type 2 diabetes and likely underestimations of the true incidence of adult-onset type 1 diabetes.

Consistent with this, among countries with multiple estimates of type 1 diabetes incidence available, the incidence is generally higher in studies that defined type 1 diabetes using biomarkers, compared to those using algorithms based on administrative data, although these estimates may not be directly comparable for other reasons (such as cohort age or calendar year).

In our review of studies reporting the incidence of adult-onset type 1 diabetes, the majority (85%) did not include the use of biomarkers for defining or diagnosing type 1 diabetes. (Table 3.14)

Table 3.14 Challenges with the diagnosis of adult-onset type 1 diabetes

Challenge	Recommendations and suggestions
Absence of classical symptoms and presentation of type 1 diabetes in adults	Maintain a high index of suspicion
	Early identification of cases with primary oral drug failure
High background rates of type 2 diabetes in adults	Consider incorporating evaluation of beta-cell function or other biomarkers in newly diagnosed cases, where resources permit
	Incorporate biomarkers of type 1 diabetes in epidemiological studies of newly diagnosed diabetes
Current biomarkers, including islet auto-antibodies, may not be readily available in different healthcare settings	A need for low-cost biomarkers that can facilitate the clinical diagnosis of type 1 diabetes in different settings

There is a lack of data on the incidence of adult-onset type 1 diabetes, particularly in low and middle-income countries, limiting our ability to accurately assess the global burden of type 1 diabetes in adults and the capacity of existing healthcare systems to plan healthcare provision (Map 3.5).

The majority of available studies are limited by the use of clinical diagnosis or diagnostic codes for ascertainment of type 1 diabetes in adults and, therefore, likely underestimate the true burden. Prompt recognition of type 1 diabetes can facilitate appropriate early insulin therapy, which may improve long-term prognosis.

There is a need for more research in different parts of the world, including more detailed phenotyping of individuals presenting with newly diagnosed diabetes to assess the true global burden of adult-onset type 1 diabetes.

Impaired glucose tolerance and impaired fasting glucose

In 2021, 541 million adults, or 10.6% of adults worldwide, are estimated to have impaired glucose tolerance (IGT). By 2045, this figure is projected to increase to 730 million adults or 11.4% of all adults.

In 2021, there are an estimated 319 million adults, or 6.2% of the global adult population, with impaired fasting glucose (IFG). An estimated 441 million adults or 6.9% of the global adult population are projected to have IFG in 2045.

Regional distribution

The age-adjusted prevalence of IGT in 2021 was highest in the Western Pacific Region and lowest in the South-East Asia Region (Table 3.15). The age-adjusted prevalence of IFG in 2021 was highest in South and Central America and lowest in the Western Pacific (Table 3.16).

Age distribution

The prevalence of IGT is estimated to increase with age (Figure 3.10). In 2045, the prevalence of IGT is expected to increase in young adults (aged 45 years or younger) and the very old (aged 70 years or older), and slightly decrease among middle-aged adults (aged 45–69 years). The 2021 prevalence of IFG was higher in older age categories and peaked among persons aged 60-64 at 8.1%. The prevalence of IFG is projected to increase across all age categories by the year 2045 (Figure 3.11).

Income distribution

For IGT, the age-adjusted prevalence in 2021 was highest for low-income countries and lowest for middle and high-income countries (Table 3.17). The age-adjusted prevalence estimates of IFG in 2021 were similar across high (5.7%), middle (5.7%), and low-income (5.8%) countries (Table 3.18).

Summary

The 2021 global prevalence estimates of IGT and IFG are substantial and are projected to increase by 2045. Currently, however, there is no consensus definition of "prediabetes". There are at least five different definitions endorsed by different clinical organisations and guidelines. Studies that reported only the American Diabetes Association (ADA) threshold for IFG (5.5–6.9 mmol/L [100–125 mg/dL]) were not included in this report.

The prevalence estimates of IFG based on ADA IFG would be higher than for estimates based on the WHO IFG criterion. Regardless of how defined, intermediate states of hyperglycaemia are common and a growing problem, suggesting major challenges for future risk of diabetes across the globe.

Figure 3.10 Prevalence of impaired glucose tolerance in adults (20–79 years) in 2021 and 2045, by age group

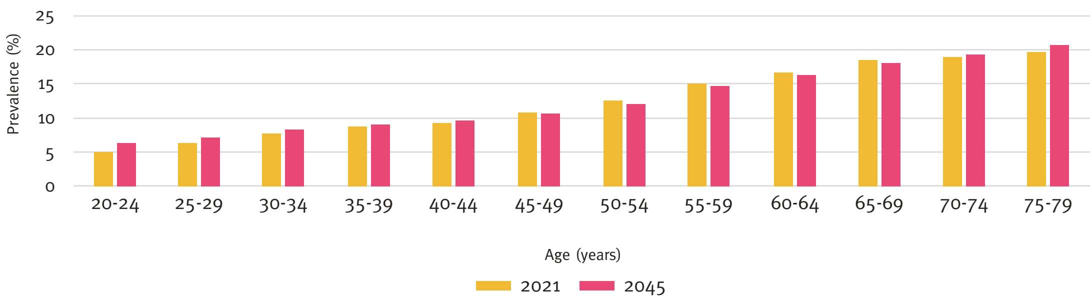


Table 3.15 Age-adjusted prevalence of impaired glucose tolerance (20–79 years) by IDF regions, ranked by 2021 prevalence (%)

		2021		2045 (projected)	
Rank	**IDF Region**	**Age-adjusted comparative IGT prevalence (%)**	**Number of people with IGT (millions)**	**Age-adjusted comparative IGT prevalence (%)**	**Number of people with IGT (millions)**
1	WP	12.9	253.0	14.0	291.8
2	AFR	12.6	52.5	14.1	116.7
3	NAC	11.6	47.0	13.0	56.6
4	MENA	11.2	47.6	11.7	80.5
5	SACA	10.9	39.6	11.7	52.7
6	EUR	7.1	54.8	7.8	55.3
7	SEA	5.4	46.9	5.8	76.6

IGT: Impaired glucose tolerance; IDF: International Diabetes Federation; AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific

Table 3.16 Age-adjusted prevalence of impaired fasting glucose in adults (20–79 years) by IDF regions, ranked by 2021 prevalence (%)

		2021		2045 (projected)	
Rank	**IDF Region**	**Age-adjusted comparative IFG prevalence (%)**	**Number of people with IFG (millions)**	**Age-adjusted comparative IFG prevalence (%)**	**Number of people with IFG (millions)**
1	SACA	10.0	47.0	10.6	62.8
2	SEA	8.8	95.2	9.3	125.4
3	NAC	8.3	31.6	8.7	37.6
4	AFR	8.0	40.9	7.6	84.7
5	MENA	6.1	28,9	6.3	47.5
6	EUR	3.3	25.6	3.7	26.7
7	WP	2.5	49.7	2.7	56.0

IFG: Impaired fasting glucose; IDF: International Diabetes Federation; AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific

Table 3.17 Age-adjusted prevalence of impaired glucose tolerance in adults (20–79 years), by World Bank income classification

Impaired Glucose Tolerance	2021		2045	
World Bank income classification	**Age-adjusted comparative IGT prevalence (%)**	**Number of people with IGT (millions)**	**Age-adjusted comparative IGT prevalence (%)**	**Number of people with IGT (millions)**
High-income countries	10.4	116.6	11.6	124.4
Middle-income countries	10.0	391.5	10.7	531.0
Low-income countries	12.7	33.0	14.3	75.0

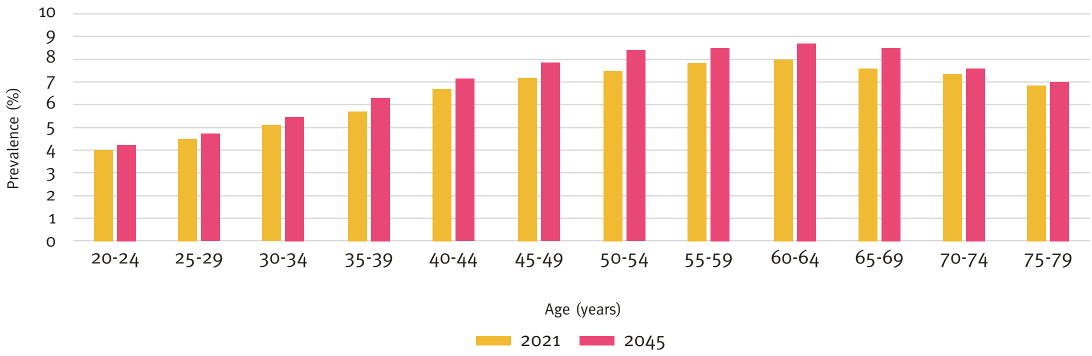
IGT: Impaired glucose tolerance

Table 3.18 Age-adjusted prevalence of impaired fasting glucose in adults (20–79 years), by World Bank income classification

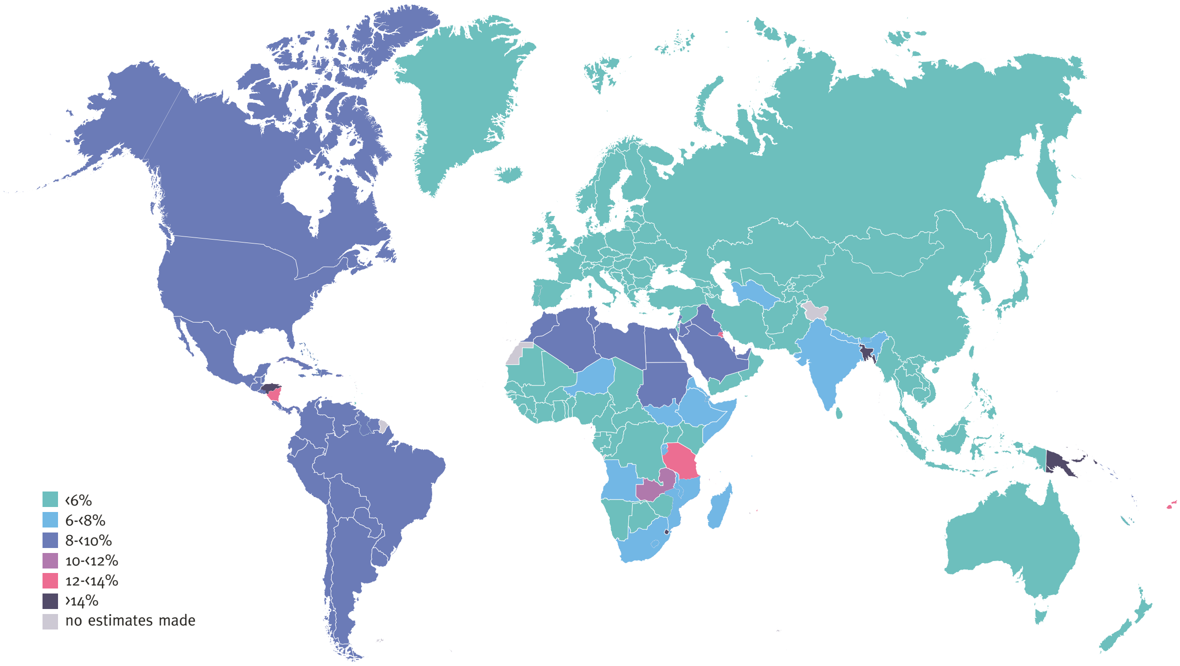
Impaired Fasting Glucose	2021		2045	
World Bank income classification	**Age-adjusted comparative IFG prevalence (%)**	**Number of people with IFG (millions)**	**Age-adjusted comparative IFG prevalence (%)**	**Number of people with IFG (millions)**
High-income countries	5.7	64.6	6.3	69.2
Middle-income countries	5.7	236.9	6.3	331.3
Low-income countries	5.8	17.5	6.0	40.3

IFG: Impaired fasting glucose

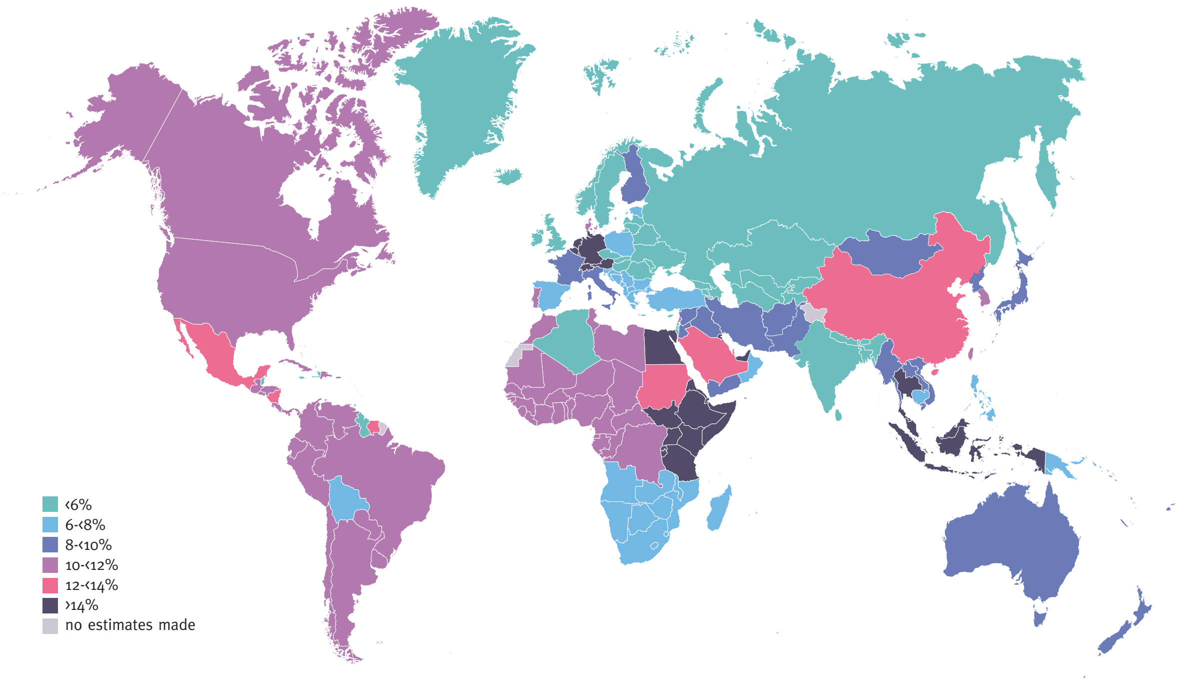
Figure 3.11 Prevalence of impaired fasting glucose in adults (20–79 years) in 2021 and 2045, by age group



Map 3.6 Age-adjusted comparative prevalence of impaired fasting glucose in adults in 2021



Map 3.7 Age-adjusted comparative prevalence of impaired glucose tolerance in adults in 2021



Hyperglycaemia in pregnancy

A total of 58 studies on hyperglycaemia in pregnancy (HIP) from 47 countries were included in the analysis, including from six new countries since the previous edition of the *IDF Diabetes Atlas*: Chile, Ethiopia, Italy, Jordan, Mexico and Trinidad.

It is estimated that 21.1 million (16.7%) of live births to women in 2021 had some form of hyperglycaemia in pregnancy. Of these, 80.3% were due to gestational diabetes mellitus (GDM), while 10.6% were the result of diabetes detected prior to pregnancy, and 9.1% due to diabetes (including type 1 and type 2) first detected in pregnancy (Table 3.19).

Differences in these results compared to earlier editions of the *IDF Diabetes Atlas* are possibly due to improved detection before and during pregnancy. More information on the methods can be found in Chapter 2.

There are some regional differences in the prevalence of HIP, with the SEA Region having the highest age-adjusted comparative prevalence at 28.0%, compared to 8.6% in the MENA Region (Table 3.20). These differences were previously projected for the years 2030 and 2045 in the 9th IDF Atlas. The vast majority (87.5%) of cases of hyperglycaemia in pregnancy are seen in low and middle-income countries, where access to antenatal care is often limited.

Table 3.19 Global estimates of hyperglycaemia in pregnancy in 2021

Total live births to women aged 20–49 years in millions	
Hyperglycaemia in pregnancy	
Global prevalence	16.7%
Number of live births affected in millions	21.1 million
Proportion of cases due to GDM	80.3%
Proportion of cases due to other types of diabetes first detected in pregnancy	9.1%
Proportion of cases due to diabetes detected prior to pregnancy	10.6%

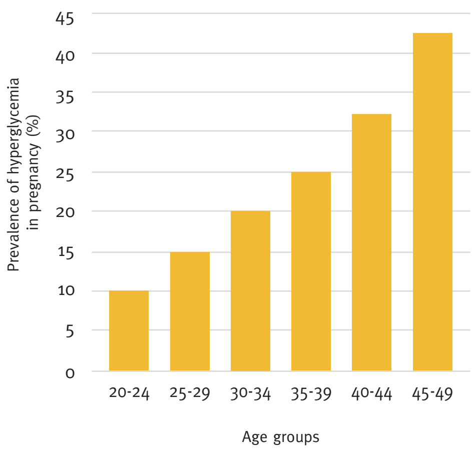
Table 3.20 Hyperglycaemia in pregnancy (20–49 years) by IDF Region, ranked by 2021 age-adjusted comparative prevalence estimates

IDF region	Age-adjusted prevalence	Raw prevalence	Number of live births affected in millions
World	**15.2%**	**16.7%**	**21.1**
SEA	28.0%	25.9%	6.8
NAC	20.7%	17.2%	1.3
SACA	13.7%	15.8%	1.0
WP	12.4%	14.0%	3.9
EUR	12.2%	15.0%	1.6
AFR	11.4%	13.0%	4.1
MENA	8.6%	14.1%	2.4

IDF: International Diabetes Federation; AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific

Prevalence of HIP, as a proportion of all pregnancies, increases rapidly with age, with the highest prevalence (42.3%) in 45–49 year-old women, although there are fewer pregnancies in this age group (Figure 3.12). Of course, this age group also has a higher prevalence of diabetes among non-pregnant women. As a result of higher fertility rates in younger women, half (46.3%) of all cases of HIP (9.8 million) occur in women under the age of 30 years.

Figure 3.12 Prevalence of hyperglycaemia in pregnancy by age group in 2021



Diabetes-related mortality

Diabetes is a major driver of mortality worldwide, though its impact varies by region. Excluding the mortality risks associated with the COVID-19 pandemic, approximately 6.7 million adults between the age of 20–79 are estimated to have died as a result of diabetes or its complications in 2021. This corresponds to 12.2% of global deaths from all causes in this age group. Approximately one-third (32.6%) of all deaths from diabetes occur in people of working age (under the age of 60) – (Figure 3.13). This corresponds to 11.8% of total global deaths in people under 60.

Regional distribution

The IDF Region with the highest estimated number of diabetes-related deaths among 20–79 years old is WP, with approximately 2.3 million deaths. This is followed by EUR, with approximately 1.1 million deaths. The IDF Region with the lowest number of deaths is SACA with approximately 0.4 million deaths. These regional discrepancies are largely driven by the relative size of their respective diabetes populations.

Approximately 6.7 million adults (20–79) are estimated to have died as a result of diabetes, or its complications in 2021

The proportion of total deaths associated with diabetes is an indicator of the relative burden of diabetes within each IDF Region. Diabetes is associated with the highest percentage of deaths from all causes in NAC at 21.7%. The second highest Region is MENA, with 20.2% of all deaths associated with diabetes. The IDF Region with the lowest percentage of deaths associated with diabetes is SEA, at 7.1%.

Diseases which disproportionately impact the working age adult population (20–60 years) can have a unequal economic impact. The IDF Region with the highest proportion of total deaths under the age of 60 associated with diabetes is MENA with 24.5% (Table 3.21), followed by NAC, with 18.4% of total diabetes-related deaths under the age of 60. In the SEA Region, only 6.9% of total deaths under the age of 60 are associated with diabetes.

Country distribution

Partly due to its large population, China has the highest annual number of deaths from diabetes, at approximately 1.4 million. Due to its large population and high prevalence of diabetes, the US has the second highest number of deaths with 0.7 million. The next highest is India (0.6 million), followed by Pakistan (0.4 million) and Japan (0.2 million).

The countries with the highest proportion of total deaths associated with diabetes are Singapore (29%) and Pakistan (29%). The next highest countries are Israel (29%), Barbados (28%) and Italy (26%). The countries with the lowest proportions are Russia and Czechia, each with approximately 1% of total deaths.

Pakistan is the country with the highest proportion of deaths under the age of 60 due to diabetes, with 35.5% (Map 3.8). It is followed by Singapore, Brunei, and Kiribati with 31.4%, 31.3%, and 30.4% respectively. This demonstrates a high burden of diabetes in the working age population. The countries with the lowest proportion of deaths under 60 years of age are Benin (1.7%) and Slovakia (1.6%).

Map 3.8 Proportion of total deaths related to diabetes among people under 60

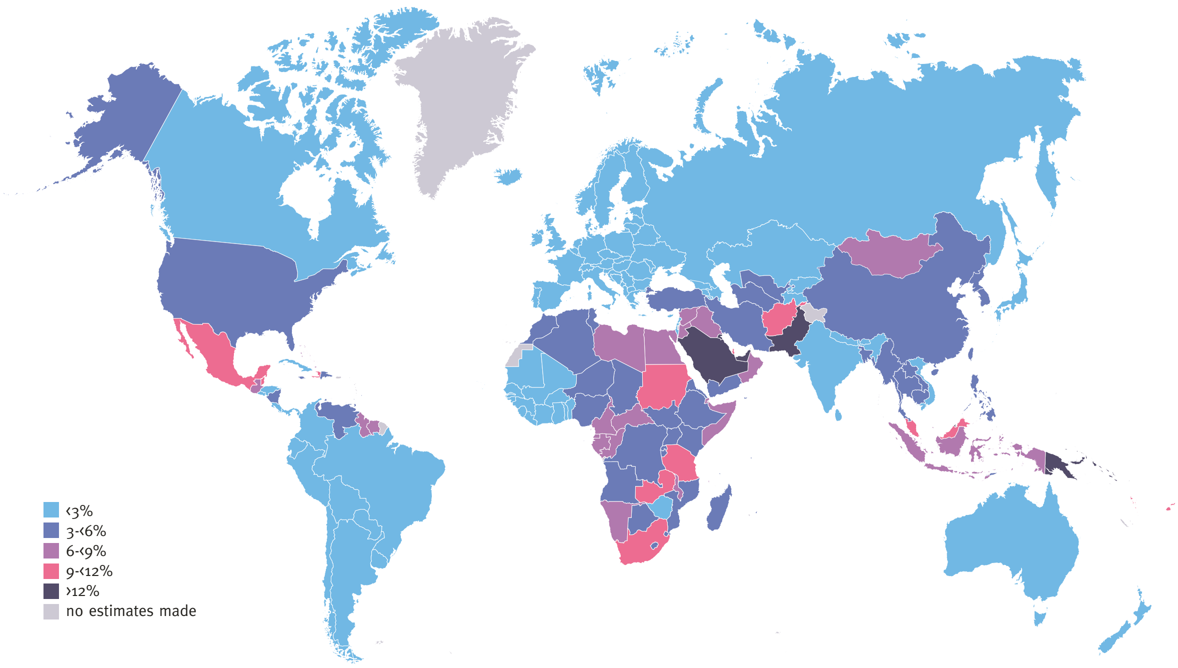


Figure 3.13 Number of deaths due to diabetes in adults (20–79 years), by age and sex in 2021

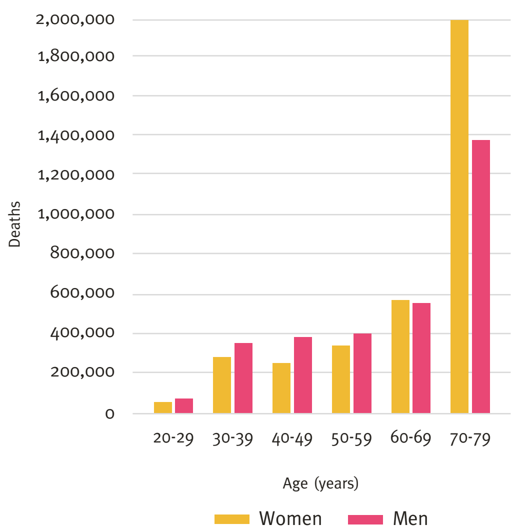


Table 3.21 Proportion and number of adults who died from diabetes before the age of 60 years in 2021, globally and by IDF Region, ranked by the proportion of deaths due to diabetes

IDF region	Number of deaths due to diabetes before the age of 60 years (thousands)	Proportion of total deaths due to diabetes before the age of 60 years (%)
World	**2,184.4**	**11.8**
MENA	428.6	24.5
NAC	199.9	18.4
WP	717.4	15.0
AFR	306.0	8.9
SACA	86.7	8.0
EUR	144.7	7.7
SEA	301.2	6.9

IDF: International Diabetes Federation; AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific

The economic impact of diabetes

Diabetes imposes a substantial economic burden on countries, health systems, people with diabetes, and their families.[39–41]

Direct costs of diabetes

Direct costs are the health expenditures that occur due to diabetes – regardless of whether the expenditure is borne out of pocket by people living with diabetes or by private or public payers, including governments. The *IDF Diabetes Atlas* has included estimates of health expenditure due to diabetes[42–47] since its 3rd edition in 2006. The increase in global health expenditure due to diabetes has been considerable, growing from USD 232 billion in 2007 to USD 966 billion in 2021 for adults aged 20–79 years (Figure 3.14).

This represents a 316% increase over 15 years. Part of this increase can be attributed to improved data quality. The direct costs of diabetes are expected to continue to grow. IDF estimates that total diabetes-related health expenditure will reach USD 1.03 trillion by 2030 and USD 1.05 trillion by 2045.

Respectively, these are increases of 66.4% and 9.1% compared to the 2021 estimate. These projections are conservative as they assume that age and sex-specific diabetes-related expenditure and diabetes prevalence remain constant, while taking into account only population size, ageing, changes in sex distribution and urbanisation.

Regional distribution

The NAC Region has the highest total diabetes-related health expenditure of the seven IDF Regions (USD 415 billion), and accounts for 42.9% of total global diabetes-related health expenditure in 2021. The second highest is the WP Region with USD 241.3 billion, followed by the EUR Region (USD 189 billion) corresponding to 25.0% and 19.6% of the total global diabetes-related health expenditure, respectively. Despite being home to 40.8% of people with diabetes in the world, the SACA, MENA, AFR, and SEA Regions are collectively responsible for only 12.5% of global diabetes-related health expenditure (Figure 3.15).

The NAC Region also has the highest diabetes-related health expenditure per adult with diabetes (USD 8,209), followed by the EUR Region (USD 3,086), SACA Region (USD 2,190) and WP Region (USD 1,204) (Figure 3.16). Health expenditure is 465 USD per person with diabetes in the MENA region, 547 USD in the AFR region, and 112 USD in the SEA region (Figure 3.16).

Expenditure due to diabetes has a substantial impact on total health expenditure worldwide, representing 11.5% of total global health spending. In the SACA Region, an average of 18.4% of the total health expenditure was due to diabetes, the highest percentage from the IDF Regions, followed by 16.6% in the MENA Region. The lowest percentage of health expenditure due to diabetes, was observed in the EUR Region (8.6%) (Figure 3.17).

