



### Key messages

- ▶ The number of people diagnosed with diabetes mellitus has risen.
- ▶ 9% of women and 8% of men have ever been diagnosed with diabetes – corresponding to a total of 6 million adults in Germany.
- ▶ In Germany there is not only an east-west decline, but also a north-south decline in the prevalence of diagnosed diabetes.
- ▶ Some diabetes complications are declining, e.g. blindness, amputations and severe pregnancy complications.
- ▶ Efforts to improve diabetes care have been intensified.

## Diabetes mellitus in Germany

Diabetes mellitus – a metabolic disorder that is now common all over the world – is characterized by elevated blood sugar concentrations. There are different types of diabetes, which are caused by insulin deficiency or impaired insulin action. Insufficient control of the blood sugar level can cause serious damage to the blood vessels and peripheral nerves.

The socio-economic importance of diabetes arises from the resultant severe long-term complications, the partial disability, the reduction in quality of life and life expectancy, and the need for medical treatment. The main complications of diabetes – which the St Vincent Declaration has targeted to reduce – are coronary heart disease, blindness, kidney failure and amputations of the lower limbs (WHO, IDF 1990).

The following overview focuses on diabetes mellitus in adults, which in 80% to 90% of cases occurs as type 2 diabetes. This type of diabetes usually develops among older adults, but is increasingly being observed in younger age groups. It is based on an interaction between genetic predisposition and environmental factors (particularly lack of exercise, unfavourable dietary habits and overweight). In cases of type 2 diabetes the effect of insulin is impaired and may be combined with an insufficient insulin secretion.

Type 1 diabetes, which is characterized by an autoimmune destruction of the insulin-producing cells, occurs predominantly in childhood and adolescence. It can also be found in adults as what is known as »latent autoimmune diabetes in adults« (LADA). Other types of diabetes include gestational diabetes – which occurs for the first time in pregnancy and usually regresses after birth – and specific, very rare types caused by genetic defects or specific diseases (Kerner, Brückel 2010).

The information provided below on the prevalence of diabetes in the German adult population is based on data from the »German Health Update« (GEDA), a telephone health survey conducted by the Robert Koch Institute (RKI) in 2009 (Kurth et al. 2009). The prevalence of diabetes complications is presented by including results from the RKI's 2003 telephone health survey »GSTelo3«. The article also tracks the trend in prevalence of diabetes and its complications since the 1990s. Finally, aspects of diabetes care are examined using data from various other sources.

### A total of 9 percent of the adult population suffer from diabetes

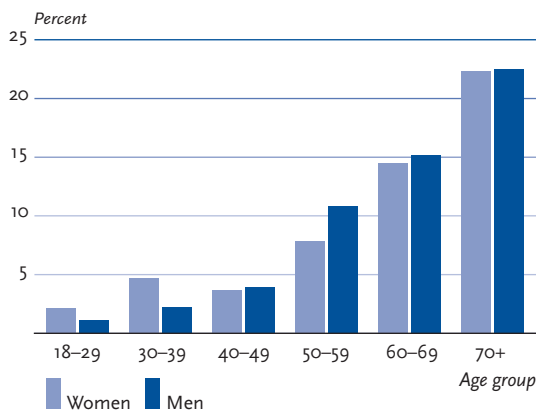
In the 2009 GEDA study, the German population aged 18 years and older living in private households was asked whether a physician had ever diagnosed a diabetes (lifetime prevalence). A total of 8.8% of adults – 9.3% of the women and 8.2% of the men – stated a diagnosis of diabetes. Extrapolating these results to

the adult population in Germany (per 31 December 2007) suggests that 5.98 million adults have ever been diagnosed with diabetes.

### High prevalence among adults aged over 50 years

In both sexes, the prevalence of diabetes is less than 5% among people aged up to 40-49 years, but strongly increases in the older age groups: diabetes was reported from one in eleven among the 50- to 59-year-olds, one in seven among the 60- to 69-year-olds, and as many as one in five people among the over-70s (Figure 1).

