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### Journal of Health Monitoring

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Time trends in incidence and mortality of respiratory diseases of high public health relevance in Germany

Abstract
Respiratory diseases are major causes of disease burden and mortality throughout the world. In Germany, alongside acute respiratory infections (ARI), chronic lung diseases – including lung cancer, chronic obstructive pulmonary disease (COPD), and asthma – are of particular socioeconomic importance. ARI incidence rates differ significantly according to age, season and year. They are recorded as weekly consultation rates as reported by selected outpatient and inpatient care facilities. Between 2009 and 2016, the highest incidence rates of severe acute respiratory infection (SARI) were recorded among young children in outpatient (9.4%) and inpatient (0.2%) care. Mortality rates for ARI are also subject to seasonal and annual fluctuations. However, the official statistics on causes of death, which lead to estimates of more than 17,000 annual deaths, provide an inadequate measure of death rates because chronic underlying illnesses are often recorded as the cause of death rather than a more recently acquired acute infection. Therefore, the excess mortality caused by ARI needs to be assessed in the context of influenza outbreaks. Regarding lung cancer, COPD and asthma, the long-term time trends in disease incidence and mortality rates are of particular interest from a health policy perspective. Analyses of data from the official statistics on causes of death for the years 1998 through 2015 show that mortality rates for lung cancer and COPD decreased on average by 1.8% and 1.1% per year respectively, among men, whereas among women they increased by 2.5% (lung cancer) and 2.3% (COPD) annually. Nevertheless, more men than women died of lung cancer or COPD in 2015 in Germany: 29,378 men and 15,881 women died from lung cancer, and 17,300 men and 13,773 women died from COPD. During the same period, the asthma mortality rates decreased on average by 8.3% annually among women and by 11.2% annually among men, and the absolute number of deaths came down to 659 among women and 393 among men. Lung cancer incidence rates have been at similar levels as lung cancer death rates since 1998. No such data are available on time trends in COPD or asthma incidence rates. Coordinated surveillance of respiratory diseases needs to be expanded within the framework of international action plans for disease prevention.
1. Introduction

In Germany and throughout the world, diseases of the airways and lung are of significant socioeconomic importance [1-7]. Within the current framework of the international system of disease classification (10th revision of the International Statistical Classification of Diseases and Related Health Problems, ICD-10), this group of diseases not only covers a wide range of acute and chronic disorders of the respiratory system (J00-J99), but also malignant neoplasms (cancer) of the trachea, bronchus and lung (C33-C34) [2]. Recent data from Germany (2015) show that 12.3% of all deaths are caused by respiratory diseases (ICD-10: J00-J99 including C33-C34) [8]. The direct costs incurred from the treatment of respiratory disorders alone (including C33-C34) amount to EUR 14.7 billion (2008) [2]. Respiratory system disorders – alongside musculoskeletal disorders and connective tissue diseases – were the most common reason that patients sought treatment in a doctor’s practice in 2016 [9]. They are also among the most important factors that cause people to take time off work [2, 10]. In Germany, alongside acute diseases of the respiratory tract (J00-J22), lung cancer (C33-C34), chronic obstructive pulmonary disease (COPD, J44), and asthma (J45-J46), in particular, are associated with a high burden of disease and mortality [1-7, 11, 12]. They are, therefore, of particular relevance to public health and are also the central focus of the World Health Organization’s (WHO) surveillance and prevention strategies [1, 11-13].

Lung cancer (C33-C34) and COPD (J44) among both genders, and pneumonia (pneumonia, organism unspecified (J18)) among men, count among the ten most frequent causes of death in Germany [8]. The importance of these diseases is also reflected by the impact on the health care system. Every year, seasonal influenza is a major cause of extra visits in ambulatory care [14]. Depending on the season, influenza can cause up to 30,000 hospitalisations due to complications of primary influenza and secondary bacterial infection [14]. The number of pulmonary infections that occur outside of hospital (community-acquired pneumonia) is estimated at between 400,000 and 600,000. Approximately 30% to 50% of these cases lead to hospitalisation [15, 16]; community-acquired pneumonia should be treated in accordance with the S3 guideline [17]. Nevertheless, pneumonia is often the result of hospital-acquired (nosocomial) infections. According to a study of the burden of disease associated with nosocomial infections in Europe, the incidence of nosocomial pneumonia (healthcare-associated pneumonia – HAP) is 138 per 100,000 population [18]. Calculated in DALYs (disability-adjusted life years), which is an internationally established standard for measuring the burden of disease caused by an illness or pathogen, HAP (with a rate of 169 per 100,000 individuals) is the most important disease in terms of severity and case fatality among the six frequently occurring nosocomial infections examined in this study. However, only data from hospitals were taken into account in this case – data from nursing homes were not included [18]. In addition, COPD and asthma are not only common causes of outpatient care visits [19]. As chronic conditions that can be treated in an ambulatory care setting, both diseases are among the major causes of...
potentially avoidable hospital admissions with more than 270,000 hospitalisations in 2015 [20-23]. Around 190,000 cases of lung cancer were treated in hospitals in 2015, which provides an illustration of the considerable level of medical care associated with this disease [23, 24].

Continuous and timely disease monitoring including incidence and mortality rates is indispensable in infection control and also forms the basis of the WHO’s Global Action Plan for the Prevention and Control of NCDs 2013-2020 [12, 13]. At the Robert Koch Institute (RKI), assessments of the rates of new cases and deaths (incidence and mortality, see Info box 1, 2, 3 and 4) associated with acute respiratory infections (ARI) and cancer, including lung cancer, are carried out continuously as part of the ongoing surveillance of infectious diseases and the pooled analyses of federal state-level epidemiological cancer registry data held by the German Centre for Cancer Registry Data (ZfKD). In addition, data on the epidemiology of respiratory diseases are available from the population-based, representative health surveys carried out at regular intervals by the RKI and from the official statistics on causes of death published by the Federal Statistical Office (Info box 3). All these data are integrated into the German Federal Health Monitoring information system [25]. Additional information on the prevalence (Info box 1) of lung cancer is published at regular intervals by the ZfKD [24]. Two Fact sheets published in this issue use data from the German Health Update (GEDA 2014/2015-EHIS) nationally health interview survey to provide current assessments of the prevalence of known COPD and asthma among adults. The current analyses are based on data available at the national level to describe time trends in the incidence and mortality due to acute respiratory infections and chronic lung diseases of high relevance to public health.

2. Methods

The current investigation relies on data sources available at the national level to analyse time trends in incidence (Info boxes 1 and 2) and mortality rates (Info boxes 3 and 4) of acute respiratory infections (ARI), lung cancer, COPD and asthma. It includes data on ARI from primary care practices and hospitals (syndromic surveillance), [26, 27] from the RKI’s Centre for Cancer Registry Data (ZfKD) [28, 29], and from the official statistics on causes of death [8] (Info boxes 3, 5, 6 and 7). In addition, the incidence rate of asthma among adults during the observation period between 1997-1999 and 2008-2011 was estimated based on data from the nationwide interview and examination surveys regularly conducted by the RKI as part of the German Federal Health Monitoring system [30-33] (Info box 8).

2.1 Acute respiratory infection (ARI)

Case definition

In primary care practices, an acute respiratory infection (ARI) was counted if a doctor diagnosed a disease by entering at least one of the following ICD-10 codes into the medical information system: J00-J22 (J00-J06: acute upper respiratory infections; J09-J18: influenza and pneumonia; J20-J22: other acute lower respiratory infections) or an individual diagnosis of J44.0 (chronic obstructive
pulmonary disease with acute lower respiratory infection) or B34.9 (viral infection, unspecified). In order to assess the burden of severe acute respiratory infections (SARI) in inpatient care, cases with a discharge diagnosis of influenza, pneumonia or other acute lower respiratory infection (ICD-10 J09-J22, Table 1) were selected.

### Incidence of acute respiratory infection (ARI)

A syndrome is a typical combination of several symptoms or diagnoses (or, in this case, the ICD-10 codes used to describe them) associated with a particular disease. The RKI conducts syndromic surveillance of acute respiratory infection (ARI) in both outpatient (general practitioners and paediatricians) and inpatient (hospital) care. It is particularly used to monitor the conditions resulting from influenza, as influenza viruses can cause acute respiratory diseases, and unlike many viruses causing the common cold, can account for serious illnesses and death. The RKI’s Working Group Influenza (Arbeitsgemeinschaft Influenza, AGI) has provided data on outpatient care for many years (see Info box 5). Moreover, an ICD-10-code based, electronic reporting system was included in the syndromic routine surveillance since 2012/2013. This includes keeping electronic records of diagnostic codes [26]. The weekly ARI consultation rate (see Info box 2) is an important indicator for ARI activity. Due to its strong association with age, the consultation rate is estimated in five age groups separately [27]. For severe acute respiratory infections (SARI), the RKI has also developed a continuous syndromic sentinel

<table>
<thead>
<tr>
<th>ICD-10 codes</th>
<th>Gender</th>
<th>Number of deaths</th>
<th>Deaths per 100 thousand population (crude rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J00-J99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>31,700</td>
<td>76.4</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>36,600</td>
<td>91.1</td>
</tr>
<tr>
<td>J09-J22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>10,743</td>
<td>25.9</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>10,816</td>
<td>26.9</td>
</tr>
<tr>
<td>J40-J44, J47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>15,166</td>
<td>36.5</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>18,877</td>
<td>47.0</td>
</tr>
<tr>
<td>J44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>13,773</td>
<td>33.2</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>17,300</td>
<td>43.1</td>
</tr>
<tr>
<td>J45-J46</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>659</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>393</td>
<td>1.0</td>
</tr>
<tr>
<td>C33-C34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>15,881</td>
<td>38.3</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>29,378</td>
<td>73.1</td>
</tr>
<tr>
<td>C34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>15,870</td>
<td>38.2</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>29,354</td>
<td>73.1</td>
</tr>
</tbody>
</table>

1 Severe acute respiratory infections (SARI): influenza, pneumonia and other acute infections of the lower respiratory tract.

ICD-10=10th revision of the International Statistical Classification of Diseases and Related Health Problems
surveillance system in hospitals (the ICOSARI project) within a scientific cooperation with the HELIOS Kliniken GmbH (see Info box 6). An important indicator in this regard is the weekly SARI hospitalisation rate (see Info box 2). Just as the ARI consultation rate, these estimates are also reported stratified by five age groups (0-4, 5-14, 15-34, 35-59 and 60 years of age or older) [14, 34].

Mortality of severe acute respiratory infections (SARI)
Age and gender-specific mortality rates for severe acute respiratory infections are based on data from the official statistics on causes of death provided by the Federal Statistical Office (Info box 3 and 4). Trends in mortality rates for severe acute respiratory infections were examined for the years 1998 through 2015 (see 2.5).

2.2 Lung cancer

Case definition
The definition of incident cases and deaths from lung cancer was made in accordance with the current international classification of diseases (10th revision of the International Statistical Classification of Diseases and Related Health Problems, ICD-10) and is based on the following ICD-10 codes: C33 for very rare malignant neoplasms of the trachea, and C34 for malignant neoplasms of the bronchus and lung (Table 1). In order to differentiate among the different types of lung cancer, the morphology codes recorded in the cancer registries were classified as follows (in accordance with the current International Classification of Diseases for Oncology – ICD-O-3): small cell lung carcinomas (8041-8045), adenocarcinomas (8140-8384), squamous cell carcinomas (8050-8080), unspecified lung tumours (8000-8005), and other malignant lung carcinomas (8010-8011) (Annex Figure 1).

Incidence of lung cancer
The analyses of lung cancer incidence rates are based on data from the epidemiological cancer registries of the federal states, which transmit data annually to the German Centre for Cancer Registry Data (ZfKD) in accordance with the Federal Cancer Registry Data Act (Info box 7). The nationwide incidence of lung cancer (Info box 1) was calculated using this data [29]. Trends in lung cancer incidence rates were examined for the years 1998 through 2013 (see 2.5).

Mortality of lung cancer
Age and gender-specific mortality rates for lung cancer are based on data from the official statistics on causes of death provided by the Federal Statistical Office (Info box 3 and 4). Trends in lung cancer mortality rates were examined for the years 1998 through 2015 (see 2.5).

2.3 Chronic obstructive pulmonary disease (COPD)

Case definition
The case definition of deaths from COPD was based on the ICD-10 code (Info box 3) J44 for other chronic obstructive pulmonary disease [2] (Table 1). In order to ensure comparability with previous analyses of COPD mortality, ICD-10 codes for COPD and other chronic lower respiratory diseases (ICD-10: J40-J44, J47) were con-
The mortality rate for severe acute respiratory infections is not recorded adequately by statistics on causes of death; therefore, additional estimates need to be made of the excess mortality associated with influenza outbreaks.

Info box 3: Causes of death

Causes of death: The official statistics on causes of death provide information about the most important causes of death and trends in death rates. From 1 January 1998 onwards, the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) has been in use to code the causes of death that occurred during the observation period. The statistics on causes of death are derived from an evaluation of death certificates. These are issued individually on the basis of the federal states' burial laws for all deaths as well as for stillborns with a birth weight of at least 500g and are pooled at the Federal Statistical Office.

Source: [129]
and 4). Trends in asthma mortality rates were examined for the years 1998 through 2015 (see 2.5).

2.5 Analysis of time trends

The Joinpoint Regression Program (version 4.4.0.0, [43]) was used to analyse time trends in incidence and mortality rates per 100,000 population. The average annual percentage change (AAPC) in the age-standardised rates (Info box 9) at the national level was estimated by performing joinpoint regression analyses [43, 44]. Trends in the incidence rates for lung cancer were examined for the years 1998 through 2013, whereas trends in mortality rates for each included respiratory disease were examined for the years 1998 through 2015. In each analysis, years (‘joinpoints’) were identified, in which statistically significant changes in trends occurred. Such joinpoints indicate, for example, points at which incidence rates begin increasing more noticeably or level out [44]. In order to account for the impact of changes to the population age structure, the rates were standardised according to age using the old European standard population (Info box 9). In addition, time trends in mortality rates for asthma and COPD were compared to time trends in mortality rates for all causes [37, 45]. For all outcomes of interest, the number of absolute cases as well as the number of cases per 100,000 population were presented by calendar year. Population estimates reflect the average total population of the respective reference year. For the years 1998 through 2010, these figures were based on projections of census data collected in the former FRG in 1987 and in the former GDR in 1990 [8]. From 2011 onwards, projections obtained from the 2011 census were used [8]. All results were reported by gender.

<table>
<thead>
<tr>
<th>ICD-10 codes</th>
<th>Gender</th>
<th>Period</th>
<th>APC</th>
<th>(95% CI)</th>
<th>Period</th>
<th>APC</th>
<th>(95% CI)</th>
<th>AAPC</th>
<th>(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J09-J22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Severe acute respiratory infections – SARI)</td>
<td>Women</td>
<td>1998-2005</td>
<td>1.9</td>
<td>-1.4/-5.2</td>
<td>2005-2015</td>
<td>-4.3</td>
<td>-6.2/-2.4</td>
<td>-1.8</td>
<td>-3.4/-0.2</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>1998-2007</td>
<td>0.0</td>
<td>-1.9/1.9</td>
<td>2007-2015</td>
<td>-3.9</td>
<td>-5.9/-1.9</td>
<td>-1.9</td>
<td>-3.1/-0.6</td>
</tr>
<tr>
<td>C33-C34</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Malignant neoplasms of the trachea, bronchus and lung)</td>
<td>Women</td>
<td>1998-2015</td>
<td>2.5</td>
<td>2.4/2.6</td>
<td>2006-2015</td>
<td>-1.4</td>
<td>-1.7/-1.1</td>
<td>-1.8</td>
<td>-2.0/-1.6</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>1998-2006</td>
<td>-2.3</td>
<td>-2.7/-2.0</td>
<td>2007-2015</td>
<td>-1.4</td>
<td>-1.7/-1.1</td>
<td>-1.8</td>
<td>-2.0/-1.6</td>
</tr>
<tr>
<td>J40-J44, J47</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(COPD and other chronic lower respiratory diseases excluding asthma)</td>
<td>Women</td>
<td>1998-2015</td>
<td>2.3</td>
<td>1.8/2.9</td>
<td>2007-2015</td>
<td>-0.8</td>
<td>-0.5/2.1</td>
<td>-1.1</td>
<td>-1.8/-0.3</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>1998-2007</td>
<td>-2.7</td>
<td>-3.8/-1.5</td>
<td>2007-2015</td>
<td>-0.8</td>
<td>-0.5/2.1</td>
<td>-1.1</td>
<td>-1.8/-0.3</td>
</tr>
<tr>
<td>J45-J46</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Asthma)</td>
<td>Women</td>
<td>1998-2006</td>
<td>-10.3</td>
<td>-11.2/-9.3</td>
<td>2006-2015</td>
<td>-6.5</td>
<td>-7.7/-5.4</td>
<td>-8.3</td>
<td>-9.0/-7.6</td>
</tr>
<tr>
<td>A00-T98</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(All causes of death)</td>
<td>Women</td>
<td>1998-2015</td>
<td>-1.4</td>
<td>-1.6/-1.2</td>
<td>2008-2015</td>
<td>-0.8</td>
<td>-1.3/-0.2</td>
<td>-1.8</td>
<td>-2.1/-1.5</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>1998-2008</td>
<td>-2.5</td>
<td>-2.9/-2.2</td>
<td>2008-2015</td>
<td>-0.8</td>
<td>-1.3/-0.2</td>
<td>-1.8</td>
<td>-2.1/-1.5</td>
</tr>
</tbody>
</table>

AAPC=annual percentage change, and 95% confidence interval (95% CI)
AAPC=average annual percentage change, and 95% confidence interval (95% CI) between 1998 and 2015
COPD=chronic obstructive pulmonary disease

Table 2

Trends in age-standardised mortality rates (deaths per 100,000 population) due to respiratory diseases of high public health relevance and for all causes of death between 1998 and 2015, Germany (old European standard population; ≥0 years of age) by gender

Data source: Official statistics on causes of death [8]
2012/2013 influenza season) visited a general or paediatric practice due to an acute respiratory infection. Large differences between age groups were identified year-round, whereas gender-specific differences hardly played a role (data not shown). Each week, between 1.5% and 9.4% of children aged 0 to 4 years visited a paediatrician. By contrast, no more than 1.3% of people aged 60 years or older visited their general practitioner due to an acute respiratory complaint – even in winter during weeks with high levels of influenza activity.

Only a small proportion of acute respiratory infections is severe enough to result in hospital treatment. Hospital admission due to severe acute respiratory infection (SARI) is also highly dependent on age. The weekly incidence of SARI (hospitalisation incidence, Info box 1) is highest among children aged 0 to 4 years. In the period of 2009 to 2016, it ranged from 0.001% to 0.19% depending on the season and level of influenza activity. Between 0.01% and 0.06% of adults aged 60 years or older were admitted to a hospital each week. The risk of a serious illness increases with age and with the presence of other risk factors, such as chronic pre-existing illnesses.

In 2015, a severe acute respiratory infection (ICD-10: J09-J22) was reported as the underlying cause of death (monocausal cause of death) for 10,743 women and 10,816 men in Germany (Table 1). The crude mor-

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age group</th>
<th>Cumulative incidence (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>Total (18-79 years)</td>
<td>4.1 (2.8-5.7)</td>
</tr>
<tr>
<td></td>
<td>18-44 years</td>
<td>3.6 (1.9-6.1)</td>
</tr>
<tr>
<td></td>
<td>45-79 years</td>
<td>4.7 (2.8-7.3)</td>
</tr>
<tr>
<td>Men</td>
<td>Total (18-79 years)</td>
<td>1.6 (0.9-2.6)</td>
</tr>
<tr>
<td></td>
<td>18-44 years</td>
<td>1.9 (1.0-3.5)</td>
</tr>
<tr>
<td></td>
<td>45-79 years</td>
<td>1.2 (0.5-2.2)</td>
</tr>
</tbody>
</table>

CI=Confidence interval
Lung cancer incidence and mortality rates decreased among men and increased among women.

3.2 Lung cancer

18,810 women and 34,693 men in Germany were diagnosed with lung cancer (ICD-10: C33-C34) in 2013 (see Figure 5). The average age at diagnosis was around 69 years. The crude incidence rate was 87.9 per 100,000 for men and 45.7 per 100,000 for women (data not shown) and increased with age (Figure 4). The absolute number of cases increased since 1998 among women but remained relatively constant among men. Correspondingly, sex-specific differences were found in the time trends of age-standardised incidence rates (Figure 6). Whereas among men the lung cancer incidence rate decreased on average (AAPC) by 1.5% annually between 1998 and 2013, women
In 2015, lung cancer was reported as the underlying cause of death among more men (29,378) than women (15,881) (Table 1). The average age at death from lung cancer was 71 years. The crude mortality rate of 73.1 per 100,000 was considerably higher among men than among women (38.3 per 100,000) and substantially increased with age particularly among men (Figure 2).