Figure 3.14 Total diabetes-related health expenditure for adults (20–79 years) with diabetes from 2006 to 2045

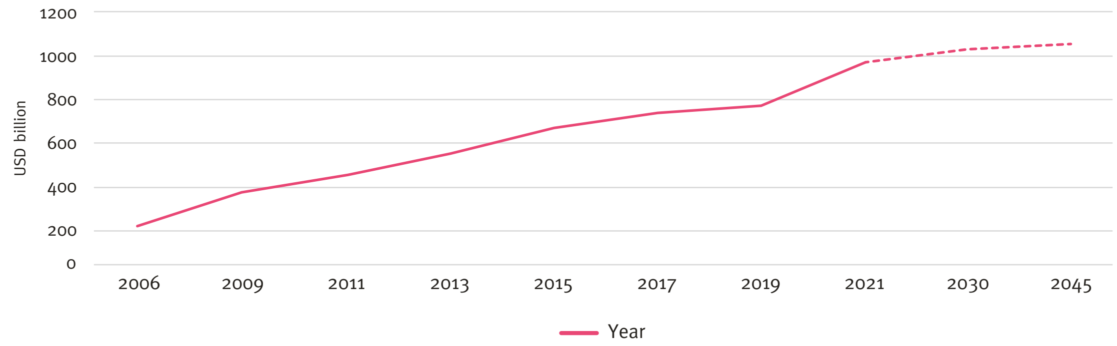
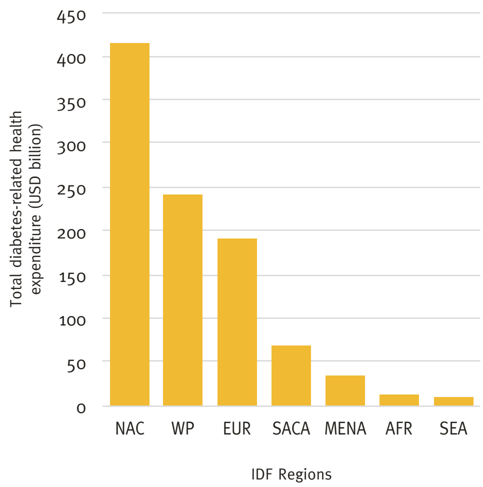
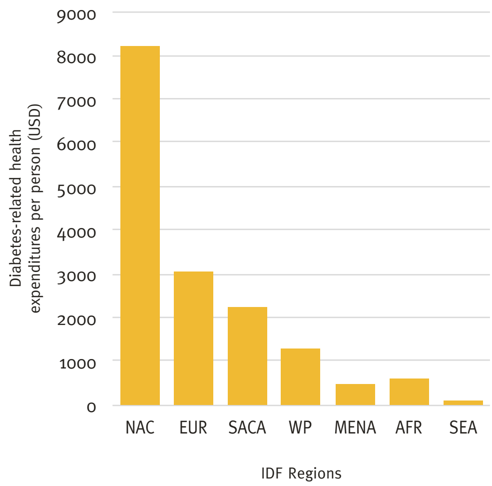


Figure 3.15 Total diabetes-related health expenditure (USD billion) in adults with diabetes (20–79 years) in 2021 by IDF Region



IDF: International Diabetes Federation; AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific

Figure 3.16 Diabetes-related health expenditure (USD) per person with diabetes (20–79 years) in 2021 by IDF Region



IDF: International Diabetes Federation; AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific

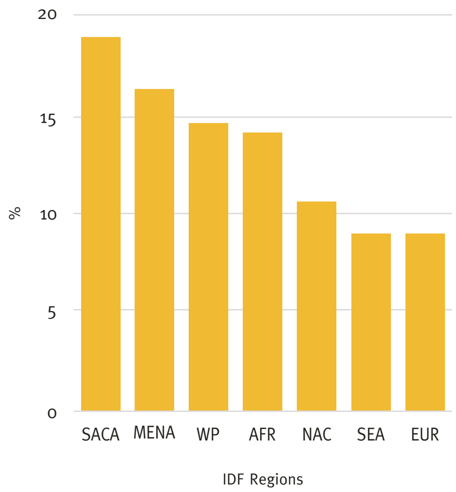
Diabetes-related health expenditure as a percentage of Gross Domestic Product (GDP) is highest in the SACA Region at 1.71%, followed by 1.69% in the NAC Region (Figure 3.18). When considering World Bank income classification, diabetes-related health expenditure as a percentage of GDP is highest amongst high-income countries (1.16%), followed by middle-income countries (1.08%), and followed distantly by low-income countries (0.51%) (Figure 3.19).

Country distribution

On a country level, the highest diabetes-related health expenditure is observed in the United States of America (USD 379.5 billion), followed by China and Brazil, (USD 165.3 billion and USD 42.9 billion, respectively) (Table 3.22).

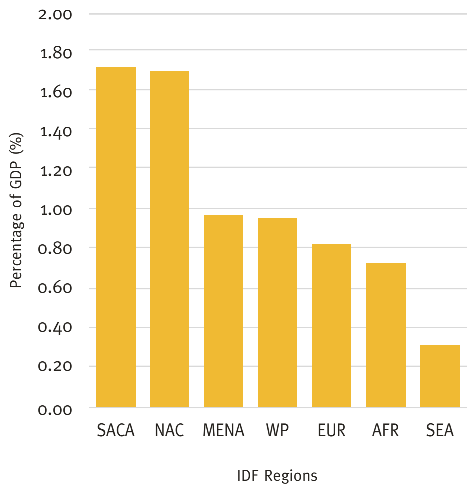
The countries with the lowest diabetes-related health expenditure in 2021 are Gambia and Nauru, with total expenditure of USD 2.4 million and USD 1.6 million, respectively (Map 3.9).

Figure 3.17 Percentage of diabetes-related health expenditure for adults (20–79 years) with diabetes, by IDF Region in 2021



IDF: International Diabetes Federation; AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific

Figure 3.18 Diabetes-related health expenditure as a percentage of Gross Domestic Product (GDP), by IDF region



IDF: International Diabetes Federation; AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific

Figure 3.19 Diabetes-related health expenditure as a percentage of Gross Domestic Product (GDP), by World Bank income classification

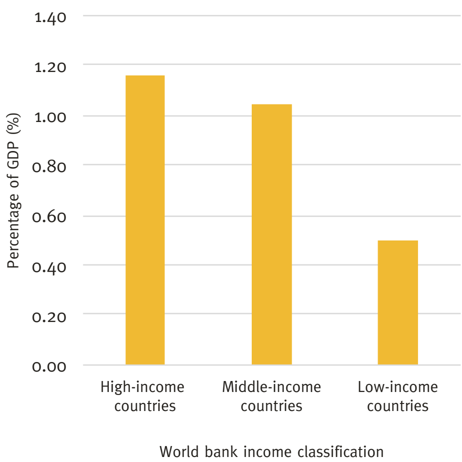
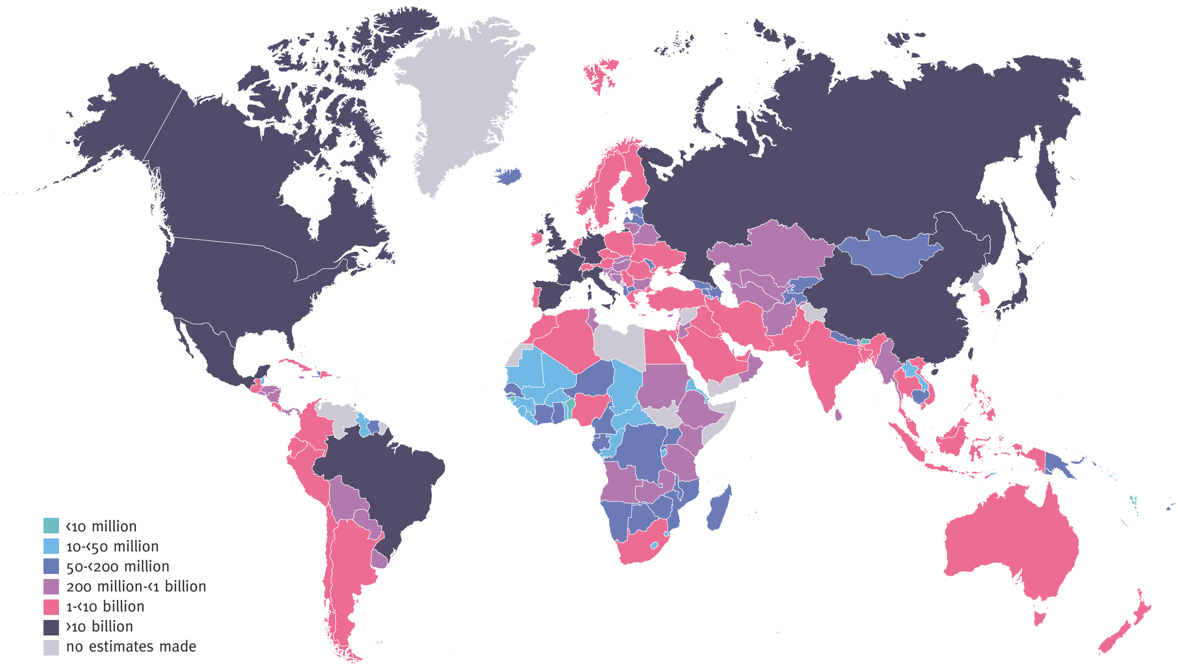


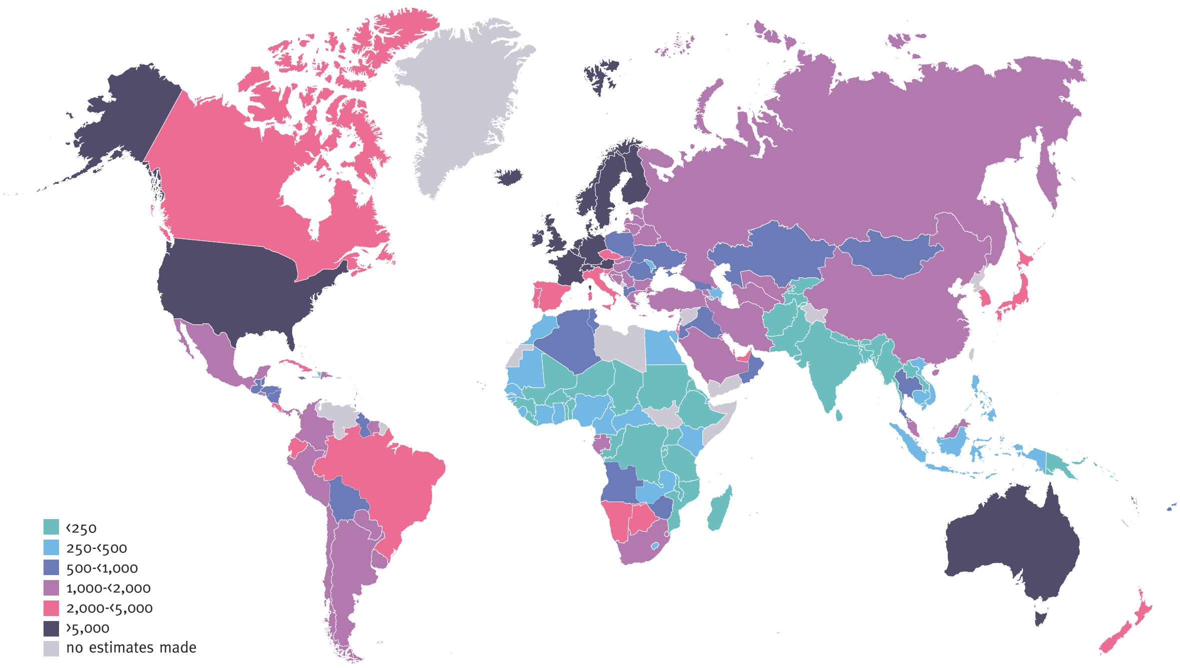
Table 3.22 Ten countries or territories with the highest total health expenditure (USD) due to diabetes (20–79 years) in 2021

Rank	Country or territory	Total diabetes-related health expenditure in 2021 (USD billion) in adults (20–79 years)
1	United States of America	379.5
2	China	165.3
3	Brazil	42.9
4	Germany	41.3
5	Japan	35.6
6	United Kingdom	23.4
7	France	22.7
8	Mexico	19.9
9	Spain	15.5
10	Italy	14.7

Map 3.9 Total diabetes-related health expenditure (USD) for adults (20–79 years) with diabetes, 2021



Map 3.10 Diabetes-related health expenditure (USD) per person with diabetes (20–79 years) in 2021



In 2021, huge disparities exist among countries in per person diabetes-related health expenditure. The countries with the highest yearly expenditure per person are Switzerland (USD 12,828), followed by the United States of America (USD 11,779) and Norway (USD 11,166). Countries with the lowest annual expenditure per person are The Democratic Republic of the Congo (USD 94), Pakistan (USD 80) and Bangladesh (USD 77) (Map 3.10).

Of the 10 countries with the highest health expenditure for diabetes per person, nine are from the EUR Region and one is from the NAC Region (Table 3.23).

Table 3.23 Top 10 countries or territories for diabetes-related health expenditure (USD) per person with diabetes (20–79 years) in 2021

Rank	Country or territory	Diabetes-related health expenditure (USD) per person with diabetes (20–79 years)
1	Switzerland	12,828
2	United States of America	11,779
3	Norway	11,166
4	Iceland	8,401
5	Luxembourg	8,193
6	Denmark	7,844
7	Ireland	7,843
8	Sweden	7,675
9	Germany	6,661
10	Austria	6,575

The total diabetes-related health expenditure will reach one trillion USD by 2030

3

References

1 Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, *et al*. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diab Res Clin Pract*. 2021 (in press)

2 Dall TM, Yang W, Halder P, *et al*. The economic burden of elevated blood glucose levels in 2012: diagnosed and undiagnosed diabetes, gestational diabetes mellitus, and prediabetes. *Diabetes Care* 2014; 37: 3172-9; DOI: http://dx.doi.org/10.2337/dc14-1036.

3 Manne-Goehler J, Geldsetzer P, Agoudavi K, Andall-Brereton G, Aryal KK, Bicaba BW, *et al*. Health system performance for people with diabetes in 28 low- and middle-income countries: A cross-sectional study of nationally representative surveys. *PLOS Med* 2019;16:e1002751. https://doi.org/10.1371/journal.pmed.1002751.

4 Ekoe J-M, Goldenberg R, Katz P. Screening for Diabetes in Adults. Can J *Diabetes* 2018;42:S16–9. https://doi.org/10.1016/j.jcjd.2017.10.004.

5 Magliano DJ, Islam RM, Barr ELM, *et al*. Trends in incidence of total or type 2 diabetes: systematic review. *BMJ* 2019; 366: l5003.

6 Magliano DJ, Chen L, Islam RM, *et al*. Trends in the incidence of diagnosed diabetes: a multicountry analysis of aggregate data from 22 million diagnoses in high-income and middle-income settings. *Lancet Diabetes Endocrinol* 2021; 9(4): 203-11.

7 Tuomilehto J, Ogle GD, Lund-Blix N, Stene LC. Epidemiology of childhood type 1 diabetes. *Pediatr Endocrinol Rev* 2020;17(Suppl 1):198-209. doi: 10.17458/per.vol17.2020.tol.epidemiologychildtype1diabetes.

8 Ogle GD, James S, Dabelea D, Pihoker C, Svennson J, Maniam J, *et al*. Global estimates of incidence of type 1 diabetes in children and adolescents; Results from the International Diabetes Federation Atlas, 10th Edition. *Diabetes Res Clin Pract* 2021 (to be submitted).

9 Mebrahtu G, Maniam J, James S, Ogle GD. High incidence of type 1 diabetes in adolescents and young adults in Eritrea. *Diabetic Med* 2021 Feb 15;e14544, doi: 10.1111/dme.14544.

10 Pambou-Damiens A, Ganga-Zandzou PS, Tsoucka Ibounde E, Kayemba-Kay's S, Baye E, Bilóghe P *et al*. Type 1 diabetes mellitus in Gabon: A study of epidemiological aspects. *Int J Pediatr Adolesc Med* 2019 Sep;6(3):87-91. doi: 10.1016/j.ijpam.2019.02.007.

11 Sandy JL, Besançon S, Sidibé AT, Minkailou M, Togo A, Ogle GD. Rapid increases in observed incidence and prevalence of Type 1 diabetes in children and youth in Mali, 2007–2016. *Pediatr Diabetes* 2021;2021:1-7. DOI: 10.1111/pedi.13191.

12 Jasem D, Majaliwa ES, Ramiaya K, Najem S, Swai ABM, Ludvigsson J. Incidence, prevalence and clinical manifestations at onset of juvenile diabetes in Tanzania. *Diabetes Res Clin Pract* 2019 Oct;156:107817. doi: 10.1016/j.diabres.2019.107817.

13 Majeed NA, Shiruhana SA, Maniam J, Eigenmann CA, Siyan A, Ogle GD. Incidence, prevalence and mortality of diabetes in children and adolescents aged under 20 years in the Republic of Maldives. *J Paed Child Health* 2020;56:746-750. DOI: 10.1111/jpc.14726.

14 Cummings E, Flemming M, Talbot P. Trends in incidence of type 1 diabetes in children and adolescents over 25 years in Nova Scotia Canada: 1994–2018. *Pediatr Diabetes* 2021;22(Suppl 29) EP003. DOI: 10.1111/pedi.13198.

15 Fox DA, Islam N, Sutherland J, Reimer K, Amed S. Type 1 diabetes incidence and prevalence trends in a cohort of Canadian children and youth. *Pediatr Diabetes* 2018; 19(3):501-505. doi: 10.1016/j.jpeds.2020.02.069.

16 International Diabetes Federation. *IDF Guide for Diabetes Epidemiological Studies*. International Diabetes Federation: Brussels; 2021. Available at: https://idf.org/our-activities/epidemiology-research/idf-guide-for-diabetes-epidemiology-studies.html

17 Shulman R, Slater M, Khan S, Jones C, Walker JD, Jacklin K, *et al*. Prevalence, incidence and outcomes of diabetes in Ontario First Nations children: a longitudinal population-based cohort study. *CMAJ Open* 2020; 8(1):E48-E55

18 Powell J, Isom S, Divers J, Bellatorre A, Johnson M, Smiley J, *et al*. Increasing burden of type 2 diabetes in Navajo youth: The SEARCH for diabetes in youth study. *Pediatr Diabetes* 2019; 20(7):815-820

19 Divers J, Mayer-Davis EJ, Lawrence JM, Isom S, Dabelea D, Dolan L, *et al*. Trends in incidence of type 1 and type 2 diabetes among youth – selected counties and Indian Reservations, United States, 2002-2015. *MMWR Morb Mortal Wkly Rep* 2020; 69(6):161-165

20 Haynes A, Kalic R, Cooper M, Hewitt JK, Davis EA. Increasing incidence of type 2 diabetes in indigenous and non-indigenous children in Western Australia, 1990-2012. *Med J* Aust 2016; 204(8):303

21 Candler TP, Mahmoud O, Lynn RM, Majbar AA, Barrett TG, Shield JPH. Continuing rise of Type 2 diabetes incidence in children and young people in the UK. *Diabet Med* 2018; 35(6):737-744

22 Galler A, Stange T, Müller G, Näke A, Vogel C, Kapellen T, *et al*. Incidence of childhood diabetes in children aged less than 15 years and its clinical and metabolic characteristics at the time of diagnosis: data from the Childhood Diabetes Registry of Saxony, Germany. *Horm Res Paediatr* 2010; 74(4)):285-291

23 Telo GH, Cureau FV, Szklo M, Bloch KV, Schaan BD. Prevalence of type 2 diabetes among adolescents in Brazil: Findings from Study of Cardiovascular Risk in Adolescents (ERICA). *Pediatr Diabetes* 2019; 20(4):389-396

24 Simental-Mendía LE, Gamboa-Gómez CI, Aradillas-García C, Rodríguez-Morán M, Guerrero-Romero F. The triglyceride and glucose index is a useful biomarker to recognize glucose disorders in apparently healthy children and adolescents. E*ur J Pediatr* 2020; 179(6):953-958

25 Lawrence JM, Divers J, Isom S, Saydah S, Imperatore G, Pihoker C, Marcovina SM, Mayer-Davis EJ, Hamman RF, Dolan L, Dabelea D, Pettitt DJ, Liese AD; SEARCH for Diabetes in Youth Study Group. Trends in Prevalence of Type 1 and Type 2 Diabetes in Children and Adolescents in the US, 2001-2017. *JAMA*. 2021 Aug 24;326(8):717-727

26 Oester IM, Kloppenborg JT, Olsen BS, Johannesen J. Type 2 diabetes mellitus in Danish children and adolescents in 2014. *Pediatr Diabetes* 2016; 17(5):368-373

27 Rhanolkar AR, Amin R, Taylor-Robinson D, Viner R, Warner J, Stephenson T. Ethnic minorities are at greater risk for childhood-onset type 2 diabetes and poorer glycemic control in England and Wales. *J Adolesc Health* 2006; 59(3):354-361

28 GBD 2015 Obesity Collaborators. Health effects of overweight and obesity in 195 countries over 25 years. *N Engl J Med* 2017; 377(1):13-27

29 Wei JN, Sung FC, Lin CC, Lin RS, Chiang CC, Chuang LM. National surveillance for type 2 diabetes mellitus in Taiwanese children. *JAMA* 2003; 290(10):1345-1350

30 Mahajan A, Taliun D, Thurner M, Robertson NR, Torres JM, Rayner WN *et al*. Fine-mapping type 2 diabetes loci to single-variant resolution using high-density imputation and islet-specific epigenome maps. *Nat Genet* 2008; 50(11):1505-1513

31 Seiglie JA, Marcus M-E, Ebert C, Prodromidis N, Geldsetzer P, Theilmann M, *et al*. Diabetes Prevalence and Its Relationship With Education, Wealth, and BMI in Twenty-Nine Low- and Middle-Income Countries. *Diabetes Care* 2020; 43(4):767-775

32 RISE Consortium; RISE Consortium Investigators. Effects of treatment of impaired glucose tolerance or recently diagnosed type 2 diabetes with metformin alone or in combination with insulin glargine on β-cell function: Comparison of responses in youth and adults. *Diabetes* 2019; 68(8):1670-1680

33 Kim G, Divers J, Fino NF, Dabelea D, Lawrence JM, Reynolds K, *et al*. Trends in prevalence of cardiovascular risk factors from 2002 to 2012 among youth early in the course of type 1 and type 2 diabetes. The SEARCH for Diabetes in Youth Study. *Pediatr Diabetes* 2019; 20(6):693-701

34 Dabelea D, Stafford JM, Mayer-Davis EJ, D'Agostino Jr R, Dolan L, Imperatore G, *et al*. Association of type 1 diabetes vs type 2 diabetes diagnosed during childhood and adolescence with complications during teenage years and young adulthood. *JAMA* 2017; 317(8):825-835

35 TODAY Study Group. Longitudinal changes in cardiac structure and function from adolescence to young adulthood in participants with type 2 diabetes mellitus: The TODAY Follow-Up Study. *Circ Heart Fail* 2020; 13(6):e006685

36 Shah AS, El Ghormli L, Vajravelu ME, Bacha F, Farrell RM, Gidding SS, *et al*. Heart rate variability and cardiac autonomic dysfunction: prevalence, risk factors, and relationship to arterial stiffness in the Treatment Options for Type 2 Diabetes in Adolescents and Youth (TODAY) study. *Diabetes Care* 2019; 42(11):2143-2150

37 Reynolds K, Saydah SH, Isom S, Divers J, Lawrence JM, Dabelea D, *et al*. Mortality in youth-onset type 1 and type 2 diabetes: The SEARCH for Diabetes in Youth Study. *J Diabetes Complications* 2018; 32(6):545-549

38 Harding JL, Wander PL, Zhang X, Li X, Karuranga S, Chen H, *et al*. The International Incidence of Adult-onset Type 1 Diabetes: A Systematic Review. *Diabetes Care*. Provisionally accepted

39 Association AD. Economic Costs of Diabetes in the U.S. in 2017. *Diabetes Care* 2018 May 1;41(5):917–28.

40 Peters ML, Huisman EL, Schoonen M, Wolffenbuttel BHR. The current total economic burden of diabetes mellitus in the Netherlands. *Neth J Med*. 2017 Sep;75(7):281–97.

41 Yang W, Zhao W, Xiao J, Li R, Zhang P, Kissimova-Skarbek K, *et al*. Medical care and payment for diabetes in China: enormous threat and great opportunity. *PLoS ONE*. 2012;7(9):e39513.

42 International Diabetes Federation. *IDF Diabetes Atlas, 8th edition*. Brussels, Belgium; 2017

43 International Diabetes Federation. *IDF Diabetes Atlas, 7th edition*. Brussels, Belgium; 2015

44 International Diabetes Federation. *IDF Diabetes Atlas, 6th edition*. Brussels, Belgium; 2013

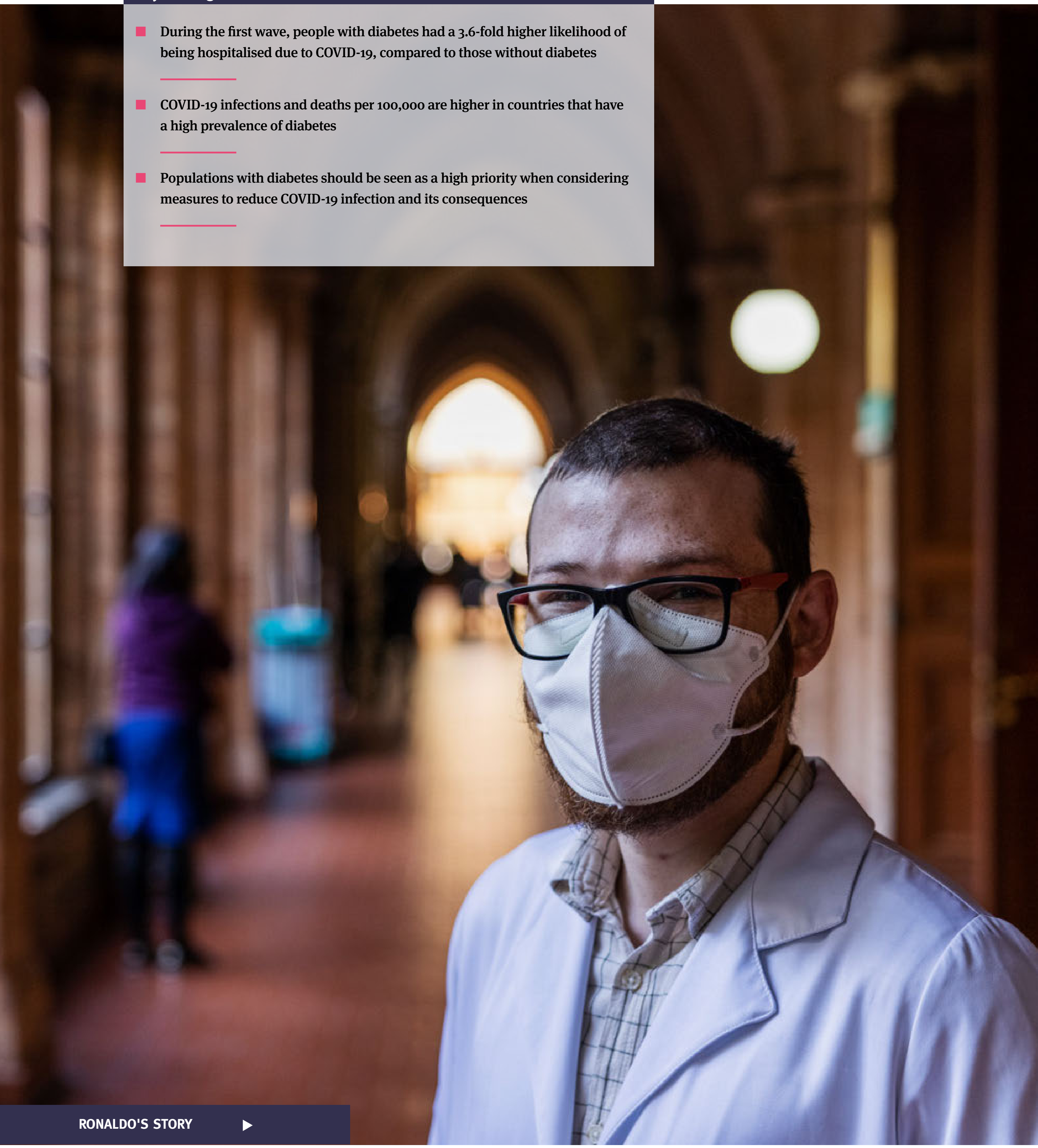
45 International Diabetes Federation. *IDF Diabetes Atlas, 5th edition*. Brussels, Belgium; 2011

46 International Diabetes Federation. *IDF Diabetes Atlas, 4th edition*. Brussels, Belgium; 2009

47 International Diabetes Federation. I*DF Diabetes Atlas, 3rd edition*. Brussels, Belgium; 2006

Key messages

- During the first wave, people with diabetes had a 3.6-fold higher likelihood of being hospitalised due to COVID-19, compared to those without diabetes
- COVID-19 infections and deaths per 100,000 are higher in countries that have a high prevalence of diabetes
- Populations with diabetes should be seen as a high priority when considering measures to reduce COVID-19 infection and its consequences



RONALDO'S STORY ▶

COVID-19 and diabetes

4 COVID-19 and diabetes

Globally, the SARS-CoV-2 (COVID-19) pandemic has created an enormous strain on Healthcare systems, economies and our way of life. Since its initial outbreak in December 2019, involving clusters of cases in the city of Wuhan, China, COVID-19 infections spread rapidly, prompting the World Health Organization (WHO) to declare a global pandemic in March 2020.[1]

Initial studies suggested that people with diabetes had a particularly high risk of developing severe complications from COVID-19 infection, including COVID-19 pneumonia, acute respiratory distress syndrome (ARDS) and respiratory failure.[2–4] These preliminary studies showed that people with diabetes had a greater need for hospitalisation, mechanical ventilation, and other life sustaining measures, compared to people without diabetes.[4–6]

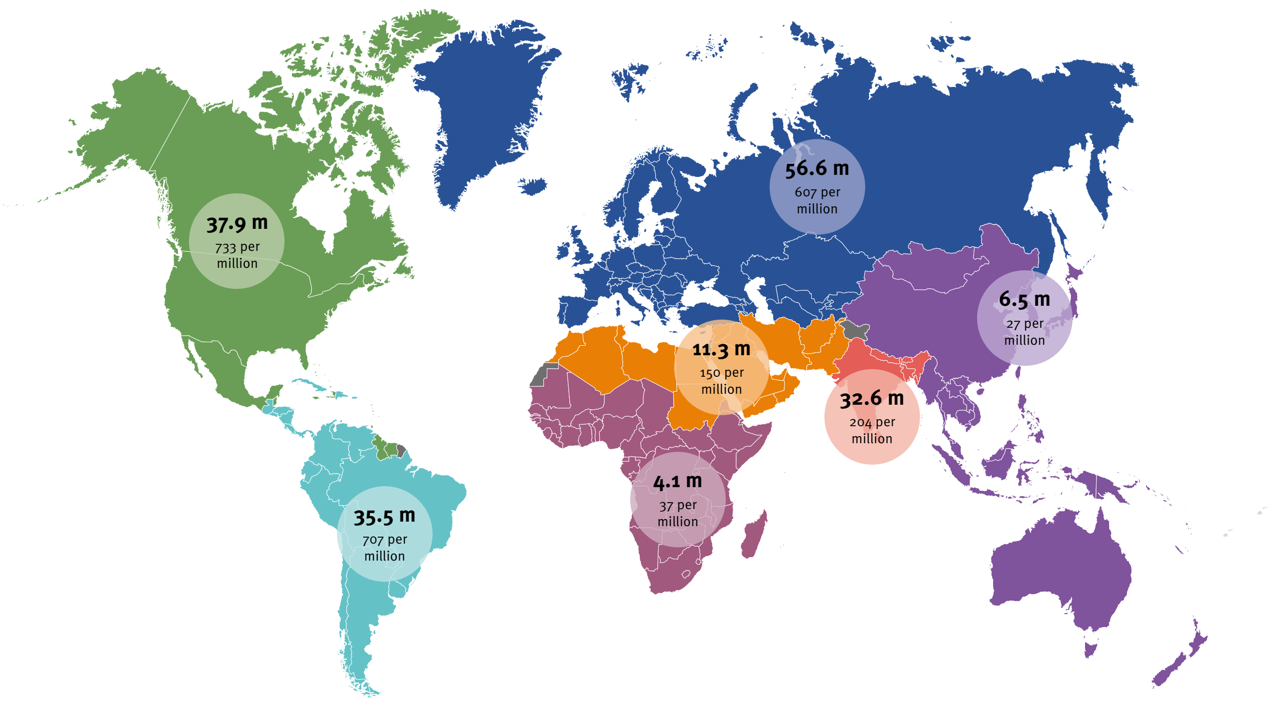
Since then, the number of studies devoted to COVID-19 has grown exponentially, offering the opportunity to examine the association between diabetes and severe COVID-19-related outcomes, including the likelihood of hospitalisation and death.