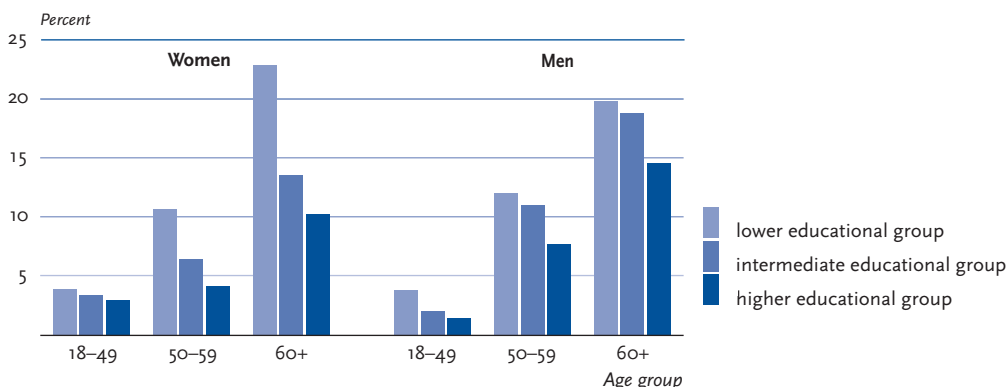
**Figure 1**  
Gender-specific prevalence of diagnosed diabetes, by age group  
Data basis: GEDA 2009



### Diabetes prevalence rises with decreasing educational status

Ascertainment of school education and vocational training in the 2009 GEDA study facilitate to examine the prevalence of diabetes in relation to a person's educational status (CASMIN Index, Braun et al. 2003). The results show a rising prevalence of diabetes as educational status decreases. This association is most evident among women above the age of 50 years (Figure 2).

**Figure 2**  
Gender-specific prevalence of diagnosed diabetes, by educational status and age group  
Data basis: GEDA 2009



### German Health Update (GEDA)

<i>Data holder:</i>	Robert Koch Institute
<i>Objectives:</i>	To provide up-to-date data on health-related issues, to analyse temporal developments and trends
<i>Survey method:</i>	Computer-assisted telephone interviews (CATI)
<i>Population:</i>	Residential population of Germany aged 18 and over
<i>Sample:</i>	21,262 women und men
<i>Cooperation rate:</i>	51.2%
<i>Survey period:</i>	July 2008 to June 2009

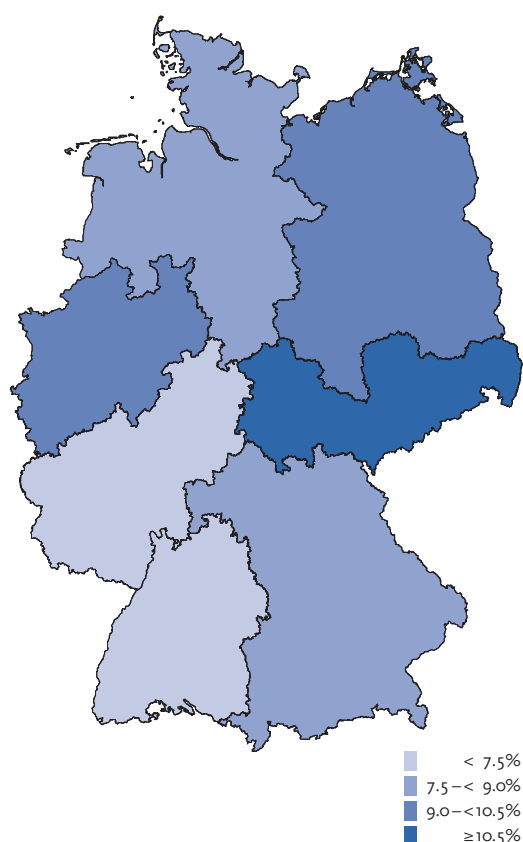
### Regional differences in the prevalence of diabetes

In the 2009 GEDA study, 11.5% of the women and 9.5% of the men in eastern Germany (including Berlin) reported that they had ever been diagnosed with diabetes, reflecting that they were more frequently affected by diabetes than women and men in western Germany (excluding Berlin), where the figures were 8.7% and 7.9%, respectively. An analysis at the regional level also points to north-south differences in the prevalence of diabetes among the adult population (Figure 3).