In a manner similar to the incidence, there has been a clear increase since 1998 in the absolute number of deaths among women, whereas deaths among men remained largely unchanged during the same period (Figure 3; Figure 5). Differences were also found between age-standardised death rates among women showed a contrasting trend with an average annual increase of 3.3% (Table 3). However, among women under 55 years of age, a 1.4% annual drop in the incidence of lung cancer can be observed from 2007 onwards (Annex Table 2). When lung cancer incidence among women is examined according to morphological type, a larger increase can be identified for adenocarcinomas compared to squamous cell carcinomas and small cell carcinomas. Adenocarcinomas also appear to be increasing among men despite the overall trend towards decreasing lung cancer incidence rates. However, it is important to recognise that the incidence rate of tumours classified as ‘unspecified’ also decreased during this period (Annex Figure 1) [24].
**COPD mortality rates decreased among men and increased among women, whereas asthma mortality rates substantially declined for both genders.**
3.3 COPD

In 2015, COPD (ICD-10: J44) was reported as the underlying cause of death among more men (17,300) than women (13,773) (Table 1). The crude death rate was substantially higher among men (43.1 per 100,000 population) than among women (33.2 per 100,000 population) and strongly increased with age particularly among men. Similar results were also seen when ICD-10 codes of COPD and other chronic lower respiratory diseases excluding asthma were considered (ICD-10: J40-J44, J47) (Table 1, Figure 2). This combination of ICD-10 codes is used internationally to enable comparability of long-term trends in COPD mortality over time, and is therefore also used below (see 2.3).
Figure 3 shows that the absolute number of deaths in 1998 was considerably lower among both women and men than in 2015. However, time trends in age-standardised death rates differed between women and men (Figure 3 and Table 2). Among women, there was a significant increase of 2.3% annually over the entire observation period (Table 2). At the same time, an average annual increase in COPD mortality rates was most noticeable among women aged 55 to 74 years (Annex Table 1). Among men, there was, by contrast, a significant overall average decline (AAPC) in COPD mortality rates of 1.1% annually (Table 2). However, this decrease came to a halt in 2007. A continuous decrease in mortality rates was only seen among men aged 75 years or older (Annex Table 1). Gender differences can also be observed when time trends in COPD mortality rates are compared to time trends in all-cause mortality (Table 2): between 1998 and 2015, a similar average decline in COPD and in all-cause mortality rates was observed among men (-1.1% and -1.8% annually). By contrast, time trends in COPD and all-cause mortality differed among women: COPD mortality rates rose by 2.3% annually as opposed to a significant decrease in all-cause mortality rates of 1.4% annually.

3.4 Asthma

During an average observation period of approximately 12 years, the cumulative incidence (Info box 1) of asthma was higher among women (4.1%) than among men (1.6%) (Table 4). This gender difference was observed both at a younger age (18 to 44 years) and among older
4. Discussion

4.1 Acute respiratory infection

Syndromic surveillance of acute respiratory infections with a focus on influenza is an internationally recognised and established practice [52]. Laboratory analyses are only conducted in a very small proportion of cases with an acute respiratory infection. Moreover, 75% of all patients who were treated in inpatient care for community acquired pneumonia left hospital with a diagnosis of J18 (pneumonia, unspecified organism) [53]. As such, assessing the individual diagnoses of influenza (instead of the fixed diagnostic groups used in syndromic surveillance) would probably provide an incomplete and distorted depiction of the situation. Nevertheless, the syndromic approach has a clear disadvantage: the burden of disease caused by individual pathogens such as influenza can only be estimated using relatively complex statistical procedures, which, at least in some cases, need to be accompanied by representative microbiological examinations [12, 54]. Influenza infections and subsequent pneumonia can also occur in hospitals. Such nosocomial pneumonia is often caused by pathogens that are already found in the respiratory tract (‘commensals’) which are normally harmless and only cause disease once the mucous membrane of the respiratory tract has been weakened, for example, due to an influenza infection [55].

The occurrence of acute respiratory infections is characterised by strong seasonal fluctuations. As such, a close (weekly) assessment of consultation rates is as relevant to health policy as analyses of long-term trends.
In general, acute respiratory illnesses during the winter are significantly more pronounced in both outpatient and inpatient care than during the summer months. Although efficient health care systems, such as the one in Germany, are designed with this in mind, seasonal influenza waves occur in various strengths. A particularly severe wave of influenza can tax the resources of outpatient and inpatient care for a few weeks. Furthermore, medical staff can also be affected by these outbreaks and may fall ill during periods that already require greater level of medical care. Finally, people with chronic diseases are at a higher risk during these periods, as an additional respiratory infection could lead to a severe or even fatal disease; this also increases the level of care needed during influenza outbreaks.

Even if respiratory infections contribute to or actually cause death, they are rarely recorded as the moncausal cause of death; instead, an underlying condition is usually documented in the statistics on causes of death. Therefore, mortality rates and absolute number of deaths due to severe acute respiratory infections are likely underestimated, despite the fact that the mortality rate for community acquired, hospital-treated pneumonia is already high (at approximately 13% depending on age) [53]. As such, it is an international standard practice to estimate the influenza-related deaths by utilising the total number of deaths by any cause (Info box 10). This method usually involves calculating a background mortality rate – the all-cause mortality rate that would have been expected at the time of the influenza season if there had been no influenza virus circulation. If the total mortality rate observed during the influenza season is markedly higher than the background mortality, the difference between expected and observed mortality rates can be attributed to the disease. This is referred to as excess mortality and can be estimated using statistical methods [56]. In the case of severe influenza seasons, such as those that occurred in 2012/2013 and 2014/2015, an excess mortality of 26 per 100,000 has been identified [14, 57]. This corresponds to 20,700 and 21,300 influenza-related deaths during the respective periods. Clearly, only a fraction of influenza-related deaths are stated as such in the annual statistics on causes of death due to severe respiratory infections. However, many respiratory infections that occur during an influenza season – including the majority of pneumonia cases – are not caused by influenza; this applies even more to respiratory-coded deaths that occurred outside the influenza season.

4.2 Lung cancer

In the case of lung cancer, continuous and nationwide estimates of incidence and mortality rates are made in accordance with the Federal Cancer Registry Data Act of 2009. Consistent with developments in the incidence rates, age-standardised mortality rates of lung cancer have been declining for decades among men and are still rising substantially among women. Due to the poor prognosis associated with lung cancer (about half of patients die within one year of being diagnosed) [24], the trends in mortality reflect the trends in incidence.

As the majority of lung cancer in Germany can be attributed to smoking, the different temporal trends found among women and men can be traced to changes...
in smoking habits that occurred towards the end of the 20th century. Whereas the proportion of smokers decreased among men, it rose among women until about 2000, although it never reached the same level as among men [58]. Women have now also begun reducing their tobacco consumption, and this will have a significant effect in the coming decades. The rate of new lung cancer cases among women below the age of 55 years has fallen by 1.4% per year since 2007, and the mortality rate in this age group has been decreasing by 2.8% per year since 2008. This trend has been observed in almost all Western industrialised countries. In fact, in the US and some Scandinavian countries, a reduction in lung cancer incidence and mortality has already been observed among women overall, although the peak rates in these countries were substantially higher than in Germany. There are clear regional differences in lung cancer mortality within the EU, and this is particularly the case among men: rates in some Eastern European countries are approximately three to four times higher than in Germany. There are clear regional differences in lung cancer mortality within the EU, and this is particularly the case among men: rates in some Eastern European countries are approximately three to four times higher than, for example, in Finland or Sweden [24].

Passive smoking, radon gas, other forms of environmental pollution (especially particulates) and exposure to asbestos can also increase the risk of lung cancer. Long-term exposure not only to particulates themselves but also to the pollutants that they carry increases the likelihood of lung cancer [59, 60, 61]. Whereas tobacco consumption is the major risk factor of lung cancer in Europe and North America, exposure to air pollution from open fires used for cooking and heating within households is an additional cause of lung cancer in large parts of sub-Saharan Africa and in some regions of Asia and Oceania [62]. The increase in the proportion of adenocarcinomas observed in Germany has also been observed in many other countries over the last few decades [63, 64]. Compared to the other two main forms of lung cancer (squamous cell carcinoma and small cell lung carcinoma), adenocarcinoma is less strongly associated with smoking and is the most common form of lung cancer in non-smokers [65]. In this respect, a growing influence of environmental risk factors, such as particulate air pollution, which are especially associated with adenocarcinomas, could play a role. However, the evidence in this regard is still limited [66], and particulate matter pollution (measured as PM10 values) seems to have declined in Germany since the mid-1990s, even if the values recommended by the WHO are still frequently exceeded in urban areas [67]. Other possible explanations for the increase in adenocarcinomas could be changes in the levels of tobacco consumption, the composition of tobacco products, the depth of inhalation and the age at which people begin to smoke.

### 4.3 COPD

Consistent with results on lung cancer mortality, in 2015, COPD was recorded as the underlying cause of death among more men than women. However, due to different time trends in COPD mortality between women and men a further narrowing of the gender gap in death rates for COPD can be observed as already reported in Germany and other European countries since 1994 [35]. As with lung cancer, smoking is the most important modifiable risk factor of COPD in Germany [48, 68].
opining COPD depends on the total amount of cigarette smoking over time (‘pack years’) [2, 7]. However, reliable data on time trends in COPD morbidity or survival rates are not available in Germany [2, 48, 69]. Since a high proportion of people with unknown or undiagnosed COPD within the population is to be expected, this would require a consideration of reliable data based on a pulmonary function test (spirometry) [70-73]. In the absence of such data, it cannot be determined to what extent differing time trends in COPD mortality between women and men can be attributed to gender differences in the development of COPD incidence – e.g., due to secular trends in smoking – or survival rates and resulting changes in prevalence (Info box 1) over time [74, 75]. In addition, COPD is a long-term chronic condition that may progress over decades accompanied by increasing health-related disability [2, 50]. Assessments of the burden of disease associated with COPD therefore highly depend on the availability of reliable data permitting analyses on time trends in the number of years spent with health-related disability [4, 5, 7]. In turn, this requires a reliable database for the analysis of trends in the prevalence of COPD and COPD-related disability over time [4, 5, 7].

In international comparison, such as with data from Hannover (2006), there is a regional association between the local average amount of cigarette smoking over the time (‘pack years’) and the prevalence of COPD [76]. In Spain, moreover, a decline in COPD prevalence estimates based on spirometry testing was observed among adults aged 40 to 69 years between 1997 and 2007. This decline in prevalence was recorded across all age groups among men and in particular among women under 50 years of age [77]. The authors discussed that in addition to changes in smoking habits, prenatal and early-childhood influences may be contributing to COPD morbidity in later life [77]. Impaired growth and functional development of the lungs also relates to COPD risk [50, 78, 79]. In addition to a genetic predisposition and prenatal influences (e.g., maternal smoking during pregnancy), repeated respiratory infections in early childhood, exposure to airborne pollutants, or childhood asthma may contribute to developing COPD in later adulthood [48, 50, 68, 78-80]. Further work-related factors (such as exposure to coal dust) are also important modifiable risk factors of COPD [48, 68, 81]. Moreover, exposure to high levels of air pollution in households that, for example, result from burning biomass (such as wood or animal dung) in open fires or leaky stoves is also a known cause of COPD [2, 3, 50, 82, 83]. This is particularly the case in low and middle income countries [3, 82, 83]. The survival prospects of people with COPD are further influenced by the quality of medical care, including prevention and treatment of concurrent conditions and sequelae (such as cardiovascular disease, but also respiratory infections and lung cancer) [50].

4.4 Asthma

Consistent with results observed at the global level, age-standardised asthma mortality rates and annual number of asthma deaths have both substantially decreased among women and men in Germany [51, 84]. The considerable faster decline in asthma mortality when compared with all-cause mortality indicates that sur-
vival prospects of asthma patients may have improved. This development has been related particularly to improvements in drug therapy of asthma patients [51, 84]. However, low asthma mortality rates could probably be reduced even further, particular through the implementation of appropriate medical care, including adequate management of the condition by patients themselves [51, 85]. In the current analyses, the incidence rate of asthma during the observation period between 1997-1999 and 2008-2011 among women was higher than among men. Results from other epidemiological studies also point to an increased asthma risk for women compared to men, whereby this difference is already evident in adolescence, and besides hormonal factors, differences in lung development or in the vulnerability (susceptibility) to environmental factors have been related to the observed gender differences in asthma incidence [42, 86-90]. Further, no nationwide studies are available on long-term trends in asthma incidence or survival rates in Germany [2, 91, 92].

Repeated population-based surveys have, however, demonstrated that the prevalence (Info box 1) of asthma increased during the second half of the last century not only in Germany, but also in other parts of the world [46, 93-102]. This increase has been linked to changes in lifestyle and environmental factors (such as infections, exposure to microbes, allergens and airborne pollutants, or diet) possibly resulting in an increment in asthma incidence particularly among children and young adults [46, 94-96, 99, 103]. Most recently, a further rise in the lifetime prevalence of physician-diagnosed asthma among both genders was recorded from national inter-

4.5 Summary overview and conclusions

Both the burden of acute respiratory infections and the resulting need for medical care are subject to strong seasonal fluctuations. A close (weekly) surveillance of short-term trends in incidence is thus as relevant to health policy as the analysis of long-term trends over time. A large proportion of influenza-related deaths are attributed to existing chronic underlying diseases or to complications frequently associated with bacteria-related pneumonia instead of the acute influenza infections themselves. Therefore, evaluations of mortality using the official statistics on causes of death are inadequate and additional
assessments of the excess mortality associated with influenza are necessary. For that purpose, the method of estimating influenza-related excess mortality has been implemented in Germany (Info box 10) [56]. However, compared to other countries, timely data that could provide an up-to-date assessment of time trends in the influenza-attributable mortality in Germany are lacking [113].

Regarding chronic lung diseases including lung cancer, long-term trends in incidence and mortality rates are of particular relevance. A decline in asthma mortality rates is observed among both genders. However, mortality rates for COPD and lung cancer are decreasing among men, whereas they are increasing among women. Incidence trends for longer periods of time are only available for lung cancer and remain at a very similar level to mortality rates. The contrasting developments in lung cancer incidence and mortality among women and men can be attributed to sex differences in smoking habits that occurred in the second half of the 20th century—the proportion of men who smoked was already declining during this time, whereas it was still increasing among women [58]. Overall, the proportion of smokers in Germany has decreased in recent years, but still around one quarter of adults is currently smoking (women: 20.8%, men: 27.0%, see also fact sheet on Smoking among adults in Germany in issue 2/2017). The sustainable reduction of tobacco consumption is therefore an important goal in terms of preventing lung cancer and COPD as well as other chronic diseases. In addition, some of the burden of disease and premature mortality associated with acute respiratory infections could be avoided by vaccination (influenza and pneumococcal vaccination) [114, 115]. This is particularly the case among elderly patients with multiple chronic diseases, as they are significantly more likely to suffer from a severe illness which could even have a fatal outcome [114].

The results of the present investigation illustrate a number of aspects that are of particular relevance for the continuous analysis of time trends in morbidity and mortality of respiratory diseases. Detailed analyses of gender and age-specific trends enables conclusions to be drawn about changes in underlying behavioural or environmental determinants of disease that may explain these trends (for example, temporal changes in tobacco consumption and the incidence rates for lung cancer). At the same time, trends in morbidity and mortality for age-associated diseases such as COPD and lung cancer are also influenced by changes to the population age structure. This can be seen, for example, in the difference in time trends between the absolute number of incident cases and age-standardised incidence rates for lung cancer among men (Info box 9). Clearly, temporal changes in mortality rates can also be influenced by changes in survival, such as through improved treatments. Regarding lung cancer, survival rates are estimated regularly in Germany as part of national cancer surveillance activities in accordance with the Federal Cancer Registry Data Act [24, 116, 117]. For COPD and asthma, mortality follow-up of national health survey participants could help to close this gap in the future [74, 118, 119]. Additional information can be derived by considering process data of in- and outpatient care [75, 120].

Based on data from the official statistics on causes of death, the present analysis investigated time trends...
in mortality of severe acute respiratory infections and chronic lung diseases, including lung cancer with a high relevance to public health. Compared to lung cancer, which represents a clearly defined underlying disease, there is a far higher risk of misclassification for COPD or asthma as the underlying cause of death, not least because of the possible overlap of both diseases in middle and older age [50, 121-123]. However, a decline in asthma mortality was evident also among younger people aged 5 to 34 years. The fact that patients with COPD often suffer from other chronic diseases, such as cardiovascular disease or lung cancer, can also affect the risk of death [123, 124]. Furthermore, it is particularly difficult to identify the single cause of death in COPD patients with severe acute respiratory infections [123, 124]. Besides, the analysis of time trends in mortality based on data from the official statistics on causes of death faces a limitation due to the fact that coding practices can change over long periods of time. For example, since the death certificates are processed electronically in England and Spain using the IRIS software, dementia is now documented more frequently as an underlying cause of death instead of aspiration pneumonia (pneumonia due to substances entering the lungs, such as after swallowing food). In these cases, by contrast, manual coding would more likely have resulted in an acute respiratory illness being documented as the underlying cause of death [125, 126]. In Germany, the electronic coding of causes of death using IRIS software has been piloted at the regional level since 2007; some federal states now use the system to process all of their death certificates electronically [127]. Improving the statistics on causes of death through quality control in death registration and the implementation of multi-causal coding of the underlying diseases that led to the death represents a major challenge for the future [127, 128].

4.6 Conclusion

This article underlines the need for continuous and coordinated surveillance of morbidity and mortality related to acute respiratory infections as well as lung cancer, COPD and asthma as chronic lung diseases of high public health relevance. In doing so, it is essential that the association between respiratory diseases and the concurrence of other, mainly age-related, diseases is taken into account. The analysis of existing data – also with regard to their limitations and the potential for future development – is a particularly important step in establishing sustainable surveillance structures in Germany within the framework of international public health strategies aimed at the prevention and control of communicable and non-communicable diseases.
5. **Annex**

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### Annex Table 1 (continued)

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<td>-10.4</td>
<td>-11.7/-9.1</td>
<td>2007-2015</td>
<td>-4.2</td>
<td>-6.3/-1.9</td>
<td>-7.5</td>
<td>-8.6/-6.4</td>
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<tr>
<td><strong>Men</strong></td>
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<tr>
<td>0-54 years</td>
<td>1998-2008</td>
<td>-9.0</td>
<td>-10.7/-7.2</td>
<td>2008-2015</td>
<td>-2.7</td>
<td>-6.8/1.6</td>
<td>-6.4</td>
<td>-8.2/-4.6</td>
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<tr>
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<td>-14.1/-1.5</td>
<td>-12.3</td>
<td>-14.0/-10.6</td>
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<td><strong>A00-T98 (All causes of death)</strong></td>
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<tr>
<td><strong>Women</strong></td>
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<tr>
<td>0-54 years</td>
<td>1998-2007</td>
<td>-2.5</td>
<td>-2.8/-2.2</td>
<td>2007-2015</td>
<td>-1.6</td>
<td>-2.0/-1.2</td>
<td>-2.1</td>
<td>-2.3/-1.8</td>
</tr>
<tr>
<td>55-74 years</td>
<td>1998-2007</td>
<td>-2.5</td>
<td>-2.8/-2.2</td>
<td>2007-2015</td>
<td>-0.2</td>
<td>-0.6/0.2</td>
<td>-1.4</td>
<td>-1.7/-1.2</td>
</tr>
<tr>
<td>≥75 years</td>
<td>1998-2015</td>
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<td>-1.5/-1.1</td>
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<td></td>
</tr>
<tr>
<td>0-54 years</td>
<td>1998-2003</td>
<td>-2.2</td>
<td>-2.8/-1.6</td>
<td>2003-2006</td>
<td>-3.8</td>
<td>-6.5/-1.1</td>
<td>-2.6</td>
<td>-3.0/2.1</td>
</tr>
<tr>
<td>2006-2015</td>
<td>-2.3</td>
<td>-2.6/-2.1</td>
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<td></td>
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<tr>
<td>55-74 years</td>
<td>1998-2008</td>
<td>-2.9</td>
<td>-3.1/-2.6</td>
<td>2008-2015</td>
<td>-0.6</td>
<td>-1.1/-0.1</td>
<td>-1.9</td>
<td>-2.2/-1.7</td>
</tr>
<tr>
<td>≥75 years</td>
<td>1998-2008</td>
<td>-2.2</td>
<td>-2.7/-1.7</td>
<td>2008-2015</td>
<td>-0.4</td>
<td>-1.2/0.3</td>
<td>-1.5</td>
<td>-1.9/-1.1</td>
</tr>
</tbody>
</table>

**APC**=annual percentage change, and 95% confidence interval (95% CI)

**AAPC**=average annual percentage change, and 95% confidence interval (95% CI) between 1998 and 2015

**COPD**=chronic obstructive pulmonary disease

**ICD-10**=10th revision of the International Statistical Classification of Diseases and Related Health Problems
### Annex Table 2