Regional distribution

By July 2021, the IDF regions with the highest cumulative number of COVID-19 infections were Europe, North America and the Caribbean, and South and Central America (Map 4.1). Accordingly, high-income countries had vastly higher infection rates and numbers of deaths from COVID-19 per capita than low or middle-income countries (Figure 4.1). Lastly, while we noted that higher income countries had increased infection rates, we were unable to test whether this was due to differences in resources and capacity for COVID-19 testing or due to less mobility and international travel to and from lower income countries over this period of time.

In addition, countries that had a high prevalence of diabetes reported increased numbers and rates of COVID-19 infections and deaths than countries with a lower prevalence of diabetes (Figure 4.2), after accounting for the income level of each country (Figure 4.3).

Map 4.1 Cumulative number of COVID-19 infections[7] overall and per 100,000 population[8], by IDF Region



Number of COVID-19 infections and deaths per country were sourced from Johns Hopkins Coronavirus Resource Centre[7]; Country population size estimates were sourced from Our World in Data[8]

Figure 4.1 COVID-19 infections and deaths per 100,000 population across countries, by World Bank income classification[9]

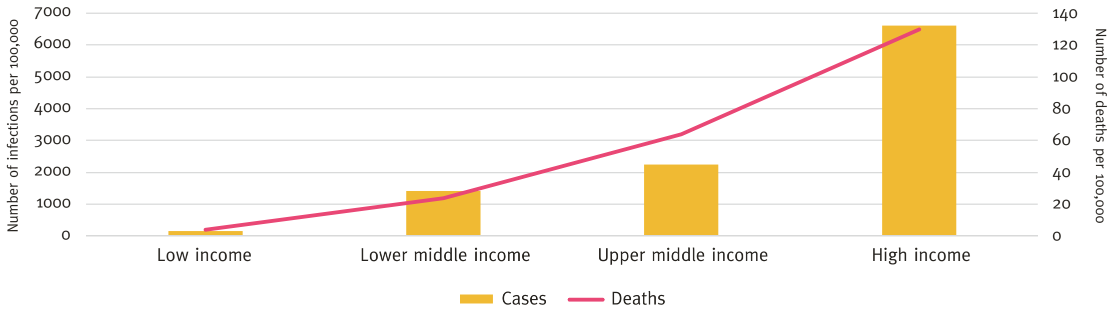


Figure 4.2 Cumulative number of COVID-19 infections, and rate of COVID-19 deaths across countries according to IDF diabetes prevalence categories

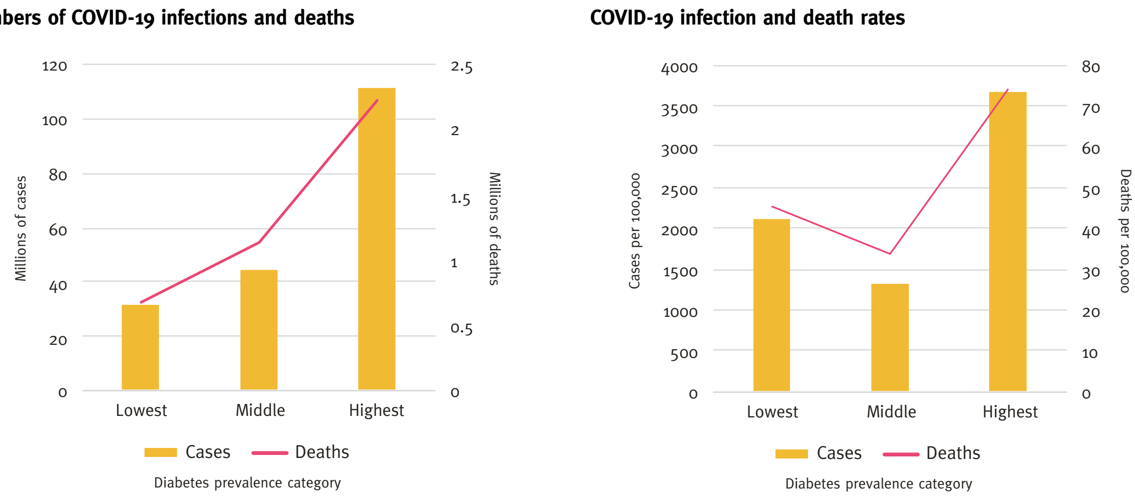
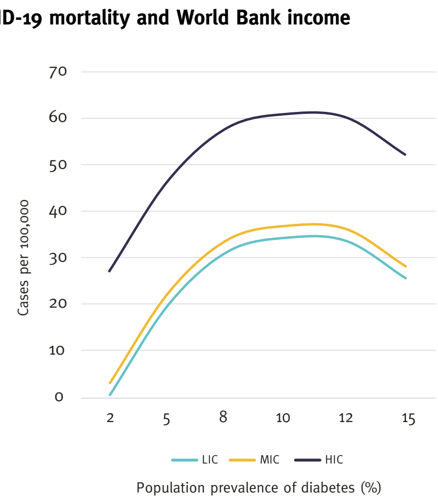


Figure 4.3 Rate of COVID-19 deaths across countries according to IDF Diabetes prevalence categories



Estimates from regression models included the following variables, specific to each country: age-adjusted diabetes prevalence and prevalence², and gross domestic product (GDP) per capita. P <0.0001 for each variable

Diabetes as a risk factor for COVID-19-related hospitalisation

In a systematic review of 300 studies, only 22 were derived from a population- or community-based sample of people with COVID-19 and were able to examine their risk of hospitalisation. Overall, individuals with diabetes had a 3.6-fold higher likelihood of being hospitalised due to COVID-19, compared to those without diabetes.

These findings were partially explained by differences in the age and sex distribution of populations with and without diabetes, and in the prevalence of prior comorbidities, such as cardiovascular and chronic kidney disease. In analyses that adjusted for all three of these factors, diabetes remained an independent predictor of hospitalisation, with likelihood for hospitalisation in people with diabetes 1.7 times higher than in those without.

Diabetes and COVID-19-related mortality

Estimates from 282 research studies suggest that people with diabetes who are hospitalised with COVID-19 are 2.3 times more at risk of death than people without diabetes who were admitted to the same hospital or health system. In analyses that adjusted for age, sex, and comorbidities, diabetes remained a significant risk factor for death from COVID-19, with in-hospital mortality 1.6 times higher, relative to those without diabetes. Estimates were remarkably similar in both high- and low-to-middle income countries and across IDF Regions.

The highest risks were observed in studies from the Western Pacific, African, and South and Central American regions, where people with diabetes who were admitted to hospital with COVID-19 were nearly three times more at risk of death compared to those without diabetes. After accounting for other risk factors, the risk of death was reduced but remained significant.

While all global regions were represented, the majority of studies were conducted in only 12 countries, with the largest number coming from China, Italy and the United States of America. Findings from these three countries appeared similar to those in all other countries combined.

Risk factors for severe COVID-19-related outcomes in the diabetes population

There are many reasons why people with diabetes may be more susceptible to develop adverse events following COVID-19 infection. Diabetes is extremely common in older populations, including those living in long-term care facilities, a setting that was particularly affected by early outbreaks of COVID-19 severity and death.[10] As in the general population, age appears to be an important risk factor for COVID-19 severity and mortality in hospitalised people with diabetes.[11–17]

A UK population-based cohort study of more than three million people with diabetes revealed a sudden increase in overall mortality and COVID-19-related mortality in March 2020, with the greatest rise among those with type 1 diabetes.[18] Several other studies have compared COVID-19-related outcomes in those with type

1 diabetes, compared to type 2 diabetes, but most were too small to draw firm conclusions.[19–21]

There has been considerable interest in the role of glycaemic control as a risk factor for severe COVID-19-related diseases. In general, studies that adjusted for age, sex and other risk factors, found that poorer glucose control, as measured by a higher HbA1c level, was associated with worse COVID-19 endpoints, including hospitalisation, ICU admission and death.[17, 22–25] Relatively fewer studies examined whether blood glucose levels at the time of admission are a risk factor for adverse outcomes as some show significant findings, while others do not.[14, 17, 24, 26–32]

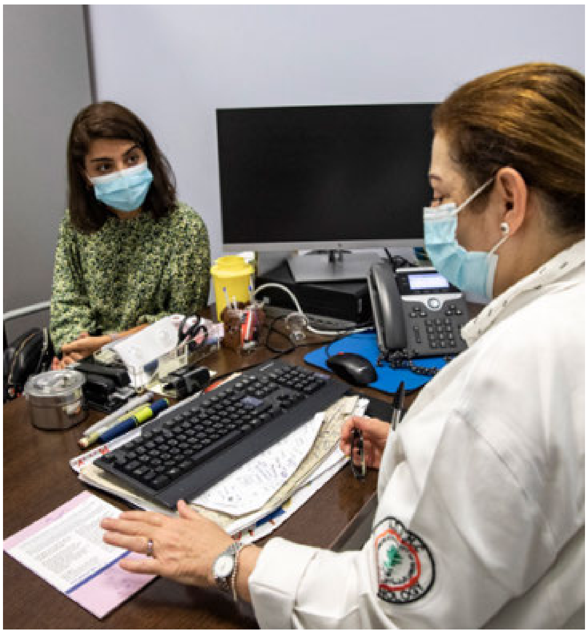
A propensity score-matched study conducted in China found glucose to be a predictor of severe COVID-19-related outcomes.[33] Long-term diabetes complications, including cardiovascular and kidney disease, also appear to be risk factors for mortality in people hospitalised with COVID-19 and may account for some of the excess risk of adverse consequences associated with diabetes.[11, 30, 34]

Limitations of conducted research

While this systematic review provides important data for future healthcare and policy interventions, there are a few factors that need to be considered in future research. First, most of the studies reviewed were conducted during the first wave of the pandemic, when many health systems were overwhelmed and had insufficient resources to allow comprehensive reporting of cases on a broad scale. Second, many papers were largely descriptive, providing only an overview of the clinical manifestations of COVID-19 in various populations.

Accordingly, many lacked detailed information about participant recruitment, data sources and other aspects of study methods. This was fuelled by the need to share information on COVID-19 severity in a timely way, resulting in an expedited publication of research articles in the early phases of the pandemic. In many studies, it was unclear whether people who were classified as having diabetes had new or pre-existing diabetes, or whether this included those with ‘stress’ hyperglycaemia caused by the infection itself or its management.

Third, the true burden of COVID-19 among people living with diabetes could not be determined due to limited numbers of pre-hospital studies and the inability to screen large segments of the population in the early stages of the pandemic. Lastly, research studies from low and lower middle-income countries were lacking at the time of this review.



Summary

The COVID-19 pandemic has created an unprecedented challenge for global healthcare systems. COVID-19 infections and deaths per 100,000 are higher in countries that have a high prevalence of diabetes, for reasons that are unclear. Research studies suggest that diabetes is a risk factor for severe COVID-19-related disease, resulting in a greater risk of hospitalisation and death.

Populations with diabetes should be considered a high priority when considering measures to reduce COVID-19 infection and its consequences. Further research is needed to understand the interplay between COVID-19 and diabetes and how best to address the disproportionate burden of COVID-19 among people living with diabetes.

4

References

1 World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19 – 11 March 2020. WHO: May 11 2020. Available from: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-11-march-2020

2 Wu C, Chen X, Cai Y. Risk Factors Associated With Acute Respiratory Distress Syndrome and Death in Patients With Coronavirus Disease 2019 Pneumonia in Wuhan, China. *JAMA Intern Med*. 2020 Mar 13; 180(7):934-943; DOI:10.1001/jamainternmed.2020.0994

3 Hu Y, Sun J., Dai Z, Deng H, Li X, Huang Q. Prevalence and severity of corona virus disease 2019 (COVID-19): A systematic review and meta-analysis. *J Clin Virol*. 2020 Jun; 127:104371. DOI: 10.1016/j.jcv.2020.104371

4 Huang I, Lim MA, Pranata R. Diabetes mellitus is associated with increased mortality and severity of disease in COVID-19 pneumonia – A systematic review, meta-analysis, and meta-regression. *Diabetes Metab Syndr*. 2020 Jul-Aug; 14(4):395-403. Epub 2020 April 17. DOI: 10.1016/j.dsx.2020.04.018

5 Zhang Y, Cui Y, Shen M, Zhang J, Liu B, Dai M et al. Association of diabetes mellitus with disease severity and prognosis in COVID-19: A retrospective cohort study. *Diabetes Res Clin Pract*. 2020 May 22; (165); DOI: 10.1016/j.diabres.2020.108227

6 Killerby ME, Link-Gelles, R, Haight SC, Schrodt CA, England L, Gomes DJ et al. Characteristics Associated with Hospitalization Among Patients with COVID-19 — Metropolitan Atlanta, Georgia, March–April 2020. *MMWR Morb Mortal Wkly Rep*. 2020 June 26; 69(25);790–794; DOI: http://dx.doi.org/10.15585/mmwr.mm6925e1

7 John Hopkins Coronavirus Research Center [Internet]. Cases by World Countries. John Hopkins University & Medicine: 2021; [Retrieved 2021 July 7]. Available from: https://coronavirus.jhu.edu/

8 Our World in Data [Internet]. Country Population, 2021. [Retrieved 2021 July 7]. Available from: https://ourworldindata.org/

9 The World Bank [Internet]. The World by Income and Region. [Retrieved 2021 July 7]. Available from: https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html

10 Thompson DC, Barbu MG, Beiu C, Popa LG, Mihai MM, Berteanu, M *et al*. The Impact of COVID-19 Pandemic on Long-Term Care Facilities Worldwide: An Overview on International Issues. *Biomed Res Int*. 2020 Nov 4; 8870249. DOI: 10.1155/2020/8870249

11 Schlesinger S, Neuenschwander M, Lang A, Pafili K, Kuss O, Herder C. Risk phenotypes of diabetes and association with COVID-19 severity and death: a living systematic review and meta-analysis. *Diabetologia*. 2021 April 28; 64(7): 1480–1491. DOI: 10.1007/s00125-021-05458-8

12 Do JY, Kim SW, Park JW, Cho KH, Kang, SH. Is there an association between metformin use and clinical outcomes in diabetes patients with COVID-19? *Diabetes Metab*. 2021 Jul; 47(4):101208. Epub 2020 Nov 4. DOI: 10.1016/j.diabet.2020.10.006

13 Fox T, Ruddiman, K, Lo KB, Peterson E, DeJoy R, Salacup G. The relationship between diabetes and clinical outcomes in COVID-19: a single-center retrospective analysis. *Acta Diabetol*. 2020 Aug 17 : 1–6. DOI: 10.1007/s00592-020-01592-8

14 Lampasona V, Secchi M, Scavini M, Bazzigaluppi E, Brigatti C, Marzinotto I. Antibody response to multiple antigens of SARS-CoV-2 in patients with diabetes: an observational cohort study. *Diabetologia*. 2020 Oct 8; 1-11. DOI: 10.1007/s00125-020-05284-4

15 Lei M, Lin K, Pi Y, Huang X, Fan L, Huang J. Clinical Features and Risk Factors of ICU Admission for COVID-19 Patients with Diabetes. *J Diabetes Res*. 2020 Dec 11; 2020:5237840; DOI: 10.1155/2020/5237840

16 Sourij H, Aziz, F, Bräuer A, Ciardi C, Clodi M, Fasching P. COVID-19 fatality prediction in people with diabetes and prediabetes using a simple score upon hospital admission. *Diabetes Obes Metab*. 2021 Feb;23 (2):589-598. Epub 2020 Dec 4. DOI: 10.1111/dom.14256

17 Myers AK, Kim TS, Zhu X, Liu Y, Qiu, M, Pekmezaris R. Predictors of mortality in a multiracial urban cohort of persons with type 2 diabetes and novel coronavirus 19. *J Diabetes*. 2021 Feb 26; DOI: 10.1111/1753-0407.13158

18 Holman N, Knighton P, Kar P, O'Keefe J, Curley M, Weaver A. Risk factors for COVID-19-related mortality in people with type 1 and type 2 diabetes in England: a population-based cohort study. *Lancet Diabetes Endocrinol*. 2020 Oct; 8(10): 823-833; DOI: 10.1016/S2213-8587(20)30271-0

19 Cariou B, Hadjadj S, Wargny M, Pichelin M, Al-Salameh A, Allix I. Phenotypic characteristics and prognosis of inpatients with COVID-19 and diabetes: the CORONADO study. *Diabetologia*. 2020 May 29; 63(8):1500–1515. DOI: 10.1007/s00125-020-05180-x

20 Izzi-Engbeaya C, Distaso W, Amin A, Yang W, Idowu O, Kenkre JS. Adverse outcomes in COVID-19 and diabetes: a retrospective cohort study from three London teaching hospitals. *BMJ Open Diabetes Res Care*. 2021 Jan 9; 9(1):e001858. DOI: 10.1136/bmjdrc-2020-001858

21 Crouse A, Grimes T, Li P, Might M, Ovalle F, Shaley A. Metformin Use is Associated with Reduced Mortality in a Diverse Population with COVID-19 and Diabetes. *Front Endocrinol (Lausanne)*. 2021 Jan 13; 11: 600439. DOI: 10.3389/fendo.2020.600439

22 Zhu Z, Mao Y, Chen G. Predictive value of HbA1c for in-hospital adverse prognosis in COVID-19: A systematic review and meta-analysis. *Prim Care Diabetes*. 2021 Aug 11; S1751-9918(21)00130-3. DOI: 10.1016/j.pcd.2021.07.013

23 Prattichizzo F, de Candia P, Nicolucci A, Ceriello A. Elevated HbA1c levels in pre-Covid-19 infection increases the risk of mortality: A sistematic review and meta-analysis. *Diabetes Metab Res Rev*. 2021 May 20 e3476. DOI: 10.1002/dmrr.3476

24 Liu Z, Bai X, Han X, Jiang W, Qiu L, Chen S *et al*. The association of diabetes and the prognosis of COVID-19 patients: A retrospective study. *Diabetes Res Clin Pract*. 2020 Nov; 169:108386. Epub 2020 Aug 25. DOI: 10.1016/j.diabres.2020.108386

25 Cheng, Y, Yue L, Wang, Z, Zhang, J, Xiang G. Hyperglycemia associated with lymphopenia and disease severity of COVID-19 in type 2 diabetes mellitus. *J Diabetes Complications*. 2021 Feb; 35(2):107809. Epub 2020 Nov 26.DOI: 10.1016/j.jdiacomp.2020.107809

26 Lazarus G, Audrey J, Wangsaputra VK, Tamara A, Tahapary DL. High admission blood glucose independently predicts poor prognosis in COVID-19 patients: A systematic review and dose-response meta-analysis. *Diabetes Res Clin Pract*. 2021 Jan; 171: 108561.Epub 2020 Dec 9. DOI: 10.1016/j.diabres.2020.108561

27 Chen Y, Yang D, Cheng B, Chen J, Peng A, Yang C *et al*. Clinical Characteristics and Outcomes of Patients With Diabetes and COVID-19 in Association With Glucose-Lowering Medication. *Diabetes Care*. 2020 July; 43(7): 1399-1407. DOI: 10.2337/dc20-0660

28 Hui Y, Li Y, Tong X, Wang Z, Mao X, Huang L *et al*. The risk factors for mortality of diabetic patients with severe COVID-19: A retrospective study of 167 severe COVID-19 cases in Wuhan. *PLoS One*. 2020 Dec 31; 15(12): e0243602. DOI: 10.1371/journal.pone.0243602

29 Li Y, Han X, Alwalid O, Cui Y, Cao Y, Liu J *et al*. Baseline characteristics and risk factors for short-term outcomes in 132 COVID-19 patients with diabetes in Wuhan China: A retrospective study. *Diabetes Res Clin Pract*. 2020 Aug; 166: 108299. Epub 2020 Jul 3. DOI: 10.1016/j.diabres.2020.108299

30 Mirani M, Favacchio G, Carrone F, Betella N, Biamonte E, Morenghi G. Impact of Comorbidities and Glycemia at Admission and Dipeptidyl Peptidase 4 Inhibitors in Patients With Type 2 Diabetes With COVID-19: A Case Series From an Academic Hospital in Lombardy, Italy. *Diabetes Care*. 2020 Dec; 43(12):3042-3049. DOI: 10.2337/dc20-1340

31 Zhang N, Wang C, Zhu F, Mao H, Bai P, Chen LL *et al*. Risk Factors for Poor Outcomes of Diabetes Patients With COVID-19: A Single-Center, Retrospective Study in Early Outbreak in China. *Front Endocrinol (Lausanne)*. 2020; 11: 571037. Epub 2020 Sep 24; DOI: 10.3389/fendo.2020.571037

32 Chung SM, Lee, YY, Ha EY, Yoon JS, Won KC, Lee HW *et al*. The Risk of Diabetes on Clinical Outcomes in Patients with Coronavirus Disease 2019: A Retrospective Cohort Study. *Diabetes Metab J*. 2020 Jun; 44(3): 405–413. Epub 2020 May 21; DOI: 10.4093/dmj.2020.0105

33 Zhu L, She ZG, Cheng X, Qin, JJ, Zhang XJ, Cai J *et al*. Association of Blood Glucose Control and Outcomes in Patients with COVID-19 and Pre-existing Type 2 Diabetes. *Cell Metabolism*. 2020 June 2; 31(6): DOI: 10.1016/j.cmet.2020.04.021

34 Khalil S, Sabaghian T, Sedaghat M, Soroureddin Z, Askari E, Khalili N. Prevalence, Risk Factors and Outcomes Associated with Acute Kidney Injury in Patients Hospitalized for COVID-19: A Comparative Study between Diabetic and Nondiabetic Patients. *J Diabetes Res*. 2021 Jan 6; 2021:6666086; DOI: 10.1155/2021/6666086

Key messages

- The number of people with diabetes in the IDF Africa Region is expected to increase by 129% by 2045, the highest predicted increase of all regions
- The IDF Europe Region has the highest number of children and adolescents (0–19 years) with type 1 diabetes – 295,000 in total
- The IDF Middle-East and North Africa Region has the highest percentage (24.5%) of diabetes-related deaths in people of working age
- The IDF North America and Caribbean Region accounts for 43% of global diabetes-related health expenditure – USD 415 billion
- 1 in 3 (33%) adults living with diabetes in the IDF South and Central America Region are undiagnosed
- 1 in 4 live births in the IDF South-East Asia Region are affected by hyperglycaemia in pregnancy
- Western Pacific is the IDF Region with the highest number of people living with diabetes, at 206 million adults (20–79 years), or 1 in 8 adults

TAZUL'S STORY ▶

5

Diabetes by region

5

Diabetes in Africa

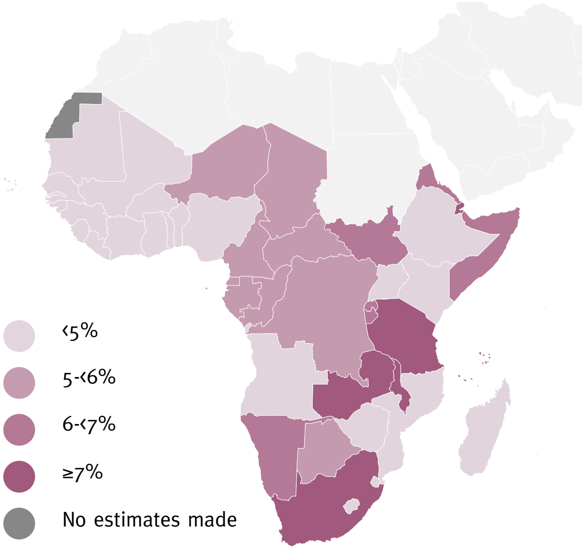
2021

Estimates were made for 48 Sub-Saharan African countries and territories in the IDF Africa (AFR) Region. For this edition of the *IDF Diabetes Atlas*, a total of 25 data sources (from 20 countries) were selected. About half (58%) of the countries in the IDF AFR Region lack high-quality in-country data sources. Only one country (Zambia) had studies conducted within the past five years.

Despite the lowest prevalence estimate of 4.5% among IDF Regions, the expected increase in the number of people with diabetes by 2045 is the highest at 129%, reaching 55 million. The AFR Region is also predicted to have the highest increase of 107% in the number of people with impaired glucose tolerance by 2045, reaching 117 million. The proportion of undiagnosed diabetes is also highest in the AFR Region at 53.6%.

Only 12.6 billion USD was spent on diabetes in AFR Region, representing 1.3% of the total spent worldwide, despite the Region being home to 4.5% of people with diabetes worldwide.

Figure 5.1 Age-adjusted comparative prevalence (%) of diabetes (20–79 years) in IDF Europe Region in 2021



Highlights

1 in 22 adults have diabetes — 24 million.

The total number of people with diabetes is predicted to increase by 129% to 55 million by 2045, the highest percentage increase of all IDF Regions.

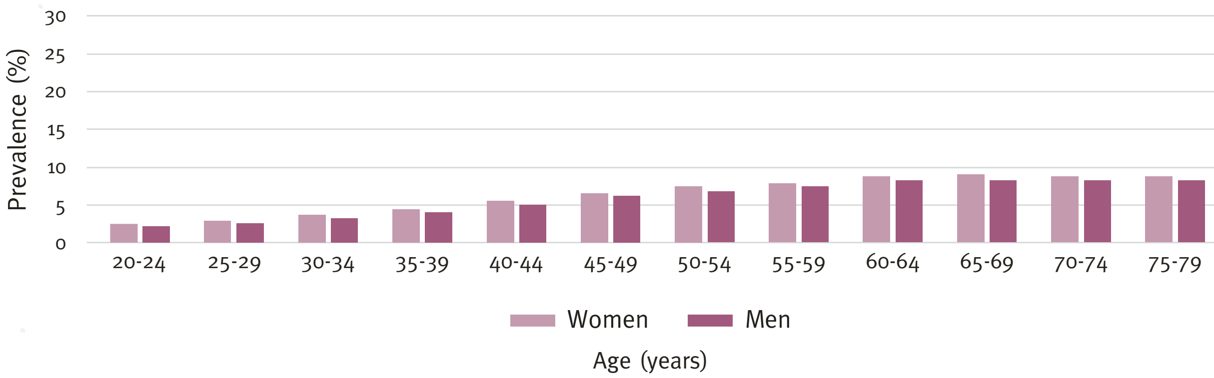
1 in 5 (54%) of people living with diabetes in the Region are undiagnosed, the highest proportion of all IDF Regions.

Diabetes is responsible for 416,000 deaths in 2021.

Africa has the second lowest diabetes-related expenditure (USD 13 billion) associated with diabetes, 1% of global expenditure.

1 in 8 live births are affected by hyperglycaemia in pregnancy.