### Increase in diabetes prevalence

By including previous RKI health surveys it was feasible to trace the temporal development of the prevalence of diagnosed diabetes since 1990/92 among the population aged 25-69 years. Up until a few years ago (1990/92 to 2003/05), there was no statistically significant trend, at least not for this age group (Heidemann et al. 2009). When the latest data from the 2009 GEDA are included, however, a significant increase in diabetes prevalence among the 25- to 69-year-olds can be shown for the first time at the population level (RKI 2009a). The increase is even stronger when adults from the age of 18 years with no upper age limit are examined (Table 1). However, because of the different age

**Figure 3**  
Prevalence of diagnosed diabetes, by region (Nielsen areas)  
Data basis: GEDA 2009



limits on recruiting participants in earlier health surveys, only two observation periods can be examined in this comparison: the GSTelo3 survey conducted in 2002/03 and the 2009 GEDA study.

The observed increase in diabetes prevalence is partially (about one-fifth) due to the 'ageing' of the population. However, even over and above demographic ageing there was a statistically significant increase in diabetes prevalence between 2003 and 2009.

### Heart disease is most common long-term complication

In the »GSTelo3« telephone health survey, participants with physician-diagnosed diabetes were asked whether they

**Table 1**  
Prevalence of diagnosed diabetes among the adult population aged 18 years and older (percent, 95% confidence interval)  
Data basis: GSTelo3 und GEDA 2009 (RKI 2010)

Sex	2003* % (95 %-KI)	2009* % (95 %-KI)
Women	6.8 (5.9–7.8)	9.3 (8.5–10.2)
Men	5.4 (4.6–6.2)	8.2 (7.5–9.0)

\* weighted according to the respective representative population

had ever had typical diabetes complications. Over 10 % of the participants with diabetes stated (acute) severe hypoglycaemia. The most commonly reported long-term complications were heart complications, followed by diabetic eye disease, diabetic neuropathy, diabetic foot syndrome, diabetic kidney disease and amputations (Table 2). In total, about half of the people with diabetes stated that they had not experienced any of these complications to date (Burger, Tiemann 2005).

### Partial success in achieving the St Vincent objectives

Analyses of regional disease data and health insurance data indicate that there has been at least a partial reduction in the occurrence of some serious diabetes complications over time, as envisaged by the 1989 St Vincent Declaration.

Although people with diabetes still suffer blindness, amputations, kidney failure, heart disease and pregnancy complications much more frequently than non-diabetics, the incidence rates of blindness (Genz et al. 2010) and amputations (Icks et al. 2009a) and the frequency of severe pregnancy complications (Beyerlein et al. 2010) have declined since the 1990s – to a greater extent among diabetics than non-diabetics. This observation was not made regarding renal failure (Icks et al. 2011) or heart disease (Icks et al. 2009b).

**Table 2**  
Prevalence of complications among adults aged 18 years and older who have been diagnosed with diabetes, as a percentage  
Data basis: GSTelo3 (Burger, Tiemann 2005)

Diabetes complications*	Women	Men
Severe hypoglycaemia	14.7 %	11.6 %
Heart complications	26.0 %	20.6 %
Diabetic eye disease	15.5 %	13.9 %
Diabetic neuropathy	11.8 %	9.2 %
Diabetic foot syndrome	6.5 %	7.4 %
Diabetic kidney disease	4.6 %	2.3 %
Amputation	1.4 %	2.6 %

\* as formulated in the GSTelo3 interview

### Growing efforts to improve the quality of diabetes care

To date there are no nationwide data available assessing the extent to which the St Vincent Declaration targets have been met in diabetes care. The results of various studies described above, however, indicate that some progress has been made. This is probably due in part to the considerable efforts made in recent years to structure diabetes care and to integrate diabetes care into a comprehensive system of quality management. The disease-manage-

ment programmes (DMPs) for type 2 and type 1 diabetes introduced in 2003 and 2004 are essential components in this context. By February 2011 a total of 3.43 million people were enrolled in a DMP for type 2 diabetes and 138,000 people in a DMP for type 1 diabetes. In addition, the National Disease Management Guidelines Programme for type 2 diabetes (DM-CPG Programme) was revised into the form of modules aimed at diagnosing and treating specific diabetes complications and encouraging patients to become actively involved in their diabetes care (<http://www.diabetes.versorgungsleitlinien.de>).