**Trends in age-standardised incidence rates (incident cases per 100,000 population) for malignant neoplasms of the trachea, bronchus and lung (ICD-10 C33-C34) between 1998 and 2013, Germany (old European standard population; ≥0 years of age) by age and gender**

Data Source: German Centre for Cancer Registry Data [28, 29]

<table>
<thead>
<tr>
<th>ICD-10 codes</th>
<th>Period</th>
<th>APC (95% CI)</th>
<th>Period</th>
<th>APC (95% CI)</th>
<th>AAPC (95% CI)</th>
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<tbody>
<tr>
<td>C33-C34 (Malignant neoplasms of the trachea, bronchus and lung)</td>
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</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-54 years</td>
<td>1998-2000</td>
<td>9.9</td>
<td>1.0/19.6</td>
<td>2000-2007</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>2007-2013</td>
<td>-1.4</td>
<td>-2.5/-0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55-74 years</td>
<td>1998-2005</td>
<td>4.2</td>
<td>3.9/4.5</td>
<td>2005-2008</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>2008-2013</td>
<td>3.6</td>
<td>3.2/4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥75 years</td>
<td>1998-2004</td>
<td>2.2</td>
<td>1.4/2.9</td>
<td>2004-2008</td>
<td>4.5</td>
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<tr>
<td></td>
<td>2008-2013</td>
<td>0.1</td>
<td>-0.7/0.9</td>
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<tr>
<td><strong>Men</strong></td>
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<td></td>
</tr>
<tr>
<td>0-54 years</td>
<td>1998-2010</td>
<td>-2.0</td>
<td>-2.2/-1.8</td>
<td>2010-2013</td>
<td>-4.9</td>
</tr>
<tr>
<td></td>
<td>1998-2000</td>
<td>-0.4</td>
<td>-2.9/2.2</td>
<td>2000-2005</td>
<td>-2.4</td>
</tr>
<tr>
<td></td>
<td>2005-2013</td>
<td>-0.8</td>
<td>-1.1/-0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55-74 years</td>
<td>1998-2002</td>
<td>-2.3</td>
<td>-3.6/-1.0</td>
<td>2002-2011</td>
<td>-0.2</td>
</tr>
<tr>
<td></td>
<td>2011-2013</td>
<td>-5.2</td>
<td>-8.5/-1.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥75 years</td>
<td>1998-2002</td>
<td>-2.3</td>
<td>-3.6/-1.0</td>
<td>2002-2011</td>
<td>-0.2</td>
</tr>
<tr>
<td></td>
<td>2011-2013</td>
<td>-5.2</td>
<td>-8.5/-1.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

APC=annual percentage change, and 95% confidence interval (95% CI)
AAPC=average annual percentage change, and 95% confidence interval (95% CI) between 1998 and 2013

### Annex Table 3

**Cumulative incidence and incidence rates (per 1,000 person-years, PY) for asthma among adults (18-79 years of age)**

Data source: German Health Interview and Examination Survey for Adults 1997-1999 and 2008-2011 [30-32]

<table>
<thead>
<tr>
<th></th>
<th>Cumulative incidence (95% CI)</th>
<th>Incidence rate per 1,000 PY (95% CI)</th>
<th>Incidence rate* per 1,000 PY (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (18-79 years)</td>
<td>4.1 (2.8-5.7)</td>
<td>3.4 (2.2-4.6)</td>
<td>2.7 (1.7-3.6)</td>
</tr>
<tr>
<td>18-44 years</td>
<td>3.6 (1.9-6.1)</td>
<td>3.0 (1.3-4.6)</td>
<td>1.8 (0.8-2.8)</td>
</tr>
<tr>
<td>45-79 years</td>
<td>4.7 (2.8-7.3)</td>
<td>4.0 (2.2-5.8)</td>
<td>3.7 (2.0-5.5)</td>
</tr>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (18-79 years)</td>
<td>1.6 (0.9-2.6)</td>
<td>1.3 (0.7-2.0)</td>
<td>1.1 (0.5-1.7)</td>
</tr>
<tr>
<td>18-44 years</td>
<td>1.9 (1.0-3.5)</td>
<td>1.6 (0.7-2.6)</td>
<td>1.4 (0.5-2.3)</td>
</tr>
<tr>
<td>45-79 years</td>
<td>1.2 (0.5-2.2)</td>
<td>1.0 (0.3-1.6)</td>
<td>0.6 (0.2-1.0)</td>
</tr>
</tbody>
</table>

* in addition, participants of the follow-up survey in 2008-2011 (n=18) reporting a year of asthma diagnosis ≥5 years before the baseline survey (1997-1999) were excluded [41]
CI=Confidence interval
PY=person years
Annex Figure 1

Trends in age-standardised incidence rates (incident cases per 100,000 population) for malignant neoplasms of the bronchus and lung (ICD-10 C34) between 1998 and 2013, Germany (selected registries; old European standard population; ≥0 years of age) by gender and type of lung cancer histology:

In accordance with the current International Classification of Diseases for Oncology (ICD-O-3), the figures were divided into small-cell lung cancers (8041-8045), adenocarcinomas (8140-8384), squamous cell carcinomas (8050-8080), non-specific lung carcinomas (8000-8005), and other malignant lung carcinomas (8010-8011)

Data Source: German Centre for Cancer Registry Data [24, 28-29]
Time trends in incidence and mortality of respiratory diseases of high public health relevance in Germany

References


Time trends in incidence and mortality of respiratory diseases of high public health relevance in Germany


http://www.gbe-bund.de (As at 03.08.2017)


32. Scheidt-Nave C, Kamtsiuris P, Gößwald A et al. (2012) German health interview and examination survey for adults (DEGS) - design, objectives and implementation of the first data collection wave. BMC Public Health 12:730


34. Buda S, Tolksdorf K, Schuler E et al. (2017) Establishing an ICD-10 code based SARI-surveillance in Germany - description of the system and first results from five recent influenza seasons. BMC Public Health 17(1):612


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http://edoc.rki.de/documents/rki_fv/refNzCggQ8fNw/PDF/29PIbXnI56Jfc.pdf (As at 03.08.2017)
Time trends in incidence and mortality of respiratory diseases of high public health relevance in Germany

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Journal of Health Monitoring

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12-month prevalence of asthma among adults in Germany

Abstract

Asthma is a chronic inflammatory disease of the airways affecting people of all ages. The disease is characterised by a variable narrowing of the bronchia, which may be accompanied by symptoms such as wheezing or shortness of breath. In GEDA 2014/2015-EHIS, 6.2% of respondents aged 18 years or older with complete information on the respective indicator (n=22,671) reported having had asthma during the past 12 months. The 12-month prevalence among women (7.1%) is higher than among men (5.4%). Overall, women and men with a low level of education more often reported having had asthma than those with a higher level of education. In analyses stratified by age and gender, differences in asthma prevalence with regard to educational level are evident among women under 30 years of age. In a comparison of federal states, the prevalence of asthma ranges from 3.0% to 9.7% among women and from 2.9% to 7.0% among men.

Introduction

According to the World Health Organization (WHO), asthma is one of the most common chronic diseases affecting around 235 million people globally [1]. Asthma can occur among people of all ages [2-5]. The disease is characterised by chronic inflammation and increased sensitivity (hyperresponsiveness) of the airways to diverse inhaled stimuli [5, 6]. Asthma patients moreover suffer from variable narrowing of the bronchia (airway obstruction) accompanied by symptoms such as wheezing, shortness of breath, chest tightness or coughing which vary over time and in intensity [5, 6]. Some patients with mild asthma may experience periods when they are completely free of symptoms [5, 7]. In particular, in case of an asthma onset in childhood, remission of symptoms during puberty is frequently observed [4, 8].

Asthma is a heterogeneous disease which results from different underlying disease mechanisms [5, 9]. Allergic asthma and also other forms of non-allergic asthma are marked by a characteristic type of inflammation [5, 9]. This (TH2) type of inflammation is indicated by elevated concentrations of specific immune cells (eosinophils) in the airway mucosa and in the blood (eosinophilic asthma) [5, 6, 9]. Further, mainly adult-onset, forms of asthma exist, where such an overproduction of eosinophils cannot be observed (non-eosinophilic asthma) [5, 6, 9]. It is important to distinguish between eosinophilic and non-eosinophilic asthma, when treating patients with severe asthma [5, 6, 9].

A family history of asthma or of certain allergies (such as hay fever) is an important predisposing factor [5, 10-12]. Asthma thereby results from complex interactions.
between genetic and environmental factors [2, 5, 12]. Early childhood yet also prenatal influences are highly relevant in the induction of the disease [2, 5, 12]. Infections, exposure to microbes, pollutants and allergens, but also diet or psychosocial factors may contribute to asthma development [2, 5, 12]. Furthermore, occupational exposures have been identified (e.g., allergens such as flour and cow hair or chemical irritants such as disinfectants and agents used by hairdressers) which can induce or aggravate asthma in adulthood [2, 13]. Providing appropriate medical care to asthma patients is highly important to prevent episodes in which the disease worsens acutely and which can require emergency care or lead to premature mortality [5]. In the majority of patients, however, adequate treatment can minimise the symptoms of asthma and associated limitations in usual activities [5].

**Results and discussion**

6.2% of adults aged 18 years or older reported having had asthma during the past 12 months. Overall, women (7.1%) show a higher 12-month prevalence of asthma than men (5.4%) (Table 1). Asthma prevalence is highest in the age group 45 to 64 years among men while it remains on a similar level across all age groups among women. Overall, women and men with a low level of education more frequently reported to have had asthma than those with a medium or high level of education (7.7% vs. 5.9% and 5.7%). In analyses stratified by age and gender, these differences with regard to educational level are evident among women aged 18 to 29 years (Table 1). Prevalence estimates vary considerably between federal states ranging from 3.0% in Mecklenburg-Western-Pomerania to 9.7% in Brandenburg among women.
12-month prevalence of asthma among adults in Germany

About 6% of adults reported having had asthma during the past 12 months.

and from 2.9% in Saxony-Anhalt to 7.0% in North Rhine Westphalia and Saarland among men (Figure 1).

The current results on the 12-month prevalence of asthma in GEDA 2014/2015-EHIS are consistent with results of the German national telephone health interview survey German Health Update (GEDA 2012) conducted by the Robert Koch Institute in 2012 [16]. This applies both to the overall prevalence of asthma among adults (6.2% vs. 6.3% in 2012) and to estimates by gender (women: 7.1% vs. 7.5%; men: 5.4% vs. 5.0%) [16]. Comparable differences between genders (an overall 1.3 to 1.5-fold higher prevalence of asthma among women) were observed in epidemiological surveys in Europe, Australia and the USA [17]. Results from longitudinal studies moreover point to an increased asthma risk for women relative to men, whereby this difference is already evident in adolescence (see also the Focus article on respiratory diseases in this issue) [17, 18]. Regarding socio-economic differences, the surveys available revealed heterogeneous results. Overall, in the majority of studies, however, a higher prevalence of asthma is related to lower social status [19]. A comparison of GEDA 2014/2015-EHIS results by gender or socio-economic criteria needs to consider further aspects. Differences in the way patients perceive symptoms, seek medical care or adhere to treatment recommendations - and

### Table 1
12-month prevalence of asthma by gender, age and educational level (n=12,448 women; n=10,223 men)

Source: GEDA 2014/2015-EHIS

<table>
<thead>
<tr>
<th></th>
<th>Women (%) (95% CI)</th>
<th>Men (%) (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>6.2 (5.8-6.7)</td>
<td>5.4 (4.8-5.9)</td>
</tr>
<tr>
<td><strong>18-29 Years</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>13.3 (8.9-19.4)</td>
<td>4.1 (2.1-7.7)</td>
</tr>
<tr>
<td>Medium education</td>
<td>6.5 (5.1-8.2)</td>
<td>2.9 (2.0-4.1)</td>
</tr>
<tr>
<td>High education</td>
<td>5.2 (3.3-8.2)</td>
<td>5.8 (3.5-9.5)</td>
</tr>
<tr>
<td><strong>30-44 Years</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>8.5 (5.4-13.1)</td>
<td>7.3 (4.1-12.6)</td>
</tr>
<tr>
<td>Medium education</td>
<td>6.1 (4.8-7.6)</td>
<td>4.4 (3.1-6.1)</td>
</tr>
<tr>
<td>High education</td>
<td>6.2 (4.8-8.0)</td>
<td>5.7 (4.0-8.1)</td>
</tr>
<tr>
<td><strong>45-64 Years</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>7.0 (5.0-9.6)</td>
<td>8.5 (5.8-12.3)</td>
</tr>
<tr>
<td>Medium education</td>
<td>7.1 (6.1-8.4)</td>
<td>6.6 (5.3-8.1)</td>
</tr>
<tr>
<td>High education</td>
<td>7.2 (5.8-8.8)</td>
<td>5.0 (4.0-6.2)</td>
</tr>
<tr>
<td><strong>≥ 65 Years</strong></td>
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<td></td>
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<tr>
<td>Low education</td>
<td>7.3 (5.6-9.5)</td>
<td>8.0 (5.3-11.9)</td>
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<tr>
<td>Medium education</td>
<td>6.7 (5.2-8.5)</td>
<td>5.3 (3.9-7.0)</td>
</tr>
<tr>
<td>High education</td>
<td>6.9 (4.7-10.1)</td>
<td>4.8 (3.4-6.7)</td>
</tr>
</tbody>
</table>

CI=Confidence interval  
* n=51 additional missing values (26 women, 25 men) when stratifying by educational level
resulting differences in the degree of treatment and asthma control - may all affect levels of self-reported asthma prevalence [20, 21].

Direct comparisons of prevalence estimates obtained from GEDA 2014/2015-EHIS with those obtained from previous German national health surveys need to consider some change in methods and hence preclude analyses of trends in asthma prevalence over time [16, 22-24]. In accordance with the regulation on the harmonisation of European health reporting, GEDA 2014/2015-EHIS used self-reported information on asthma prevalence based on the self-assessment of respondents. As in other

Women (7.1%) show a higher 12-month prevalence of asthma than men (5.4%).

Confidence intervals in parentheses

Figure 1
12-month prevalence of asthma by gender and federal state (n=12,448 women; n=10,223 men)
Source: GEDA 2014/2015-EHIS
12-month prevalence of asthma among adults in Germany

large epidemiological surveys [25-34], all national health surveys previously conducted in Germany, starting with the German Health Interview and Examination Survey 1997-1999 (GHNIES98) [16, 22-24], however, collected data on self-reported physician-diagnosed asthma. In comparison with the currently applied indicator on self-assessed asthma, prior results on the prevalence of physician-diagnosed asthma may be less prone to misclassification [32]. In addition, previous national health surveys also assessed the lifetime prevalence of physician-diagnosed asthma which was consistently higher than the recorded 12-month prevalence [16, 22-24]. These differences between lifetime and 12-month prevalence indicate the varying degrees of disease activity over time in individuals with asthma [4, 7, 8]. In some patients, symptoms of asthma may resolve, at least for longer periods of time [4, 7, 8].

In Germany, an increase in the lifetime prevalence of physician-diagnosed asthma was recorded for both genders among adults (1997-1999 and 2008-2011) as well as among children and adolescents (2003-2006 and 2009-2012) [22-24]. At the same time, an increment in the 12-month prevalence was likewise observed; among adults this was attributable mainly to an increase in the prevalence among women [23, 35]. Interview survey data had already indicated a rising prevalence of asthma in the 1990s in Germany especially among children [26, 29, 36-40]. Moreover, an increase in the prevalence of asthma was also observed in other parts of the world during the second half of the last century [29]. Recent data indicates that this trend has come to a halt at least in certain regions such as Australia where prevalence is already high [25, 29, 41]. Among adults, however, a further increase in prevalence over the course of the last decade has nonetheless been recorded in several countries in Europe and in the USA [27, 28, 31, 33, 42].

High regional variation in asthma prevalence has been observed not only in GEDA 2014/2015-EHIS based on analyses stratified by federal state. Using ambulatory health care data, a recent study reported considerable variation in asthma prevalence at the county level ranging from 2.5% to 7.7% for the total population [43]. Earlier European surveys indicated significant regional differences with a high prevalence mainly in the United Kingdom and low prevalence in Eastern European regions [2, 3, 44, 45]. In line with Europe-wide data for adults [2, 46], current asthma prevalence in Germany as recorded in GEDA 2014/2015-EHIS is mid-range compared to other countries of the EU. Previous studies including a national health survey of adults in Germany indicated a lower prevalence of asthma in East than in West Germany [47-51]. The German Health Interview and Examination Survey for Children and Adolescents (KiGGS) 2003-2006, however, which was conducted among children and adolescents most of whom were born after German reunification, revealed no significant differences between East (including Berlin) and West Germany [24]. Future investigations on the regional differences in asthma prevalence among adults in Germany should thus include in-depth analyses that do not only stratify by age and birth year, respectively, but also consider the place where respondents were born and raised.

Previously observed temporal and regional differences in asthma prevalence were related to the develop-
ment of time trends and the geographical distribution of several lifestyle and environmental factors [12, 29, 50]. In addition, the influence of temporal changes and regional differences in degrees of awareness and provision of care, respectively, was also discussed [27, 29, 43, 50]. The recently observed changes in asthma prevalence over time point to the importance of continuous health monitoring based on periodically repeated national health surveys using comparable instruments of data collection. Besides extending the available database from national health interview and examination surveys permitting analyses of trends in the prevalence of physician-diagnosed asthma, it will be highly important to build a reliable database for the analysis of trends in self-assessed asthma prevalence using the current indicator in the context of European health interview surveys. Moreover, clarifying the underlying causes of regional and gender-specific differences in the prevalence of asthma remains a key challenge [12].

References


12-month prevalence of asthma among adults in Germany


43. Pollmanns J, Romano PS, Weyermann M et al. (2017) Impact of Disease Prevalence Adjustment on Hospitalization Rates for Chronic Ambulatory Care-Sensitive Conditions in Germany. Health Serv Res Mar 22


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The Robert Koch Institute is a Federal Institute within the portfolio of the German Federal Ministry of Health.
12-month prevalence of known chronic obstructive pulmonary disease (COPD) in Germany

Abstract
Chronic obstructive pulmonary disease (COPD) is associated with a high disease burden and is one of the leading causes of death worldwide. Smoking is the key modifiable risk factor for COPD in Germany. GEDA 2014/2015-EHIS surveyed the 12-month prevalence of known COPD using the European indicator on self-reported chronic bronchitis, chronic obstructive pulmonary disease, emphysema. Among adults aged 18 years or older with complete information on the indicator (n=22,702), the 12-month prevalence of known COPD is 5.8% (5.8% for women and 5.7% for men). In both genders, the prevalence increases strongly with age. Overall, the presence of COPD was more often reported by women and men with a low educational level than by those with a higher one. In a comparison of federal states, the 12-month prevalence of known COPD varies between 3.6% and 7.5% for women and 4.3% and 11.2% for men.

Introduction
Chronic obstructive pulmonary disease (COPD) is associated with a high disease burden and is one of the leading causes of death in Germany and globally [1-3]. COPD is a prevalent chronic disease of middle and older age [1, 4-7]. It is marked by chronic inflammation and progressive obstruction (narrowing) of the airways and destruction of lung tissue (parenchyma) [1, 8]. Chronic cough and phlegm production (chronic bronchitis) as well as a permanent over-inflation of the air sacks (emphysema) are common among COPD patients and often occur together [1, 8]. Moreover, shortness of breath under physical strain is a typical symptom. At more progressed stages of the disease, patients may also suffer from shortness of breath even at rest [1, 8].

Smoking is the most important modifiable risk factor for COPD in Germany [1, 7-9]. The risk of developing COPD is thereby related to the total amount of cigarette smoking over time (pack years) [7, 9]. Moreover, specific occupational exposures (e.g., coal dust) are important COPD risk factors [1, 7, 9, 10]. COPD is therefore considered a potentially preventable disease [1, 8]. However, impaired growth and functional development of the lungs also affect a person’s COPD risk [1, 9, 11]. Besides genetic factors and prenatal influences (e.g., maternal smoking during pregnancy), repeated respiratory infections in early childhood, exposure to airborne pollutants, or childhood asthma potentially contribute to developing COPD in later life [1, 7, 9, 12, 13].
Adults with COPD frequently suffer from other chronic conditions such as cardiovascular diseases [1, 7, 9]. These concurrent conditions considerably impact the quality of life of COPD patients and contribute to the high COPD-related costs of illness [14-17]. COPD-related costs of illness are also significantly determined by the severity of the disease [17, 18]. A recent study of COPD patients in Germany revealed that in comparison to a control group from the region of Augsburg, excess (direct) costs resulting from healthcare utilization ranged between 2,595 and 8,924 EUR per patient in 2012 [17]. The indirect costs (e.g., due to work absence) were significantly higher ranging from 8,621 to 27,658 EUR [17].