Figure 5.1 Estimated prevalence (%) of diabetes by age and sex for the IDF Africa Region in 2021



At a glance

	2021	2030	2045
Adult population in Africa			
Aged 20–79 years	527m	696m	1.05b
Diabetes (20–79 years)			
Regional prevalence	4.5%	4.8%	5.2%
Age-adjusted comparative prevalence	5.3%	5.5%	5.6%
Number of people with diabetes	24m	33m	55m
Number of deaths due to diabetes	416,000	–	–
Healthcare expenditure due to diabetes (20–79 years)			
Total healthcare expenditure, USD	12.6b	43.1b	46.7b
Impaired glucose tolerance (20–79 years)			
Regional prevalence	9.9%	10.1%	11.1%
Age-adjusted comparative prevalence	12.6%	13.4%	14.1%
Number of people with impaired glucose tolerance	52.2m	70.6m	116.7m
Impaired fasting glucose (20–79 years)			
Regional prevalence	7.8%	7.9%	8.0%
Age-adjusted comparative prevalence	8.0%	7.9%	7.6%
Number of people with impaired fasting glucose	40.9m	55.2m	84.7m
Undiagnosed diabetes (20–79 years)			
Regional prevalence	53.6%	–	–
Number of people with undiagnosed diabetes	12.7m	–	–
Type 1 diabetes (0–19 years)			
Number of children and adolescents with type 1 diabetes	59,500	–	–
Number of newly diagnosed children and adolescents each year	19,700	–	–

m= million b=billion

Top 5 countries

	2011	2021
Top 5 countries for age-adjusted prevalence of people with diabetes (20–79 years)		
United Republic of Tanzania	2.8%	12.3%
Zambia	4.8%	11.9%
Comoros	8.6%	11.7%
South Africa	7.1%	10.8%
Seychelles	12.4%	8.5%

	2011	2021
Top 5 countries for number of people with diabetes (20–79 years)		
South Africa	1.9m	4.2m
Nigeria	3.1m	3.6m
United Republic of Tanzania	472,900	2.9m
Ethiopia	1.4m	1.9m
Democratic Republic of the Congo[i]	730,700	1.9m

[i] based on extrapolation from similar countries

m=million b = billion

5

Living with diabetes in Africa

Carol Hendricks, South Africa

The first thing that came to my mind when I was diagnosed with type 2 diabetes was that I would have to live with the condition for the rest of my life. I knew this because I was taking care of my mother who lived with diabetes. I went to her doctor to ask for advice and I looked for support within the community. I noticed that there was limited knowledge about diabetes and that some people living with the condition were not taking their medication.

"I was advised one day to set a goal in life and decided that I wanted to see my children all grown-up"

“Limited knowledge about diabetes in my community inspired me to improve awareness and understanding of the condition”

This concerned me and inspired me to do something to improve awareness and understanding of diabetes. I followed a leadership course to improve my public speaking skills and started collaborating with Diabetes South Africa, where I volunteered to start a support group for people living with diabetes. In 20 years, the group I look after has grown from 13 to over 100.

The challenges I have faced living with type 2 diabetes have included eating healthy food with my family and accepting that I have to inject insulin.

I was advised one day to set a goal in life and decided that I wanted to see my children all grown-up. Today, I am blessed to have four grandchildren.

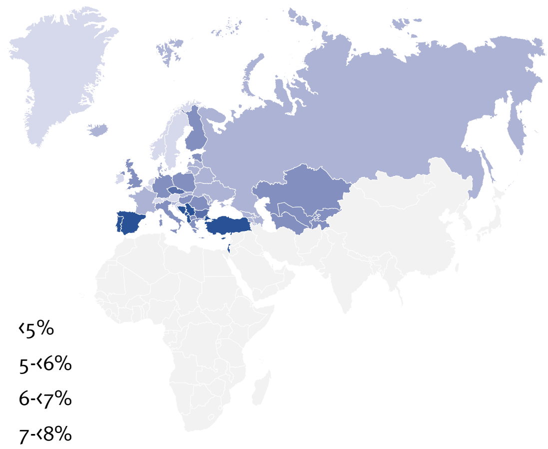
5 Diabetes in Europe

2021

Estimates were made for 59 countries and territories in the IDF Europe (EUR) Region. A total of 60 data sources from 39 countries were used to generate diabetes estimates among adults in the Region. Estimates for 14 countries (Austria, Denmark, Finland, France, Georgia, Greece, Greenland, Hungary, Lithuania, Malta, Russian Federation, Turkmenistan, United Kingdom, and Uzbekistan) were based on studies conducted within the past five years

IDF projects that diabetes prevalence (9.2%) and the number of people with diabetes (61 million) in EUR Region will see a 13% increase by 2045. The EUR Region has the highest number of children and adolescents with type 1 diabetes (295,000) as well as the highest incidence annually, with 31,000 new cases per year. The EUR Region has the second highest average cost per person with diabetes (USD 3,086). In 2021, 189.3 billion USD was spent on diabetes, representing 19.6% of the total spent worldwide.

Map 5.2 Age-adjusted comparative prevalence (%) of diabetes (20–79 years) in IDF Europe Region in 2021

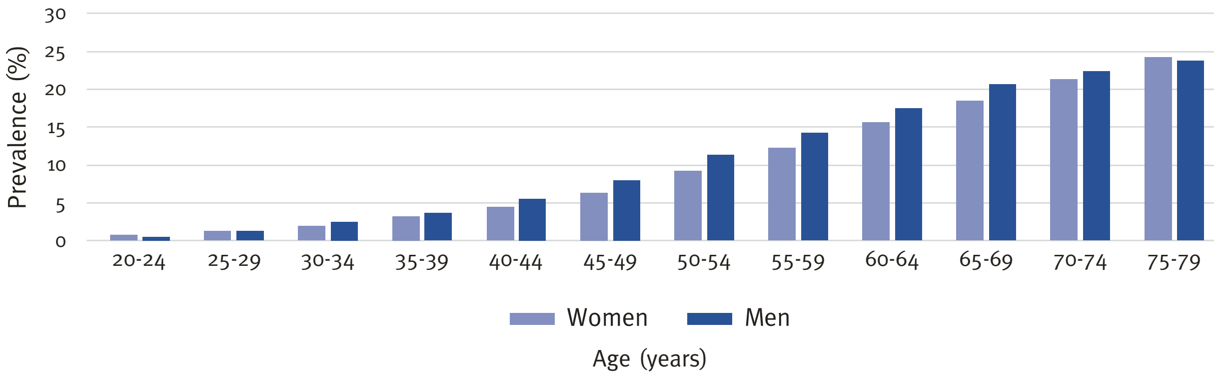


- ‹5%
- 5-‹6%
- 6-‹7%
- 7-‹8%
- ≥8%
- No estimates made

Highlights

- 1 in 11 adults have diabetes – 61 million.
- 1 in 3 (36%) people living with diabetes are undiagnosed.
- 1 in 7 live births are affected by hyperglycaemia in pregnancy.
- The Europe Region has the highest number of children and adolescents with type 1 diabetes – 295,000.
- Diabetes-related expenditure in the Europe Region totals USD 189 billion – 19.6% of global expenditure.
- The Europe Region has the second highest average cost per person with diabetes (20-79y) – USD 3,086.

Figure 5.2 Estimated prevalence (%) of diabetes by age and sex for the IDF Europe Region in 2021



At a glance

	2021	2030	2045
Adult population in Europe			
Aged 20–79 years	670m	677m	668m
Diabetes (20–79 years)			
Regional prevalence	9.2%	9.8%	10.4%
Age-adjusted comparative prevalence	7.0%	8.0%	8.7%
Number of people with diabetes	61m	67m	69m
Number of deaths due to diabetes	111,100	–	–
Healthcare expenditure due to diabetes (20–79 years)			
Total healthcare expenditure, USD	189.3b	189.6b	185.3b
Impaired glucose tolerance (20–79 years)			
Regional prevalence	8.2%	8.3%	8.3%
Age-adjusted comparative prevalence	7.1%	7.6%	7.8%
Number of people with impaired glucose tolerance	54.8m	56.1m	55.3m
Impaired fasting glucose (20–79 years)			
Regional prevalence	3.8%	4.0%	4.0%
Age-adjusted comparative prevalence	3.3%	3.5%	3.7%
Number of people with impaired fasting glucose	25.6m	26.8m	26.7m
Undiagnosed diabetes (20–79 years)			
Regional prevalence	35.7%	–	–
Number of people with undiagnosed diabetes	21.9m	–	–
Type 1 diabetes (0–19 years)			
Number of children and adolescents with type 1 diabetes	294,900	–	–
Number of newly diagnosed children and adolescents each year	31,000	–	–

m= million b=billion

Top 5 countries

	2011	2021
Top 5 countries for age-adjusted prevalence of people with diabetes (20–79 years)		
Turkey	8.1%	14.5%
Spain	6.5%	10.3%
Andorra[i]	5.6%	9.7%
Portugal	9.8%	9.1%
Serbia	7.9%	9.1%

	2011	2021
Top 5 countries for number of people with diabetes (20–79 years) in millions		
Turkey	3.5m	9m
Russian Federation	12.6m	7.4m
Germany	5m	6.2m
Spain	2.8m	5.1m
Italy	3.6m	4.5m

[i] based on extrapolation from similar countries

m= million b=billion

Living with diabetes in Europe

Charlie Churchill, UK

> "I was diagnosed with diabetes at the age of 34. It was one of those life-changing moments that you never forget"

Growing up in the swinging sixties was a lot of fun – the Beatles, the Rolling Stones, fashion, and England winning the Football World Cup in 1966. However, I also vividly remember my father grappling with huge syringe needles and relentlessly agonising over his blood glucose readings every day after meals. He had what people in those days referred to as 'sugar diabetes'.

Diabetes couldn't happen to me, could it? Eventually, it did. After persistent prompting from my mother, I eventually got myself tested for diabetes. I had none of the most common symptoms – no sudden weight loss or excessive thirst, unexplained tiredness or frequent trips to the toilet. I felt totally fine.

"I am very fortunate here in the UK that I have so many resources to help me live with my diabetes"

However, in 1989 I was diagnosed with diabetes at the age of 34. It was one of those life-changing moments that you never forget. Since then, diabetes knowledge, education and self-management has evolved progressively at increasing speed. My initial treatment consisted of tablets with occasional blood glucose tests. There were no digital blood glucose meters, just test strips with different coloured results. Fifteen years later, I was prescribed multiple daily injections of insulin to manage my blood glucose better. This, and everything that came with it, was a very big psychological change in my life. Learning to constantly carry around a pouch with insulin pens, needles and a blood glucose meter became socially awkward. The routine of carbohydrate counting for every meal was a real but necessary intrusion that took a while to master. However, as time went on I became accustomed to this new way of living.

I never appreciated there were different types of diabetes until I started volunteering with Diabetes UK a few years ago. Given my medical and lifestyle management plan, I neither have type 1 nor type 2 diabetes. I am caught somewhere in between. For me, this is of minor significance compared to the ongoing challenges that managing my diabetes presents daily.

I am very fortunate to have many resources at my disposal to help me and have benefitted from the support and encouragement of many experts in my country's health service. In the long run, however, it's all down to me and my self-motivation to rise to the daily challenges. After all, there are no holidays with diabetes.

When it comes to consultations with health professionals, there is only one thing that every person with diabetes is looking for – to come away feeling that little bit more positive to be able to live more confidently. A little extra self-belief can help everyone live a better day.

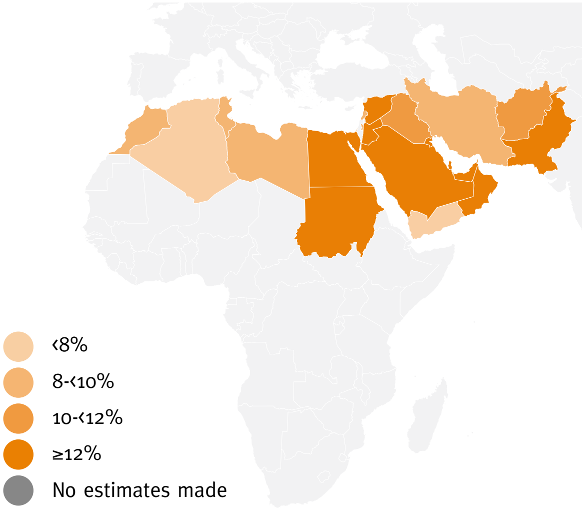
5 Diabetes in Middle-East and North Africa

2021

Estimates were made for 21 countries and territories in the IDF Middle-East and North Africa (MENA) Region. A total of 31 data sources from 18 countries were used to estimate diabetes prevalence in 20–79 year-old adults in the Region. Eight countries: Afghanistan, Bahrain, Egypt, Jordan, Lebanon, Morocco, Pakistan and Tunisia, had studies conducted within the past five years.

MENA Region has the highest regional prevalence at 16.2% and the second highest expected increase (86%) in the number of people with diabetes, reaching a predicted 136 million by 2045. The MENA Region has the highest percentage (24.5%) of diabetes-related deaths in people of working age. Despite being home to 13.6% of people with diabetes worldwide, only 32.6 billion USD was spent on diabetes in the MENA Region, representing 3.4% of the total spent worldwide.

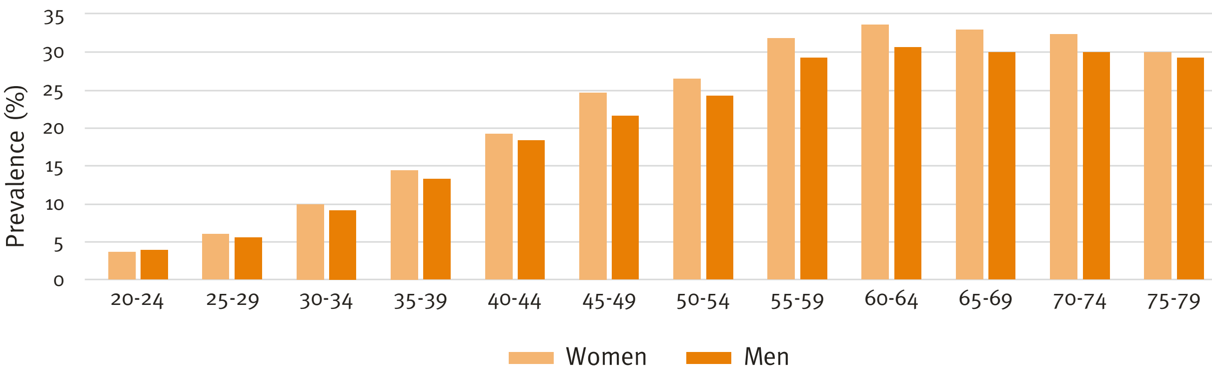
Map 5.3 Age-adjusted comparative prevalence (%) of diabetes (20–79 years) in IDF Middle-East and North Africa Region in 2021



Highlights

- 1 in 6 adults has diabetes – 73 million. The highest proportion of all IDF Regions.
- The number of people with diabetes is predicted to increase by 86% to 136 million by 2045 – the second highest increase of all IDF Regions.
- 1 in 3 people living with diabetes in the Region are undiagnosed.
- Diabetes is responsible for 796,000 deaths in 2021.
- The Middle-East and North Africa Region has the highest percentage (24.5%) of diabetes-related deaths in people of working age.
- Diabetes-related expenditure in the Middle-East and North Africa Region totals USD 33 billion in 2021.
- 1 in 7 live births are affected by hyperglycaemia in pregnancy.

Figure 5.3 Prevalence (%) estimates of diabetes by age and sex, IDF Middle East and North Africa Region in 2021



At a glance

	2021	2030	2045
Adult population in Middle-East and North Africa			
Aged 20–79 years	448m	540m	703m
Diabetes (20–79 years)			
Regional prevalence	16.2%	17.6%	19.3%
Age-adjusted comparative prevalence	18.1%	19.6%	20.4%
Number of people with diabetes	73m	95m	135.7m
Number of deaths due to diabetes	796,000	–	–
Healthcare expenditure due to diabetes (20–79 years)			
Total healthcare expenditure, USD	32.6b	43.3b	46.3b
Impaired glucose tolerance (20–79 years)			
Regional prevalence	10.6%	10.9%	11.5%
Age-adjusted comparative prevalence	11.2%	11.5%	11.7%
Number of people with impaired glucose tolerance	47.6m	59m	80.5m
Impaired fasting glucose (20–79 years)			
Regional prevalence	6.5%	6.6%	6.8%
Age-adjusted comparative prevalence	6.1%	6.2%	6.3%
Number of people with impaired fasting glucose	28.9m	35.7m	47.5m
Undiagnosed diabetes (20–79 years)			
Regional prevalence	37.6%	–	–
Number of people with undiagnosed diabetes	27.3m	–	–
Type 1 diabetes (0–19 years)			
Number of children and adolescents with type 1 diabetes	192,500	–	–
Number of newly diagnosed children and adolescents each year	25,000	–	–

m= million b=billion

Top 5 countries

	2011	2021
Top 5 countries for age-adjusted prevalence of people with diabetes (20–79 years)		
Pakistan	8.0%	30.8%
Egypt	21.1%	20.9%
Iran (Islamic Republic of)	16.9%	9.1%
Saudi Arabia	20.2%	18.7%
Sudan	8.7%	18.9%

	2011	2021
Top 5 countries for number of people with diabetes (20–79 years) in millions		
Pakistan	6.3m	33.0m
Egypt	7.3m	10.9m
Iran (Islamic Republic of)	4.7m	5.5m
Saudi Arabia	2.8m	4.3m
Sudan	1.7m	3.5m

m= million b=billion

Living with Diabetes in the Middle-East and North Africa

Cyrine Farhat, Lebanon

"Diabetes took away a lot of the freedom that I felt I needed growing up"

"The government must develop a national diabetes programme that ensures access to the fundamental components of care for people living with diabetes"

Living with diabetes has given me a new perspective. When I was diagnosed at 15, I had to suddenly take charge of my life and make important daily decisions to stay healthy and thrive. Diabetes took away a lot of the freedom that I felt I needed growing up. I could not do many of the things that my friends did. This gave me more drive later in life to expand and push the norms of what a woman with diabetes can and cannot do.

My father's diabetes diagnosis was the trigger that pushed me into diabetes advocacy. I had always coped well with my type 1 diabetes, but felt that there was a great need for support groups and free access to information for people living with diabetes in my country. As the carer of someone living with the condition, I felt more tools were needed to empower those affected to take control of their diabetes in a positive away. On the day that my father was diagnosed, I came up with the idea for "Positive on Glucose", which started as an Instagram page and has grown into an NGO.

Lebanon is going through an economic crisis that is having a devastating impact on people living with diabetes. Access to fundamental components of care like insulin, syringes, monitoring equipment and supplies has been severely disrupted, with hospitals and health services lacking electricity and fuel to function properly.

The government must develop a national diabetes programme that ensures access to the fundamental components of care for people living with diabetes, including services that focus on management, nutrition, and mental health.

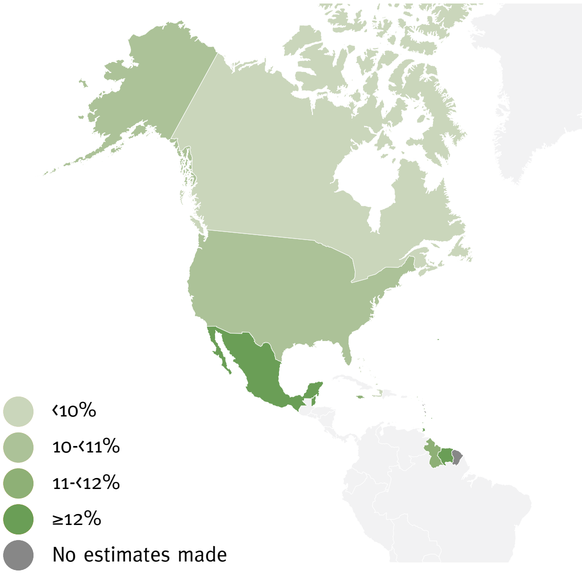
5 Diabetes in North America and the Caribbean

2021

Estimates were made for Canada, Mexico, the United States of America and 20 Caribbean countries and territories in the IDF North America and Caribbean (NAC) Region. Estimates for diabetes in adults in the Region were taken from 26 data sources, representing 17 of the 23 countries. Estimates for Bangladesh and Nepal were based on studies conducted within the past five years.

NAC Region has the second highest diabetes prevalence among IDF Regions at 14%. IDF projects that the number of people with diabetes in the NAC Region will increase 24%, reaching 63 million by 2045. The NAC Region has the second highest number of children and adolescents with type 1 diabetes - 193,000 in total. The NAC Region has the second highest mortality due to diabetes (931,000) and the second highest percentage (18,4%) of diabetes-related deaths in people of working age among IDF Regions. The NAC Region has the highest diabetes-related expenditure (USD 415 billion) associated with diabetes, 43% of global expenditure and has the highest average cost per person with diabetes (20–79y) – USD 8,208.

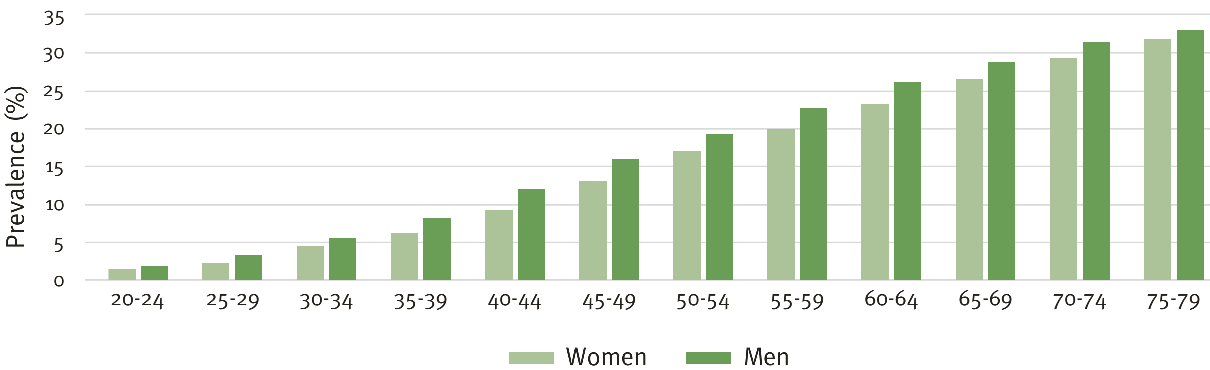
Map 5.4 Age-adjusted comparative prevalence (%) of diabetes (20–79 years) in IDF North American and Caribbean Region in 2021



Highlights

- 1 in 7 adults have diabetes – 51 million.
- The North America and Caribbean Region has the second highest diabetes prevalence (14%) of all IDF Regions.
- 1 in 4 people living with diabetes are undiagnosed.
- The North America and Caribbean Region has the highest diabetes-related expenditure (USD 415 billion) associated with diabetes, 43% of global expenditure.
- The North America and Caribbean Region has the second highest number of children and adolescents with type 1 diabetes – 193,000 in total.
- The North America and Caribbean Region has the highest average cost per person with diabetes (20-79y) – USD 8,208.
- 1 in 6 live births are affected by hyperglycaemia in pregnancy.

Figure 5.4 Prevalence (%) estimates of diabetes by age and sex, IDF North American and Caribbean Region in 2021



At a glance

	2021	2030	2045
Adult population in North America and Caribbean			
Aged 20–79 years	361m	388m	413m
Diabetes (20–79 years)			
Regional prevalence	14.0%	14.6%	15.2%
Age-adjusted comparative prevalence	11.9%	13.3%	14.2%
Number of people with diabetes	51m	57m	63m
Number of deaths due to diabetes	931,000	–	–
Healthcare expenditure due to diabetes (20–79 years)			
Total healthcare expenditure, USD	414.5b	404.7b	408.7b
Impaired glucose tolerance (20–79 years)			
Regional prevalence	13.0%	13.4%	13.7%
Age-adjusted comparative prevalence	11.2%	11.5%	11.7%
Number of people with impaired glucose tolerance	47m	51.8m	56.6m
Impaired fasting glucose (20–79 years)			
Regional prevalence	8.8%	8.8%	9.1%
Age-adjusted comparative prevalence	8.3%	8.6%	8.7%
Number of people with impaired fasting glucose	31.6m	34.2m	37.6m
Undiagnosed diabetes (20–79 years)			
Regional prevalence	24.1%	–	–
Number of people with undiagnosed diabetes	12.2m	–	–
Type 1 diabetes (0–19 years)			
Number of children and adolescents with type 1 diabetes	192,500	–	–
Number of newly diagnosed children and adolescents each year	24,400	–	–

m= million b=billion

Top 5 countries

	2011	2021
Top 5 countries for age-adjusted prevalence of people with diabetes (20–79 years)		
Mexico	15.9%	16.9%
Saint Kitts and Nevis	8.7%	16.1%
Belize	17.4%	14.5%
Barbados	12.7%	14.0%
Bermuda	12.3%	13.0%

	2011	2021
Top 5 countries for number of people with diabetes (20–79 years)		
United States of America	23.7m	32.2m
Mexico	10.3m	14.1m
Canada	2.7m	3m
Haiti	295,500	548,700
Jamaica	258,500	231,100

m= million b=billion

5 Living with diabetes in North America and the Caribbean

Michael Donohoe, USA

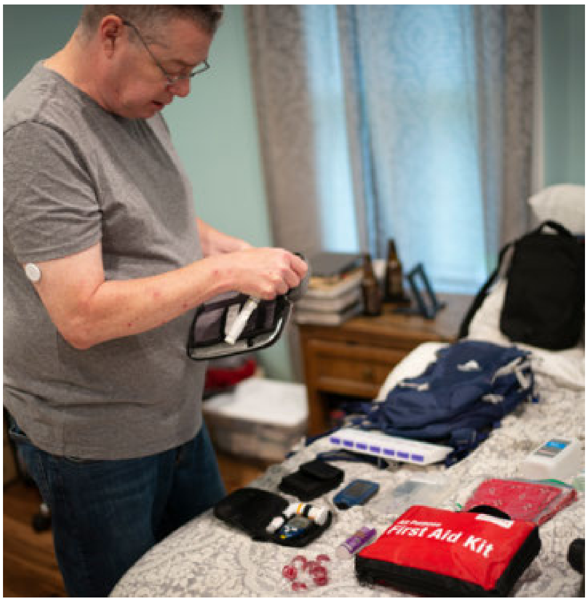
"I try to tackle stigma and improve awareness and understanding by being as open about my diabetes as possible"

Type 2 diabetes was very prevalent in my father's family. He lost family members to kidney and related cardiovascular issues, and my mother also lost a brother to diabetes. She was diagnosed with the condition six months before me.

When I was diagnosed with type 2 diabetes, I also discovered that I had a heart condition. I was living on my own and got married shortly after. The diagnosis changed some of my habits like going out with friends and I started to eat healthier and exercise more. Given my family history, I was anxious that my diagnosis could lead to an early death.

Time has provided perspective and now that I live with multiple complications and related conditions, I am less anxious and more focused on what I can do to help others. I have five children and am a little concerned that they will develop type 2 diabetes at some point in their lives. I therefore keep an eye on any potential risk factors that they may have.

Stigma can result when you take an "invisible" condition like diabetes out into the open. I try to tackle this and improve awareness and understanding by



"Stigma can result when you take an 'invisible' condition like diabetes out into the open. I try to tackle this by being as open about my diabetes as possible"

being as open about my diabetes as possible. I also advocate loudly for people who are newly diagnosed or severely impacted by the condition. In my country, many people living with diabetes have issues accessing diabetes medicines and care. I focus my time on developing programmes and encouraging action to tackle the many local and national policies that do not benefit the diabetes and wider NCD community.

In diabetes advocacy, people living with type 1 diabetes are 90% of the voice, while people with type 2 diabetes, who account for 90% of all diabetes, are no more than 10% of the voice. It is therefore important to reach out to and engage this population to ensure a united community to improve the lives of everyone affected by diabetes.

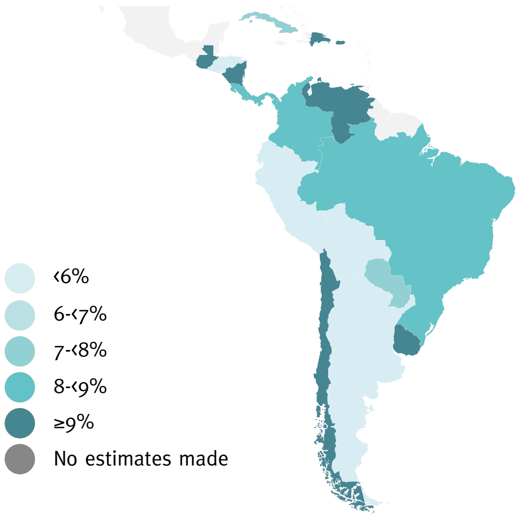
Diabetes in South and Central America

2021

Estimates were made for 19 countries and territories in the IDF South and Central America (SACA) Region. Estimates for diabetes prevalence in adults aged 20–79 years were based on 27 data sources from 16 countries. Only Brazil and Chile had studies completed within the past five years.

IDF projects that the number of people with diabetes in the SACA Region will increase by 48%, reaching 49 million by 2045. Over the same period, the prevalence of diabetes will increase by 25%, reaching 11.9%. In 2021, 65.3 billion USD was spent on diabetes in the SACA Region, representing 6.7% of the total spent worldwide.