Further, indicators are currently being developed in Germany to describe the quality of care in line with central recommendations of the DM-CPG Programme to facilitate to put the guidelines into practice and to evaluate their effect on the quality of diabetes care (Nothacker et al. 2011). However, this does not mean that the development of the quality indicators for diabetes care is complete (<http://www.aqua-institut.de>).

### Improvement in the implementation of services for diabetes care possible

The GSTelo3 data are the most recent available nationwide survey data providing information on the extent to which treatment and care services are actually received by people with diabetes. All participants who had reported a diagnosis of diabetes were asked about the type of treatment they were currently receiving. Altogether, only one in seven (14 %) stated a treatment based on changes in diet and/or physical activity only (Burger, Tiemann, 2005) – although lifestyle modifications should be a main focus in the treatment of persons with type 2 diabetes (which represent the largest portion among all persons with diabetes). For almost half of the participants with diabetes the treatment was based on a combination of lifestyle modification and drug treatment, either using tablets (26 %) or insulin (14 %) or both tablets and insulin (5 %). 14 % of the participants with diabetes were treated exclusively with medication. According to self-reports, about one in ten (11 %) were not treated at all.

In the GSTelo3 survey, participants diagnosed with diabetes were also asked about the frequency of important health-care measures. On average, more than half reported that their HbA<sub>1c</sub> was measured less frequently than once a quarter; about 10 % stated that it had not been measured at all in the last 12 months. About 70 % of the participants with diabetes reported that their eyeground had been measured during the last 12 months, but only just under half reported a medical foot examination. Only about one in four (28 %) received all three services.

### Diabetes is one of the most frequent primary diagnoses in hospitals

According to hospital statistics, the total number of diabetes cases treated as inpatients remained relatively constant at

about 210,000 per annum between 2000 and 2009. It is believed, however, that these data underestimate the importance of diabetes as the underlying disease for hospitalization. Often not the diabetes, but one of its complications is entered in official statistics as the responsible primary diagnosis. Furthermore, when assessing time series, it must also be kept in mind that changes made for technical, invoicing reasons can have an effect on the number of cases via the Diagnosis Related Group (DRG) system.

### Diabetes is one of Germany's most expensive chronic diseases

The Federal Statistical Office estimates that the direct costs of caring for diabetes patients in Germany (outpatient and inpatient treatment, nursing, rehabilitation services and drugs) totalled €6.34 billion in 2008. This corresponds to a 2.5 % of health expenditure for all diseases (Federal Statistical Office 2011b). Over time, the direct costs of diabetes gradually increased. For example, diabetes-related costs in 2008 were 28 % higher than in 2002 – while the costs of all diseases had increased by only 16 %. Expenditures on the treatment of diabetic complications and secondary diseases were not included in these estimates.

When these expenditures are also taken into account, the direct costs – in accordance with the Costs of Diabetes Mellitus (CoDiM) study – are probably about three times higher (for 2007: €19.1 billion) (Köster et al. 2011). Further, when the indirect costs resulting from diabetes (loss of resources through disability or early retirement) are also included, total costs could be as much as four times higher (Hauner 2006).

### Conclusion and outlook

The presented data show that the prevalence of diagnosed diabetes in the adult population of Germany increased between 2003 and 2009. This increase can be partly explained by the »ageing« of the population. The role played by additional factors (such as an increasing prevalence of diabetes risk factors, improved measures for early diagnosis and improved treatment) needs to be investigated.

Moreover, there are signs of improvement in diabetes care in terms of both care processes and care outcomes. At the same time, however, there are indications that diabetic patients with a high risk of complications are not being reached via the structured DMP care service (Schafer et al. 2010).

When interpreting the diabetes prevalence estimates given above, it should be noted that the available data do not allow an estimation that includes the prevalence of undiagnosed diabetes. Yet this would be necessary to assess the overall disease burden associated with diabetes mellitus. An increase in the prevalence of diagnosed diabetes in Germany could largely be the result of improved health education and earlier diagnosis. The prevalence

of undiagnosed diabetes would correspondingly tend to remain constant or even decline – a trend that has been observed in the USA and the UK, for example (Gregg et al. 2004, Pierce et al. 2009).