Indicator
GEDA 2014/2015-EHIS surveyed the prevalence of known COPD during the past 12 months based on an instrument from the indicator set of the European health monitoring by using self-administered paper-based or online questionnaires. Respondents were asked, ‘During the past 12 months, have you had any of the following diseases or conditions?’ This question was followed by a list of conditions that also included ‘chronic bronchitis, chronic obstructive pulmonary disease, emphysema’. Out of a total of 24,016 respondents aged 18 years or older (13,144 women, 10,872 men), 1,314 respondents (696 women and 618 men) with missing information on the indicator were excluded from the analysis. COPD prevalence was calculated using a weighting factor that corrects for deviations within the sample from the German population structure (as of 31 December 2014) with regard to gender, age, district type and education. The district type reflects the degree of urbanisation and corresponds to the regional distribution in Germany. The International Standard Classification of Education (ISCED) was used to classify the responses provided on educational level [19]. Lange et al. [20] set out the details of the methodology applied in GEDA 2014/15-EHIS including a description of the method used to calculate the weighting factor and an assessment of the response rate. Background information on GEDA 2014/15-EHIS are also provided in the article German Health Update: New data for Germany and Europe, which was published in Issue 1/2017 of the Journal of Health Monitoring.

Results and discussion
In GEDA 2014/2015-EHIS, 5.8% of adults aged 18 years or older reported the presence of COPD during the past 12 months. The 12-month prevalence of known COPD for women (5.8%) is comparable to the prevalence for men (5.7%). In both genders, the 12-month prevalence increases strongly with age (Table 1). Overall, the presence of COPD was more often reported by women and men with a low educational level than by those with a medium or high one (8.1% vs. 5.7% and 4.0%). Stratified by age and sex, these differences with regard to educational level are particularly evident for women under 65 years of age and for men aged 45 to 64 years (Table 1). The prevalence of known COPD varies considerably between federal states, ranging from 3.6% in Saxony-Anhalt to 7.5% in Bremen for women and from 4.3% in Hesse to 11.2% in Saarland for men (Figure 1).
12-month prevalence of known chronic obstructive pulmonary disease (COPD) in Germany

When comparing these results on the prevalence of known COPD with the results from previous epidemiological studies, considerable methodological differences need to be taken into account. For example, a comparison with the results from the interview survey of adults aged 18 years or older conducted by the Robert Koch Institute in 2012 (GEDA 2012) is not possible because both the type of the interview (written/online questionnaire now, telephone interview then) and the indicator differ [21]. GEDA 2012 surveyed the 12-month prevalence of physician-diagnosed chronic bronchitis defined as coughing with phlegm for at least 3 months per year [21].

Prevalence estimates for this indicator were 6.0% for women and 4.0% for men [21].

Besides interview data, COPD prevalence estimates are mainly based on data obtained from a pulmonary function test (spirometry) [4, 6, 18, 22, 23]. However, there is poor agreement between estimates of spirometrically defined and self-reported COPD prevalence [4, 6, 22, 24, 25]. For example in a population-based cohort study among adults 41 to 90 years of age from the region of Augsburg (KORA), less than 40% of participants with spirometrically defined COPD reported to have physician-diagnosed COPD [22]. This was explained by a high

<table>
<thead>
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<td>2.0</td>
<td>(1.2-3.3)</td>
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<tr>
<td>30-44 Years</td>
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<tr>
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</tr>
<tr>
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<td>(2.0-4.1)</td>
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<td></td>
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<td>(5.2-9.8)</td>
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<td>(4.2-6.2)</td>
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<td>Total (women and men)</td>
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<td>(5.4-6.2)</td>
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<table>
<thead>
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<th>Men</th>
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<th>(95% CI)</th>
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<td>(5.2-6.3)</td>
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<td>18-29 Years</td>
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<td>(0.6-2.4)</td>
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<tr>
<td>30-44 Years</td>
<td></td>
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<tr>
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<td>(1.4-2.9)</td>
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<td>Medium education</td>
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<tr>
<td>High education</td>
<td>2.5</td>
<td>(1.7-3.9)</td>
</tr>
<tr>
<td>≥ 65 Years</td>
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<td>Low education</td>
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<tr>
<td>High education</td>
<td>7.0</td>
<td>(5.8-8.5)</td>
</tr>
<tr>
<td>Total (women and men)</td>
<td>5.8</td>
<td>(5.4-6.2)</td>
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</table>
In both genders, the 12-month prevalence of known COPD increases strongly with age.

Figure 1
12-month prevalence of known COPD according to gender and federal state (n=12,448 women; n=10,254 men)
Source: GEDA 2014/2015-EHIS

Confidence intervals in parentheses

In both genders, the 12-month prevalence of known COPD increases strongly with age. A comparison with prevalence estimates of spirometrically defined COPD must, however, take into account that lung function generally decreases with age and also shows considerable variation in the older population [27-29]. In particular, age-specific estimates on COPD prevalence based on spirometry data differ depending on the chosen reference criteria and method of examination, e.g. with or without the use of medications to dilate airways [1, 9, 22, 27-29]. Besides,
The presence of COPD was more often reported by women and men with a low educational level than by those with a higher one.

the available prevalence data on spirometrically defined COPD is based alone on the detection of an airflow obstruction [1, 4, 6]. A clinical diagnosis of COPD, however, also requires the consideration of risk factors, symptoms, the corresponding individual clinical history and, where necessary, further clinical examinations [1, 9, 27, 29].

Results from international surveys including data from Germany reveal a higher prevalence of spirometrically defined COPD among men than among women [5, 7, 18, 24, 30, 31]. For example, the estimated prevalence of spirometrically defined COPD among adults 40 year of age or older was 9.3% for women and 18.1% for men based on data collected in the German study centre Hanover of the international Burden of Obstructive Lung Disease (BOLD) study in 2006 [24]. This difference between women and men was observed independent of disease severity [5]. Higher prevalence among men, however, was only seen among those aged 50 years or older and was considered to be potentially related to the gender-specific differences in smoking habits across age groups [24]. In agreement with the findings presented here, results from this previous survey demonstrated that there were no gender differences regarding the prevalence of known COPD: 7.7% of women and 7.6% of men reported to have been diagnosed with COPD by a physician [24]. Further analyses on the basis of BOLD and other survey data indicated underlying differences in COPD awareness between women and men, as male gender was associated with an undiagnosed COPD [25]. In the GEDA 2014/2015-EHIS survey conducted across Europe, data collection on the prevalence of known COPD was based on the composite indicator compelling information on chronic bronchitis, chronic obstructive pulmonary disease, emphysema in line with other cross-country surveys [4, 6, 23]. Thereby, however, adults with chronic cough and phlegm production might have been included who have otherwise normal spirometry results and will not develop COPD in later life [1, 32-34]. This is particularly relevant with regard to the prevalence of known COPD assessed among young adults in GEDA 2014/2015-EHIS [31]. Moreover, current findings on the prevalence of known COPD are based on the self-assessment of respondents and not on self-reported medical diagnoses [4, 6, 22, 24]. This increases the likelihood of misclassifying patients with other diseases that are marked by similar symptoms, in particular asthma [31].

In accordance with other data on spirometrically defined COPD, GEDA 2014/2015-EHIS results indicate a higher prevalence of known COPD among adults with a low educational level compared to those with a higher one [7, 9, 35, 36]. In line with these findings, comparable differences in prevalence had previously been reported with regard to different socio-economic criteria [7, 9, 35, 36]. GEDA 2014/2015-EHIS revealed considerable regional differences in the prevalence of known COPD not only between federal states but also between EU countries. Germany thereby ranked in the group of countries presenting the highest prevalence [37] (see issue 1/2017 Journal of Health Monitoring). The interpretation of social and regional differences in known COPD prevalence needs to consider differences in the distribution of risk factors such as smoking (see also the Fact sheet Smoking among adults in Germany in issue 2/2017 Jour-
nal of Health Monitoring) as well as in COPD awareness and care provision [36, 38-40]. Periodically repeated collection of nationally representative population-based data on major modifiable risk factors as well as on lung function, diagnosis, symptoms, and mortality of COPD is essential in order to identify successes and remaining or new challenges of COPD prevention and care.

References


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12-month prevalence of osteoarthritis in Germany

Abstract
Osteoarthritis is the most common joint disease worldwide. In the advanced stage the disease is characterised by joint pain and loss of joint functionality. In the Robert Koch Institute's GEDA 2014/2015-EHIS health interview survey, 17.9% of adults over 18 reported having suffered from osteoarthritis during the past twelve months, whereby prevalence for women (21.8%) was higher than for men (13.9%). Osteoarthritis becomes more common with age. Among those aged 65 and over, around half of all women (48.1%) and nearly one third of men (31.2%) are affected. Due to population ageing, the prevalence of osteoarthritis in Germany can be expected to increase further in the future.

Introduction
In Germany as well as globally, osteoarthritis is the most common joint disease [1, 2]. The disease is characterised by degenerative processes in the joints that begin with the gradual erosion of joint cartilage, and which can lead to the full exposure of bone surfaces. The bones, muscles and ligaments attached to the affected joints can also be affected [3]. Non-modifiable risk factors for osteoarthritis include older age, female gender and genetic predisposition. Further acquired (or contributing) causes include overstretch and misload of joints due to congenital misalignments (axis misalignment, hip dysplasia); injuries and accidents; excessive physical activity or inactivity and overweight or obesity. At advanced stages, osteoarthritis causes pain and leads to joint dysfunction, both of which result in loss of mobility, physical disability and limitations in usual activities, and consequently significant loss of quality of life. Beyond the personal burdens suffered by osteoarthritis patients, the disease also generates considerable economic costs [3].

Numerous efforts at the international level currently target musculoskeletal diseases and the related disease burden. When the World Health Organization (WHO) endorsed the Bone and Joint Decade 2000-2010, experts estimated that due to demographic developments the number of patients affected by bone and joint diseases would approximately double between 2000 and 2020 [2]. The WHO strategy therefore focussed on promoting research and enhancing the quality of healthcare services. This initiative led to an increased awareness for musculoskeletal diseases and the insight that the capacity to provide prompt and adequate care would require new models of care [4].

Given the ageing of society, osteoarthritis prevalence in Germany will continue to rise. This will lead to further burdens on the healthcare system. Considering the iden-
12-month prevalence of osteoarthritis in Germany

17.9% of adults over 18 report having had osteoarthritis during the past twelve months, whereby prevalence among women (21.8%) is higher than among men (13.9%).

Osteoarthritis is more common among older than among young people. During early adulthood (18 to 29 years) osteoarthritis is very rare with a prevalence of 0.9% among women and 0.4% among men. Among 30- to 44-year-olds this rises to 4.3% (women) and 4.1% (men) (Table 1) and then increases steeply, with 23.2% of women and 16.6% of men in the 45 to 64 age group reporting cases of osteoarthritis.

In the 45 to 64 age group a correlation between osteoarthritis and education is apparent for both sexes. People with higher educational levels have a lower prevalence of osteoarthritis. This correlation is found among both men and women. However, there is no clear association between osteoarthritis and gender, age, district type and education. The district type accounts for the degree of urbanisation and reflects the regional distribution in Germany. The International Standard Classification of Education (ISCED) was used to classify the responses provided on educational level [9].

For a detailed description of the methodology applied in the GEDA 2014/2015-EHIS study see Lange et al. 2017 [10] as well as the article German Health Update: New data for Germany and Europe, in Issue 1/2017 of the Journal of Health Monitoring.
Around 22% of women and 14% of men suffer from osteoarthritis during the past twelve months.

Table 1
12-month prevalence of osteoarthritis stratified according to gender, age and educational level (n=12,481 women; n=10,272 men)  
Source: GEDA 2014/2015-EHIS

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>(95% CI)</th>
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</tr>
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<td>(0.5-1.5)</td>
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<td>0.9</td>
<td>(0.3-2.6)</td>
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<td>30-44 Years</td>
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<td>(2.0-7.1)</td>
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<tr>
<td>45-64 Years</td>
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<td><strong>Total (women and men)</strong></td>
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<td>(17.3-18.5)</td>
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</table>

CI=Confidence interval

People with higher levels of education report osteoarthritis significantly less often than those from a medium- or low-education background. For the other age groups no significant differences by level of education were observed.

Stratified by federal state there are no regional differences in the prevalence of osteoarthritis.

Comparisons between these results and the findings of previous national health surveys regarding the prevalence of osteoarthritis in Germany are difficult: Methods regarding both the collection of data (telephone interview, paper-based questionnaire, interview by physician) as well as the operationalisation (how questions were posed) of indicators have changed over time, which can lead to discrepancies in prevalence estimates. Personal interaction between interviewers and interviewees and thus, possibilities to clarify questions, for example, can have an impact on responses. Similarly, the composition of a survey’s population sample (for example according to age, sex, social status, acute pain) can also lead to discrepancies in prevalence estimates between different surveys [11, 12]. In its 2012 interview survey (GEDA 2012) the Robert Koch Institute reported that 24.5% of women and 16.1% of men aged 18 and over had ever been diagnosed with osteoarthritis or another degenerative joint disease by a physician and that this...
Osteoarthritis rates increase with age and particularly during people’s second half of life. Nearly half of all women and one third of all men aged 65 and over suffer from osteoarthritis.

Among persons in middle adulthood, osteoarthritis prevalence is lower among women and men with high education than among women and men with medium or low education.

Osteoarthritis had persisted into the past twelve months. The available sex-stratified results on the 12-month prevalence of osteoarthritis from GEDA 2014/2015-EHIS are marginally lower, which might be due to the fact that the question here did not include degenerative joint disease. The German Health Interview and Examination Survey for Adults (DEGS1, 2008-2011) surveyed the lifetime prevalence of a medical diagnosis of osteoarthritis or other degenerative joint disease among adults aged 18-to 79-years based on personal interviews. Compared to current prevalence estimates, DEGS1 results for women (22.3%) did not differ much, whereas the estimates for men (18.1%) were significantly higher than in the current study [13]. Results on osteoarthritis prevalence among adults aged 18 to 79 years from an even earlier German national health survey are also not comparable to the current analysis, neither regarding how the question was posed (asking whether a physician had ever diagnosed osteoarthritis or another degenerative joint disease of the hips, knees or spine), nor regarding the timespan (ever diagnosed, persisted into the past four weeks). In this earlier analysis, the estimated overall prevalence was 27.7%. Significantly higher prevalence rates among women were only evident for the older age groups [14]. All publications consistently reveal a significant increase in osteoarthritis prevalence for the second half of life [3, 12, 13, 15].

GEDA 2014/2015-EHIS did not assess the localisation of osteoarthritis. DEGS1 results [11] reveal that in more than half of participants osteoarthritis affected the knee and in about one quarter the hip joint. Around one third of women and one seventh of men reported osteoarthritis in their finger joints. Half of those suffering osteoarthritis reported further joints were affected as well.

Overall, osteoarthritis is a common disease among older people in Germany. Joint pain and loss of function are likely to lead to a loss of quality of life. Osteoarthritis in the lower extremities (hips and knees) obviously involves a higher degree of loss of mobility than osteoarthritis in the upper extremities (fingers, hands and shoulders). Preventive healthcare strategies should first and foremost focus on preventing obesity and joint injuries. With patients who have already developed osteoarthritis the focus should be on maintaining joint functionality. Establishing a continuous database for analyses of time trends as well as collecting additional information through interview and examination surveys on comorbidity, loss of function, administered medications, joint replacements or joint pains will be key to describing the development of osteoarthritis (see the Fact sheet in this issue).
12-month prevalence of osteoarthritis in Germany

References


10. Lange C, Finger JD, Allen J et al. (in press) Implementation of the European Health Interview Survey (EHIS) in Germany. Further development of the German Health Update (GEDA) Archives of Public Health


12-month prevalence of osteoporosis in Germany

Abstract
Osteoporosis is a systemic skeletal disease associated with increased bone fragility, which correspondingly leads to increased bone fractures. In the GEDA 2014/2015-EHIS survey, 7.8% of women and 2.0% of men aged 18 and over reported suffering from osteoporosis during the past 12 months. The share of people reporting osteoporosis increases considerably in the age group 65 and over. Elder women significantly more often report osteoporosis than men. As this was the first time the present indicator for the 12-month prevalence of osteoporosis was evaluated in the context of the European Health Interview Survey (EHIS) 2014/2015, there is no comparative data available.

Introduction
The Umbrella Organization for Osteology (Dachverband Osteologie) defines osteoporosis as a systemic skeletal disease that is characterised by low bone mass and a microarchitectural deterioration of bone tissue which results in greater bone fragility [1]. With osteoporosis patients, external causes that would not normally affect a healthy bone can already cause bone fractures (fragility fractures). These fragility fractures most commonly occur in the vertebrae, the upper parts of the thigh bone close to the hip (femoral neck and trochanteric region) as well as the forearm close to the wrist (in particular the distal radius) [2].

Various factors contribute to osteoporosis. There are behavioural risk factors, which persons can influence such as a lack of physical exercise and dietary habits, as well as further risk factors such as underlying diseases and also certain medications. These risks can be reduced by treating the underlying causes or by adapting behaviour. Moreover, there are also non-modifiable factors such as age, female gender and familial predisposition [1].

Osteoporosis has health policy relevance mainly because osteoporosis incidence rates and the consequences of fragility fractures increase with age. Fractures of the thigh bone close to the hip as well as of the vertebrae particularly impact people's quality of life and their ability to live independently. Unlike fractures of the vertebrae, which often go unnoticed, fractures of the bone close to the hip joint are rarely overlooked and therefore treated in hospital. Hip fracture surgery and subsequent rehabilitation, as well as age-related co- and multi-morbidity issues generate high costs to the health system [3, 4].

Indicator
The osteoporosis indicator in the GEDA 2014/2015-EHIS health interview survey was calculated using a self-administered paper-based or online questionnaire. Numer-
12-month prevalence of osteoporosis in Germany

The share of people reporting osteoporosis increases considerably with age. Young and middle-aged adults only rarely report osteoporosis. Prevalence in the age group under 45 is below 1% for both genders (Table 1). In the age group 45 to 64, 4.4% of women and 1.9% of men report osteoporosis. Beyond the age of 65 osteoporosis rates increase significantly: nearly one quarter of women (24%) and 5.6% of men are affected. Osteoporosis rates are significantly higher among women in the age groups 45 to 64 and 65 and over than among men.

Osteoporosis prevalence is significantly higher among women aged 45 to 64 with a low-education background (7.2%) than among those with a medium- (4.0%) or high-education (2.9%) background. Low overall rates of osteoporosis in the other age groups allow no conclusions on the significance of levels of education for differences in osteoporosis prevalence in these groups. Possible links between prevalence and education are subject to controversial discussion among researchers [7], and need to be proved by further studies. These will also need to consider changes in the prescription of hormone replacement therapy, which also affects bone structure.

There are no regional differences in osteoporosis prevalence between federal states.

Estimates on the prevalence of osteoporosis vary depending on the type of data collection, sources and the composition of the survey population. Given that guidelines on the diagnosis and treatment of osteoporosis have changed in recent years [1], comparisons of results need to take into account the time period in which data was collected. However, sex differences regarding the preva-
12-month prevalence of osteoporosis in Germany

Table 1
12-month prevalence of osteoporosis by gender, age and educational level
(n=12,270 women; n=10,074 men)
Source: GEDA 2014/2015-EHIS

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women total</td>
<td>7.8</td>
<td>(7.2-8.5)</td>
</tr>
<tr>
<td>18-29 Years</td>
<td>0.3</td>
<td>(0.1-1.1)</td>
</tr>
<tr>
<td>Low education</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Medium education</td>
<td>0.4</td>
<td>(0.1-1.8)</td>
</tr>
<tr>
<td>High education</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>30-44 Years</td>
<td>0.7</td>
<td>(0.4-1.2)</td>
</tr>
<tr>
<td>Low education</td>
<td>1.8</td>
<td>(0.6-4.8)</td>
</tr>
<tr>
<td>Medium education</td>
<td>0.8</td>
<td>(0.4-1.5)</td>
</tr>
<tr>
<td>High education</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>45-64 Years</td>
<td>4.4</td>
<td>(3.7-5.1)</td>
</tr>
<tr>
<td>Low education</td>
<td>7.2</td>
<td>(5.2-9.9)</td>
</tr>
<tr>
<td>Medium education</td>
<td>4.0</td>
<td>(3.2-5.0)</td>
</tr>
<tr>
<td>High education</td>
<td>2.9</td>
<td>(2.0-4.2)</td>
</tr>
<tr>
<td>≥ 65 Years</td>
<td>24.0</td>
<td>(21.9-26.2)</td>
</tr>
<tr>
<td>Low education</td>
<td>25.9</td>
<td>(22.9-29.1)</td>
</tr>
<tr>
<td>Medium education</td>
<td>23.4</td>
<td>(20.6-26.4)</td>
</tr>
<tr>
<td>High education</td>
<td>18.2</td>
<td>(14.0-23.2)</td>
</tr>
<tr>
<td>Total (women and men)</td>
<td>5.0</td>
<td>(4.6-5.4)</td>
</tr>
</tbody>
</table>

Men

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men total</td>
<td>2.0</td>
<td>(1.7-2.4)</td>
</tr>
<tr>
<td>18-29 Years</td>
<td>0.3</td>
<td>(0.1-0.8)</td>
</tr>
<tr>
<td>Low education</td>
<td>0.5</td>
<td>(0.1-2.3)</td>
</tr>
<tr>
<td>Medium education</td>
<td>0.3</td>
<td>(0.1-0.9)</td>
</tr>
<tr>
<td>High education</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>30-44 Years</td>
<td>0.5</td>
<td>(0.2-1.0)</td>
</tr>
<tr>
<td>Low education</td>
<td>1.2</td>
<td>(0.4-4.2)</td>
</tr>
<tr>
<td>Medium education</td>
<td>0.5</td>
<td>(0.2-1.3)</td>
</tr>
<tr>
<td>High education</td>
<td>0.2</td>
<td>(0.0-0.8)</td>
</tr>
<tr>
<td>45-64 Years</td>
<td>1.9</td>
<td>(1.4-2.6)</td>
</tr>
<tr>
<td>Low education</td>
<td>2.7</td>
<td>(1.3-5.7)</td>
</tr>
<tr>
<td>Medium education</td>
<td>2.4</td>
<td>(1.7-3.4)</td>
</tr>
<tr>
<td>High education</td>
<td>0.7</td>
<td>(0.4-1.3)</td>
</tr>
<tr>
<td>≥ 65 Years</td>
<td>5.6</td>
<td>(4.5-6.9)</td>
</tr>
<tr>
<td>Low education</td>
<td>9.0</td>
<td>(6.3-12.8)</td>
</tr>
<tr>
<td>Medium education</td>
<td>5.3</td>
<td>(3.9-7.2)</td>
</tr>
<tr>
<td>High education</td>
<td>4.6</td>
<td>(3.2-6.5)</td>
</tr>
<tr>
<td>Total (women and men)</td>
<td>5.0</td>
<td>(4.6-5.4)</td>
</tr>
</tbody>
</table>

CI=Confidence interval

Around 8% of women and 2% of men aged 18 and over reported osteoporosis during the past 12 months.