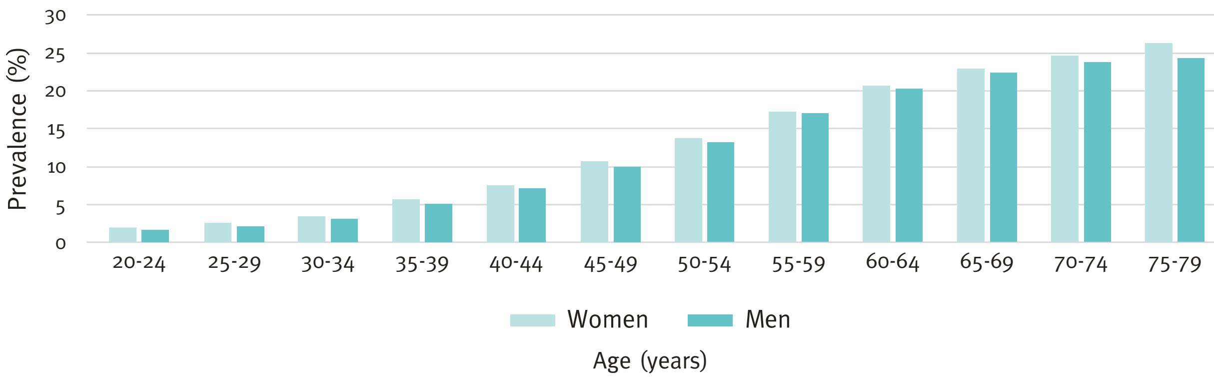
Map 5.5 Age-adjusted comparative prevalence (%) of diabetes (20–79 years) in the IDF South and Central America Region in 2021



Highlights

- 1 in 11 adults have diabetes – 33 million.
- The number of people with diabetes is expected to increase by 48% to 49 million by 2045.
- 1 in 3 people living with diabetes (33%) are undiagnosed.
- Diabetes is responsible for 410,000 deaths in 2021.
- 121,000 children and adolescents live with Type 1 diabetes.
- Diabetes-related expenditure totals USD 65 billion in 2021.
- 1 in 6 live births are affected by hyperglycemia in pregnancy.

Figure 5.5 Prevalence (%) estimates of diabetes by age and sex, IDF South and Central America Region in 2021



At a glance

	2021	2030	2045
Adult population in South and Central America			
Aged 20–79 years	341m	377m	412m
Diabetes (20–79 years)			
Regional prevalence	9.5%	10.6%	11.9%
Age-adjusted comparative prevalence	8.2%	9.2%	9.8%
Number of people with diabetes	33m	40m	49m
Number of deaths due to diabetes	410,000	–	–
Healthcare expenditure due to diabetes (20–79 years)			
Total healthcare expenditure, USD	65.3b	75.5b	81.6b
Impaired glucose tolerance (20–79 years)			
Regional prevalence	11.6%	12.1%	12.8%
Age-adjusted comparative prevalence	10.9%	11.5%	11.7%
Number of people with impaired glucose tolerance	39.6m	45.7m	52.7m
Impaired fasting glucose (20–79 years)			
Regional prevalence	13.8%	14.4%	15.3%
Age-adjusted comparative prevalence	10.0%	10.4%	10.6%
Number of people with impaired fasting glucose	47m	54.3m	62.8m
Undiagnosed diabetes (20–79 years)			
Regional prevalence	32.9%	–	–
Number of people with undiagnosed diabetes	10.7m	–	–
Type 1 diabetes (0–19 years)			
Number of children and adolescents with type 1 diabetes	121,300	–	–
Number of newly diagnosed children and adolescents each year	12,300	–	–

m= million b=billion

Top 5 countries

	2011	2021
Top 5 countries for age-adjusted prevalence of people with diabetes (20–79 years)		
Puerto Rico	13.3%	13.3%
Guatemala[i]	9.5%	13.1%
Chile	9.8%	10.8%
Dominican Republic	8.3%	10.5%
Venezuela (Bolivarian Republic of)	10.5%	9.6%

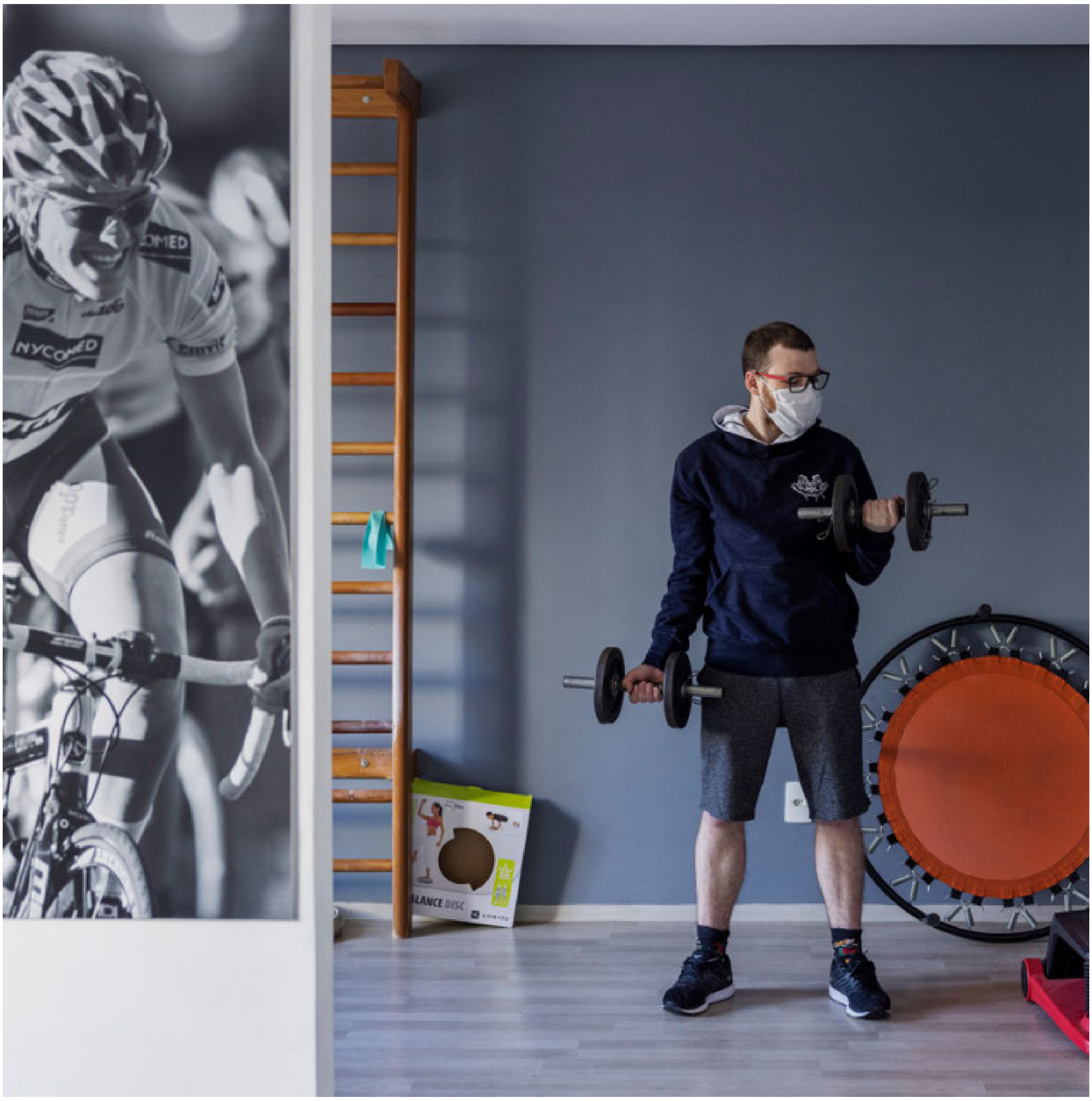
	2011	2021
Top 5 countries for number of people with diabetes (20–79 years) in millions		
Brazil	12.4m	15.7m
Colombia	2.6m	3.4m
Venezuela (Bolivarian Republic of)	1.7m	2.3m
Argentina	1.5m	1.8m
Chile	1.2m	1.7m

[i] based on extrapolation from similar countries

m= million b=billion

Living with diabetes in South and Central America

Ronaldo Wieselberg, Brazil



Having been diagnosed at the age of two, I don't remember life before diabetes. What I do remember are all the changes in my treatment that have occurred since then. In 1993, diabetes treatment was very different from what it is now. Multiple insulin dose therapy was relatively new and not commonly prescribed, and technology to deliver insulin and monitor blood glucose levels was much less technologically advanced.

"A friend's death from DKA completely changed my life and led me to devote myself to helping avoid as many diabetes-related deaths as I can"

Adolescence was a particularly challenging time for me. Fear of blame and criticism from others led me to hide my blood glucose results and neglect my diabetes care. Things improved when I started to attend diabetes camps and meet other young people living with diabetes, sharing experiences and supporting one another. When I was 17, a friend living with diabetes died diabetic ketoacidosis (DKA). This completely changed my life and led me to devote myself to helping avoid as many diabetes-related deaths as I can.

Living through Covid-19 has also been a challenge. As a physician on the front line of the pandemic, I was confronted with daily life and death decisions in a health system at breaking point. This resulted in depression that required medical and psychological support. I got through it with small things, like playing with my cats and reading, which helped a lot.

I think it's important for health professionals to understand the person living with diabetes and make the effort to explain how a decision regarding their therapy and treatment will benefit them.

"I think it's important for health professionals to understand the person living with diabetes and make the effort to explain how a decision regarding their therapy and treatment will benefit them"

5 Diabetes in South-East Asia

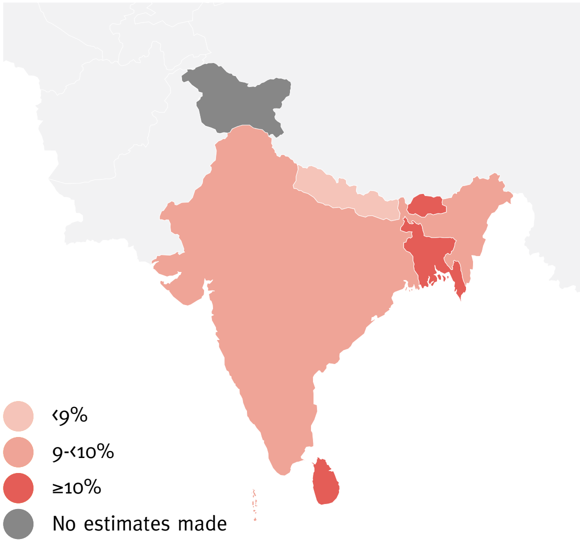
2021

Estimates were made for the seven countries and territories in the IDF South-East Asia (SEA) Region. All countries except Bhutan had primary data sources, which were used to generate estimates for diabetes in adults aged 20–79 years. A total of nine data sources from these six countries were used. Estimates for Bangladesh and Nepal were based on studies conducted within the past five years.

IDF projects that the number of people with diabetes in the SEA Region will increase 68%, reaching 152 million by 2045. Over the same period, the prevalence of diabetes will increase 30% to reach 11.3%. The proportion of undiagnosed diabetes is third highest of the IDF Regions at 51.2%. The proportion of pregnancies affected by hyperglycaemia is the highest among IDF Regions at 25.9%.

Only 10.1 billion USD was spent on diabetes in the SEA Region, representing 1% of the total spent worldwide, despite the region being home to 16.8% of people with diabetes worldwide.

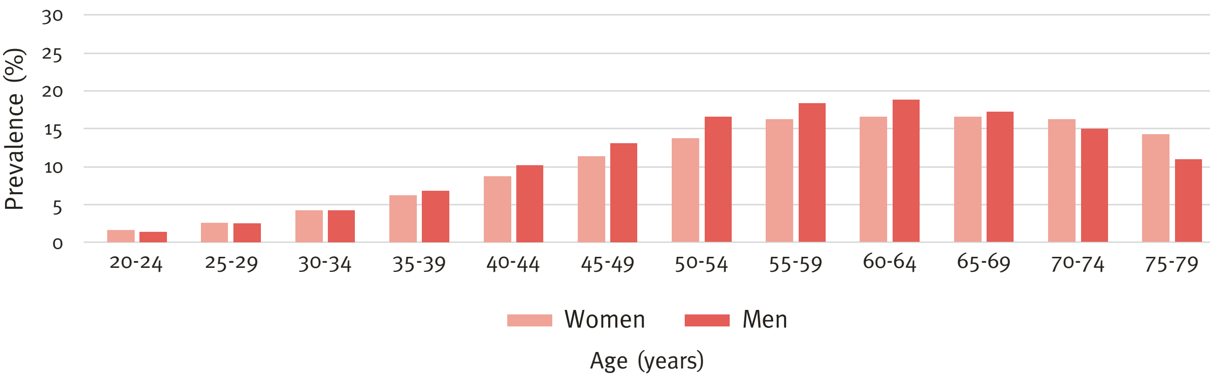
Map 5.6 Age-adjusted comparative prevalence (%) of diabetes (20–79 years) in the IDF South-East Asia Region in 2021



Highlights

- 1 in 11 adults have diabetes – 90 million.
- India accounts for 1 in 7 of all adults living with diabetes worldwide.
- The number of people living with diabetes is predicted to increase by 69% to 152 million by 2045.
- Over 1 in 2 (51.2%) adults living with diabetes are undiagnosed.
- Diabetes is responsible for 747,000 deaths in 2021.
- Total diabetes-related expenditure in the Region amounts to USD 10 billion – the second lowest of all IDF Regions.
- 1 in 4 live births are affected by hyperglycemia in pregnancy.

Figure 5.6 Prevalence (%) estimates of diabetes by age and sex, IDF South-East Asia Region in 2021



At a glance

	2021	2030	2045
Adult population in South-Asia			
Aged 20–79 years	1.03m	1.18m	1.34b
Diabetes (20–79 years)			
Regional prevalence	8.7%	9.6%	11.3%
Age-adjusted comparative prevalence	10.0%	10.9%	11.3%
Number of people with diabetes	90m	113.3m	151.5m
Number of deaths due to diabetes	747,000	–	–
Healthcare expenditure due to diabetes (20–79 years)			
Total healthcare expenditure, USD	10.1b	12.1b	15.0b
Impaired glucose tolerance (20–79 years)			
Regional prevalence	4.5%	4.9%	5.7%
Age-adjusted comparative prevalence	5.4%	5.7%	5.8%
Number of people with impaired glucose tolerance	46.9m	58.5m	76.6m
Impaired fasting glucose (20–79 years)			
Regional prevalence	9.2%	9.2%	9.4%
Age-adjusted comparative prevalence	8.8%	9.2%	9.3%
Number of people with impaired fasting glucose	95.2m	109.4m	125.4m
Undiagnosed diabetes (20–79 years)			
Regional prevalence	51.2%	–	–
Number of people with undiagnosed diabetes	46.2m	–	–
Type 1 diabetes (0–19 years)			
Number of children and adolescents with type 1 diabetes	244,500	–	–
Number of newly diagnosed children and adolescents each year	25,700	–	–

m= million b=billion

Top 5 countries

	2011	2021
Top 5 countries for age-adjusted prevalence of people with diabetes (20–79 years)		
Mauritius	15.1%	22.6%
Bangladesh	10.7%	14.2%
Sri Lanka	7.6%	11.3%
Bhutan[i]	5.8%	10.4%
India	9.2%	9.6%

	2011	2021
Top 5 countries for number of people with diabetes (20–79 years)		
India	61.3m	74.2m
Bangladesh	8.4m	13.1m
Sri Lanka	1.1m	1.4m
Nepal	488,200	1.1m
Mauritius	138,200	250,400

[i] based on extrapolation from similar countries

m= million b=billion

Living with diabetes in South-East Asia

Tazul Islam, Bangladesh

I was 16 when I was diagnosed and getting ready to take my final secondary school exams. I was losing a lot of weight, feeling weak, tired and thirsty, and going to the toilet often. My parents thought that this was linked to the stress I was under for the exams.

My diagnosis had a huge impact on me, my family and friends. I am an only child and my parents were very worried about my future. Misguided and misinformed comments from other people ("He can't live long" "His eyes and kidneys will be damaged soon") made things worse. I felt alone and depressed. My parents hid my condition from other others and told me not to talk

"My diagnosis had a huge impact on me, my family and friends"

about it with anyone. They used to lock me in a room and I was not allowed to go outside by myself. They also tried alternative remedies to stop me having to take insulin. When my friends found out that I had diabetes, they bullied and made fun of me. They would say that a person with diabetes could not get married because they are impotent.

When I was diagnosed, limited services and facilities were available for children with type 1 diabetes in my country. I was treated with people living with type 2 diabetes, which had a negative effect on my diabetes management. I had trouble managing my blood glucose levels and my HbA1c was high. Things improved when I started receiving support from the Changing Diabetes in Children Program (CDiC) Paediatric Diabetes Center at BIRDEM General Hospital and Life for a Child. I met other children with type 1 diabetes and was provided with free insulin, care, education and counseling. Interacting with other people with type 1 diabetes inspired me to manage my diabetes better and improved my quality of life.

A large number of people in my country live below the poverty line and in rural areas, where there is limited access to medicines, health services and trained health professionals. They have to go to a city to receive treatment and follow-up. The government has taken limited action to provide free insulin and diabetes care for all people with diabetes. The Diabetic Association of Bangladesh (BADAS) has a large network of centres across the country that mainly support adults living with diabetes. However, the shortage of trained health professionals means that some people with diabetes

"Interacting with other people with type 1 diabetes has inspired me to manage my diabetes better and improved my quality of life"

who receive free medicines are not provided with the education and guidance to use them and manage their condition appropriately. This inspired me and a group of other young people living with diabetes to organise awareness, education and counselling activities for people who are recently diagnosed. We do our best with limited funding and support.

I think the most important things to focus on to improve the lives of people living with diabetes in my country are nutritional education and guidance on how to administer medication and self-monitor the condition. Diabetes education provided by health professionals should also be more person-centered and complemented with counselling and psychological support, particularly for people who are newly diagnosed.

My message to children recently diagnosed with diabetes is to not pay any attention to people around them who know nothing about the condition. Listen to the health professionals that support your treatment. You are not responsible for having diabetes so, don't hide it, stay positive and make the most of your potential. You can make your life what you want it to be.

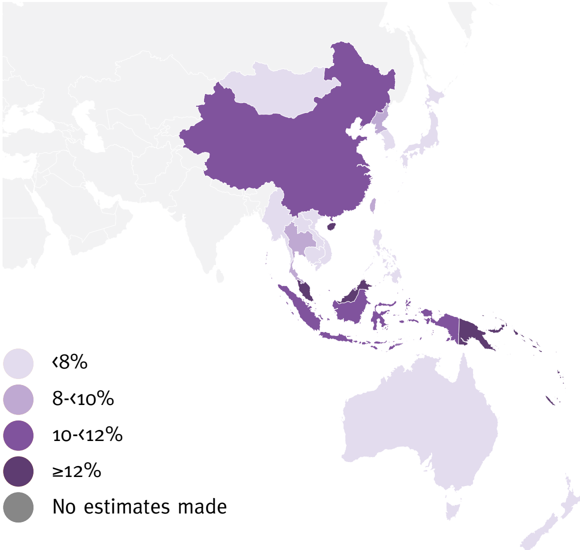
5 Diabetes in the Western Pacific

2021

Estimates were made for 38 countries and territories in the IDF Western Pacific (WP) Region. For this edition of the *IDF Diabetes Atlas*, 41 data sources from 28 countries were used to generate estimates of diabetes in adults aged 20–79 years. Estimates for Australia, Brunei Darussalam, China, Indonesia, Kiribati, Malaysia and the Marshal Islands were based on studies conducted within the past five years.

The WP Region accounts for over a third (38%) of the total number of adults living with diabetes. The WP Region has the third highest prevalence of diabetes (11.9%) in the world. IDF projects that the number of people with diabetes in the WP Region will increase by 27%, reaching 260 million by 2045 and that the prevalence of diabetes will increase 21% to reach 14.4% in 2045. The proportion of undiagnosed diabetes (52.9%) is the second highest of the IDF Regions. Diabetes is responsible for 2.3 million deaths in 2021, which is the highest number of all IDF Regions. Diabetes-related expenditure in 2021 totals USD241 billion, representing 25% of global expenditure.

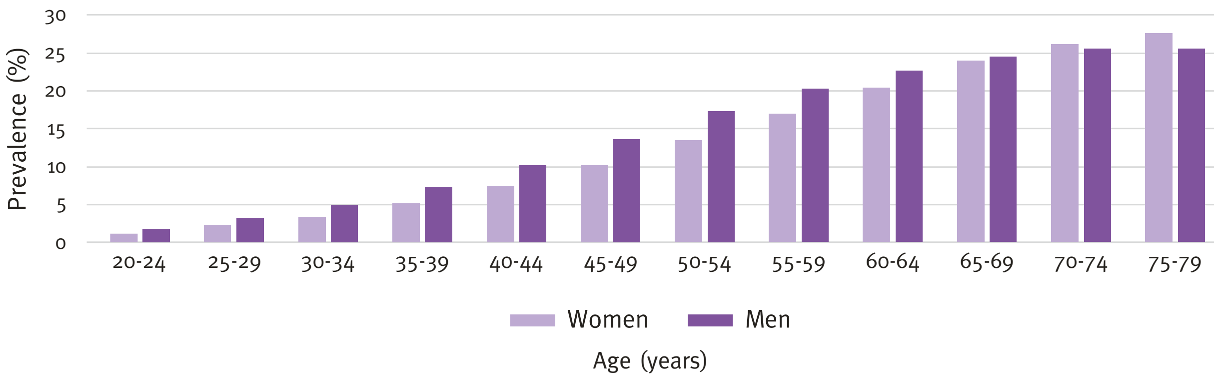
Map 5.7 Age-adjusted comparative prevalence (%) of diabetes (20–79 years) in the IDF Western Pacific Region in 2021



Highlights

- 1 in 8 adults have diabetes – 206 million.
- The Western Pacific Region accounts for over a third (38%) of the total number of adults living with diabetes.
- China accounts for 1 in 4 of all adults living with diabetes worldwide.
- Over half (53%) of adults living with diabetes are undiagnosed.
- Diabetes is responsible for 2.3 million deaths in 2021 – the highest number of all IDF Regions.
- Diabetes-related expenditure in 2021 totals USD 241 billion – 25% of global expenditure.
- 1 in 7 live births are affected by hyperglycemia in pregnancy.

Figure 5.7 Age-adjusted comparative prevalence (%) of diabetes (20–79 years) in IDF Western Pacific Region in 2021



At a glance

	2021	2030	2045
Adult population in Western Pacific			
Aged 20–79 years	1.73b	1.81b	1.81b
Diabetes (20–79 years)			
Regional prevalence	11.9%	13.2%	14.4%
Age-adjusted comparative prevalence	9.9%	10.9%	11.5%
Number of people with diabetes	205.6m	238.3m	260.2m
Number of deaths due to diabetes	2.3m	–	–
Healthcare expenditure due to diabetes (20–79 years)			
Total healthcare expenditure, USD	241.3b	262.4b	269.5b
Impaired glucose tolerance (20–79 years)			
Regional prevalence	14.6%	15.5%	16.1%
Age-adjusted comparative prevalence	12.9%	13.7%	14.0%
Number of people with impaired glucose tolerance	253m	280.9m	291.8m
Impaired fasting glucose (20–79 years)			
Regional prevalence	2.9%	3.0%	3.1%
Age-adjusted comparative prevalence	2.5%	2.7%	2.7%
Number of people with impaired fasting glucose	49.7m	54.1m	56m
Undiagnosed diabetes (20–79 years)			
Regional prevalence	52.9%	–	–
Number of people with undiagnosed diabetes	108.7m		
Type 1 diabetes (0–19 years)			
Number of children and adolescents with type 1 diabetes	107,900	–	–
Number of newly diagnosed children and adolescents each year	11,600	–	–

m= million b=billion

Top 5 countries

	2011	2021
Top 5 countries for age-adjusted prevalence of people with diabetes (20–79 years)		
French Polynesia	8.8%	25.2%
New Caledonia[i]	8.8%	23.4%
Northern Mariana Islands[i]	–	23.4%
Nauru[i]	20.7%	23.4%
Marshall Islands	22.2%	23.0%

	2011	2021
Top 5 countries for number of people with diabetes (20–79 years) in millions		
China	90m	140.9m
Indonesia	7.3m	19.5m
Japan	10.7m	11m
Thailand	4m	6.1m
Malaysia	2m	4.4m

[i] based on extrapolation from similar countries

m= million b=billion

Living with diabetes in Western Pacific

Ashley Ng, Australia

> **"Finding like-minded peers in the diabetes community as well as passionate and caring healthcare professionals has been crucial to my diabetes care"**

When I was told that I had type 2 diabetes, I was in total shock and denial. I was only 19 and thought that diabetes only happened to older adults. Initially I wanted to hide my diagnosis from my family and friends. As I came to terms with the knowledge that I would have to be on medication for the rest of my life, I decided that I had to at least tell my family.

Being diagnosed with diabetes was a difficult adjustment both physically and mentally, but I credit it for helping me live more healthily. It was helpful that my family have been very supportive throughout my journey. Together, we started eating healthier food and being more active, which has also benefited their lives. Finding like-minded peers in the diabetes community as well as passionate and caring healthcare professionals has also been crucial to my diabetes care.

I recently became a mother to a beautiful baby girl. Planning for the pregnancy with diabetes was challenging and hard work. I was in regular discussions with my diabetes doctor and educator to make sure my blood glucose levels and health were as well managed as possible.

Being pregnant with diabetes was even more challenging and scary than planning for it! I was constantly worried about how everything I was doing would impact my baby. I was very lucky to have a great healthcare team who monitored us regularly during my pregnancy and after the birth.

“The biggest thing now is to make sure all people with diabetes can access the care and essential medicines they need to survive.”