To date, estimates on the prevalence of undiagnosed diabetes in Germany have only been available from regional studies in the Augsburg area. On the basis of a standardized glucose tolerance test, a prevalence of undiagnosed diabetes was observed in subsamples of the KORA cohort that was just as high as the prevalence of diagnosed diabetes (Rathmann et al. 2003, Meisinger et al. 2010). The Robert Koch Institute's ongoing »Adult Health in Germany« (DEGS) study, which includes at least measurements of fasting glucose in a subsample of the study participants, will be able to contribute nationwide data for the first time (RKI 2009b).

In the context of continuous health monitoring, the RKI's recurring, population-representative cross-sectional surveys will also be able to contribute important data on diabetes prevalence and the utilization of diabetes-specific care services in the future. In addition, regularly available data on the incidence of type 2 diabetes, and its organ complications and on regional care processes and structures will be needed for a comprehensive surveillance of the disease and the quality of care in Germany. This would facilitate to identify special needs at the regional level in a much more differentiated way and meet them by allocating resources accordingly.

As long as the corresponding data are only partially available, it will be necessary to resort to other data sources. For example the Organization for Economic Cooperation and Development (OECD) has proposed estimating the quality of care of chronic diseases with a high care potential via the rate of avoidable hospital admissions, which are defined in the case of diabetes as hospital admissions due to acute diabetes-specific complications (Drösler, Scheidt-Nave, 2010).

A consortium of regional (SHIP, KORA S4/F4, MONICA, CARLA, DGS, HNR) and nationwide population-representative health studies (BGS98, DEGS) has been achieved within the Competence Network Diabetes Mellitus (<http://www.kompetenznetz-diabetes-mellitus.net>). Baseline data of this consortium allow to investigate regional differences in the prevalence of diagnosed diabetes mellitus and the influence of socio-demographic differences.

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## Bibliography

- Beyerlein A, von Kries R, Hummel M et al. (2010) Improvement in pregnancy-related outcomes in the offspring of diabetic mothers in Bavaria, Germany, during 1987–2007. *Diabet Med* 27 (12): 1379–1384
- Brauns H, Scherer S, Steinmann S (2003) The CASMIN Educational Classification in International Comparative Research. In: Hoffmeyer-Zlotnik JHP, Wolf C (Hrsg) *Advances in Cross-National Comparison*, Kluwer New York, S 221–244
- Burger M, Tiemann F (2005) Diabetes mellitus in Deutschland. Eine Bestandsaufnahme nach Daten des telefonischen Gesundheits surveys 2003. *Bundesgesundheitsbl – Gesundheitsforsch – Gesundheitsschutz* 48(11): 1242–1249
- Drösler S, Scheidt-Nave C (2010) Indikatoren zur Messung von Qualität in der Gesundheitsversorgung: das Beispiel OECD. In: Gesellschaft für Versicherungswissenschaft und -gestaltung e.V. (Hrsg) *EU-Gesundheitspolitik im nicht-harmonisierten Bereich. Aktuelle Entwicklungen der Offenen Methode der Koordinierung*. Nanos Verlag, Bonn, S 235–267
- Genz J, Scheer M, Trautner C et al. (2010) Reduced incidence of blindness in relation to diabetes mellitus in southern Germany? *Diabet Med* 27 (10): 1138–1143
- Gregg EW, Cadwell BL, Cheng YJ et al. (2004) Trends in the prevalence and ratio of diagnosed to undiagnosed diabetes according to obesity levels in the U.S. *Diabetes Care* 27(12): 2806–2812
- Hauner H (2006) Die Kosten des Diabetes mellitus und seiner Komplikationen in Deutschland. *Dtsch Med Wochenschr* 131 Suppl 8: S240–242
- Heidemann C, Kroll L, Icks A et al. (2009) Prevalence of known diabetes in German adults aged 25–69 years: results from national health surveys over 15 years. *Diabet Med* 26(6): 655–658
- Icks A, Haastert B, Trautner C et al. (2009a) Incidence of lower-limb amputations in the diabetic compared to the non-diabetic population. Findings from nationwide insurance data, Germany, 2005–2007. *Exp Clin Endocrinol Diabetes* 17 (9): 500–504
- Icks A, Dickhaus T, Hormann A et al. (2009b) Differences in trends in estimated incidence of myocardial infarction in non-diabetic and diabetic people: Monitoring Trends and Determinants on Cardiovascular Diseases (MONICA)/Cooperative Health Research in the Region of Augsburg (KORA) registry. *Diabetologia* 52 (9): 1836–1841
- Icks A, Haastert B, Genz J et al. (2011) Incidence of renal replacement therapy (RRT) in the diabetic compared with the non-diabetic population in a German region, 2002–08. *Nephrol Dial Transplant* 26 (1): 264–269
- Kerner W, Brückel J (2010) Definition, Klassifikation und Diagnostik des Diabetes mellitus. *Diabetologie* 5(Suppl 2):S109–S112
- Köster I, Huppertz E, Hauner H et al. (2011) Direct Costs of Diabetes Mellitus in Germany – CoDiM 2000–2007. *Exp Clin Endocrinol Diabetes* Epub 24.01.2011
- Kurth BM, Lange C, Kamtsiuris P et al. (2009) Gesundheitsmonitoring am Robert Koch-Institut. Sachstand und Perspektiven. *Bundesgesundheitsbl – Gesundheitsforsch – Gesundheitsschutz* 52(5): 557–570
- Meisinger C, Strassburger K, Heier M et al. (2010) Prevalence of undiagnosed diabetes and impaired glucose regulation in 35–59-year-old individuals in Southern Germany: the KORA F4 Study. *Diabet Med* 27(3): 360–362