Table 1
12-month prevalence of osteoporosis by gender, age and educational level
(n=12,270 women; n=10,074 men)
Source: GEDA 2014/2015-EHIS

The share of people reporting osteoporosis increases considerably with age.

Overall, the new indicator for the prevalence of osteoporosis in Germany reveals the characteristic pattern of a common and age-related chronic disease with a typically higher prevalence among women compared to men. Current recommendations for osteoporosis prophylaxis include regular physical exercise, preventing immobility and falls as well as ensuring a sufficient intake of calcium and vitamin D. Doctors should also assess whether patients take prescribed medications that increase the risk of fractures. Risks-and-benefits analyses can help to establish the usefulness of such medication on a case-to-case basis [1].

Lence of self-reported osteoporosis, which are described in this Fact sheet, are confirmed by all previous national surveys that have been conducted in Germany [8-11].

Comparability with the results from a previous telephone interview survey conducted by the Robert Koch Institute in 2012 (GEDA 2012) are limited due to differences in posing the question (time frame: ever vs. 12-months; physician diagnosis vs. self-assessment). Due to EHIS regulations, GEDA 2014/2015-EHIS, was conducted using a new system of data collection. The survey for the first time collected data on the 12-month prevalence of diseases and used the results for comparisons between EU countries.
12-month prevalence of osteoporosis in Germany

References


12-month prevalence of osteoporosis in Germany

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The Robert Koch Institute is a Federal Institute within the portfolio of the German Federal Ministry of Health
Prevalence of joint pain in Germany

Abstract
Joint symptoms and pain belong to the most common diseases worldwide that affect people in their usual activities and lead to loss of quality of life. 29.3% of women and 24.4% of men reported acute joint pain, which is defined as pain suffered during the past 24 hours. With age, these figures increase. Women report pain in 3.9 joints on average and men in 3.6. In both genders the joints most affected are the shoulders, knees and hips. Respondents suffering from joint pain significantly more often report medically diagnosed osteoarthritis or rheumatoid arthritis than respondents who were free of pain.

Introduction
Joint symptoms and pain belong to the most common diseases worldwide. They affect people in their everyday lives and can lead to loss of quality of life [1]. Most commonly joint pain is caused by a musculoskeletal disease such as osteoarthritis (see the Fact sheet in this issue) or rheumatoid arthritis (RA) [2]. The diagnosis of joint diseases and provision of corresponding care leads to considerable costs to the healthcare system [3].

The International Association for the Study of Pain (IASP) defines pain as ‘an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage’ [4]. There are two types of pain: acute and chronic. Acute pain lasts seconds to maximally weeks and has a clearly defined trigger. Chronic pain, in contrast, is not necessarily linked to such damaging factors and is characterised as being permanent or recurrent and lasting for a period of at least three months [5]. Chronic pain is a complex and multidimensional phenomenon influenced by somatic, psychological and social factors [6].

Indicator
For the German Health Interview and Examination Survey for Adults (DEGS1) respondents received a questionnaire asking: ‘Have you had joint pains during the past 12 months?’ and, if yes: ‘Have you had joint pain today?’ which was more narrowly defined by adding: ‘Meaning during the past 24 hours’. This was followed by a table where participants were asked to mark the intensity of their pain during the past 24 hours. The table listed the right and left shoulders, elbows, wrists, fingers, hips, knees, ankles and toes. Pain could be marked as low, medium or strong.

The following sections present data on joint pain by gender, age and educational level, describe which joints are most commonly affected and analyse the rate at which people with joint pains are affected by medically diag-
nosed musculoskeletal diseases such as osteoarthritis, RA or osteoporosis. Differences between groups are interpreted as statistically significant if the respective 95% confidence intervals (CI) of relative frequencies do not overlap.

The analyses are based on data from 7,727 participants aged between 18 and 79 (4,061 women, 3,666 men) with valid data on joint pain. The calculations were carried out using a weighting factor that corrects for deviations within the sample from the German population (as of 31 December 2010) with regard to gender, age, region and nationality, as well as district type and educational level [7]. The district type accounts for the degree of urbanisation and reflects the regional distribution in Germany. The International Standard Classification of Education (ISCED) was used to classify the responses provided on educational level [8]. Scheidt-Nave et al. contains a detailed discussion of the methodology applied in DEGS1 [9].

Results and discussion

57.9% of women and 52.2% of men reported experiencing joint pain during the past 12 months. 29.3% of women and 24.4% of men stated acute joint pain, i.e. that they had suffered from pain during the past 24 hours. With increasing age, the percentage of people experiencing acute joint pain increases. For women it rises from 9.0% among 18- to 29-year-olds to 48% among 65- to 79-year-olds and for men from 11.4% to 34.9% respectively (Table 1).

Women with low education report joint pains more frequently (35.3%) than women from medium (28.6%) or high (24.3%) education backgrounds. No such difference exists for men.

Whilst women report that 3.9 joints were affected on average during the past 24 hours, the corresponding figure for men is 3.6. For both sexes the most frequently reported joints causing pain are the shoulders, knees and hips. Overall, 17.3% of women and 15.1% of men report knee pain, 14.1% of women and 11.6% of men shoulder pain, and 13.3% of women and 11.9% of men pain in the hip joints. Both sides of the body are equally affected (Figure 1 and Figure 2). The percentage of people experiencing strong joint pain is low, and, independently of the joint affected, strong pain is only reported by between 0.2% and 2.2% of respondents.

DEGS1 prevalence rates are slightly lower than those reported in the survey conducted in the town of Herne in 2005 [10], which conservatively estimated that 28.9% of respondents were suffering from acute joint pain. 18.2% of participants reported knee pain and 9.1% hip pain. However, the age span of respondents in this survey (40- to 95-years old) is not immediately comparable to the DEGS sample.

Women with joint pain significantly more often report a medically diagnosed osteoarthritis (46.1%, CI 42.9-49.3) than women without joint pain (12.0%, CI 10.6-15.5). For men, the corresponding share is 40.6% (CI 36.8-44.4) and 10.4% (CI 9.2-11.8). People with joint pain also reported a medically diagnosed RA more often (women: 5.7%, CI 4.4-7.4; men: 5.5%, CI 3.9-7.8) than people who were free of joint pain (women: 1.7%, CI 1.2-2.4; men: 0.7%, CI 0.4-1.3). Further diseases such as gout, morbus Bechterew or psoriatic arthritis may also lead to joint pain. The same
is true for sports or other accidents, such as in the case of a torn meniscus.

For musculoskeletal diseases, which are a major cause of joint pain, there is currently no cure. This highlights the importance of identifying those factors that effectively prevent pain and loss of functionality. Obesity and a lack of physical exercise can contribute to pain particularly in the joints of the lower extremities [11, 12]. Focus should therefore be put on preventing overweight, promoting physical exercise and the proper prescription of medicines including pain relievers.

### Table 1

<table>
<thead>
<tr>
<th>Gender</th>
<th>12-month prevalence of joint symptoms</th>
<th>% (95% CI)</th>
<th>Total (women and men)</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>57.9</td>
<td>(56.1-59.6)</td>
<td>55.1</td>
<td>(53.6-56.5)</td>
</tr>
<tr>
<td>Total</td>
<td>55.1</td>
<td>(53.6-56.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>52.2</td>
<td>(50.1-54.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Joint symptoms during the past 24 hours

<table>
<thead>
<tr>
<th>Gender</th>
<th>Total</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>29.3</td>
<td>(27.7-31.0)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-29 Years</td>
<td>9.0 (6.6-12.0)</td>
</tr>
<tr>
<td>30-44 Years</td>
<td>16.8 (13.9-20.1)</td>
</tr>
<tr>
<td>45-64 Years</td>
<td>37.9 (34.9-41.0)</td>
</tr>
<tr>
<td>65-79 Years</td>
<td>48.0 (43.9-52.0)</td>
</tr>
</tbody>
</table>

#### Educational level

<table>
<thead>
<tr>
<th>Level</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low education</td>
<td>35.3 (31.6-39.1)</td>
</tr>
<tr>
<td>Medium education</td>
<td>28.6 (26.4-30.8)</td>
</tr>
<tr>
<td>High education</td>
<td>24.3 (21.4-27.4)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total (women and men)</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (women and men)</td>
<td>26.9 (25.7-28.1)</td>
</tr>
</tbody>
</table>

CI=Confidence interval

Around 29% of the women and 24% of the men surveyed reported having experienced joint pains during the past 24 hours.

Joint pain rates increase significantly with age.
Pain generally affects more than just one joint.

People who report joint pain more often have osteoarthritis and rheumatoid arthritis than people without pain.

Figure 1
Localisation of joint pain and pain intensity among women (n=4,061)
Source: DEGS1

Figure 2
Localisation of joint pain and pain intensity among men (n=3,666)
Source: DEGS1

Prevalence of joint pain in Germany

Pain generally affects more than just one joint.

People who report joint pain more often have osteoarthritis and rheumatoid arthritis than people without pain.
Prevalence of joint pain in Germany

References
4. International Association for the Study of Pain Task Force on Taxonomy (1994) Classification of Chronic Pain (2nd edn), Seattle
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The Robert Koch Institute is a Federal Institute within the portfolio of the German Federal Ministry of Health.
12-month prevalence of self-reported medical diagnoses of depression in Germany

Abstract
Depression is a frequent mental disorder and has a growing importance in health care provision. In GEDA 2014/2015-EHIS, 9.7% of women and 6.3% of men self-reported having received a medical diagnosis of depression during the past 12 months. For both genders, the rate of self-reported diagnoses of depression is highest in the 45- to 64-year age group. Education thereby plays a significant role. Prevalence for women from low education is about double that of women from high education backgrounds (12.2% compared with 6.5%). The education gradient for men is smaller (7.5% compared with 5.1%). Prevalence rates also differ sharply between federal states (for women, between 5.4% and 13.4%; for men, between 3.3% and 9.4%). These results are discussed in the light of data currently available.

Introduction
Depression is a mental disorder that is characterised by despondency, lack of motivation, severe weariness and the loss of interest in activities that used to produce pleasure [1]. Further symptoms include difficulties concentrating, a lack of self-confidence and suicidal tendencies in more severe cases. For those affected, depression implies severe impacts on quality of life and the ability to lead a productive life [2]. Among all chronic diseases, depression accounts for the greatest number of disability-adjusted years of life [3] and is considered to be a factor in at least half of all accomplished suicides [4]. Social insurance policies document the increasing care relevance of depression and its role in cases where people become incapable of working, require rehabilitation services and/or retire [5-8]. However, based on the epidemiological data available, the rate of depression in the population is a controversial issue [9-11]. To measure the prevalence of depression, beside further indicators, health monitoring at the Robert Koch Institute also collects data on self-reported medical diagnoses of depression.

Indicator
To survey self-reported medical diagnoses of depression, the GEDA 2014/2015-EHIS survey used self-administered paper-based and online questionnaires. Respondents were asked, ‘During the past 12 months, have you had one of the following diseases or disorders?’, followed by a list of diseases which also included depression. In the face of previous surveys and to increase the interpretive and comparative value of this data, the discussion in the
GEDA 2014/2015-EHIS
Data holder: Robert Koch Institute
Aims: To provide reliable information about the population’s health status, health-related behaviour and health care in Germany, with the possibility of a European comparison
Method: Questionnaires completed on paper or online
Population: People aged 18 years and above with permanent residency in Germany
Sampling: Registry office sample; randomly selected individuals from 301 communities in Germany were invited to participate
Participants: 24,016 people (13,144 women; 10,872 men)
Response rate: 26.9%
Study period: November 2014 - July 2015
Data protection: This study was undertaken in strict accordance with the data protection regulations set out in the German Federal Data Protection Act and was approved by the German Federal Commissioner for Data Protection and Freedom of Information. Participation in the study was voluntary. The participants were fully informed about the study’s aims and content, and about data protection. All participants provided written informed consent.

More information in German is available at www.geda-studie.de

following sections only considers respondents who said they had suffered from depression during the past 12 months and also reported having been ‘diagnosed at least once by a doctor’ with depression. This led to the exclusion of 26.4% (n=657) of respondents who reported depression during the past 12 months but failed to provide a lifetime medical diagnosis.

Whilst such an approach allows for efficient estimates on the prevalence of depression and is also widely used in international health surveys [12, 13], the approach is nonetheless tied to numerous prerequisites and therefore also has its limitations. Respondents need to have 1) consulted a physician; 2) received the diagnosis of depression; 3) this diagnosis needs to meet the diagnostic criteria; and 4) be reported by a physician. When taking part in the survey, the respondent moreover needs to 5) remember having received the diagnosis and 6) be willing to report the diagnosis. Furthermore, this is based on the assumption that psychological psychotherapists who offer specialist medical care and also provide diagnoses of depression are categorised as a sub-group within the larger group of physicians.

The analyses are based on data from 23,179 participants aged 18 years and older (12,777 women and 10,402 men) with valid data on self-reported medical diagnoses of depression. The calculations were carried out using a weighting factor that corrects for deviations within the sample from the German population (as of 31 December 2014) with regard to gender, age, district type and education. The district type reflects the degree of urbanisation and accounts for the regional distribution in Germany. The International Standard Classification of Education (ISCED) was used to classify the responses provided on educational level [14]. Differences between these groups are interpreted as statistically significant if the respective confidence intervals do not overlap.

A detailed description of the methodology used in the GEDA 2014/2015-EHIS study can be found in Lange et al. 2017 [15] as well as in the article German Health Update: New data for Germany and Europe, which was published in Issue 1/2017 of the Journal of Health Monitoring.

Results and discussion
This section presents the results of the analyses, discusses them in the context of further findings from health monitoring and contrasts them with an analysis of the data received from health insurance funds.

The 12-month prevalence of self-reported medical diagnoses of depression in the overall population was 8.1% (Table 1). Women (9.7%) report the diagnosis of depression significantly more often than men (6.3%). Prevalence in both genders is highest in the 45- to 64-year group. These findings confirm the known gender imbalance for mental disorders. The higher prevalence of depression among women compared with men is a classic and apparently stable epidemiological finding, a fact which is confirmed by studies that used numerous different forms of measurement, were implemented in various countries and over long periods of time [16]. Differences between the genders also exist regarding their willingness to seek help because faced with a depressive disorder women are more likely to seek therapy than men [17]. The debate on differences between the genders
9.7% of women and 6.3% of men reported a medical diagnosis of depression during the past 12 months.

Table 1
12-month prevalence of self-reported medical diagnoses of depression diagnosed by a physician according to gender, age and educational level (n=12,777 women; n=10,402 men)
Source: GEDA 2014/2015-EHIS

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>(95% CI)</th>
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<tbody>
<tr>
<td><strong>Women</strong></td>
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<tr>
<td>Women total</td>
<td>9.7</td>
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</tr>
<tr>
<td>18-29 Years</td>
<td>8.1</td>
<td>(6.7-9.7)</td>
</tr>
<tr>
<td>Low education</td>
<td>12.3</td>
<td>(8.8-16.9)</td>
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<tr>
<td>Medium education</td>
<td>7.5</td>
<td>(6.0-9.4)</td>
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Among women and men, the prevalence of self-reported medical diagnoses of depression varies considerably between federal states. Prevalence is highest in the city states (13.4% of women in Bremen and 9.4% of men in Berlin) (Figure 1). Prevalence in the federal states that report the lowest rates of self-reported medical diagnoses of depression is less statistically more relevant than for men. Besides age and gender, the year of data collection also impacts the correlation between education and the prevalence of self-reported medical diagnoses of depression [20-22]. When income and professional status are considered as factors next to education, this leads to equally inconsistent patterns [23-25].

Increasing levels of education almost halve the prevalence of self-reported medical diagnoses of depression in the overall population (low education of 10.5% vs. high education background of 5.6%, data not shown). The education gradient in the group of women up to the age of 64 with a diagnosed depression is stronger and statistically more relevant than for men. Besides age and gender, the year of data collection also impacts the correlation between education and the prevalence of self-reported medical diagnoses of depression [20-22]. When income and professional status are considered as factors next to education, this leads to equally inconsistent patterns [23-25].

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Significant differences in rates of self-reported medical diagnoses of depression exist between the federal states. More than half of this and affects 5.4% of women in Thuringia and 3.3% of men in Saxony-Anhalt. Excluding Bavaria, where prevalence is low, the map reveals an east to west gradient for men. Surveys from previous years [25] and data from health insurance funds [6, 11] evidence comparable differences between federal states. When comparing urban and rural areas, both of these sources of data highlight that prevalence is highest in the major cities and lowest in provincial towns [11, 23, 24]. In the accounts data from statutory health insurance funds, the frequency of depression diagnoses at the level of individual districts can vary by the factor 3 (between 5.3%...
and 18.2%) [26] and non-associated towns (between 7.2% and 21.4%) [11] even if regional differences are adjusted for age, gender and physical morbidity. Complex differences between regions must be taken into account to explain the unequal spatial distribution, such as varying concentrations of risk and protective factors, local factors that influence how willing the population is to seek help, local availability of treatment options as well as the frequency with which depression being treated is recognised and documented [26, 27]. As evidenced by a comparison with surveys from the past few years, the number of self-reported medical diagnoses of depression is no longer rising. Whereas in GEDA 2009, 8% of women and 4.5% of men reported depression [20], GEDA 2014/2015-EHIS results are comparable to the findings presented in GEDA 2012 (women 9.8%; men 6.1%) [22]. However, it has to be considered that the form of data collection has changed between these older surveys (a telephone interview) and GEDA 2014/15-EHIS (a self-administered paper-based or online questionnaire), which might have influenced responses.

This trend is also reflected in the diagnoses of depression according to the accounting data of health insurance funds. This data reveals a continuous increase in the reporting of medical classifications by physicians related to depressive disorders as a cause of incapacity to work over the past few years [6-8]. An evaluation of Company Health Insurance Fund (BKK) data reveals that depression-related absences from work more than doubled between 2003 and 2013 [8]. Using health insurance fund data to calculate values for the 12-month prevalence of depression would lead to rates between 10% and 13% depending on individual funds [11, 26, 28, 29]. Differences between the self-reported medical diagnoses of depression published in GEDA 2014/2015-EHIS and depression diagnoses as recorded by insurance funds exist for example concerning age distribution [6, 20-23, 26, 28]. These facts indicate conceptual differences between the data collected in surveys and accounting data [30]. Accounting data for example depends highly on the capacity of doctors to provide correct medical classifications and the validity of this data on depressive disorders is questionable [29, 31]. On the other hand, the significance of the survey data presented here depends on the degree with which the survey represents the population (response bias) as well as the above-mentioned limitations regarding the indicator itself (willingness to seek help, recall and reporting bias).