MICHAEL'S STORY ▶

Appendices

Country summary tables

Africa

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
Africa –AFR	**23,633.9 (15,020.8-29,834.2)**	**4.5 (2.8-5.7)**	**5.3 (3.6-6.7)**	**12,658.6 (8,229.9-16,178.4)**	**547.1**
Angola	584.5 (561.8-1289.3)	4.0 (3.9-8.9)	4.6 (4.5-9.5)	311.3 (299.3-686.8)	519.8
Benin	50.4 (40.2-117.8)	.9 (.7-2.0)	1.1 (.8-2.4)	26.8 (21.4-62.7)	181.6
Botswana	69.1 (49.7-86.8)	5.1 (3.7-6.4)	5.2 (3.8-6.5)	36.8 (26.5-46.2)	2,155.3
Burkina Faso	164.4 (120.3-244.3)	1.7 (1.3-2.5)	2.1 (1.7-3.3)	94.7 (69.3-140.7)	192.3
Burundi	223.1 (156.7-259.7)	4.1 (2.9-4.8)	6.5 (4.6-7.6)	128.5 (90.3-149.6)	102.5
Cabo Verde	7.3 (6.2-13.7)	2.1 (1.8-3.9)	2.1 (1.7-3.7)	3.9 (3.3-7.3)	912.1
Cameroon	620.8 (599.1-639.1)	4.8 (4.7-5.0)	5.5 (5.3-5.7)	330.7 (319.1-340.5)	286.2
Central African Republic	96.9 (93.3-99.8)	4.5 (4.3-4.6)	5.8 (5.6-6.0)	55.8 (53.8-57.5)	267.7
Chad	268.3 (258.4-276.5)	3.8 (3.6-3.9)	5.8 (5.6-6.0)	154.6 (148.9-159.2)	133.6
Comoros	34.6 (17.1-38.7)	7.7 (3.8-8.6)	11.7 (4.7-12.7)	17.8 (8.8-19.9)	205.6
Congo	151.6 (146.5-156.0)	5.6 (5.4-5.7)	5.5 (5.3-5.7)	80.8 (78.1-83.1)	251.4
Côte d'Ivoire	231.2 (183.1-423.6)	1.8 (1.4-3.3)	2.1 (1.7-3.7)	123.1 (97.5-225.6)	386.6
Democratic Republic of the Congo	1,908.9 (1,839.4-1,966.5)	4.8 (4.6-4.9)	5.8 (5.6-6.0)	1,099.5 (1,059.5-1,132.7)	93.9
Djibouti	53.7 (38.7-62.5)	8.7 (6.3-10.1)	7.4 (5.3-8.7)	28.6 (20.6-33.3)	288.2
Equatorial Guinea	39.4 (38.0-40.6)	5.0 (4.9-5.2)	5.5 (5.3-5.7)	21.0 (20.3-21.6)	1,712.7
Eritrea	94.2 (66.3-110.1)	5.5 (3.9-6.4)	6.5 (4.6-7.6)	54.2 (38.2-63.4)	110.6
Eswatini	21.8 (21.8-115.0)	3.6 (3.6-19.1)	4.6 (4.6-27.2)	11.6 (11.6-61.2)	1,136.2
Ethiopia	1,920.0 (1,721.7-2,686.6)	3.3 (3.0-4.7)	5.0 (4.4-6.8)	1,105.9 (991.7-1,547.5)	104.3
Gabon	79.0 (76.3-81.3)	6.5 (6.3-6.7)	5.5 (5.3-5.7)	42.1 (40.7-43.3)	1,137.8
Gambia	18.1 (16.5-33.9)	1.6 (1.5-3.0)	1.9 (1.7-3.2)	10.4 (9.5-19.5)	132.7
Ghana	329.2 (145.2-538.5)	2.0 (.9-3.2)	2.6 (1.1-3.8)	175.4 (77.4-286.8)	279.4
Guinea	103.7 (76.8-163.4)	1.7 (1.3-2.7)	2.1 (1.7-3.3)	59.7 (44.3-94.1)	184.6
Guinea-Bissau	16.8 (12.9-26.8)	1.8 (1.3-2.8)	2.1 (1.7-3.3)	9.7 (7.4-15.4)	270.9

Total Regional estimates — Countries with in-country sources on diabetes

Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
1,404.0	**416,163**	**1,240**	**52,151.4 (41,677.5-66,309.4)**	**12.6 (10.0-16.4)**	**40,925.2 (16,264.2-52,632.5)**	**8.0 (3.4-10.3)**
977.1	11,173	2,388	1,031.7 (599.9-1,442.3)	6.9 (4.3-9.7)	1,419.6 (1,053.8-1,596.4)	9.6 (7.2-10.8)
488.4	927	544	569.0 (447.3-773.9)	11.3 (8.4-16.2)	291.4 (101.8-479.9)	4.9 (1.8-8.0)
4,858.6	2,044	108	102.8 (63.6-143.2)	6.9 (4.3-9.7)	60.9 (54.8-155.8)	4.2 (3.7-10.6)
533.8	2,813	254	866.9 (685.5-1,179.3)	11.3 (8.4-16.2)	410.6 (142.9-676.5)	4.8 (1.7-7.8)
280.6	3,925	608	581.7 (523.1-651.6)	19.2 (16.9-22.0)	269.6 (135.0-333.6)	6.7 (3.7-8.3)
1,870.2	70	43	35.4 (28.6-46.9)	11.3 (8.4-16.2)	19.7 (7.0-32.3)	4.9 (1.8-8.0)
706.3	12,614	1,458	1,229.0 (984.2-1,627.3)	11.3 (8.4-16.2)	680.2 (233.8-1,123.5)	4.9 (1.8-8.0)
483.8	3,655	17	202.5 (158.9-277.3)	11.3 (8.4-16.2)	100.8 (35.2-165.9)	4.8 (1.7-7.8)
361.1	5,247	91	630.9 (491.2-874.5)	11.3 (8.4-16.2)	287.3 (98.5-474.7)	4.8 (1.7-7.8)
423.1	440	53	39.7 (37.2-43.3)	12.1 (11.3-13.2)	25.9 (13.3-32.1)	6.9 (3.8-8.5)
663.3	3,104	488	272.4 (220.1-357.3)	11.3 (8.4-16.2)	153.9 (53.8-253.4)	4.9 (1.8-8.0)
948.1	3,991	1,014	1,241.8 (977.5-1,674.9)	11.3 (8.4-16.2)	649.1 (221.8-1,073.6)	4.9 (1.8-8.0)
155.8	34,151	2,156	3,864.3 (3,023.9-5,280.7)	11.3 (8.4-16.2)	1,897.7 (660.2-3,127.3)	4.8 (1.7-7.8)
548.6	883	357	108.9 (97.2-122.9)	16.7 (14.7-19.1)	50.3 (26.6-62.2)	6.9 (3.8-8.5)
3,795.8	824	54	74.0 (60.7-94.3)	11.3 (8.4-16.2)	46.4 (15.2-77.3)	4.9 (1.8-8.0)
342.7	2,129	1,928	276.2 (244.7-314.0)	19.2 (16.9-22.0)	107.3 (55.2-133.0)	6.7 (3.7-8.3)
2,915.3	846	97	31.7 (18.9-44.1)	6.9 (4.3-9.7)	66.0 (39.4-70.0)	14.4 (8.8-15.3)
286.8	26,448	2,363	7,140.7 (6,365.0-8,072.4)	19.2 (16.9-22.0)	3,077.5 (1,549.1-3,814.4)	6.7 (3.7-8.3)
2,557.6	1,215	171	125.1 (101.9-160.4)	11.3 (8.4-16.2)	78.3 (26.8-129.4)	4.9 (1.8-8.0)
484.1	325	47	108.5 (86.8-143.0)	11.3 (8.4-16.2)	59.8 (20.6-98.8)	4.8 (1.7-7.8)
602.4	6,255	2,551	1,666.8 (1,328.8-2,228.0)	11.3 (8.4-16.2)	881.3 (309.1-1,450.0)	4.9 (1.8-8.0)
526.4	2,176	113	564.1 (442.0-776.5)	11.3 (8.4-16.2)	275.1 (98.1-451.0)	4.8 (1.7-7.8)
626.2	411	26	89.1 (70.8-120.2)	11.3 (8.4-16.2)	45.2 (15.7-74.4)	4.8 (1.7-7.8)

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
Kenya	821.5 (524.6-1,094.3)	3.0 (1.9-3.9)	4.0 (2.5-5.4)	3,58.7 (229.0-477.7)	448.6
Lesotho	48.4 (47.5-87.4)	3.9 (3.8-7.1)	4.6 (4.5-9.5)	25.8 (25.3-46.6)	474.9
Liberia	47.1 (37.5-76.1)	1.9 (1.5-3.0)	2.1 (1.7-3.3)	27.1 (21.6-43.8)	231.2
Madagascar	535.8 (522.7-916.1)	3.9 (3.8-6.6)	4.6 (4.5-8.3)	308.6 (301.1-527.7)	98.5
Malawi	486.0 (460.9-511.1)	5.4 (5.1-5.7)	7.3 (6.9-7.7)	280.0 (265.5-294.4)	150.7
Mali	152.5 (117.1-242.7)	1.8 (1.3-2.8)	2.1 (1.7-3.3)	87.8 (67.4-139.8)	189.6
Mauritania	45.0 (36.4-82.6)	1.9 (1.5-3.5)	2.1 (1.7-3.7)	24.0 (19.4-44.0)	284.5
Mayotte	5.7 (5.6-10.0)	4.1 (4.0-7.2)	4.6 (4.5-8.3)	3.3 (3.2-5.8)	–
Mozambique	349.3 (328.4-877.7)	2.4 (2.3-6.1)	3.3 (3.1-8.1)	302.9 (284.7-761.0)	226.7
Namibia	75.0 (49.1-95.3)	5.5 (3.6-6.9)	6.7 (4.1-8.5)	40.0 (26.1-50.8)	2,120.9
Niger	423.1 (109.2-466.0)	4.3 (1.1-4.7)	5.2 (1.8-5.8)	243.7 (62.9-268.4)	142.0
Nigeria	3,623.5 (1,576.6-4,502.8)	3.7 (1.6-4.7)	3.6 (1.8-4.5)	1,930.2 (839.9-2,398.6)	499.7
Rwanda	297.0 (210.2-346.1)	4.5 (3.2-5.2)	6.5 (4.6-7.6)	171.1 (121.1-199.3)	230.7
Sao Tome and Principe	6.1 (5.9-6.2)	5.8 (5.6-6.0)	5.5 (5.3-5.7)	3.2 (3.1-3.3)	664.4
Senegal	189.4 (115.9-229.4)	2.4 (1.4-2.9)	3.1 (1.8-3.7)	109.1 (66.8-132.1)	299.7
Seychelles	6.6 (2.4-7.8)	9.9 (3.5-11.7)	8.5 (3.1-10.3)	3.1 (1.1-3.6)	940.7
Sierra Leone	70.6 (54.3-110.7)	1.8 (1.4-2.8)	2.1 (1.7-3.3)	40.7 (31.3-63.8)	422.2
Somalia	376.0 (263.3-439.5)	5.4 (3.8-6.4)	6.5 (4.6-7.6)	216.6 (151.7-253.1)	–
South Africa	4,234.0 (1,737.7-4,628.4)	11.3 (4.6-12.4)	10.8 (4.7-11.8)	1,922.2 (788.9-2,101.3)	1,700.7
South Sudan	246.2 (173.8-287.1)	4.5 (3.2-5.3)	6.5 (4.6-7.6)	141.8 (100.1-165.4)	–
Togo	75.4 (58.3-116.4)	1.8 (1.4-2.8)	2.1 (1.7-3.3)	43.4 (33.6-67.1)	205.3
Uganda	716.0 (579.1-1,070.7)	3.6 (2.9-5.3)	4.6 (3.8-7.4)	412.5 (333.6-616.7)	227.4
United Republic of Tanzania	2,884.0 (1,279.2-3,043.8)	10.3 (4.6-10.9)	12.3 (6.1-13.0)	1,536.3 (681.4-1,621.4)	149.8
Zambia	726.3 (350.2-773.4)	8.6 (4.1-9.2)	11.9 (5.1-12.7)	386.9 (186.5-412.0)	334.4
Zimbabwe	106.4 (89.1-342.4)	1.5 (1.3-4.8)	2.1 (1.8-5.6)	56.7 (47.5-182.4)	794.4

Total Regional estimates

Countries with in-country sources on diabetes

Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
909.5	15,285	5,279	3,200.8 (2,886.3-3,575.0)	16.7 (14.7-19.1)	986.9 (885.3-1,077.3)	5.0 (4.4-5.5)
1,175.9	2,761	60	69.7 (42.4-97.4)	6.9 (4.3-9.7)	96.3 (71.6-108.1)	9.6 (7.2-10.8)
64,347.7	802	54	247.3 (195.1-334.5)	11.3 (8.4-16.2)	124.5 (43.5-205.0)	4.8 (1.7-7.8)
353.2	9,718	2,566	936.2 (548.1-1,315.5)	7.9 (5.0-11.2)	1,118.9 (830.1-1,257.0)	9.4 (7.0-10.5)
507.3	7,917	1,979	472.5 (273.9-658.8)	7.9 (5.0-11.2)	382.8 (347.2-429.7)	6.0 (5.4-6.9)
488.3	2,616	249	813.2 (644.5-1,095.6)	11.3 (8.4-16.2)	410.5 (142.1-677.2)	4.8 (1.7-7.8)
992.7	514	321	233.3 (186.0-311.8)	11.3 (8.4-16.2)	124.6 (43.4-205.3)	4.9 (1.8-8.0)
–	–	24	16.5 (15.5-18.0)	13.9 (13.1-15.2)	8.9 (4.7-11.1)	6.7 (3.7-8.3)
663.4	11,832	1,945	943.9 (551.3-1,315.3)	7.9 (5.0-11.2)	1,110.1 (828.9-1,248.9)	9.4 (7.0-10.5)
3,970.5	1,674	225	90.7 (54.3-126.7)	6.9 (4.3-9.7)	72.5 (63.7-136.7)	5.8 (5.1-10.6)
364.8	5,302	333	897.9 (686.8-1,276.8)	11.3 (8.4-16.2)	603.2 (128.1-648.8)	7.5 (1.7-8.2)
1,390.0	48,375	4,440	9,418.3 (7,466.7-12,653.2)	11.3 (8.4-16.2)	4,929.0 (1,711.7-8,125.3)	4.9 (1.8-8.0)
672.0	4,075	671	777.8 (697.2-873.8)	19.2 (16.9-22.0)	340.9 (175.3-422.0)	6.7 (3.7-8.3)
1,133.4	73	23	10.6 (8.5-13.9)	11.3 (8.4-16.2)	6.1 (2.2-10.1)	4.9 (1.8-8.0)
744.9	3,028	1,451	769.3 (608.9-1,039.3)	11.3 (8.4-16.2)	150.4 (126.0-647.1)	2.0 (1.6-8.0)
1,749.0	91	5	6.6 (6.2-7.1)	8.5 (8.0-9.4)	3.3 (1.9-4.1)	4.9 (2.7-6.0)
1,266.7	1,353	27	372.2 (294.9-502.8)	11.3 (8.4-16.2)	184.8 (64.0-304.9)	4.8 (1.7-7.8)
–	8,834	2,405	10,99.1 (980.5-1,241.8)	19.2 (16.9-22.0)	445.1 (222.8-552.2)	6.7 (3.7-8.3)
3,651.9	95,676	4,526	3,009.6 (1,711.0-4,152.6)	7.6 (4.2-10.3)	13,263.0 (3,202.6-13,506.6)	32.2 (7.8-32.8)
–	4,021	2,695	664.0 (592.8-749.4)	19.2 (16.9-22.0)	286.9 (145.8-355.4)	6.7 (3.7-8.3)
536.7	1,338	125	394.5 (312.3-533.1)	11.3 (8.4-16.2)	191.9 (66.8-316.2)	4.8 (1.7-7.8)
734.4	10,416	4,578	2,429.5 (2,189.3-2,716.7)	19.2 (16.9-22.0)	380.1 (340.3-1355.0)	2.2 (2.0-8.3)
457.4	36,334	5,655	3,502.8 (3,144.1-3,930.8)	16.7 (14.7-19.1)	3,383.4 (872.5-3,609.2)	13.1 (3.8-14.0)
917.2	15,519	1,594	513.4 (296.7-715.9)	6.9 (4.3-9.7)	825.3 (570.8-924.8)	10.6 (7.7-12.1)
1,121.1	2,942	1,343	408.3 (226.4-605.6)	6.4 (4.0-10.4)	541.8 (405.3-609.1)	9.6 (7.2-10.8)

Europe

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
Europe –EUR	**61,425.1 (47,459.9-69,888.4)**	**9.2 (7.1-10.4)**	**7.0 (5.5-8.1)**	**21,935.0 (16,753.0-25,149.3)**	**3,086.4**
Albania	241.1 (150.0-304.0)	11.5 (7.1-14.5)	9.1 (5.9-11.2)	95.4 (59.4-120.3)	676.1
Andorra	8.0 (7.2-8.8)	13.9 (12.5-15.3)	9.7 (8.8-10.7)	2.7 (2.4-3.0)	3,063.9
Armenia	133.6 (122.1-143.6)	6.4 (5.8-6.9)	5.6 (5.1-6.0)	52.9 (48.3-56.9)	1,174.3
Austria	447.1 (398.9-496.9)	6.6 (5.9-7.3)	4.6 (4.1-5.2)	149.8 (133.6-166.5)	6,574.7
Azerbaijan	397.1 (367.3-429.1)	5.6 (5.2-6.1)	5.6 (5.1-6.0)	157.2 (145.4-169.8)	482.4
Belarus	483.0 (439.4-517.3)	6.9 (6.3-7.4)	5.6 (5.1-6.0)	191.1 (173.9-204.7)	1,023.5
Belgium	404.9 (394.6-549.7)	4.9 (4.7-6.6)	3.6 (3.5-5.4)	135.6 (132.2-184.2)	6,433.2
Bosnia and Herzegovina	305.9 (204.6-375.2)	12.2 (8.2-15.0)	9.1 (5.9-11.2)	121.1 (81.0-148.5)	1,125.2
Bulgaria	519.3 (432.8-554.4)	9.9 (8.3-10.6)	7.4 (6.0-8.3)	134.0 (111.7-143.0)	1,892.4
Channel Islands	10.8 (10.8-10.8)	8.2 (8.2-8.2)	6.3 (6.3-6.3)	3.6 (3.6-3.6)	–
Croatia	212.7 (199.0-396.5)	7.0 (6.5-13.0)	4.8 (4.4-9.2)	71.3 (66.7-132.8)	1,197.5
Cyprus	87.5 (69.8-118.1)	9.7 (7.8-13.1)	8.6 (6.5-11.3)	32.0 (25.6-43.2)	2,570.8
Czechia	791.4 (634.1-1,230.2)	9.8 (7.9-15.3)	7.1 (5.5-11.0)	265.1 (212.5-412.1)	2,177.5
Denmark	309.4 (287.9-328.2)	7.3 (6.8-7.7)	5.3 (4.9-5.6)	103.6 (96.4-110.0)	7,844.4
Estonia	83.9 (63.7-103.2)	8.7 (6.6-10.7)	6.5 (4.8-7.8)	40.9 (31.0-50.3)	1,826.6
Faroe Islands	1.8 (1.7-3.0)	5.2 (4.8-8.6)	3.8 (3.4-5.7)	.6 (.5-1.0)	–
Finland	392.9 (334.8-435.9)	9.7 (8.2-10.7)	6.1 (5.4-7.0)	73.7 (62.8-81.7)	5,514.6
France	3,942.9 (2,229.6-4,428.8)	8.6 (4.8-9.6)	5.3 (3.4-6.6)	1,098.6 (621.3-1,234.0)	5,760.1
Georgia	190.6 (172.3-246.4)	6.8 (6.1-8.8)	5.7 (5.1-7.2)	75.4 (68.2-97.5)	877.1
Germany	6,199.9 (5,033.4-6,847.3)	10.0 (8.1-11.0)	6.9 (5.5-7.7)	1,345.4 (1,092.2-1,485.9)	6,660.7
Greece	736.1 (675.3-803.3)	9.6 (8.8-10.5)	6.4 (5.8-7.1)	246.6 (226.2-269.1)	1,747.1
Greenland	1.8 (1.8-3.4)	4.5 (4.4-8.4)	3.3 (3.2-5.7)	.6 (.6-1.1)	–
Holy See	.1 (.1-.1)	10.7 (9.2-12.3)	7.3 (6.2-8.3)	.0 (.0-.0)	–

Total Regional estimates   Countries with in-country sources on diabetes

Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
4,316.7	1,111,201	4,977	54,780.2 (41,729.3-78,561.1)	7.1 (5.3-9.7)	25,608.0 (20,572.6-34,409.3)	3.3 (2.6-4.5)
1,714.9	4,248	493	160.5 (122.7-189.1)	7.3 (5.2-8.5)	45.0 (41.8-47.6)	1.7 (1.6-1.9)
3,916.4	–	27	6.1 (4.3-7.9)	8.4 (6.2-10.6)	2.0 (1.9-2.2)	2.8 (2.7-3.0)
2,883.5	2,392	498	71.2 (54.7-183.2)	3.5 (2.6-7.4)	51.5 (39.7-86.9)	2.3 (1.7-3.9)
7,256.9	12,021	3,592	1,387.0 (1,144.0-1,571.1)	16.7 (14.1-19.5)	179.0 (136.7-288.0)	2.2 (1.7-3.8)
1,843.9	7,577	1,908	236.5 (177.3-556.2)	3.5 (2.6-7.4)	166.6 (126.7-284.4)	2.3 (1.7-3.9)
3,253.5	11,242	1,062	184.6 (148.0-658.7)	3.5 (2.6-7.4)	187.5 (144.9-306.0)	2.3 (1.7-3.9)
7,077.8	10,714	4,330	1,599.3 (1,400.0-1,893.1)	15.8 (14.1-19.2)	484.6 (404.4-581.1)	4.9 (4.1-5.7)
2,712.6	5,113	497	200.2 (159.7-235.1)	7.3 (5.2-8.5)	58.8 (54.5-61.9)	1.7 (1.6-1.9)
4,481.5	10,521	1,129	88.3 (78.8-503.7)	1.4 (1.2-6.9)	147.1 (112.5-233.3)	2.3 (1.7-3.9)
–	–	73	5.5 (4.0-7.6)	3.8 (2.7-5.6)	7.6 (6.3-9.1)	4.9 (4.1-5.7)
2,215.1	6,218	1,278	244.9 (194.2-286.2)	7.3 (5.2-8.5)	72.3 (67.1-76.0)	1.7 (1.6-1.8)
3,452.7	1,101	390	57.4 (49.1-79.8)	5.7 (5.0-8.5)	17.8 (16.6-18.9)	1.7 (1.6-1.8)
3,749.9	1,146	4,284	251.6 (195.9-751.5)	3.5 (2.6-7.3)	216.5 (165.0-346.2)	2.2 (1.7-3.8)
7,311.3	7,010	3,103	617.1 (409.3-658.8)	11.9 (4.5-12.5)	259.0 (161.5-318.6)	5.4 (3.3-6.7)
2,855.4	174	473	87.8 (25.7-103.0)	6.8 (2.5-8.3)	25.5 (19.5-40.8)	2.2 (1.7-3.8)
–	–	26	.6 (.5-4.5)	1.2 (1.0-10.4)	1.9 (1.3-2.5)	4.8 (3.3-6.7)
5,443.1	9,338	5,410	474.5 (385.2-618.2)	8.1 (4.2-10.7)	198.0 (144.3-319.5)	4.5 (3.1-7.4)
6,448.4	87,434	27,128	48,28.6 (3,429.5-6,228.7)	8.4 (6.2-10.6)	2,728.6 (2,271.9-3,289.5)	4.9 (4.1-5.7)
2,232.0	4,271	429	109.7 (84.1-263.9)	3.5 (2.6-7.4)	60.6 (54.0-120.1)	1.8 (1.6-3.9)
7,422.7	151,463	35,144	12,197.5 (10,399.9-14,554.5)	16.8 (13.7-19.5)	3,716.1 (3,102.4-4,468.2)	4.9 (4.1-5.7)
2,609.3	22,350	2,905	596.9 (469.1-700.3)	7.3 (5.2-8.5)	180.5 (167.6-189.8)	1.7 (1.6-1.8)
–	–	33	4.3 (3.7-5.7)	5.4 (4.4-11.2)	2.1 (1.5-2.9)	4.8 (3.3-6.7)
–	–	–	.1 (.0-.1)	8.3 (6.1-10.5)	.0 (.0-.0)	2.8 (2.6-3.0)

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
Hungary	661.4 (523.3-865.6)	9.1 (7.2-11.8)	7.0 (5.3-8.8)	110.3 (87.2-144.3)	1,465.9
Iceland	20.1 (14.0-21.7)	8.3 (5.8-9.0)	5.5 (4.5-6.0)	6.7 (4.7-7.3)	8,400.7
Ireland	139.1 (123.5-156.3)	4.0 (3.6-4.5)	3.0 (2.6-3.5)	46.6 (41.4-52.4)	7,843.3
Isle of Man	5.1 (5.1-5.1)	8.3 (8.3-8.3)	6.3 (6.3-6.3)	1.7 (1.7-1.7)	–
Israel	536.5 (536.0-536.9)	9.9 (9.9-9.9)	8.5 (8.5-8.5)	179.7 (179.6-179.9)	4,807.4
Italy	4,470.3 (4,019.4-5,743.5)	9.9 (8.9-12.7)	6.4 (5.7-8.3)	1,497.7 (1,346.6-1,924.2)	3,280.8
Kazakhstan	807.7 (670.2-1,143.5)	6.8 (5.6-9.6)	6.6 (5.4-9.3)	319.7 (265.2-452.5)	764.2
Kyrgyzstan	256.4 (206.6-347.2)	6.6 (5.3-8.9)	6.6 (5.4-9.3)	101.5 (81.8-137.4)	231.0
Latvia	115.8 (105.7-134.9)	8.6 (7.8-10.0)	5.9 (5.2-6.9)	38.8 (35.4-45.2)	1,335.0
Liechtenstein	2.5 (2.1-2.7)	8.9 (7.6-9.6)	6.1 (5.1-6.6)	.8 (.7-.9)	–
Lithuania	186.9 (145.2-214.1)	9.5 (7.4-10.8)	5.8 (5.0-7.1)	62.6 (48.7-71.7)	1,342.5
Luxembourg	34.6 (25.5-43.2)	7.3 (5.3-9.1)	5.9 (4.3-7.4)	11.6 (8.5-14.5)	8,192.5
Malta	37.8 (29.2-46.5)	11.2 (8.7-13.8)	8.0 (6.4-9.6)	17.9 (13.9-22.0)	2,837.6
Monaco	2.7 (1.4-2.9)	9.3 (5.0-10.0)	6.2 (3.6-7.0)	.9 (.5-1.0)	3,416.9
Montenegro	54.7 (33.0-69.7)	12.0 (7.3-15.3)	9.1 (5.9-11.2)	21.6 (13.0-27.6)	–
Netherlands	857.0 (800.8-1069.5)	6.8 (6.3-8.5)	4.5 (4.2-5.6)	287.1 (268.3-358.3)	6,444.9
North Macedonia	116.1 (107.1-229.6)	7.4 (6.8-14.6)	6.1 (5.6-11.4)	46.0 (42.4-90.9)	980.5
Norway	190.7 (187.9-334.7)	4.8 (4.7-8.4)	3.6 (3.6-5.6)	63.9 (63.0-112.1)	11,166.4
Poland	2,677.0 (2,274.8-2,948.4)	9.4 (8.0-10.3)	6.8 (6.0-7.6)	1,745.1 (1,483.0-1,922.1)	994.3
Portugal	994.1 (958.4-1,195.8)	13.0 (12.5-15.7)	9.1 (8.6-10.8)	433.3 (417.8-521.2)	2,293.3
Republic of Moldova	207.3 (188.1-223.1)	6.7 (6.1-7.2)	5.6 (5.1-6.0)	82.0 (74.4-88.3)	491.7
Romania	1,199.0 (632.5-1,670.3)	8.4 (4.4-11.7)	6.5 (3.1-9.2)	255.4 (134.7-355.8)	930.2
Russian Federation	7,392.1 (6,810.3-7,783.1)	7.0 (6.4-7.3)	5.6 (5.1-5.9)	3,029.2 (2,790.8-3,189.5)	1,739.8
San Marino	2.7 (2.3-3.1)	10.8 (9.2-12.3)	7.4 (6.3-8.5)	.9 (.8-1.1)	3,852.2
Serbia	796.8 (512.7-992.3)	12.2 (7.9-15.2)	9.1 (5.9-11.2)	315.3 (202.9-392.7)	1,424.4
Slovakia	349.7 (290.8-429.8)	8.4 (7.0-10.3)	5.8 (5.1-7.7)	117.2 (97.4-144.0)	1,554.2

Total Regional estimates   Countries with in-country sources on diabetes

Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
2,866.1	10,701	3,496	236.8 (184.9-680.0)	3.5 (2.6-7.3)	306.9 (153.6-352.0)	3.8 (1.7-4.3)
6,577.1	394	137	26.6 (22.6-33.5)	5.4 (4.4-11.2)	12.8 (9.0-17.3)	4.8 (3.3-6.7)
8,425.8	2,958	3,364	110.0 (54.5-176.6)	3.0 (1.2-5.3)	194.4 (162.0-231.3)	4.9 (4.1-5.7)
–	–	39	2.6 (1.9-3.6)	3.8 (2.7-5.6)	3.6 (3.0-4.3)	4.9 (4.1-5.7)
4,639.3	13,230	4,077	82.6 (77.1-334.1)	3.5 (3.2-7.3)	126.9 (95.6-210.8)	2.2 (1.7-3.8)
3,977.9	172,943	13,715	4,907.3 (3,472.2-6,343.3)	8.4 (6.2-10.6)	1625.3 (1531.4-1719.7)	2.8 (2.7-3.0)
2,171.1	11,806	1,001	443.5 (397.3-486.7)	3.3 (2.9-3.6)	481.7 (392.1-1020.2)	4.3 (3.5-8.3)
700.3	2,966	400	116.9 (103.4-129.4)	3.3 (2.9-3.6)	189.5 (155.0-319.4)	4.3 (3.5-8.3)
2,297.6	2,229	256	49.8 (38.9-133.2)	3.5 (2.6-7.3)	36.7 (28.3-58.8)	2.2 (1.7-3.8)
–	–	10	5.5 (4.8-6.5)	15.8 (14.1-19.2)	.7 (.6-1.2)	2.2 (1.7-3.8)
2,485.6	5,870	907	73.2 (57.2-196.2)	3.5 (2.6-7.3)	53.4 (41.3-85.4)	2.2 (1.7-3.8)
7,956.7	788	223	84.4 (75.0-101.1)	15.8 (14.1-19.2)	25.8 (21.6-30.5)	4.9 (4.1-5.7)
4,016.3	735	189	35.1 (25.1-45.2)	8.4 (6.2-10.6)	11.3 (10.6-11.9)	2.8 (2.7-3.0)
3,433.0	–	15	3.0 (2.1-3.9)	8.3 (6.1-10.5)	1.0 (.9-1.0)	2.8 (2.6-3.0)
–	1,014	277	35.0 (26.9-41.2)	7.3 (5.2-8.5)	10.0 (9.3-10.6)	1.7 (1.6-1.9)
6,843.2	21,213	6,393	2,478.6 (2,160.6-2,926.3)	15.8 (14.1-19.2)	749.8 (624.7-904.7)	4.9 (4.1-5.7)
2,636.6	2,590	330	120.9 (93.2-141.8)	7.3 (5.2-8.5)	33.7 (31.4-35.7)	1.7 (1.6-1.9)
9,240.9	2,788	3,821	404.0 (344.1-555.6)	5.4 (4.4-11.2)	213.7 (151.8-287.9)	4.8 (3.3-6.7)
2,047.3	5,330	12,447	2,446.4 (914.4-2,854.8)	6.8 (2.7-8.0)	747.7 (570.6-1205.0)	2.2 (1.7-3.8)
3,356.8	22,858	2,443	1,064.9 (581.5-1,095.3)	10.5 (6.1-10.9)	270.8 (255.2-286.8)	2.8 (2.7-3.0)
1,108.0	4,025	802	142.5 (106.9-273.1)	3.5 (2.6-7.4)	77.4 (59.2-128.9)	2.3 (1.7-3.9)
2,133.4	24,213	3,860	635.0 (480.7-1,373.3)	3.5 (2.6-7.3)	381.8 (292.8-612.4)	2.2 (1.7-3.8)
4,251.8	20,723	38,140	3,124.3 (2,471.7-9,895.4)	3.5 (2.6-7.4)	2,823.9 (2,181.0-4,623.5)	2.3 (1.7-3.9)
4,826.9	–	10	2.7 (1.9-3.5)	8.4 (6.2-10.6)	.9 (.8-.9)	2.8 (2.7-3.0)
3,426.9	15,908	2,820	515.8 (406.1-609.5)	7.3 (5.2-8.5)	151.0 (140.2-159.1)	1.7 (1.6-1.9)
2,605.9	628	1,375	179.2 (135.4-386.0)	3.5 (2.6-7.3)	108.9 (83.2-176.3)	2.2 (1.7-3.8)