- Nothacker MJ, Langer T, Weinbrenner S (2011) Qualitätsindikatoren zu Nationalen VersorgungsLeitlinien (NVL) am Beispiel der NVL Herzinsuffizienz. *Z Evid Fortbild Qual Gesundh wesen (ZEFQ)* 105: 27–37
- Pierce MB, Zaninotto P, Steel N et al. (2009) Undiagnosed diabetes-data from the English longitudinal study of ageing. *Diabet Med* 26(7): 679–685
- Rathmann W, Haastert B, Icks A et al. (2003) High prevalence of undiagnosed diabetes mellitus in Southern Germany: target populations for efficient screening. The KORA survey 2000. *Diabetologia* 46(2): 182–189
- Robert Koch-Institut (2009a) Diabetes mellitus. In: Robert Koch-Institut (Hrsg) 20 Jahre nach dem Fall der Mauer: Wie hat sich die Gesundheit in Deutschland entwickelt? Beiträge zur Gesundheitsberichterstattung des Bundes. RKI, Berlin, S 71–75  
<http://www.rki.de/gbe> (last revised: 18.04.2011)
- Robert Koch-Institut (2009b) DEGS – Studie zur Gesundheit Erwachsener in Deutschland. Beiträge zur Gesundheitsberichterstattung des Bundes. RKI, Berlin
- Robert Koch-Institut (2010) Daten und Fakten: Ergebnisse der Studie »Gesundheit in Deutschland aktuell 2009«. Beiträge zur Gesundheitsberichterstattung des Bundes. RKI, Berlin
- Schäfer I, Küver C, Gedrose B et al. (2010) Selection effects may account for better outcomes of the German Disease Management Program for type 2 diabetes. *BMC Health Serv Res* 10: 351
- Statistisches Bundesamt (2011a) Krankenhausstatistik für Deutschland 2009  
<http://www.gbe-bund.de> (last revised: 26.04.2011)
- Statistisches Bundesamt (2011b) Krankheitskosten für Deutschland 2008  
<http://www.gbe-bund.de> (last revised: 26.04.2011)
- WHO, IDF (1990) Diabetes care and research in Europe: the Saint Vincent declaration. *Diabet Med* 7(4): 360

GBE kompakt

**Published by**

Robert Koch Institute  
Nordufer 20  
13353 Berlin

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**How to quote the title**

Heidemann C, Du Y, Scheidt-Nave C (2011)  
Diabetes mellitus in Germany.  
Published by Robert Koch Institute Berlin  
GBE kompakt 2(3)  
[www.rki.de/gbe-kompakt](http://www.rki.de/gbe-kompakt) (last revised: 06.05.2011)

ISSN 2191-4974

The Robert Koch Institute is a federal institute  
within the portfolio of the Federal Ministry of Health