Whether a self-reported medical diagnosis of depression actually indicates depression according to clinical diagnostic criteria was a question that was analysed using data from the German Health Interview and Examination Survey for Adults (DEGS1) and its additional mental health module (DEGS1-MH) [32]. Standardised clinical interviews according to current classification criteria detect depression in only 37.2% of respondents who self-reported a medical diagnosis of depression during the past 12 months. 36.2% fulfil the criteria for a different mental disorder, whereas in 26.6% of cases the diagnosis reveals no mental disorder. On the other hand, only 33.0% of those who are diagnosed with depression in a clinical interview report a medical diagnosis of depression. Estimates on the prevalence of depression therefore both under- and overestimate the number of

Prevalence of self-reported medical diagnoses of depression is highest at age 45 to 64.
The 12-month prevalence of self-reported medically diagnosed depression decreases with increasing education.

Cases depending on whether diagnostic criteria or self-reported medical diagnoses are used as a basis. Surveys that collect epidemiological data and link it to the data from health insurance funds could provide more differentiated results (data linkage).

If, instead of looking at the diagnoses physicians provide, we use a questionnaire to survey the presence of individual symptoms of depression during the past two weeks (PHQ-8 [33, 34]), 10.1% of the population show depressive symptoms. Women are affected more often than men, there are clear regional differences and contradictory findings related to age. Whereas women aged 18 to 29 show the highest rates of depressive symptoms, it is women aged 45 to 64 who most often report a medical diagnosis of depression. For men, the number of those with depressive symptoms nearly halves at age 65 and above, but remains constant up to that age. This also highlights the fact that pressures can only be reflected in documented diagnoses once patients turn to a doctor. Compared to men, women seek medical consultation more often, a fact which is also true for younger people compared to older people [35]. Physicians who diagnose depressive symptoms in a patient do not necessarily medically classify these as depression. This is the case when for example the number and severity of depressive symptoms is low and do not therefore fulfill the general diagnosis of the disorder or when patients present further symptoms that are then collectively classified as a different mental disorder.

The data on self-reported medical diagnoses of depression published in the health survey enable, as long as we consider the limitations described, a description of the people who receive the diagnosis of depression in the healthcare system. The socio-demographic, socio-economic and regional imbalances in rates of diagnosis of depression reflect as many differences in morbidity as levels of care provision between different groups in the population. An analysis of data based on standardised diagnosed depression within a clinical interview compared to self-reported medical diagnoses highlights that different indicators in epidemiology and healthcare services diagnose reveal different groups of people with depression. Clarifying these discrepancies could contribute to a provision of services according to need, for example through an increased use of screening instruments in medical practice.
12-month prevalence of self-reported medical diagnoses of depression in Germany

References
13. Substance Abuse and Mental Health Services Administration (2011) Results from the 2010 National Survey on Drug Use and Health: Summary of National Findings. Substance Abuse and Mental Health Services Administration, Rockville
   http://edoc.rki.de/oa/articles/reLPtvNhG572/PDF/22QgLkXlIqgU.pdf (As at 13.07.2017)

24. Maske UE, Buttery AK, Beesdo-Baum K et al. (2016) Prevalence and correlates of DSM-IV-TR major depressive disorder, self-reported diagnosed depression and current depressive symptoms among adults in Germany. Journal of Affective Disorders 190:167-177


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Depressive symptoms among adults in Germany

Abstract
Depressive symptoms imply a loss of quality of life, leading to increased morbidity and mortality as well as increased costs to the healthcare system. Information on the prevalence and distribution of depressive symptoms in the population is essential in light of planning prevention and care. GEDA 2014/2015-EHIS surveyed current depressive symptoms among adults in Germany through the Patient Health Questionnaire (PHQ-8). The surveyed prevalence of 10.1% indicates the widespread occurrence of depressive symptoms, regardless of an actual clinical diagnosis of depression. Prevalence for women (11.6%) is higher than for men (8.6%). Further differences exist concerning age and education as well as regional differences. The results are discussed in the light of the data available so far.

Introduction
Depression is one of the most common mental health disorders and is related to a high disease burden both for individuals suffering from the condition as also for society as a whole [1-3]. German social insurance carriers have recorded a significant increase in the role of depression in health services over the past few years, a process which has been accompanied by increasing public awareness [4-6].

The term depression covers a heterogeneous spectrum of depressive disorders which can be categorised for example with regard to the severity and course of depressive symptoms [7]. For a physician to diagnose depression requires, beyond simply confirming the presence of depressive symptoms, the fulfilment of specific diagnostic criteria, such as the presence of certain key symptoms. However, depressive symptoms such as despondency and loss of energy can also affect persons that do not fulfil the necessary clinical diagnostic criteria of depression and for example experience subthreshold depression, or experience such symptoms yet in the context of other mental and physical disorders. Among these are depressive symptoms related to emotionally stressful life events, substance abuse (alcohol, drugs, etc.) and chronic physical illness or as side effects of certain medications. Regardless of their diagnostic classification, depressive symptoms lead to a subjective deterioration in health and health-related quality of life [8, 9] and are associated with increased morbidity and mortality rates [10, 11]. Moreover, depressive symptoms increase the number of outpatient physician visits and sick leave days [12] and in particular in older age lead to increasing health service utilisation [13].

Epidemiological estimates on the prevalence and distribution of depression symptoms in the population are therefore highly relevant to public health and are an...
The analyses are based on data from 23,602 participants aged 18 years and older (12,900 women and 10,702 men) with valid PHQ-8 data. The calculations were carried out using a weighting factor that corrects for deviations within the sample from the German population (as of 31 December 2014) with regard to gender, age, district type and educational level. The International Standard Classification of Education (ISCED) was used to classify the responses provided on educational level [16]. A detailed description of the methodology used in the GEDA 2014/2015-EHIS study can be found in Lange et al. 2017 [17] as well as in the article German Health Update: New data for Germany and Europe, which was published in Issue 1/2017 of the Journal of Health Monitoring.

**Results and discussion**

The prevalence of current depressive symptoms among adults in Germany is 10.1% (Table 1). Prevalence among women (11.6%) is significantly higher than among men (8.6%). Gender differences are recorded across all age groups. Significant differences also exist with regard to age: Among women aged 18 to 29, prevalence is 16.4% and therefore higher than among older women. The lowest frequencies are recorded for women and men aged 65 and over (women 8.7%; men 5.4%).

Prevalence is lower among respondents with a high education level than with a medium or low one. Population prevalence of depressive symptoms thereby increases by the factor 2.5 (high education 5.9%; low education 14.8%, data not shown). Differences in prevalence with regard to levels of education are recorded...
One in ten adults in Germany experiences current depressive symptoms.

Table 1
Prevalence of depressive symptoms in the past 2 weeks (PHQ-8 score ≥10) according to gender, age and educational level (n=12,900 women; n=10,702 men)
Source: GEDA 2014/2015-EHIS

<table>
<thead>
<tr>
<th></th>
<th>Women total</th>
<th>%</th>
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<tbody>
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<td>High education</td>
<td>5.9</td>
<td>(4.7-7.4)</td>
<td></td>
</tr>
<tr>
<td>≥65 Years</td>
<td>5.4</td>
<td>(4.5-6.5)</td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>7.1</td>
<td>(4.8-10.5)</td>
<td></td>
</tr>
<tr>
<td>Medium education</td>
<td>5.7</td>
<td>(4.4-7.5)</td>
<td></td>
</tr>
<tr>
<td>High education</td>
<td>4.2</td>
<td>(3.0-5.9)</td>
<td></td>
</tr>
<tr>
<td>Total (women and men)</td>
<td>10.1</td>
<td>(9.6-10.7)</td>
<td></td>
</tr>
</tbody>
</table>

CI=Confidence interval

across all age groups. Analyses that take into account age, gender and education indicate a prevalence of depressive symptoms of over one fifth (22.4%) of women with low education aged 18 to 29. Analogous analyses for men show the highest prevalence in those with low education aged 30 to 44 (17.8%). Prevalence is lowest in both genders for those aged over 65 with high education (women 3.6%; men 4.2%).

The prevalence of depressive symptoms varies between federal states (Figure 1). Women from Berlin and Brandenburg (14.6%) are nearly twice as likely to present depressive symptoms compared to women from Thuringia (7.4%). Significant differences in prevalence for men are found between Bavaria (5.7%) and Saarland (11.4%), as well as North-Rhine Westphalia (10.9%). Differences in prevalence between women and men are particularly high in Bavaria (11.2% vs. 5.7%) and Brandenburg (14.6% vs. 7.5%) and low in Saarland (11.0% vs. 11.4%) and Thuringia (7.4% vs. 7.9%).

Total prevalence (10.1%) is comparable to current findings from the US-American National Health and Nutrition Examination Survey (NHANES) and the Behavioral Risk Factor Surveillance System (BRFSS) [18, 19]. However, the new data is not consistent with data from previous surveys that were conducted in Germany. According to DEGS1 (2008-2011), the prevalence of
Women aged 18 to 29 present a particularly high prevalence of depressive symptoms (16.4%).

Depressive symptoms (8.1% overall, 6.1% for men) was significantly lower than the prevalence reported by the current survey [14]. An older population survey indicated an overall prevalence of 7.2%, which is even lower than the prevalence recorded by DEGS1 [20]. Whether these differences indicate a trend over time in the prevalence of depressive symptoms among adults and/or men in Germany is unclear and to clarify this question will require further comparative data, also because the PHQ version applied differed as did the surveyed age groups. In the US, however, an increase in depressive symptoms in the population has been documented since 2005 [18].
Depressive symptoms among adults in Germany

Previous surveys have already highlighted the importance of differences in prevalence between women and men [8, 14, 19]. The results highlight the importance of the age factor and are in line with the data available, according to which depressive symptoms among adults are clearly and particularly linked to younger age [12, 14, 19]. Equally, the links between depressive symptoms and education [8, 18] as well as socioeconomic status [12, 14, 21] are well known. No comparative data on the differences in prevalence between the German federal states is available. Regional differences could be related to a region’s age and social structure, but could also be related to differences in the spatial distribution of risk and protective factors. A comparison between cities and rural areas reveals different levels of prevalence, whereby the frequencies of depressive symptoms are higher in medium-sized and large cities than in small rural towns [12, 14].

The reported results can be classified in the context of available epidemiological findings on the prevalence of diagnoses of depression. GEDA 2014/2015-EHIS reports a 12-month prevalence of self-reported medical diagnoses of depression of 8.1% which is lower than the overall prevalence of depression symptoms. DEGS1 data (additional mental health module) too reveals a lower prevalence of diagnoses of depression that are recorded through standardised clinical interviews [12, 22, 23]; whereby methodological differences in the surveys need to be considered. When the definition of depressive symptoms according to PHQ is adjusted to include defining criteria for a diagnosis of depression, frequencies also drop [24]. A medical diagnosis moreover depends on patients turning to health services and is influenced by further factors such as healthcare services coverage [25].

To record depressive symptoms, the survey applied the internationally established PHQ instrument. Based on the results from GEDA 2014/2015-EHIS, we can make statements on the adult population in Germany. Identifying the particularly burdened segments of the population provides a basis to develop target groups to which to direct prevention and care. Moreover, the survey reveals relevant questions for future surveys on the prevalence of depressive symptoms, for example concerning trends over time and regional differences. The reported prevalence should be considered as conservative estimates because persons with acute or severe depression are less likely to participate in the survey [26].

References


17. Lange C, Finger JD, Allen J et al. (in press) Implementation of the European Health Interview Survey (EHIS) in Germany. Further development of the German Health Update (GEDA) Archives of Public Health


24. Maske UE, Busch MA, Jacobi F et al. (2015) Current major depressive syndrome measured with the Patient Health Questionnaire-9 (PHQ-9) and the Composite International Diagnostic Interview (CIDI): results from a cross-sectional population-based study of adults in Germany. BMC Psychiatry 15(1):77


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The Robert Koch Institute is a Federal Institute within the portfolio of the German Federal Ministry of Health.
Limitations to usual activities due to health problems in Germany

Abstract

Limitations to usual activities due to health problems impact quality of life and well-being. The Global Activity Limitation Indicator (GALI) was developed to assess the trends in limitations to usual activities. The GALI question is applied in a single or routed, multi-question version. GEDA 2014/2015-EHIS for the first time applied a three-question version. Three quarters of respondents reported that they did not experience any limitations to their usual activities. 18.7% of women and 17.0% of men said they had experienced moderate limitations. 6.4% of women and 6.8% of men reported severe limitations. The share of respondents experiencing limitations increases with age and shows a clear education gradient. Changes in methodology, however, mean that current results based on the GALI question cannot be compared to the results from earlier survey waves of the same study.

Introduction

Physical or mental health problems that lead to limitations in usual activities have the potential to significantly impact quality of life and personal well-being. Given the demographic change and the rise in life expectancy, the number of people experiencing limitations to their usual activities will likely increase in the future. The years of life gained may be spent in good or bad health [1, 2]. A key challenge for health policy, therefore, will be to provide the conditions for people to age in good health and maintain their quality of life. That is why it is crucial to investigate if the rise in life expectancy is related to an increase in years spent without limitations to usual activities due to health problems. There seems to be a trend in Germany towards the occurrence of diseases and limitations to usual activities at a later stage in life and therefore towards a longer life with good health [3, 4].

Political measures and preventive healthcare programmes that focus on these developments require an indicator that determines the share of people in the population affected by limitations. The Global Activity Limitation Indicator (GALI) was developed to measure such trends in the limitations to usual activities over time. The GALI question collects data on self-rated limitations. Data obtained through the GALI question is used to calculate the Healthy Life Years (HLY) indicator, which is also known as disability free life expectancy. It provides information on the number of remaining life years that respondents will spend without limitations to usual activities due to health problems [5]. The GALI question is part of the Minimum European Health Module (MEHM) [6] and is also surveyed in the context of the EU-Statistics on Income and Living Conditions (EU-SILC). Prütz and Lange 2016 provide an overview of the available data.
Classification of Education (ISCED) was used to classify the responses provided on educational level [9]. Differences between these groups are interpreted as statistically significant if the respective confidence intervals do not overlap.

A detailed description of the methodology applied in the GEDA 2014/2015-EHIS study can be found in Lange et al. 2017 [10] as well as in the article German Health Update: New data for Germany and Europe in Issue 1/2017 of the Journal of Health Monitoring.

**Results and discussion**

Three quarters of respondents reported no limitations to their usual activities. 25.2% of women and 23.8% of men said they are long-term limited in their usual activities (Table 1 and Table 2). 6.4% of women and 6.8% of men reported severe limitations to their usual activities. When looking at both categories together, severely and moderately limited, it becomes evident that the share of respondents experiencing limitations strongly increases with age. Whereas 12.0% of women and 9.5% of men aged 18 to 29 reported limitations, this figure rises to 41.1% of women and 39.4% of men aged 65 and over. A clear education gradient is evident for both sexes regarding limitations. Across all age groups, the share of women and men facing limitations to usual activities due to health problems is significantly lower for those with high education than those with low education.

Regional differences in the share of people experiencing limitations also exist (Figure 1). Compared to the German average, prevalence among women from...
Baden-Württemberg (21.6%) is significantly lower, while among women from Brandenburg it is significantly higher (32.0%). For men, no such differences compared to the German average were observed. A significant difference was recorded for men from Baden-Württemberg (21.7%) compared to men from Saxony-Anhalt (28.6%). These results, however, do not take into account the regional differences in the age composition of the population. The different age patterns in the federal states could explain regional differences regarding limitations due to health problems. Studies show that the shift between the age groups is stronger in East than in West Germany. In East Germany, the share of those aged 65 and over is 23%, whereas in the west it is 21% [11].

The GALI question can be implemented in different ways. Whereas GEDA 2014/2015-EHIS applied the three-question version (see above), data for the indicator can also be collected through a single question with multiple dimensions (existence of a limitation, its duration and severity). Previous GEDA survey waves [12-14] used a single-question version. In 2015, the German question-
Limitations to usual activities due to health problems in Germany

The share of respondents who experience severe or moderate limitations (GEDA 2012) changed between GEDA 2012 (11.3%) and GEDA 2014/2015-EHIS (6.6%) as did the share of those experiencing moderate limitations (GEDA 2012 21.7%; GEDA 2014/2015-EHIS 17.9%). Published EU-SILC results for Germany reveal that in 2015 21.2% of the population experienced limitations (women 21.7%; men 20.6%) [15]. In comparison, in 2014, 36.2% of respondents reported limitations to usual activities [16]. Independently of each other, 2015 EU-SILC and GEDA 2014/2015-EHIS data therefore reveal similar shifts to previous survey results.

Table 2: 12-month prevalence of limitations due to health problems among men according to age and educational level (n=10,738 men)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Total</th>
<th>Not limited</th>
<th>% (95% CI)</th>
<th>Moderately limited</th>
<th>% (95% CI)</th>
<th>Severely limited</th>
<th>% (95% CI)</th>
<th>Limited (moderately and severely limited)</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men total</td>
<td>76.2</td>
<td>76.2 (75.1-77.2)</td>
<td>17.0 (16.1-17.9)</td>
<td>6.8 (6.2-7.5)</td>
<td>23.8 (22.8-24.9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-29 Years</td>
<td>90.5</td>
<td>88.6 (92.2)</td>
<td>7.0 (5.6-8.8)</td>
<td>5.6 (3.9-7.5)</td>
<td>23.8 (22.8-24.9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>87.6</td>
<td>82.9 (91.2)</td>
<td>6.8 (4.3-10.5)</td>
<td>5.6 (3.9-7.5)</td>
<td>12.4 (8.8-17.2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium education</td>
<td>91.1</td>
<td>88.6 (93.1)</td>
<td>7.6 (5.7-9.9)</td>
<td>1.3 (0.6-2.8)</td>
<td>8.9 (6.9-11.4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High education</td>
<td>93.4</td>
<td>88.5 (96.3)</td>
<td>5.2 (3.1-8.7)</td>
<td>1.4 (0.2-9.2)</td>
<td>6.6 (3.7-11.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-44 Years</td>
<td>85.9</td>
<td>83.9 (87.8)</td>
<td>11.4 (9.8-13.2)</td>
<td>2.6 (1.8-3.8)</td>
<td>14.1 (12.2-16.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>77.2</td>
<td>68.9 (83.8)</td>
<td>14.7 (9.5-22.2)</td>
<td>8.1 (4.4-14.3)</td>
<td>22.8 (16.2-31.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium education</td>
<td>84.2</td>
<td>81.2 (86.8)</td>
<td>13.3 (10.9-16.1)</td>
<td>2.5 (1.6-3.9)</td>
<td>15.8 (13.2-18.8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High education</td>
<td>92.5</td>
<td>90.4 (94.1)</td>
<td>6.9 (5.3-8.9)</td>
<td>0.6 (0.3-1.5)</td>
<td>7.5 (5.9-9.6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-64 Years</td>
<td>72.5</td>
<td>70.6 (74.3)</td>
<td>19.6 (18.1-21.3)</td>
<td>7.9 (6.9-9.1)</td>
<td>27.5 (25.7-29.4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>65.9</td>
<td>60.9 (70.9)</td>
<td>22.0 (18.2-26.3)</td>
<td>12.1 (8.9-16.1)</td>
<td>34.1 (29.3-39.9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium education</td>
<td>67.9</td>
<td>65.0 (70.6)</td>
<td>22.5 (20.1-25.1)</td>
<td>9.7 (8.2-11.4)</td>
<td>32.1 (29.4-35.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High education</td>
<td>83.2</td>
<td>81.2 (85.1)</td>
<td>13.6 (11.9-15.5)</td>
<td>3.2 (2.3-4.3)</td>
<td>16.8 (14.9-18.8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥65 Years</td>
<td>60.6</td>
<td>58.5 (62.8)</td>
<td>26.4 (24.3-28.4)</td>
<td>13.0 (11.6-14.6)</td>
<td>39.4 (37.2-41.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>57.7</td>
<td>52.8 (62.6)</td>
<td>27.3 (22.9-32.1)</td>
<td>15.0 (12.0-18.6)</td>
<td>42.3 (37.4-47.2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium education</td>
<td>60.2</td>
<td>56.9 (63.4)</td>
<td>25.7 (23.0-28.6)</td>
<td>14.1 (12.0-16.5)</td>
<td>39.8 (36.4-43.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High education</td>
<td>62.6</td>
<td>59.2 (65.9)</td>
<td>27.3 (24.0-31.0)</td>
<td>10.1 (8.0-12.5)</td>
<td>37.4 (34.1-40.8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (women and men)</td>
<td>75.5</td>
<td>74.7 (76.3)</td>
<td>17.9 (17.2-18.5)</td>
<td>6.6 (6.2-7.1)</td>
<td>24.5 (23.7-25.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CI=Confidence interval.

6.4% of women and 6.8% of men report they are severely limited.