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
Slovenia	137.8 (132.3-201.4)	8.9 (8.5-13.0)	5.8 (5.6-9.2)	46.2 (44.3-67.5)	2,496.1
Spain	5,141.3 (4,283.6-5,313.4)	14.8 (12.3-15.3)	10.3 (8.7-10.9)	1,557.8 (1,297.9-1,610.0)	3,005.8
Sweden	496.2 (453.7-538.1)	6.8 (6.2-7.4)	5.0 (4.6-5.4)	166.3 (152.0-180.3)	7,674.7
Switzerland	389.0 (363.6-568.3)	6.0 (5.6-8.7)	4.6 (4.2-6.4)	130.3 (121.8-190.4)	12,828.4
Tajikistan	327.6 (262.3-515.1)	6.3 (5.0-9.8)	6.6 (5.6-12.3)	143.9 (115.2-226.2)	169.3
Turkey	9,020.9 (3,258.5-9,259.0)	15.9 (5.8-16.3)	14.5 (5.9-14.9)	3,770.0 (1,361.8-3,869.5)	1,044.9
Turkmenistan	223.7 (177.4-276.4)	6.0 (4.8-7.5)	6.7 (5.3-8.3)	88.3 (70.0-109.1)	1,681.1
Ukraine	2,325.0 (2,101.7-2,492.6)	7.1 (6.4-7.6)	5.6 (5.1-6.0)	920.1 (831.8-986.5)	625.4
United Kingdom	3,996.3 (3,992.0-4,000.3)	8.2 (8.2-8.2)	6.3 (6.3-6.3)	921.1 (920.1-922.0)	5,859.3
Uzbekistan	1,351.8 (997.6-2,175.8)	6.3 (4.7-10.2)	7.0 (5.3-10.9)	1,000.3 (738.3-1610.1)	205.3

Total Regional estimates

Countries with in-country sources on diabetes

Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
3,633.7	3,291	603	124.4 (99.7-144.9)	7.3 (5.2-8.5)	37.1 (34.4-39.0)	1.7 (1.6-1.8)
3,928.7	81,717	17,221	2,600.8 (2,527.1-4,706.4)	6.2 (6.0-10.6)	1,231.4 (1,160.6-1,302.9)	2.8 (2.7-3.0)
7,478.0	11,623	9,167	812.9 (695.7-1,065.4)	5.4 (4.4-11.2)	389.1 (273.6-526.3)	4.8 (3.3-6.7)
10,545.3	7,644	2,092	1,249.7 (1,093.3-1,483.4)	15.8 (14.1-19.2)	379.2 (316.0-455.3)	4.9 (4.1-5.7)
706.6	4,578	944	133.5 (117.1-148.8)	3.3 (2.9-3.6)	268.8 (218.3-476.0)	4.3 (3.5-10.5)
3,137.9	83,221	25,759	4,323.0 (2,965.4-4,838.5)	7.9 (5.2-8.7)	1,024.6 (959.3-1,099.3)	1.7 (1.6-1.9)
4,658.2	3,313	1,998	112.7 (99.3-124.4)	3.3 (2.9-3.6)	266.9 (128.4-296.6)	7.6 (3.8-8.4)
1,869.0	58,126	6,697	1,082.3 (845.6-3,072.6)	3.5 (2.6-7.4)	874.3 (674.3-1426.9)	2.3 (1.7-3.9)
6,272.2	140,775	31,623	2,967.6 (1,545.7-3,383.8)	5.3 (2.9-6.1)	2,808.8 (2,337.9-3,383.9)	4.9 (4.1-5.7)
1,146.7	16,670	2,811	636.6 (559.8-703.1)	3.3 (2.9-3.6)	879.4 (222.5-1,814.0)	4.3 (1.2-8.7)

Middle East and North Africa

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
Middle East and North Africa –MENA	**72,671.9 (38,199.4-81,837.4)**	**16.2 (8.5-18.3)**	**18.1 (9.5-20.3)**	**27,330.5 (15,710.6-30,992.8)**	**465.5**
Afghanistan	1,606.7 (1,044.0-1,713.5)	8.7 (5.6-9.2)	10.9 (8.1-11.9)	1,146.9 (745.3-1,223.2)	143.1
Algeria	2,013.0 (1,772.6-2,943.5)	7.4 (6.5-10.8)	7.1 (6.2-10.3)	810.1 (713.4-1,184.6)	862.8
Bahrain	119.8 (117.2-229.4)	9.0 (8.8-17.3)	11.3 (11.0-19.7)	40.9 (40.0-78.4)	1,324.9
Egypt	10,930.7 (6,986.8-12,001.2)	18.4 (11.8-20.2)	20.9 (13.3-22.6)	6,779.2 (4,333.2-7,443.2)	250.5
Iran (Islamic Republic of)	5,450.3 (4,685.7-6,233.2)	9.5 (8.2-10.9)	9.1 (7.6-10.4)	1,911.5 (1,643.3-2,186.1)	1,354.8
Iraq	2,011.4 (1,487.0-2,550.2)	9.4 (7.0-11.9)	10.7 (8.1-13.2)	946.4 (699.6-1,199.9)	850.4
Jordan	866.5 (731.6-1049.4)	14.8 (12.5-17.9)	15.4 (12.7-17.8)	173.0 (146.1-209.6)	980.7
Kuwait	803.4 (753.0-918.1)	25.5 (23.9-29.1)	24.9 (23.5-29.1)	299.7 (280.9-342.5)	1,823.6
Lebanon	396.1 (375.1-781.5)	8.9 (8.4-17.6)	8.0 (7.6-15.4)	159.4 (151.0-314.5)	1,930.8
Libya	399.2 (329.8-456.3)	9.0 (7.5-10.3)	8.7 (7.2-9.9)	160.7 (132.7-183.6)	–
Morocco	2,327.7 (1,895.6-2,589.4)	9.7 (7.9-10.8)	9.1 (7.4-10.1)	936.8 (762.9-1,042.1)	473.7
Oman	445.6 (433.4-649.3)	11.8 (11.5-17.3)	13.8 (13.3-21.0)	222.8 (216.7-324.7)	845.2
Pakistan	32,964.5 (8,492.7-33,445.5)	26.7 (6.9-27.1)	30.8 (8.1-31.3)	8,864.9 (2,283.9-8,994.3)	80.1
Qatar	394.9 (347.5-452.6)	16.4 (14.4-18.8)	19.5 (16.2-21.6)	135.0 (118.8-154.7)	2,017.2
Saudi Arabia	4,274.1 (2,802.8-5,335.2)	17.7 (11.6-22.1)	18.7 (12.4-22.4)	1,863.5 (1,222.0-2,326.1)	1,745.3
State of Palestine	183.0 (158.4-258.8)	6.8 (5.9-9.6)	9.2 (8.1-12.1)	73.7 (63.8-104.2)	–

Total Regional estimates

Countries with in-country sources on diabetes

Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
1,436.2	**796,362**	**9,166**	**47,610.8 (29,313.7-68,220.9)**	**11.2 (7.1-15.8)**	**28,944.6 (22,489.1-37,401.9)**	**6.1 (4.9-8.4)**
535.1	31,743	3,493	1,293.7 (782.6-1,676.3)	8.3 (5.4-10.5)	756.1 (414.7-822.2)	4.6 (2.9-5.0)
3,246.3	21,749	50,812	1,590.6 (1,488.6-5,643.8)	5.2 (4.9-18.4)	2,966.9 (2,833.3-3,087.9)	9.8 (9.3-10.1)
2,605.8	536	94	201.9 (82.2-222.8)	12.9 (6.8-18.7)	166.4 (70.4-180.1)	8.8 (4.7-12.6)
1,225.3	122,684	12,210	13,023.3 (5,030.1-13,408.2)	22.5 (8.5-23.2)	5,365.3 (5,121.1-5,590.6)	9.8 (9.3-10.1)
4,731.5	47,932	8,154	4,663.9 (3,013.0-5,918.3)	8.3 (5.4-10.5)	2,402.4 (2,057.5-2,820.6)	3.7 (3.1-4.4)
2,543.1	21,752	5,011	1,514.8 (922.1-1,959.5)	8.3 (5.4-10.5)	1,726.6 (499.2-1,826.8)	7.8 (2.1-8.3)
2,191.6	5,705	1,246	459.3 (339.5-512.5)	7.2 (6.0-9.1)	655.1 (625.4-683.1)	9.8 (9.3-10.1)
3,909.9	2,153	4,428	581.7 (234.7-606.0)	19.2 (7.2-20.0)	460.5 (181.5-469.4)	13.0 (5.1-13.3)
3,054.1	5,492	639	327.2 (295.9-1,010.9)	10.0 (8.3-20.4)	523.7 (499.8-545.0)	9.8 (9.3-10.1)
–	3,782	1,759	343.5 (306.1-975.3)	10.0 (8.3-20.4)	487.7 (466.3-507.8)	9.8 (9.3-10.1)
1,266.1	31,435	43,266	2,190.5 (1,872.2-5,108.0)	10.0 (8.3-20.4)	2,540.1 (2,424.2-2,642.8)	9.8 (9.3-10.1)
2,155.2	2,100	280	218.4 (209.7-576.6)	6.9 (6.6-18.3)	195.6 (187.5-483.8)	4.8 (4.6-12.4)
332.9	396,625	5,595	10,573.3 (8,824.6-16,587.1)	9.4 (8.1-14.7)	2,412.4 (2,266.3-8,483.7)	2.1 (1.9-7.8)
3,721.0	892	1,900	360.6 (138.0-378.1)	12.9 (6.8-18.7)	313.7 (130.3-322.3)	8.8 (4.7-12.6)
4,138.0	32,054	28,926	3,830.0 (1,643.0-4,348.2)	12.9 (6.8-18.7)	3,003.4 (1,276.8-3,351.0)	8.8 (4.7-12.6)
–	–	658	112.4 (76.9-238.9)	5.7 (3.2-9.9)	280.5 (178.1-304.9)	8.8 (6.2-10.4)

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
Sudan	3,526.6 (2,868.8-4,125.8)	16.0 (13.0-18.7)	18.9 (16.6-23.2)	1,023.8 (832.8-1,197.7)	153.4
Syrian Arab Republic	1,484.2 (754.8-1,841.3)	13.6 (6.9-16.8)	14.9 (8.0-18.3)	661.6 (336.5-820.8)	–
Tunisia	869.4 (642.0-960.7)	10.8 (8.0-11.9)	9.6 (7.1-10.7)	349.9 (258.4-386.6)	616.5
United Arab Emirates	990.9 (936.5-1,296.9)	12.3 (11.6-16.1)	16.4 (15.1-20.6)	634.2 (599.4-830.0)	2,109.5
Yemen	613.9 (583.8-2005.3)	4.0 (3.8-13.0)	5.4 (5.1-18.2)	136.6 (129.9-446.2)	–

Total Regional estimates

Countries with in-country sources on diabetes

Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
747.3	35,897	16,807	2,485.9 (1,796.5-3,566.6)	13.2 (8.5-16.3)	1,599.0 (1,525.0-1,668.6)	8.2 (7.8-8.5)
–	14,060	1,787	826.8 (521.0-1,059.4)	8.3 (5.4-10.5)	537.0 (192.9-707.3)	5.1 (1.7-6.7)
2,235.9	6,868	2,224	718.9 (626.4-1,755.6)	10.0 (8.3-20.4)	893.1 (852.8-928.7)	9.8 (9.3-10.1)
3,682.6	4,343	433	1,230.3 (475.4-1,285.3)	18.3 (6.9-19.1)	979.8 (422.2-1,074.6)	8.8 (4.7-12.6)
–	8,561	2,769	1,063.6 (635.1-1,383.4)	8.3 (5.4-10.5)	679.4 (263.9-900.6)	5.1 (1.7-6.7)

North America and Caribbean

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
North America and Caribbean –NAC	**50,547.0 (44,453.6-57,139.8)**	**14.0 (12.3-15.8)**	**11.9 (10.0-13.6)**	**12,224.9 (10,519.4-14,747.0)**	**8,208.9**
Antigua and Barbuda	8.5 (7.8-9.0)	12.5 (11.4-13.1)	11.7 (10.4-12.3)	2.5 (2.3-2.6)	1,015.8
Aruba	4.1 (3.7-12.5)	5.2 (4.7-15.8)	4.3 (3.9-12.0)	1.2 (1.1-3.6)	–
Bahamas	25.6 (23.9-35.5)	9.3 (8.7-12.9)	8.8 (8.2-11.9)	7.4 (6.9-10.3)	2,496.6
Barbados	38.8 (37.3-40.5)	18.7 (17.9-19.5)	14.0 (13.4-14.7)	11.2 (10.8-11.7)	1,106.4
Belize	32.2 (26.3-38.8)	13.2 (10.8-15.9)	14.5 (12.0-17.7)	13.5 (11.0-16.2)	830.5
Bermuda	6.9 (6.0-7.7)	15.5 (13.5-17.4)	13.0 (11.2-14.7)	2.0 (1.7-2.2)	–
British Virgin Islands	1.9 (1.5-3.1)	9.4 (7.6-15.5)	8.7 (7.0-14.5)	.5 (.4-.9)	–
Canada	2,974.0 (2,530.8-3,406.3)	10.5 (8.9-12.0)	7.7 (6.6-8.8)	1,123.3 (955.9-1,286.6)	4,802.9
Cayman Islands	6.1 (5.3-6.9)	13.8 (12.0-15.6)	13.0 (11.2-14.7)	1.8 (1.5-2.0)	–
Curaçao	20.3 (17.4-21.2)	17.2 (14.8-18.0)	11.7 (10.4-12.3)	5.9 (5.0-6.1)	–
Dominica	6.3 (5.8-6.8)	13.3 (12.2-14.3)	11.7 (10.8-12.5)	2.2 (2.0-2.4)	1,334.3
Grenada	10.1 (8.7-11.0)	13.3 (11.4-14.5)	12.6 (11.0-13.8)	3.5 (3.1-3.9)	1,058.0
Guyana	54.0 (50.1-57.5)	11.1 (10.3-11.8)	11.7 (10.8-12.5)	18.9 (17.6-20.1)	693.0
Haiti	548.7 (420.7-801.3)	8.3 (6.4-12.2)	8.9 (7.1-13.7)	161.3 (123.7-235.6)	244.5
Jamaica	231.1 (202.2-255.0)	11.6 (10.2-12.8)	11.1 (9.7-12.3)	56.5 (49.4-62.4)	884.9
Mexico	14,123.2 (11,854.4-18,490.8)	16.9 (14.2-22.1)	16.9 (12.8-21.8)	6,710.2 (5,632.2-8,785.2)	1,412.3
Saint Kitts and Nevis	6.4 (4.0-6.9)	18.1 (11.4-19.5)	16.1 (10.6-17.6)	1.8 (1.2-2.0)	1,055.7
Saint Lucia	15.9 (14.8-16.9)	11.8 (11.0-12.5)	11.7 (10.8-12.5)	5.6 (5.2-5.9)	905.0
Saint Vincent and the Grenadines	6.5 (5.8-10.1)	8.6 (7.7-13.4)	8.0 (7.1-12.3)	2.3 (2.0-3.5)	902.9
Suriname	49.7 (39.7-57.8)	13.2 (10.5-15.3)	12.7 (10.0-14.9)	19.7 (15.7-22.9)	1,277.9
Trinidad and Tobago	148.9 (124.3-169.9)	14.8 (12.4-16.9)	12.7 (10.6-14.5)	43.1 (36.0-49.2)	1,209.7
United States of America	32,215.3 (29,052.2-33,660.3)	13.6 (12.2-14.2)	10.7 (9.5-11.3)	4,026.9 (3,631.5-4,207.5)	11,779.2
US Virgin Islands	12.4 (10.8-14.0)	17.0 (14.7-19.1)	12.4 (10.5-14.1)	3.6 (3.1-4.1)	–

Total Regional estimates

Countries with in-country sources on diabetes

Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
8,648.6	930,692	8,371	46,988.5 (44,029.3-50,348.1)	11.6 (10.9-12.4)	31,637.3 (28,877.1-36,582.1)	8.3 (7.5-9.4)
1,631.6	147	10	3.9 (3.6-4.2)	5.3 (4.9-5.8)	5.0 (3.8-6.1)	9.9 (8.0-11.7)
–	–	0	5.2 (4.8-5.6)	5.3 (4.9-5.8)	8.0 (6.6-9.4)	9.9 (8.0-11.7)
2,486.6	470	123	14.8 (13.7-16.1)	5.3 (4.9-5.8)	38.0 (32.6-43.8)	9.9 (8.0-11.7)
1,143.7	1,008	35	13.5 (12.5-14.7)	5.3 (4.9-5.8)	9.4 (7.3-19.8)	4.0 (3.1-10.5)
1,470.4	441	49	10.5 (9.6-11.5)	5.0 (4.6-5.4)	19.6 (17.9-21.8)	8.7 (7.9-9.8)
–	–	3	5.9 (5.6-6.3)	11.6 (11.0-12.2)	3.8 (3.5-4.5)	8.1 (7.4-9.1)
–	–	10	2.4 (2.3-2.6)	11.6 (11.0-12.2)	1.7 (1.5-1.9)	8.1 (7.4-9.1)
5,000.1	53,046	19,831	3,710.1 (3,523.4-4,058.4)	10.9 (10.4-12.2)	2,484.0 (2,278.3-2,894.8)	8.1 (7.4-9.1)
–	–	4	5.3 (5.1-5.6)	11.6 (11.0-12.2)	3.7 (3.4-4.2)	8.1 (7.4-9.1)
–	–	1	8.0 (7.5-8.7)	5.3 (4.9-5.8)	18.3 (16.1-20.6)	9.9 (8.0-11.7)
1,930.9	–	13	2.6 (2.4-2.8)	5.0 (4.6-5.4)	6.0 (5.1-6.9)	9.9 (8.0-11.7)
1,546.9	265	16	3.9 (3.6-4.2)	5.0 (4.6-5.4)	6.5 (5.2-7.9)	9.9 (8.0-11.7)
1,202.6	1,672	4	22.9 (21.1-25.0)	5.0 (4.6-5.4)	35.0 (26.9-43.0)	9.9 (8.0-11.7)
546.6	11,811	144	273.7 (251.4-299.3)	4.7 (4.3-5.1)	659.6 (540.1-785.0)	9.9 (8.0-11.7)
1,541.4	4,303	197	101.0 (93.2-110.0)	5.0 (4.6-5.4)	211.1 (174.4-248.9)	9.9 (8.0-11.7)
2,897.4	184,384	13,952	10,655.2 (10,096.8-11,186.0)	12.4 (11.8-13.0)	7,536.3 (6,900.5-8,465.6)	8.7 (7.9-9.8)
1,654.4	–	8	2.0 (1.9-2.2)	5.3 (4.9-5.8)	2.8 (2.2-3.4)	9.9 (8.0-11.7)
1,188.9	317	23	6.7 (6.2-7.3)	5.0 (4.6-5.4)	8.8 (6.5-10.9)	9.9 (8.0-11.7)
1,507.1	131	17	4.0 (3.7-4.4)	5.0 (4.6-5.4)	2.2 (1.2-8.6)	2.6 (1.6-10.6)
3,179.3	948	3	47.5 (45.1-49.9)	12.4 (11.8-13.0)	33.8 (31.0-37.9)	8.7 (7.9-9.8)
2,260.8	2,365	184	59.5 (55.1-64.6)	5.3 (4.9-5.8)	73.6 (46.8-130.4)	6.8 (4.2-11.9)
11,779.2	669,384	157,874	32,019.0 (29,850.6-34,447.4)	11.7 (11.0-12.6)	20,463.7 (18,760.2-23,799.3)	8.1 (7.4-9.1)
–	–	35	10.7 (10.1-11.3)	11.6 (11.0-12.2)	6.5 (6.0-7.8)	8.1 (7.4-9.1)

South and Central America

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
South and Central America –SACA	**32,497.1 (27,511.1-40,445.9)**	**9.5 (8.1-11.9)**	**8.2 (6.9-10.2)**	**10,671.5 (9,039.2-13,379.4)**	**2,190.4**
Argentina	1,806.8 (1,658.1-3,324.4)	6.1 (5.6-11.2)	5.4 (5.0-9.7)	564.3 (517.9-1,038.2)	1,420.4
Bolivia (Plurinational State of)	395.9 (373.4-490.6)	5.7 (5.4-7.1)	5.5 (5.1-6.7)	147.7 (139.3-183.0)	898.8
Brazil	15,733.6 (14,037.1-17,432.3)	10.5 (9.4-11.6)	8.8 (7.8-9.9)	5,025.3 (4,483.5-5,567.9)	2,728.5
Chile	1,747.1 (940.2-1,771.4)	12.7 (6.8-12.9)	10.8 (6.8-11.1)	545.6 (293.6-553.2)	1,583.9
Colombia	3,443.6 (2,780.8-4,910.2)	9.9 (8.0-14.1)	8.3 (6.3-11.5)	1,241.4 (1,002.4-1,770.0)	1,772.8
Costa Rica	361.5 (328.6-623.2)	10.0 (9.1-17.3)	8.8 (8.0-13.4)	134.9 (122.6-232.5)	2,890.0
Cuba	761.3 (719.3-1,575.0)	9.0 (8.5-18.6)	7.6 (7.0-15.5)	284.0 (268.3-587.6)	3,117.4
Dominican Republic	865.3 (570.6-1,184.7)	12.7 (8.4-17.3)	10.5 (7.0-14.3)	322.8 (212.9-442.0)	1,490.1
Ecuador	526.7 (445.5-815.0)	4.7 (4.0-7.3)	4.4 (3.7-6.8)	105.3 (89.1-163.0)	2,280.5
El Salvador	291.5 (259.7-315.9)	7.1 (6.3-7.7)	6.3 (5.7-6.8)	108.7 (96.9-117.8)	1,061.8
Guatemala	1,149.5 (851.7-1,365.8)	11.4 (8.4-13.5)	13.1 (9.8-15.6)	561.1 (415.7-666.6)	888.5
Honduras	268.2 (220.3-321.9)	4.6 (3.7-5.5)	5.1 (4.2-6.2)	134.1 (110.2-161.0)	749.1
Nicaragua	365.8 (338.1-392.3)	9.0 (8.3-9.6)	9.3 (8.6-10.0)	163.7 (151.4-175.6)	576.5
Panama	236.0 (216.5-278.7)	8.5 (7.8-10.0)	8.2 (7.3-9.5)	73.7 (67.6-87.0)	1,460.5
Paraguay	274.6 (245.7-633.2)	6.2 (5.6-14.4)	7.5 (6.6-14.7)	102.4 (91.7-236.2)	1,331.3
Peru	1,300.7 (1,211.2-1,809.9)	5.9 (5.5-8.2)	4.8 (4.5-6.7)	485.2 (451.8-675.2)	1,331.5
Puerto Rico	413.4 (296.9-441.6)	20.1 (14.5-21.5)	13.3 (9.6-14.3)	129.1 (92.7-137.9)	–
Uruguay	275.6 (251.3-291.2)	11.6 (10.6-12.2)	9.0 (8.3-9.5)	86.1 (78.5-90.9)	1,686.3
Venezuela (Bolivarian Republic of)	2,280.0 (1,766.2-2,468.6)	12.6 (9.8-13.6)	9.6 (7.8-10.9)	456.0 (353.2-493.7)	–

Total Regional estimates

Countries with in-country sources on diabetes

	Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
	4,118.2	**410,206**	**6,385**	**39,624.6 (25,691.3-47,112.5)**	**10.9 (7.0-13.0)**	**47,005.4 (39,868.6-54,286.2)**	**10.0 (8.0-11.8)**
	2,505.6	26,944	8,581	3,611.6 (2,363.0-4,271.9)	11.8 (7.5-14.0)	4,400.1 (3,793.4-5,058.5)	9.9 (8.0-11.7)
	1,994.2	7,517	921	503.1 (463.2-854.5)	7.3 (6.8-12.5)	809.0 (674.1-952.5)	9.9 (8.0-11.7)
	4,923.2	214,175	92,348	17,774.9 (11,460.1-21,043.8)	10.8 (6.9-12.8)	21,425.6 (18,390.8-24,706.6)	9.9 (8.0-11.7)
	2,509.0	18,591	6,008	1,713.6 (1,126.1-2,029.2)	11.8 (7.5-14.0)	2,015.8 (1,737.5-2,315.7)	9.9 (8.0-11.7)
	3,991.5	35,562	3,222	4,019.7 (2,591.6-4,745.6)	10.8 (6.9-12.8)	4,678.3 (3,988.1-5,418.4)	9.9 (8.0-11.7)
	4,246.1	3,663	295	424.1 (276.0-502.5)	10.8 (6.9-12.8)	492.7 (420.5-570.0)	9.9 (8.0-11.7)
	7,957.6	10,714	492	1,086.3 (723.1-1,291.0)	10.8 (6.9-12.8)	1,199.1 (1,033.1-1,373.7)	9.9 (8.0-11.7)
	3,285.1	12,777	184	767.8 (491.8-909.4)	10.8 (6.9-12.8)	912.8 (775.3-1,061.0)	9.9 (8.0-11.7)
	4,217.6	3,970	1,290	1,208.8 (774.1-1432.6)	10.8 (6.9-12.8)	1,255.6 (1,043.2-1,478.8)	9.9 (8.0-11.7)
	2,179.9	3,692	711	453.0 (289.3-529.6)	10.8 (6.9-12.8)	495.4 (420.2-574.6)	9.9 (8.0-11.7)
	1,652.8	13,850	2,398	979.6 (614.1-1151.9)	10.8 (6.9-12.8)	924.7 (748.3-1,109.3)	9.9 (8.0-11.7)
	1,539.8	3,796	1,274	584.5 (366.5-691.4)	10.8 (6.9-12.8)	901.3 (509.3-948.2)	16.1 (8.7-16.9)
	1,572.3	3,654	769	470.4 (263.9-510.4)	12.1 (6.9-13.1)	486.7 (358.0-602.7)	12.5 (8.5-15.0)
	2,396.2	2,119	303	329.6 (211.6-391.7)	11.8 (7.5-14.0)	334.2 (280.3-391.2)	9.9 (8.0-11.7)
	3,110.0	3,467	208	454.9 (292.1-539.4)	10.8 (6.9-12.8)	471.2 (387.4-559.4)	9.9 (8.0-11.7)
	2,765.7	8,667	441	2,516.7 (1,616.8-2,993.8)	10.8 (6.9-12.8)	2,898.2 (2,455.8-3,372.2)	9.9 (8.0-11.7)
	–	–	1,140	285.0 (194.0-335.9)	11.8 (7.5-14.0)	335.3 (295.8-377.8)	9.9 (8.0-11.7)
	2,300.7	6,770	604	300.4 (199.7-355.5)	11.8 (7.5-14.0)	371.1 (322.9-423.5)	9.9 (8.0-11.7)
	–	30,280	132	2,140.4 (1,374.2-2,532.3)	10.8 (6.9-12.8)	2,598.3 (2,234.7-2,992.1)	9.9 (8.0-11.7)

South-East Asia

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
South–East Asia –SEA	**90,204.5 (76,848.0-99,900.5)**	**8.7 (7.4-9.7)**	**10.0 (8.6-11.1)**	**46,230.3 (39,636.6-51,243.3)**	**112.0**
Bangladesh	13,136.3 (8,946.2-13,493.6)	12.5 (8.5-12.8)	14.2 (10.0-14.6)	5,712.3 (3,890.2-5,867.6)	76.5
Bhutan	44.8 (39.5-49.3)	8.8 (7.8-9.7)	10.4 (9.3-11.4)	19.5 (17.2-21.4)	194.7
India	74,194.7 (65,654.0-82,861.1)	8.3 (7.3-9.3)	9.6 (8.5-10.6)	39,397.4 (34,862.3-43,999.3)	114.4
Maldives	27.0 (26.4-63.2)	6.7 (6.5-15.6)	9.2 (9.0-22.6)	11.8 (11.5-27.5)	1,867.4
Mauritius	250.4 (98.0-257.6)	26.5 (10.4-27.3)	22.6 (9.2-23.4)	89.3 (34.9-91.9)	588.4
Nepal	1,133.5 (972.4-1,289.2)	6.3 (5.4-7.2)	8.7 (7.4-9.9)	492.9 (422.8-560.6)	102.2
Sri Lanka	1,417.6 (1,111.6-1,886.4)	9.8 (7.7-13.1)	11.3 (9.1-14.5)	507.2 (397.7-675.0)	201.6