For the EU-Statistics on Income and Living Conditions (EU-SILC), implemented in Germany by the Federal Statistical Office, applied the three-question version, thereby deviating from earlier surveys. The change in the formulation of the question means that current results for the GALI question are not comparable to the results from previous survey waves of the same study. This applies both to the GEDA survey and to EU-SILC. However, similar shifts in the results of both surveys compared to their earlier waves are observed. In GEDA 2014/2015-EHIS, 75.5% of respondents report that they do not experience limitations, whereas in GEDA 2012 the corresponding figure was 67.1%. The share of respondents who experience severe or moderate limitations (GEDA 2012) changed between GEDA 2012 (11.3%) and GEDA 2014/2015-EHIS (6.6%) as did the share of those experiencing moderate limitations (GEDA 2012 21.7%; GEDA 2014/2015-EHIS 17.9%). Published EU-SILC results for Germany reveal that in 2015 21.2% of the population experienced limitations to their usual activities (women 21.7%; men 20.6%) [15]. In comparison, in 2014, 36.2% of respondents reported limitations to usual activities [16]. Independently of each other, 2015 EU-SILC and GEDA 2014/2015-EHIS data therefore reveal similar shifts to previous survey results.
The share of respondents reporting limitations increases with age and shows a strong education gradient.

There are some significant differences in limitations to usual activities between federal states.

Figures 1a and 1b show the 12-month prevalence of limitations due to health problems (severely and moderately limited) according to gender and federal state (n=13,014 women; n=10,738 men). Source: GEDA 2014/2015-EHIS

Confidence intervals in parentheses

waves. These results highlight that the indicator is sensitive to changes in the way questions are posed [17]. This aspect will be further analysed and discussed in order to identify relevant potentials for improvement.

The demographic change and the rise in life expectancy will require changes at the level of prevention and healthcare provision. Periodically collected data on limitations to usual activities due to health problems and the extent and duration of such limitations are a potentially valuable contribution to strengthening needs-based prevention and healthcare, also at regional level, where applicable.
Limitations to usual activities due to health problems in Germany

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Accident injuries of adults in Germany

Abstract
In 2014, according to estimates by the Federal Institute for Occupational Safety and Health (BAuA), around 9.8 million people in Germany suffered accident injuries. Over 22,000 people died. Federal statistics, however, cannot comprehensively describe accidents in Germany. Here, the Robert Koch Institute health surveys provide an important addition. In the GEDA 2014/2015-EHIS survey, 10.5% of men and 6.9% of women reported that they had suffered accident injuries requiring medical treatment during the past 12 months. Young men aged 18 to 29 have the highest accident risk (18.1%). The overall accident injury figures have hardly changed since the previous GEDA 2012 survey. Preventing accidents is a highly important topic not only for the victims of accidents and their families, but also for society as a whole. According to the World Health Organization, a largely untapped potential for accident prevention remains.

Introduction
Preventing accidents is highly important, both for the victims of accidents and their families and also for society as a whole. According to the Federal Institute for Occupational Safety and Health (BAuA) estimates, around 9.8 million people suffered accident injuries in 2014 [1]. More than 22,000 people died in accidents (ICD-10: V01-X59; ICD-10: International Statistical Classification of Diseases and Related Health Problems, 10th revision) [2]. Besides unintentional accident injuries, injuries can also be caused intentionally, for example during fights (interpersonal violence such as attacks or brawls) or in cases of intentional self-harm. The World Health Organization (WHO) estimates that 72% of all injuries in Europe are unintentional [3]. The medical treatment of injuries accounts for around 5% of total annual medical expenses (ICD-10: S00-T98; 2008) [4]. In 2015, around 11% of incapacity days for economically active members of the AOK health insurance fund were related to injuries [5]. Nearly every 10th premature death (death before the age of 65) in 2015 was due to injury [6].

Official statistics, however, cannot provide a comprehensive picture of accidents in Germany (see info box) [7]. Fatal accidents are recorded in cause of death statistics. Occupational accidents are documented comprehensively by the corresponding accident insurance providers; traffic accidents are recorded in road accident statistics. These statistics, however, fail to provide systematic data on further important fields such as accidents that occur at home, during leisure time or those road accidents where the police is not involved. Representative surveys (such as health surveys) can provide
Additional information and ensure a clearer overall picture of non-fatal accidents in Germany. They are therefore an important supplement [7].

Numerous health surveys which the Robert Koch Institute (RKI) conducted during the past few years provide cross-sectional and time series data on accidents for adults (and children) in Germany. The GEDA 2014/2015-EHIS survey provides current data. This survey integrated the European Health Interview Survey (EHIS) into the German Health Update survey (GEDA 2014/2015), which also involved substantial changes to the way in which questions are posed. This created challenges regarding numerous health topics as well as for non-fatal accidents mainly because, whilst GEDA 2014/2015-EHIS aims to ensure the comparability of findings across Europe, the survey also hopes to provide relevant data for preventive healthcare and health policy in Germany.

Indicator
GEDA 2014/2015-EHIS surveyed accident injuries through self-administered paper-based or online questionnaires. The first question was, ‘During the past 12 months have you suffered an injury from one of the following accidents? This includes injuries caused by poisoning, animals or insects. Injuries caused intentionally by other people are excluded.’ The available answer categories were ‘Road accident’, ‘Accident at home’, and ‘Accident during leisure time’.

All of those who had suffered an accident were then asked whether their injuries had required medical treatment, ‘Following your accident, did you require medical attention? If you suffered several accidents, this question refers to your severest accident, i.e. the accident that required the most medical care.’ Respondents could answer, ‘Care in hospital or other healthcare facility as inpatient or outpatient’, ‘Care provided by physician or nurse’, ‘No medical attention’.

GEDA 2014/2015-EHIS supplemented both of these questions, which form part of the EHIS instrument, with questions on occupational accidents so as to include accidents at work in the overall picture of accidents in Germany. Commuting accidents, i.e. accidents that occur on the way to work, were excluded. Insurance legislation in Germany covers these accidents through occupational accident insurance. Respondents were asked about occupational accidents and medical attention for resulting injuries by asking, ‘Did you suffer an injury at work during the past 12 months? This does not include commuting accidents’, and, ‘Did you require medical attention for your occupational accident?’ Possible answers were ‘Yes’ or ‘No’.

To calculate the indicator ‘Accident injury requiring medical attention’, a combination of the questions asked was used. To enter this category, a person had to have suffered a road accident, an accident at home or during leisure time and then sought medical attention in a hospital or other medical facility either as an inpatient or outpatient. Respondents who had suffered an occupational accident that had required medical attention were also included. Such a definition provides an overview of all non-fatal accidents in Germany (excluding minor injuries). Moreover, this approach allows us to continue the already established RKI time series. The results should
EHIS remained nearly unchanged (8.7% in 2012) [10]. Accident prevalence rates by gender also remained nearly constant. The survey registered a marginal decrease in the rate for men and a slight increase for women (rates of 10.9% and 6.6% respectively for accident injuries in 2012).

Stratified by age and gender, the group of young men aged 18 to 29 particularly stands out. Presenting an 18.1% accident injury rate over the past 12 months, this group is involved particularly often in accidents that require medical attention. Accident prevalence among men decreases with age, but up to the 45- to 64-year age group remains significantly higher than for women. The rate for men aged 65 and above then drops to 5.3%. Compared to the other age groups, the rates are significantly higher for the youngest group and significantly lower for the oldest group.

Accident prevalence for young women is also higher, yet lower than for men. 9.8% of women aged 18 to 29 suffer accident injuries. These rates for women drop at middle age, but, unlike men, begin to increase again at age 65. In this age group, 8.5% suffer accident injuries. The figures for the youngest and oldest age group are therefore significantly higher than for the other age groups.

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Riskier behaviour (risk seeking behaviour) is referred to as an explanation for the observed gender differences (and the particularly high accident prevalence among young men) [11]. Further differences, in which gender also plays a role, exist for the prevalence of occupational accidents. In numerous male dominated professions, the accident risk is simply higher, such as in the building sector [11].
11% of men and 7% of women suffered accident injuries requiring medical treatment during the past 12 months.

Table 1
12-month prevalence of accidents requiring medical treatment according to gender, age and educational level (n=12,625 women; n=10,527 men)

<table>
<thead>
<tr>
<th></th>
<th>Women total</th>
<th>%</th>
<th>(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-29 Years</td>
<td></td>
<td>6.9</td>
<td>(6.3-7.4)</td>
</tr>
<tr>
<td>Low education</td>
<td></td>
<td>9.8</td>
<td>(8.3-11.7)</td>
</tr>
<tr>
<td>Medium education</td>
<td></td>
<td>10.0</td>
<td>(8.1-12.3)</td>
</tr>
<tr>
<td>High education</td>
<td></td>
<td>3.7</td>
<td>(2.1-6.7)</td>
</tr>
<tr>
<td>30-44 Years</td>
<td></td>
<td>5.3</td>
<td>(4.3-6.4)</td>
</tr>
<tr>
<td>Low education</td>
<td></td>
<td>9.2</td>
<td>(5.5-15.2)</td>
</tr>
<tr>
<td>Medium education</td>
<td></td>
<td>5.4</td>
<td>(4.1-7.0)</td>
</tr>
<tr>
<td>High education</td>
<td></td>
<td>2.9</td>
<td>(2.1-4.0)</td>
</tr>
<tr>
<td>45-64 Years</td>
<td></td>
<td>5.3</td>
<td>(4.6-6.1)</td>
</tr>
<tr>
<td>Low education</td>
<td></td>
<td>6.0</td>
<td>(4.1-8.6)</td>
</tr>
<tr>
<td>Medium education</td>
<td></td>
<td>5.3</td>
<td>(4.5-6.3)</td>
</tr>
<tr>
<td>High education</td>
<td></td>
<td>4.2</td>
<td>(3.2-5.6)</td>
</tr>
<tr>
<td>≥ 65 Years</td>
<td></td>
<td>8.5</td>
<td>(7.3-10.0)</td>
</tr>
<tr>
<td>Low education</td>
<td></td>
<td>8.9</td>
<td>(6.7-11.6)</td>
</tr>
<tr>
<td>Medium education</td>
<td></td>
<td>8.5</td>
<td>(6.8-10.5)</td>
</tr>
<tr>
<td>High education</td>
<td></td>
<td>7.2</td>
<td>(4.7-10.7)</td>
</tr>
<tr>
<td>Total (women and men)</td>
<td></td>
<td>8.6</td>
<td>(8.2-9.2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Men total</th>
<th>%</th>
<th>(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-29 Years</td>
<td></td>
<td>10.5</td>
<td>(9.7-11.3)</td>
</tr>
<tr>
<td>Low education</td>
<td></td>
<td>18.1</td>
<td>(15.6-20.9)</td>
</tr>
<tr>
<td>Medium education</td>
<td></td>
<td>23.1</td>
<td>(17.3-30.1)</td>
</tr>
<tr>
<td>High education</td>
<td></td>
<td>17.2</td>
<td>(14.2-20.8)</td>
</tr>
<tr>
<td>30-44 Years</td>
<td></td>
<td>11.0</td>
<td>(9.6-12.7)</td>
</tr>
<tr>
<td>Low education</td>
<td></td>
<td>11.9</td>
<td>(7.7-18.0)</td>
</tr>
<tr>
<td>Medium education</td>
<td></td>
<td>13.8</td>
<td>(11.4-16.4)</td>
</tr>
<tr>
<td>High education</td>
<td></td>
<td>5.9</td>
<td>(4.4-7.7)</td>
</tr>
<tr>
<td>45-64 Years</td>
<td></td>
<td>9.5</td>
<td>(8.3-10.8)</td>
</tr>
<tr>
<td>Low education</td>
<td></td>
<td>11.3</td>
<td>(8.4-14.9)</td>
</tr>
<tr>
<td>Medium education</td>
<td></td>
<td>11.1</td>
<td>(9.4-13.1)</td>
</tr>
<tr>
<td>High education</td>
<td></td>
<td>5.9</td>
<td>(4.8-7.1)</td>
</tr>
<tr>
<td>≥ 65 Years</td>
<td></td>
<td>5.3</td>
<td>(4.3-6.5)</td>
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<td>(3.4-8.9)</td>
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<tr>
<td>Medium education</td>
<td></td>
<td>4.0</td>
<td>(2.9-5.5)</td>
</tr>
<tr>
<td>High education</td>
<td></td>
<td>7.5</td>
<td>(5.5-10.2)</td>
</tr>
<tr>
<td>Total (women and men)</td>
<td></td>
<td>8.6</td>
<td>(8.2-9.2)</td>
</tr>
</tbody>
</table>

CI=Confidence interval

Compared to GEDA 2012, age and gender patterns for the distribution of accident injuries are similar. However, this survey did not record an increase in accident prevalence for women aged 65 and above [10]. The only comprehensive survey of accidents and injuries so far was conducted in 2010 in the context of the accident module (GEDA 2010). The results of this survey, which the RKI published in the Contributions to Federal Health Reporting series, provided detailed insights on the accidents suffered by adults [7]. Like the current GEDA survey, the GEDA 2010 accident module already hinted at this tendency of accident rates among older women to increase again [7]. By surveying the type of accidents women suffered, it became clear that women aged 65 and above are more likely to suffer falls than men. Compared to men, the results from hospital diagnosis statistics also indicate an increased risk of injury for women aged 65 and above (inpatient treatment of injuries classified under ICD-10: S00-T98) [12].

Concerning education, GEDA 2014/2015-EHIS reveals a slightly lower accident prevalence among women and men from a high education background (Table 1). However, this does not apply equally to all age groups. The accident module in GEDA 2010 provided a more differentiated picture: people of high socio-economic status tended to report more accidents in leisure time, whereas
people with low social status more frequently reported occupational accidents [7]. For the overall prevalence of accident by social status, however, no differences were recorded. Conclusive evidence supports the existence of this strong correlation between the risk of suffering occupational accidents and social status: Employees in high status jobs significantly less often suffer accidents than those working in low status jobs. Mainly, this is due to the fact that the latter occupations more often involve hazardous work [13, 14].

GEDA 2014/2015-EHIS also provides regional prevalence data by federal state. The information system of Federal Health Reporting (www.gbe-bund.de, in German) provides data on accident prevalence by federal state, age and gender. There are only marginal differences in the prevalence of accidents between the German federal states.

Concerning the place of accident, GEDA 2014/2015-EHIS reveals that most non-fatal accidents occur at home or during leisure time. 6.4% of women (CI 5.9-6.9) and 6.2% of men (CI 5.7-6.8) reported accidents at home. 7.3% of women (CI 6.7-7.9) and 10.8% of men (CI 10.0-11.7) reported accidents during leisure time. Due to the format of the corresponding questions in the EHIS questionnaire, no conclusions can be drawn on the percentage of these accidents that required medical treatment. For fatal accidents too, cause of death statistics indicate that 80% occur at home or during leisure time [2]. Current GEDA survey results are therefore in line with earlier GEDA survey waves as well as with the annual estimates of Germany’s Federal Institute for Occupational Safety and Health (BAuA) [1, 7, 10, 15, 16]. In GEDA, the workplace figures as the third most frequent place of accident and a significantly higher number of men suffer occupational accidents than women (5.9% vs. 2.7%; CI 5.4-6.6 and 2.3-3.1).

A comparison of accident prevalence as reported in GEDA 2014/2015-EHIS with other data sources is not fully possible. This is due to the differences in survey methods and content, for example that official hospital diagnosis statistics do not differentiate between unintentional and intentional injuries. BAuA annually estimates total accident prevalence in Germany and does also differentiate according to places of accident. The current estimate reports that roughly 12% of the population suffer accident injuries per year [1]. GEDA 2014/2015-EHIS reports a lower prevalence of just under 9% for adults. BAuA figures, however, also include children and numerous surveys indicate that children are more likely to suffer accidents than adults [17-19].

In spite of highly positive developments, such as the significant decrease in fatal road accidents during the past 20 years [20], accident injuries remain a prime public health concern, regarding not only the prevalence of accidents, their sometimes dire consequences and related high costs of treatment, but also concerning prevention: The WHO considers that most intentional and unintentional injuries could be prevented [3].
Most (non-fatal and fatal) accidents occur at home and during leisure time.

### Accident injuries of adults in Germany

#### References


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Prevalence, incidence and mortality of diabetes mellitus in adults in Germany – A review in the framework of the Diabetes Surveillance

Abstract
Continuous monitoring of the key epidemiological indicators of diabetes is necessary for evaluating the magnitude of diabetes as a public health problem, but is currently not being undertaken in Germany. A comprehensive literature review covering the last decades was conducted to give an overview of population-based studies reporting on diabetes prevalence, diabetes incidence, and diabetes-related mortality among adults in Germany. This review differentiates between known and unknown diabetes, but not between individual types of diabetes.
Numerous studies have identified a considerable increase in the prevalence of known diabetes among the adult population over time. Until the 1960s, the prevalence of known diabetes remained below 1%. However, current nationwide estimates for Germany are much higher and range between 7.2% (population aged 18 to 79 years) based on health examination surveys of the Robert Koch Institute (RKI), 8.9% (population aged 18 years and over) based on RKI telephone health interview surveys and 9.9% (among all age groups) based on statutory health insurance data. Few available estimates point to an increase in the incidence of known diabetes since the 1960s. For example, a comparison of data from the diabetes register of the former German Democratic Republic (GDR) in 1960 with current follow-up data from RKI survey participants shows that incidence rates increased from 1.2 (all age groups) to 6.9 (population aged 18 to 79 years) per 1,000 person-years. Data on diabetes-related mortality are also scarce, but indicate that excess mortality persists among people with known diabetes compared to those in the same age group without the condition, despite the finding of decreasing mortality rates among people with known diabetes. For example, the mortality rate based on early data from the GDR diabetes register was 1.9-fold higher among people with known diabetes than among the general population; current mortality follow-up data of RKI survey participants show a 1.7-fold higher mortality rate among people with known diabetes compared to those without the condition. Given the limited data that are currently available and the considerable variation of diagnostic criteria, it is not possible to estimate time trends in the prevalence, incidence or mortality of unknown diabetes.
An extension of available health monitoring approaches and an improved use of existing data sources for secondary analysis are needed for a reliable evaluation of dynamics in diabetes epidemiology in Germany. To achieve these goals, a national diabetes surveillance system is currently being established under the auspices of the RKI.
1. Introduction

Diabetes mellitus is a metabolic disorder involving a disruption of the regulation of blood glucose levels [1]. It results in chronically elevated blood glucose concentrations, which, if left untreated or treated insufficiently, can lead to serious complications including myocardial infarction, stroke, renal failure, blindness and amputations. Clearly, it can therefore reduce people’s quality of life and life expectancy, while also producing high levels of costs for health care systems [2].

Information about the spread of diabetes mellitus (Prevalence, Info box 1) is particularly relevant to attempts to classify the disorder within the public health context. Around 3,500 years ago, descriptions of symptomatology demonstrate that severe cases of diabetes were rare [3]. Even as late as the first half of the 20th century, the prevalence of diabetes in Europe was still estimated to be considerably lower than 1% [4, 5]. However, since the 1960s, there has been a marked increase in the prevalence of diabetes in Germany that has led it to be viewed as endemic [6]. In fact, an alarming increase in the prevalence of diabetes has occurred throughout the world [7]; so much so that this situation has been described as a ‘diabetes pandemic’ [8, 9]. In addition to known (medically diagnosed) diabetes, unknown (medically undiagnosed) diabetes also plays an important role because it is suggested that a large number of cases go unreported [10]. There are estimations that point to a period of latency between the onset of diabetes and a medical diagnosis of the condition of at least six years on average [11].

During this time, a considerable proportion of people with unknown diabetes begin to develop diabetes-specific complications [12-14]. However, changes to the criteria used for diagnosis (Info box 4) and diabetes screening could lead to a shift in the ratio of unknown to known cases over time.

Time trends in diabetes prevalence are directly associated with developments in the rate of new cases (Incidence rate, Info box 2) and the death rate (Mortality rates, Info box 3) within a given population [15]. In turn, the incidence rate is closely associated with changes in behaviour (such as dietary habits, physical activity and associated body weight) as well as living conditions (such as economic, social and environmental factors at the individual and regional level) that have an impact on diabetes development. Apart from increases in life expectancy in the general population, the mortality rate among people with diabetes is particularly influenced by the quality of diabetes care. In addition, demographic changes (such as population ageing and migration) play a role in epidemiological developments linked to diabetes. In Germany – as in most other countries – information about the interplay of the prevalence, incidence and mortality rates linked to diabetes is limited due to the lack of continuous data collection [16-18].

This article aims to summarise available data on the prevalence, incidence and mortality of diabetes among adults in Germany and to describe time trends wherever possible. It considers both known and unknown diabetes. This article also explores approaches that could be used to continuously monitor key indicators of dynamics in diabetes epidemiology in Germany.
2. Method

A narrative literature review of the PubMed bibliographic database was conducted to identify studies that have published data on diabetes prevalence, incidence and mortality in Germany. In addition, we hand-searched the bibliographies of relevant original research articles and literature reviews. However, only studies that directly provided or permitted calculation of the following data on prevalence, incidence or mortality were included within this review: prevalence as a percentage of the population with diabetes (Info box 1); incidence as a rate, in other words, as the number of new cases of diabetes per 1,000 person-years (Info box 2); age-standardised or age-adjusted mortality rate comparing all-cause mortality rates among people with diabetes to rates among people without diabetes or in the general population (Info box 3). Given the limited availability of data on incidence, studies were also included if they provided current nationwide estimates of the cumulative incidence (Info box 2). However, studies that only provided data on children or adolescents, or on population subgroups at particular risk of diabetes (such as people with obesity, a history of heart disease or those living in nursing homes), were not included in the review. Depending on the study in question, ‘diabetes’ was usually defined as all types of the disorder or just type 2 diabetes – the most predominant form of diabetes in adults [10, 18]. Detailed descriptions of the study populations and the definition of diabetes used in the studies included in this review are set out in the figures and tables presented below.