Total Regional estimates

Countries with in-country sources on diabetes

Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
403.5	**747,367**	**34,930**	**46,882.8 (30,408.2-86,822.5)**	**5.4 (3.3-9.3)**	**95,176.1 (45,390.5-169,444.9)**	**8.8 (4.6-18.2)**
200.2	75,617	5,932	5,011.4 (3,493.0-7,310.3)	5.5 (3.9-7.7)	17,550.3 (4,606.0-17,858.9)	18.1 (4.8-18.4)
610.4	379	124	24.9 (17.0-35.7)	5.5 (3.9-7.7)	38.8 (20.9-86.8)	7.8 (4.6-18.1)
432.0	647,831	229,442	40,143.8 (25,806.9-77,448.8)	5.4 (3.2-9.6)	75,123.9 (39,305.4-146,562.4)	7.8 (4.6-18.1)
2,767.1	115	70	43.6 (32.4-53.9)	12.4 (10.1-15.7)	28.6 (15.2-67.4)	7.8 (4.6-18.1)
1,243.4	2,320	38	116.4 (81.2-132.5)	12.4 (8.0-14.0)	83.1 (47.5-120.0)	7.8 (4.6-12.5)
318.7	9,022	5,607	709.5 (484.8-929.3)	5.4 (3.9-7.0)	1,656.7 (734.2-2,625.2)	7.8 (4.6-18.1)
661.9	12,084	3,294	833.2 (493.0-912.2)	5.7 (4.1-6.8)	694.8 (661.2-2,124.2)	4.8 (4.5-18.1)

Western Pacific

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
Western Pacific –WP	**205,640.2 (174,714.2-233,241.4)**	**11.9 (10.1-13.5)**	**9.9 (8.4-11.3)**	**108,669.6 (92,103.4-122,508.3)**	**1,203.8**
American Samoa	7.8 (7.2-8.5)	23.3 (21.5-25.4)	20.3 (18.8-22.2)	4.0 (3.7-4.4)	–
Australia	1,491.8 (1,316.6-1,571.7)	8.2 (7.2-8.7)	6.4 (5.8-6.9)	372.9 (329.2-392.9)	5,944.0
Brunei Darussalam	35.0 (33.6-43.0)	11.4 (10.9-14.0)	11.1 (10.6-14.1)	15.9 (15.2-19.5)	901.3
Cambodia	596.0 (556.7-700.2)	5.9 (5.5-6.9)	7.3 (6.9-8.7)	334.4 (312.4-392.9)	261.5
China	140,869.6 (121,697.4-158,548.4)	13.0 (11.3-14.7)	10.6 (9.2-12.0)	72,839.5 (62,926.1-81,980.7)	1,173.5
China, Hong Kong SAR	686.0 (655.5-819.6)	11.6 (11.1-13.8)	7.8 (7.4-9.7)	372.0 (355.4-444.4)	–
China, Macao SAR	50.9 (48.6-61.6)	9.7 (9.2-11.7)	7.8 (7.4-9.7)	23.1 (22.0-28.0)	–
Democratic People's Republic of Korea	1,847.1 (1,633.3-1,984.1)	10.0 (8.9-10.8)	8.6 (7.6-9.2)	1,030.8 (911.5-1,107.3)	–
Fiji	99.2 (94.9-121.7)	17.7 (16.9-21.7)	17.7 (16.9-21.7)	51.1 (48.9-62.6)	524.6
French Polynesia	52.1 (39.9-53.5)	26.8 (20.5-27.5)	25.2 (19.0-25.9)	23.6 (18.1-24.3)	–
Guam	23.3 (22.5-30.7)	20.7 (20.0-27.3)	19.1 (18.4-25.3)	10.6 (10.2-13.9)	–
Indonesia	19,465.1 (15,600.7-20,632.8)	10.8 (8.7-11.5)	10.6 (8.5-11.2)	14,341.9 (11,494.6-15,202.2)	323.8
Japan	11,005.0 (8,290.6-11,410.1)	11.8 (8.9-12.2)	6.6 (5.1-7.4)	5,007.3 (3,772.2-5,191.6)	3,239.3
Kiribati	14.1 (9.8-17.1)	21.2 (14.6-25.5)	22.1 (15.1-27.7)	7.8 (5.4-9.4)	493.8
Lao People's Democratic Republic	214.8 (208.6-301.7)	5.0 (4.9-7.0)	6.2 (6.1-8.7)	90.0 (87.4-126.4)	202.9
Malaysia	4,431.5 (2,898.2-4,584.0)	20.0 (13.1-20.7)	19.0 (12.4-19.7)	2,175.6 (1,422.9-2,250.5)	1,090.7
Marshall Islands	9.1 (7.7-9.5)	25.1 (21.2-26.1)	23.0 (19.4-24.0)	5.9 (5.0-6.2)	1,493.9
Micronesia (Federated States of)	8.7 (6.5-11.4)	12.7 (9.4-16.6)	15.6 (10.8-22.5)	4.5 (3.3-5.9)	1,000.7
Mongolia	150.8 (121.2-208.1)	7.4 (5.9-10.2)	6.9 (5.6-10.1)	77.6 (62.4-107.1)	584.0
Myanmar	2,346.6 (1,241.2-3,209.7)	6.6 (3.5-9.0)	7.1 (3.6-9.9)	1,213.4 (641.8-1,659.7)	168.1
Nauru	1.5 (1.3-1.7)	23.4 (19.0-25.5)	23.4 (19.0-25.6)	.7 (.6-.8)	1,051.5
New Caledonia	49.8 (41.0-54.4)	25.0 (20.5-27.3)	23.4 (19.0-25.6)	22.6 (18.6-24.7)	–
New Zealand	268.7 (255.4-282.0)	7.9 (7.5-8.2)	6.2 (5.9-6.5)	122.0 (116.0-128.0)	3,967.5

Total Regional estimates   Countries with in-country sources on diabetes

Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
2,136.9	**2,281,732**	**2,839**	**252,984.2 (165,833.8-298,198.9)**	**12.9 (8.6-15.5)**	**49,729.7 (31,566.6-62,122.2)**	**2.5 (1.7-3.4)**
–	–	20	2.6 (2.4-3.9)	7.4 (6.7-10.1)	5.3 (3.5-6.0)	13.5 (8.9-16.4)
5,483.4	23,226	14,854	1,904.0 (1,800.0-1,984.5)	8.8 (8.3-9.2)	1,071.2 (448.6-1,317.2)	4.5 (2.2-7.0)
2,305.9	532	12	49.2 (47.8-50.7)	15.5 (15.0-16.0)	7.3 (6.5-20.8)	2.5 (2.1-6.8)
754.1	8,772	583	633.2 (537.6-899.7)	7.3 (6.5-9.7)	200.0 (141.7-263.8)	2.2 (1.6-2.9)
2,190.2	1,396,662	56,013	169,869.6 (101,823.7-174,371.7)	13.4 (8.4-14.0)	26,935.0 (18,825.4-33,626.3)	2.2 (1.6-2.9)
–	–	490	945.4 (869.3-1,019.7)	13.5 (12.3-14.8)	382.0 (157.0-437.2)	6.5 (2.2-7.2)
–	–	45	78.8 (72.4-85.2)	13.5 (12.3-14.8)	34.3 (13.1-38.6)	6.5 (2.2-7.2)
–	27,653	2,700	1,736.1 (1,466.5-2,255.8)	8.9 (7.2-12.2)	770.6 (533.3-980.1)	3.5 (2.5-4.6)
910.6	1,587	27	41.3 (37.4-57.7)	7.4 (6.7-10.1)	79.4 (52.1-94.3)	13.5 (8.9-16.4)
–	–	7	15.5 (13.5-18.2)	7.4 (6.4-8.7)	9.8 (4.5-13.8)	4.5 (2.2-7.0)
–	–	1	9.1 (7.9-10.8)	7.4 (6.4-8.7)	7.0 (2.6-8.1)	4.5 (2.2-7.0)
1,087.7	236,711	8,580	29,611.9 (14,941.8-59,340.8)	17.6 (8.1-32.1)	4,009.1 (2,799.5-5,178.0)	2.2 (1.6-2.9)
3,419.3	245,010	4,460	12,043.0 (11,756.4-15,564.9)	9.4 (9.1-13.6)	5,567.9 (2,504.1-6,845.4)	4.5 (2.2-7.0)
696.9	336	4	4.5 (4.1-6.3)	7.4 (6.7-10.1)	9.5 (6.6-11.9)	13.6 (9.7-17.4)
593.8	3,136	240	346.7 (266.2-513.1)	8.9 (7.2-12.2)	83.6 (59.0-114.4)	2.1 (1.5-2.9)
3,048.0	41,238	955	3,508.8 (3,399.4-3,617.1)	15.5 (15.0-16.0)	494.9 (350.6-642.9)	2.2 (1.6-2.9)
1,573.1	–	0	2.7 (2.5-4.0)	7.4 (6.7-10.1)	5.5 (3.6-6.4)	13.5 (8.9-16.4)
996.4	193	802	4.6 (4.1-5.7)	7.4 (6.7-10.1)	8.2 (5.3-10.5)	13.5 (8.9-16.4)
1,955.3	2,597	185	193.5 (128.2-256.0)	9.5 (6.1-12.9)	44.7 (31.3-57.6)	2.2 (1.6-2.9)
828.5	34,506	1,603	3,003.5 (2,331.5-4,571.0)	8.9 (7.2-12.2)	755.2 (527.7-979.0)	2.2 (1.6-2.9)
1,278.6	–	0	.5 (.4-.6)	7.6 (6.6-9.1)	.4 (.1-.5)	6.5 (2.2-7.2)
–	–	7	16.0 (13.8-18.7)	7.4 (6.4-8.7)	10.7 (4.6-14.3)	4.5 (2.2-7.0)
3,954.7	4,719	2,172	366.2 (346.5-381.6)	8.8 (8.3-9.2)	201.5 (85.7-247.7)	4.5 (2.2-7.0)

Country or territory	Number of adults 20–79 years with diabetes in 1,000s (95% confidence interval)	Diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Age-adjusted comparative diabetes prevalence (%) in adults 20–79 years (95% confidence interval)	Number of adults 20–79 years with undiagnosed diabetes in 1,000s (95% confidence interval)	Diabetes-related expenditure (USD) per person with diabetes (20–79 years)
Northern Mariana Islands	8.3 (6.7-9.0)	23.4 (19.0-25.5)	23.4 (19.0-25.6)	3.7 (3.0-4.1)	–
Palau	1.9 (1.7-2.1)	17.0 (15.4-18.7)	17.0 (15.4-18.7)	.9 (.8-.9)	2,012.5
Papua New Guinea	724.0 (417.0-861.4)	14.6 (8.4-17.3)	16.7 (10.9-21.2)	372.7 (214.6-443.4)	167.9
Philippines	4,303.9 (3,995.8-4,679.4)	6.5 (6.0-7.0)	7.1 (6.6-7.7)	2,869.4 (2,664.0-3,119.8)	450.8
Republic of Korea	3,511.8 (3,278.5-4,754.6)	8.6 (8.1-11.7)	6.8 (5.9-8.7)	1,264.2 (1,180.2-1,711.6)	2,554.6
Samoa	7.7 (7.1-17.3)	7.3 (6.8-16.5)	9.2 (8.6-22.4)	4.0 (3.7-8.9)	558.1
Singapore	711.8 (616.7-812.8)	14.9 (12.9-17.0)	11.6 (9.9-13.5)	358.7 (310.8-409.7)	2,486.1
Solomon Islands	53.3 (38.2-58.6)	15.3 (11.0-16.8)	19.8 (14.3-21.6)	27.4 (19.7-30.2)	245.2
Taiwan	2,457.2 (2,042.9-2,587.5)	13.1 (10.9-13.8)	9.7 (7.8-10.2)	1,115.5 (927.5-1,174.7)	–
Thailand	6,066.6 (6,009.3-10,172.3)	11.6 (11.5-19.5)	9.7 (9.6-16.7)	2,411.2 (2,388.5-4,043.1)	655.0
Timor L'Este	46.3 (41.3-49.4)	6.7 (6.0-7.2)	8.6 (7.6-9.2)	23.8 (21.3-25.4)	320.9
Tonga	7.4 (6.5-8.5)	13.0 (11.3-14.9)	15.0 (13.4-17.2)	3.8 (3.3-4.4)	563.8
Tuvalu	1.6 (1.5-1.7)	21.8 (20.1-23.7)	20.3 (18.8-22.2)	.8 (.8-.9)	1,650.4
Vanuatu	19.9 (14.4-26.6)	12.3 (8.9-16.4)	15.6 (10.8-22.5)	10.2 (7.4-13.7)	297.2
Viet Nam	3,994.1 (3,448.5-4,534.7)	6.0 (5.1-6.8)	6.1 (5.2-7.0)	2,055.9 (1,775.1-2,334.2)	418.1

Total Regional estimates

Countries with in-country sources on diabetes

Diabetes-related health expenditure (ID) per person with diabetes (20–79 years)	Diabetes-related deaths in adults 20–79 years	Prevalence of children and adolescents 0–19 years with type 1 diabetes	Number of people (20–79 years) with impaired glucose tolerance in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired glucose tolerance (20–79 years) (95% confidence interval)	Number of people (20–79 years) with impaired fasting glucose in 1000s (95% confidence interval)	Age-adjusted comparative prevalence (%) of impaired fasting glucose (20–79 years) (95% confidence interval)
–	–	19	2.7 (2.3-3.2)	7.4 (6.4-8.7)	2.2 (.8-2.5)	4.5 (2.2-7.0)
2,348.9	–	0	.8 (.7-1.0)	7.4 (6.4-8.7)	.6 (.2-.8)	4.5 (2.2-7.0)
266.7	10,717	34	322.2 (283.5-387.1)	7.4 (6.7-10.1)	980.9 (403.1-1021.3)	20.5 (11.2-21.7)
1,300.6	66,461	3,936	4,195.8 (3,829.0-4,576.0)	6.7 (6.1-7.4)	1,466.1 (942.9-1,904.6)	2.3 (1.5-3.0)
3,228.5	47,522	3,592	6,082.4 (5,627.8-6,799.0)	11.5 (10.7-14.2)	2,343.5 (1,047.6-2,942.2)	4.5 (2.2-7.0)
872.1	135	8	6.7 (6.0-9.0)	7.1 (6.5-10.1)	12.1 (8.0-15.8)	13.5 (8.9-16.4)
3,908.7	8,301	226	726.4 (666.9-784.8)	13.5 (12.3-14.8)	308.0 (122.3-348.7)	6.5 (2.2-7.2)
278.0	1,042	3	22.5 (19.9-28.2)	7.4 (6.7-10.1)	39.8 (32.5-49.2)	12.2 (10.0-15.7)
–	–	2,086	2,765.6 (2,561.2-3,107.0)	11.5 (10.7-14.2)	1,071.6 (479.5-1,358.1)	4.5 (2.2-7.0)
1,715.6	62,361	1,531	8,502.5 (8,239.8-8,773.9)	15.5 (15.0-16.0)	1,295.5 (900.3-1,622.5)	2.2 (1.6-2.9)
1,207.3	636	52	55.0 (41.3-82.9)	8.9 (7.2-12.2)	13.2 (9.3-18.0)	2.2 (1.6-2.9)
845.5	88	4	4.8 (3.6-5.2)	9.8 (6.8-10.7)	.8 (.7-8.4)	1.5 (1.2-15.4)
1,806.0	–	0	.6 (.5-.8)	7.4 (6.7-10.1)	1.0 (.7-1.2)	13.5 (8.9-16.4)
306.4	371	12	10.5 (9.4-13.2)	7.4 (6.7-10.1)	19.5 (12.7-24.9)	13.5 (8.9-16.4)
1,213.3	57,220	2,607	5,898.8 (4,668.5-8,590.0)	8.9 (7.2-12.2)	1,481.9 (1,039.3-1,889.3)	2.2 (1.6-2.9)

Abbreviations and acronyms

A

ADA American Diabetes Association

AHP analytical hierarchy process

AFR IDF Africa Region

ARDS acute respiratory distress syndrome

B

BCV Blue Circle Voices

BP blood pressure

C

CVD cardiovascular diseases

CI confidence intervals

D

DIP diabetes in pregnancy

DKA diabetic ketoacidosis

E

EUR IDF Europe Region

F

FBG fasting blood glucose

FIGO International Federation of Gynaecology and Obstetrics

G

GDM gestational diabetes mellitus

GDP gross domestic product

H

HAPO hyperglycaemia and adverse pregnancy outcomes

HbA1c haemoglobin A1c (or glycosylated haemoglobin)

HDL high-density lipoprotein

HIP hyperglycaemia in pregnancy

I

IADPSG International Association of Diabetes and Pregnancy Study Group

ID international dollar

IDF International Diabetes Federation

IFG impaired fasting glucose

IGT impaired glucose tolerance

IMR infant mortality rate

L

LDL-C low-density lipoprotein cholesterol

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

O

OGTT oral glucose tolerance test

S

SACA IDF South and Central America Region

STEPs WHO STEPwise approach to surveillance

T

T1D type 1 diabetes

T2D type 2 diabetes

U

UHC universal health coverage

UN United Nations

UNPD United Nations Population Division

USD United States dollar

W

WDD World Diabetes Day

WHO World Health Organization

WP IDF Western Pacific Region

Y

YLD Young Leaders in Diabetes

Glossary

A

Age-adjusted comparative prevalence
Also referred to as comparative prevalence, this is the prevalence calculated by adjusting to the age structure of a standard population. In this IDF Diabetes Atlas, the standard population is the UN population in 2021, 2030 or 2045. Adjusting rates is a way to make fairer comparisons between groups with different distributions.

Age-adjusted rates are rates that would have existed if the population under study had the same age distribution as the "standard" population.

Analytical hierarchy process (AHP) scoring
A methodological approach that quantifies the relative value of a variety of different aspects of study methods.

Attributable fraction method
The contribution of a risk factor to a disease is measured using the population attributable fraction (PAF). The PAF is the proportional reduction in population disease that would occur if exposure to a risk factor was removed from the population.

Autoimmune reaction
A reaction that is characterised by a specific humoral or cell-mediated immune response against the constituents of the body's own tissues.

B

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

Body mass index (BMI)
A measure of weight (or body mass), which is approximately independent of height. It is calculated by dividing weight in kilograms by the square of height in metres. The units are kilograms per square metre (kg/m2).

C

Cardiovascular diseases (CVD)
Diseases and injuries of the circulatory system: the heart, 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.

D

Diabetes complications
Acute and chronic conditions caused by diabetes.

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

Diabetes in pregnancy (DIP)
Diabetes occurring in pregnancy in women who have previously been diagnosed with diabetes or those who have hyperglycaemia first diagnosed during pregnancy, meeting the WHO criteria of diabetes in the non-pregnant state.

Diabetic ketoacidosis (DKA)
A complex metabolic disorder that occurs when the liver starts breaking down fat at an excessive rate. The by-product of this process, ketones, can cause the blood to become dangerously acidic.

Diabetes (mellitus)
A chronic condition marked by high concentrations of glucose (sugar) in the blood. It is caused by the body being unable to produce insulin (a hormone made by the pancreas to control blood glucose levels) or to use insulin effectively, or both. The three most common forms of diabetes are type 1, type 2 and gestational.

Diabetic neuropathy
A type of nerve damage that can occur if a person has diabetes; depending on the affected nerves, symptoms of diabetic neuropathy can range from pain and numbness in the legs and feet to problems with the digestive system, urinary tract, blood vessels, and heart.

Direct costs
The costs of providing, for a given condition or disease, health services (preventive and curative), family planning activities, nutrition activities and emergency aid designated for health. It does not include the provision of water and sanitation, but it does include health expenditures from both public and private sources.

DPP-4 inhibitors
A class of oral hypoglycaemic drugs that blocks the enzyme dipeptidyl peptidase 4 (DPP-4), used to treat type 2 diabetes.

E

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

Essential hormone
Hormones that are required for life including: insulin, parathyroid hormone, glucocorticosteroids (cortisol), mineral corticosteroids (aldosterone).

Estimates
Values that are usable for some purpose even if input data may be incomplete, uncertain, or unstable; the value is nonetheless usable because it is derived from the best information available.

Extrapolate
Extending values or conclusions from a known situation to an unknown situation, assuming that similar conditions, methods or trends are applicable.

F

Fasting plasma glucose (FPG)
FPG is a person's blood glucose concentration after fasting – not eating anything for at least eight hours. Normal FPG is less than or equal to 6.1 millimoles per litre (mmol/l) or less than or equal to 110 milligrams per decilitre (mg/dL). The disadvantages of using FPG for screening include: the possibility that the person has not fasted, its inability to detect diabetes diagnosed by a post-glucose load value alone and the fact that FPG alone cannot identify impaired glucose tolerance (see letter I). FPG alone fails to detect approximately 30% of undiagnosed diabetes. Using FPG to detect diabetes is a common but less sensitive diagnostic method.

G

Genes
The basic physical and functional units of heredity found in the nuclei of all cells.

Gestational diabetes mellitus (GDM)
Gestational diabetes is a condition where a woman develops high blood glucose, less than overt diabetes, that begins in, or is first recognised during pregnancy.

Glucagon
A hormone produced in the pancreas. If blood glucose levels decrease, it triggers the body to release stored glucose into the bloodstream.

Glucagon-like peptide 1
Also known as GLP-1, a naturally occurring peptide hormone, released from the gut after eating.

Glucose
Also called dextrose or blood sugar. The main sugar the body absorbs, uses as a form of energy and stores for future use. 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 action of insulin.

H

Haemoglobin A1c (HbA1c)
Also referred to as glycosylated haemoglobin, a haemoglobin to which glucose is bound. Glycosylated haemoglobin is measured to determine the average level of blood glucose over the past two to three months.

Heterogeneity
The quality or state of being diverse in character or content.

High-income country
A country defined by the World Bank to have a gross national income per capita of USD 12,696 or more (in 2020).

Hyperglycaemia
A raised concentration 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, weight loss and the need to urinate often.

Hyperglycaemia in pregnancy (HIP)
Hyperglycaemia in pregnancy (HIP) can be classified as either gestational diabetes mellitus (GDM) or diabetes in pregnancy (DIP).

Hypoglycaemia
A low concentration of glucose in the blood. This may occur when a person with diabetes has injected too much insulin, eaten too little food, or has exercised without extra food.

I

IDF Region
The International Diabetes Federation (IDF) is divided into seven regions: Africa, Europe, Middle East and North Africa, North America and the Caribbean, South and Central America, South-East Asia and Western Pacific. The IDF Regions aim to strengthen the work of national diabetes associations and enhance collaboration between them.

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). Sometimes termed impaired fasting glycaemia.

Impaired glucose tolerance (IGT)
Blood glucose that is higher than normal but below the diagnostic threshold for diabetes, after ingesting a standard amount of glucose during an oral glucose tolerance test. Fasting and two-hour glucose values are needed for its diagnosis.

Incidence
The number of new cases of a disease or condition among a group of people without the disease who are at risk of developing this condition during a specified time period.

Insulin
A hormone produced in the pancreas, as a response to glucose. Insulin triggers cells to take up glucose from the blood stream and convert it to energy.

Insulin resistance
The inability of cells to adequately respond to circulating insulin, resulting in increased levels of blood glucose.

Intermediate hyperglycaemia
The condition of raised blood glucose levels above the normal range and below the diabetes diagnostic threshold. Alternative terms are prediabetes, non-diabetic hyperglycaemia, IFG ;and IGT.

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, taken from studies of prices for the same basket of goods and services in different countries. Internationals Dollars are used to compare expenditures between different countries or regions.

L

Low-income country
A country defined by the World Bank with a gross national income per capita of USD 1,045 or less (in 2020).

Lower middle-income country
A country defined by the World Bank that has a gross national income per capita between USD 1,046 and USD 4,095 (in 2020).

M

Macrosomia
Birth weight more than 4.0 kg

Maturity-onset diabetes of the young (MODY)
A group of rare forms of diabetes caused by one of several single gene mutations, belonging to the monogenic types of diabetes.

Metformin
An oral therapy for type 2 diabetes, and one of a group of drugs known as biguanides. These lower blood glucose levels in people with type 2 diabetes by increasing the sensitivity of muscle cells to insulin, and by reducing the amount of glucose produced by the liver.

Microvascular complications
Complications of diabetes that include diabetic nephropathy, neuropathy and retinopathy, which are caused by pathological changes in the microvasculature.

Monogenic diabetes
Less common types of diabetes, resulting from single genetic mutations. Examples include MODY and Neonatal Diabetes Mellitus.

N

Neonatal diabetes mellitus
A rare form of diabetes that is diagnosed in children under six months of age. Caused by a mutation in a single gene. It is a type of monogenic diabetes.

O

Obesity
A condition in which a person carries excess weight or body fat that might affect their health (Defined by, for example, a BMI ≥30 Kg/m² in non-Asians).

Oral glucose tolerance test (OGTT)
A medical test in which glucose is given orally after an overnight fast and blood samples taken after a certain time to determine how quickly it is cleared from the blood.

Oral medication
A medication administered by mouth.

Overweight
A condition of having more body fat than is optimally healthy, though not in the obese range (Defined by a BMI of 25.0 Kg/m² to 29.9 Kg/m² in non-Asians).

P

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

Peripheral vascular disease (PVD) or peripheral artery disease (PAD)
A progressive disorder that causes narrowing or blocking of the blood vessels outside the heart, including arteries, veins, or lymphatic vessels.

Prediabetes
Elevated blood glucose above the normal range but below the diabetes diagnostic threshold. Alternative terms are IFG, IGT, non-diabetic hyperglycaemia, and intermediate hyperglycaemia.

Polydipsia
Excessive thirst.

Polyuria
Frequent urination.

Prevalence
The proportion of individuals in a population that has a disease or condition at a particular time (a point in time or over a period of time). For example, the proportion of adults aged 20–79 with diabetes in 2017.
For prevalence, the numerator is the number of people with the condition or disease and the denominator is the total population. It can be expressed as a proportion or a percentage.

Primary prevention
Disease prevention before a disease or condition occurs. Usually refers to the prevention of exposures to hazards that cause disease or injury and altering unhealthy or unsafe behaviours.

Projections
Estimates of a future situation based on a study of past and present trends.

R

Ratio
The diabetes cost ratio, which is the ratio of health expenditures for people with diabetes compared to health expenditures for age and sex matched persons who do not have diabetes. The R=2 estimates assume that healthcare expenditures for people with diabetes are on average two-fold higher than people without diabetes, and the R=3 estimate assumes that healthcare expenditures for people with diabetes are on average three-fold higher than people without diabetes.

Raw diabetes prevalence
Also called country, national or regional prevalence, the percentage of each country or region's population that has diabetes. It is useful for assessing the impact of diabetes for each country or region.

Relative risk
The ratio of the probability of an outcome in an exposed group to the probability of an outcome in an unexposed group.

S

Screening approach
A method used to make a diagnosis of a given disease or condition before it has caused symptoms.

Secondary diabetes
Less common forms of diabetes, which arise as a consequence of other diseases or conditions (e.g. diseases of the pancreas such as cystic fibrosis).

Self-management
Management of or by oneself; the taking of responsibility for one's own behaviour and well-being.

Sulphonylureas
Oral medications used for the treatment of type 2 diabetes. They work mainly by stimulating the cells in the pancreas to release more insulin.

T

Type 1 diabetes
Type 1 diabetes is thought to be an autoimmune disease that usually occurs in childhood or early adulthood, resulting in the inability to produce enough insulin due to the destruction of insulin producing islet cells in the pancreas. The condition can affect people of any age, but onset usually occurs in children or young people.

Type 2 diabetes
Type 2 diabetes is the most common form of diabetes and is characterised by high blood glucose, called hyperglycaemia. In people with type 2 diabetes, the body does not use the hormone insulin properly or cannot produce enough insulin, or both which in turn leads to hyperglycaemia. It is potentially preventable and is often associated with lifestyle factors such as insufficient physical activity, unhealthy diet, obesity and tobacco smoking. Risk is also associated with genetic and family-related factors. Type 2 diabetes is much more common than type 1 and occurs mainly in adults, although it is now also increasingly diagnosed in children and young people.

U

Universal health coverage (UHC)
Universal healthcare coverage, also referred to as universal coverage or universal care, is a healthcare system that provides free healthcare at the point of delivery to all residents of a particular country or region.

Upper middle-income country
A country defined by the World Bank that has a gross national income per capita between USD 4,096 and USD 12,695 (in 2020).

Figures, maps and tables

Figures

Maps

Tables

IDF Diabetes Atlas | 10TH edition

atlas@idf.org | diabetesatlas.org

International Diabetes Federation