3. Prevalence

3.1 Prevalence of known diabetes

Numerous estimates of the prevalence of known diabetes are available from various studies that have been conducted over recent decades. The individual estimates of prevalence from studies undertaken after around 1960 are summarised in Figure 1 (for national-level studies) and in Figure 2 (for regional studies). Overall, the available data demonstrate that the prevalence of known diabetes has strongly increased over time.

Until the beginning of the 20th century, prevalence estimates of known diabetes were based on mortality and clinical case statistics; these identified a prevalence of between 0.2% and 0.4% [4, 5, 19]. Estimates made during the Second World War, which were derived from statistics covering the provision of insulin and dietary supplements to diabetes patients, suggest a decrease in prevalence. In part, this is due to the increased mortality among people with diabetes due to deficient or low-quality medication and food supplies as well as a higher susceptibility to infection [5, 19].

Living conditions improved in the 1950s and 1960s. This went along with an increased intake of high-calorie foods, reduced levels of physical activity and increases in the prevalence of overweight and obesity in the population; at the same time, life expectancy among people with diabetes increased due to improved treatment. As a result, the prevalence of known diabetes increased considerably [5, 6, 20-22]. In addition, diabetes screening activities mainly conducted in East Germany (the former German Democratic Republic, GDR) and to a
AOK Hesse [34, 35], all demonstrate a clear increase in prevalence. According to data from the RKI examination surveys conducted between 1997 and 1999 (GNHIES98) and 2008 and 2011 (German Health Interview and Examination Survey for Adults, DEGS1), the prevalence of known diabetes rose from 5.2% to 7.2% among persons aged 18 to 79 years [31]. Health insurance data covering everyone insured by AOK Hesse between 2000 and 2009 showed a rise from 6.5% to 9.7% [35]. Differences in prevalence estimates derived from these and other studies conducted over a similar time period (Figures 1 and 2) are most likely attributable to differences in criteria used to define diabetes and in the groups of people included in the studies in question, which can differ according to the data source (Info box 5).

Consistent across studies based on survey and health insurance data, about one third of the observed increase is attributable to demographic ageing [31, 35]. Further reasons for the current increase in prevalence may be improvements in early disease detection (such as increased awareness among doctors or changes in diagnostic criteria: see Info box 4), partial improvements made to diabetes care (such as the introduction of Disease Management Programmes) [36, 37] and the associated longer life expectancy. In addition, changes in the prevalence of behavioural risk factors also need to be considered. However, these demonstrate partly opposing trends and – according to a summary measure provided by the German Diabetes Risk Score – provide no evidence of a current increase in the overall level of risk [38].

During the first decade of the 21st century, data from periodically repeated nationwide examination, telephone and postal surveys [31-33], as well as trend analyses based on insurance data from AOK Baden-Württemberg and AOK Hesse [34, 35], all demonstrate a clear increase in prevalence. According to data from the RKI examination surveys conducted between 1997 and 1999 (GNHIES98) and 2008 and 2011 (German Health Interview and Examination Survey for Adults, DEGS1), the prevalence of known diabetes rose from 5.2% to 7.2% among persons aged 18 to 79 years [31]. Health insurance data covering everyone insured by AOK Hesse between 2000 and 2009 showed a rise from 6.5% to 9.7% [35]. Differences in prevalence estimates derived from these and other studies conducted over a similar time period (Figures 1 and 2) are most likely attributable to differences in criteria used to define diabetes and in the groups of people included in the studies in question, which can differ according to the data source (Info box 5). Consistent across studies based on survey and health insurance data, about one third of the observed increase is attributable to demographic ageing [31, 35]. Further reasons for the current increase in prevalence may be improvements in early disease detection (such as increased awareness among doctors or changes in diagnostic criteria: see Info box 4), partial improvements made to diabetes care (such as the introduction of Disease Management Programmes) [36, 37] and the associated longer life expectancy. In addition, changes in the prevalence of behavioural risk factors also need to be considered. However, these demonstrate partly opposing trends and – according to a summary measure provided by the German Diabetes Risk Score – provide no evidence of a current increase in the overall level of risk [38].

Establishing a continuous monitoring system for the prevalence of known diabetes among adults in Germany
Prevalence, incidence and mortality of diabetes mellitus in adults in Germany

Figure 1
Nationwide studies providing data on the prevalence of known diabetes among adults in Germany

<table>
<thead>
<tr>
<th>Study population</th>
<th>Definition of known diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>RKI interview surveys (via telephone): ≥18-year-olds, N=8,000 to 22,000 [32, 79-82]</td>
<td>Self-report of physician-diagnosed diabetes</td>
</tr>
<tr>
<td>RKI interview survey (online/paper-based): ≥18-year-olds, N=23,345 [83]</td>
<td>Self-report of having diabetes (not including gestational diabetes) in the last 12 months</td>
</tr>
<tr>
<td>RKI examination surveys: 18-79-year-olds, N=7,000 [31]</td>
<td>Self-report of physician-diagnosed diabetes or of anti-diabetic medication</td>
</tr>
<tr>
<td>Postal surveys: 18-79-year-olds, N=1,500 [33]</td>
<td>Self-report of diabetes diagnosis (≥1 visit to a doctor per quarter or regular anti-diabetic medication)</td>
</tr>
<tr>
<td>Claims data from physicians on insurees from all statutory health insurance funds: all ages, N~70 million [40]</td>
<td>Physician-diagnosed diabetes (ICD-10 E10-E14 in ≥2 of 4 quarters with additional ICD-tag ‘G’ (confirmed) in outpatient diagnoses)</td>
</tr>
<tr>
<td>Sample of insurees from all statutory health insurance funds: all ages, N=65 million [39]</td>
<td>Physician-diagnosed diabetes (ICD-10 E10-E14 with additional ICD-tag ‘G’ (confirmed) in outpatient diagnoses)</td>
</tr>
<tr>
<td>Sample of insurees from the AOK: all ages, N=24 million [84]</td>
<td>Physician-diagnosed type 2 diabetes (ICD-10 E11-E14 in ≥2 of 4 quarters in outpatient diagnoses) or prescription of anti-diabetic medication (in ≥2 of 4 quarters)</td>
</tr>
<tr>
<td>Sample of insurees from 6 statutory health insurance funds: all ages, N=15 million [85]</td>
<td>Physician-diagnosed diabetes or prescription of anti-diabetic medication</td>
</tr>
<tr>
<td>Sample of insurees from the Techniker Krankenkasse: all ages, N=5.4 million [86]</td>
<td>Physician-diagnosed type 2 diabetes (ICD-10 E11 with additional ICD-tag ‘G’ (confirmed) in ≥2 quarters in outpatient diagnoses or in ≥1 quarter in inpatient diagnoses for the period between Jan 2006 and Dec 2008)</td>
</tr>
<tr>
<td>HYDRA patient sample from general practices: ≥16-year-olds, N=43,549 [87]</td>
<td>Physician data on diabetes diagnosis on the day the study was conducted</td>
</tr>
<tr>
<td>DETECT patient sample from general practices: ≥18-year-olds, N=55,518 [88]</td>
<td>Physician data on diabetes diagnosis on the day the study was conducted or anti-diabetic medication</td>
</tr>
<tr>
<td>GEMCAS patient sample from general practices: ≥18-year-olds, N=35,869 [89]</td>
<td>Physician-diagnosed diabetes</td>
</tr>
<tr>
<td>Health Survey East/West 91: 25-69-year-olds, N=7,448 [29] (own calculation)</td>
<td>Self-report of diabetes diagnosis</td>
</tr>
<tr>
<td>GDR diabetes register (East Germany): all ages, N=17 million [22, 23, 51]</td>
<td>Physician-diagnosed diabetes</td>
</tr>
</tbody>
</table>

For graphical presentation, the midpoint of the respective study period (0.5 yearly steps) is entered into the horizontal axis.
Figure 2
Regional studies providing data on the prevalence of known diabetes among adults in Germany

Study population
- Sample of insurees from the AOK, Berlin: all ages, N=730,196 [90]
- Sample of insurees from the AOK, Baden-Württemberg: all ages, N=4 million [34]
- Sample of insurees from the AOK, Hesse: all ages, N=300,000 [33, 91-93]
- Sample of insurees from the AOK, Dortmund: all ages, N=6,478 [27]
- ESTHER patient sample from general practices, Saarland: 50-75-year-olds, N=9,953 [94]
- SESAM 2 patient sample from general practices, Saxony: 2-102-year-olds, N=8,877 [95]
- GHS, Marz-Bingen: 35-74-year-olds, N=15,010 [96]
- CARLA, Halle: 45-74-year-olds, N=1,382 [97]
- SHIP, Western Pomerania: 45-74-year-olds, N=2,247 [97]
- KORA S4, Augsburg: 45-74-year-olds, N=2,442 [97]
- KORA F4, Augsburg: 35-39-year-olds, N=1,653 [67]
- KORA S4, Augsburg: 55-74-year-olds, N=1,353 [98]
- Population sample from 5 federal states: 18-70-year-olds, N=2,150 [99]
- GDR diabetes register, district of Neubrandenburg: all ages, N~620,000 [100]
- GDR diabetes register, East Berlin: all ages, N~1.3 million [101]
- GDR diabetes register, district of Erfurt: all ages, N~1.2 million [102]
- GDR diabetes register, district of Schwerin: all ages, N~590,000 [103]
- GDR diabetes register, district of Rostock: all ages, N~830,000 [6]
- Diabetes Screening, Munich: all ages, N=789,000 [25]
- Serial examination, Herrenberg: all ages, N=10,016 [24]

Definition of known diabetes
- Physician-diagnosed type 2 diabetes (verified)
- Physician-diagnosed type 2 diabetes (ICD-10 E11, E12 or E14 in ≥3 of 4 quarters)
- Physician-diagnosed type 2 diabetes (ICD-10 E11, E12 or E14 in ≥3 of 4 quarters or prescription of anti-diabetic medication (ATC A10A or A10B ≥2 per year or 1 per year with a diagnosis of diabetes or plus glucose or HbA1c measurements in the same quarter)
- Physician-diagnosed diabetes (in ≥3 of 4 quarters) or prescription of anti-diabetic medication (≥2 per year or 1 per year with a diagnosis of diabetes or plus glucose or HbA1c measurements in the same quarter)
- Physician-diagnosed diabetes (in ≥2 of 4 quarters) or prescription of anti-diabetic medication (>4 per year) or blood glucose measurement (in ≥3 of 4 quarters)
- Physician-diagnosed diabetes or anti-diabetic medication
- Physician-diagnosed diabetes or diabetes therapy
- Self-report of diabetes diagnosis or of anti-diabetic medication and age at diagnosis >30 years
- Self-report of physician-diagnosed diabetes or of anti-diabetic medication (verified)
- Self-report of diabetes diagnosis or of diabetes therapy
- Self-report of diabetes diagnosis or of diabetes therapy
- Physician-diagnosed diabetes

For graphical presentation, the midpoint of the respective study period (0.3 yearly steps) is entered into the horizontal axis. Additional studies exclusively reported on sex-specific prevalences [16, 28, 104, 105].
have been summarised elsewhere [4, 19, 20, 41]. In general, the data on unknown diabetes is fragmented and a reliable analysis of trends is not feasible due to the varying criteria used to define the condition. The earliest estimates of the prevalence of unknown diabetes are based on screenings undertaken during the 1950s and 1960s, which were mainly based on urine glucose screening (glucosuria screening) in combination with heterogeneous forms of follow-up examinations. These earlier estimates usually suggest a prevalence of below 1% or a ratio of persons with known diabetes to newly diagnosed cases of about 1:1 [42]. As of the 1970s, glucosuria screening, which has a low sensitivity, moderate specificity and an unfavourable cost-benefit ratio, became increasingly less important [23, 43, 44]. Subsequent estimates of prevalence start to become available during the mid-1990s. These are mainly derived from nationwide, population-based RKI interview and examination surveys [31, 32] as well as routine data for secondary analysis available at the national level within the statutory health insurance system (Info box 5) [39, 40]. A comprehensive analysis is essential in this context, since the available data sources all have specific strengths and limitations (Info box 5).

### 3.2 Prevalence of unknown diabetes

Some studies have been conducted over recent decades on unknown diabetes; Table 1 summarises the prevalence estimates that they have identified. A number of major systematic diabetes screenings and serial examinations that were conducted during the 1960s are included as examples. Numerous other screening activities have been summarised elsewhere [4, 19, 20, 41]. In general, the data on unknown diabetes is fragmented and a reliable analysis of trends is not feasible due to the varying criteria used to define the condition.

The earliest estimates of the prevalence of unknown diabetes are based on screenings undertaken during the 1950s and 1960s, which were mainly based on urine glucose screening (glucosuria screening) in combination with heterogeneous forms of follow-up examinations. These earlier estimates usually suggest a prevalence of below 1% or a ratio of persons with known diabetes to newly diagnosed cases of about 1:1 [42]. As of the 1970s, glucosuria screening, which has a low sensitivity, moderate specificity and an unfavourable cost-benefit ratio, became increasingly less important [23, 43, 44]. Subsequent estimates of prevalence start to become available during the mid-1990s. These are mainly derived from regional cohort studies and are partly based on
Info box 5: Primary and secondary data

Definition: In contrast to primary data, secondary data are data that are not directly collected for a research interest that was specified in advance or that are evaluated differently from their intended usage [64].

Data sources: Primary data sources that are important for the identification of the frequency of diseases include 1) the examination and interview surveys conducted regularly at nationwide level by the Robert Koch Institute (RKI) [57] and 2) ongoing cohort studies such as the GNC that is being undertaken in 18 study centres [50]. Secondary data sources include administrative data routinely collected within the German social security and health system for documentation and reimbursement. Of particular importance in this context are nationwide routine data that come from multiple statutory health insurers such as 1) the data reported to the German Federal Insurance Office (BVA) for the Morbidity-oriented Risk Structure Compensation (Morbi-RSA). Since 2014, these data have been merged for research purposes in accordance with the Data Transparency Regulation (DaTraV) and are held by the German Institute of Medical Documentation and Information (DIMDI). Another important source of nationwide routine data is 2) the data collected on people with statutory health insurance sent for billing purposes by contract doctors and that are regularly analysed by the Central Research Institute of Ambulatory Health Care in Germany (Zi) [65].

Advantages and limitations: Primary data sources such as the RKI examination surveys often include information on health-related behaviours and laboratory measures. This permits monitoring of risk factor profiles and undiagnosed conditions, such as unknown diabetes. However, these surveys miss certain groups of people (e.g. nursing home residents, people who are very old) and not everyone who is fasting blood glucose levels in combination with glucose values measured 2 hours after an oral glucose tolerance test (2h-OGTT glucose) or at a random time (random glucose) (Info box 4). However, some are based on measurements of glycated haemoglobin (HbA1c). This method is now recognised as a criterion for diagnosis (Info box 4) and it is especially employed in epidemiological studies because HbA1c measures are not affected by fasting time. Nevertheless, as the studies employed different methods, and each method relates to a different aspect of glucose metabolism [45], they also identified different groups of people. Therefore, study results differ considerably depending on the method employed by the study in question [46]. Different study regions or age ranges within individual study populations makes a direct comparison of prevalence even more difficult. For example, the KORA F4 study that covers the Augsburg region employed fasting glucose levels and 2h-OGTT glucose measurements and identified a prevalence of unknown diabetes of 2.0% among 35- to 59-year-olds and of 3.9% among 35- to 79-year-olds between 2006 and 2008 [47, 48]. Using the same criteria the Study of Health in Pomerania (SHIP)-TREND, which covers Western Pomerania and was conducted between 2006 and 2012, found a prevalence of 7.1% among 35- to 79-year-olds [48]. Data from nationwide RKI health examination surveys that are based on HbA1c measurements identified a 3.4% prevalence of unknown diabetes between 1997 and 1999 and a 2.0% prevalence between 2008 and 2011 among 18- to 79-year-olds [49]. This study, which is still the only one to have employed a comparable definition of unknown diabetes at two points in time, identified a decrease in the prevalence of unknown diabetes over the last decade.

In order to continuously monitor the prevalence of unknown diabetes in the adult population in Germany, it is essential that studies employ a definition that is comparable over time. Currently, this can only be done by continuing the RKI health examination surveys, which are conducted at relatively wide intervals. Nevertheless, cohort studies, such as the German National Cohort (GNC) [50], which is being conducted in 18 study centres, will also provide valuable point estimates of the ratio of people with known and unknown diabetes.

4. Incidence

4.1 Incidence rate of known diabetes

Few estimates of incidence rates (Info box 2) are available for known diabetes from studies that were conducted over the last few decades with various designs; the results are summarised in Table 2. Overall, these estimates indicate a clear increase in the incidence rate of known diabetes since 1960.

An incidence rate of 1.2 per 1,000 person-years (py) was observed from data sourced from the GDR diabetes register for 1960 [23]. Until 1989, when the registry was closed, an increased incidence rate of 3.8 per 1,000 py was observed [22, 51]. Apart from changes in people’s behaviour, the frequency of glucosuria screening activities [22] as well as changes to the diagnostic criteria used to define diabetes (Info box 4) most likely contributed to what was described as a stepwise increase in incidence rates.
For the subsequent period, point estimates from regional cohort studies indicate continued increase in diabetes incidence rates [52-54]. A recent investigation based on pooled data from five regional cohort studies (Diabetes-Collaborative Research of Epidemiologic Studies, DIAB-CORE; follow-up between 1997 to 2010) found an incidence rate of 11.8 per 1,000 py among 45- to 74-year-olds [54].

Our own analyses of nationwide data from the panel of adults who participated in two subsequent RKI health examination surveys with an average follow-up time of 12 years (follow-up period: 1997-1999 to 2008-2011) revealed an incidence rate of known diabetes of 6.9 per 1,000 py among people aged 18 to 79 years at baseline and 11.4 per 1,000 py among people aged 45 to 79 years at baseline. Based on current population estimates [55] this amounts to an estimate of about 442,000 new cases of known diabetes occurring annually among 18- to 79-year-olds in Germany. Based on routine data that are made available for research in accordance with the Data Transparency Regulation (Info box 5), a recent nationwide study has provided estimates of the type 2 diabetes incidence rate among persons 40 years and older within the German statutory health insurance system. Incidence rates amounted to 13 per 1,000 py among women and 16 per 1,000 py among men. These rates were calculated using a differential equation that took the following variables into account: 1) the prevalence of known diabetes among people with statutory health insurance between 2009 and 2010, 2) mortality rates for the general population in Germany as obtained from official statistics, and 3) the ratio of mortality rates among people with and without diabetes based on estimates available from the neighbouring country of Denmark [39]. A further nationwide analysis of routine data available within the German statutory health insurance system was carried out by the Central Research Institute of Ambulatory Health Care in Germany (Info box 5). Among persons 40 years and older, these authors found a slight decrease in the cumulative incidence (Info box 2) of type 2 diabetes from 1.63% in 2012 to 1.47% in 2014. Calculations of the proportion of new cases within a given year were based on the requirement of a three-year pre-observation period during which the participants had received no medical diagnosis of diabetes [40].

Continuous monitoring of incidence rates of known diabetes among the general adult population in Germany at the national level, such as through continued follow-up of RKI health survey participants, is currently not being realised. However, using available routine data provides a feasible approach to obtain estimates of the cumulative incidence on a regular basis [40]. It would also be possible to use available data for continuous calculations of incidence rates using the known mathematical relationships between prevalence, incidence and mortality [39]. Country-wide estimates on the prevalence of known diabetes are available on a regular basis using data collected within the RKI Health Monitoring framework and from the routine data sources of the statutory health insurance system. Regular estimates of the mortality rate among the general population are made available by official cause-of-death statistics. Data on the ratio of mortality rates among people
# Prevalence, Incidence and Mortality of Diabetes Mellitus in Adults in Germany

<table>
<thead>
<tr>
<th>Study population</th>
<th>Study period</th>
<th>Definition of unknown diabetes</th>
<th>Prevalence</th>
<th>Reference time point</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nationwide surveys</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEGS1: 18-79-year-olds; N=7,017 [49]</td>
<td>2008-2011</td>
<td>HbA1c ≥6.5%</td>
<td>Total: 2.0% (Women: 1.2%; Men: 2.9%)</td>
<td>31 Dec 2010</td>
</tr>
<tr>
<td>GNHIES98: 18-79-year-olds; N=6,655 [49]</td>
<td>1997-1999</td>
<td>HbA1c ≥6.5%</td>
<td>Total: 3.0% (Women: 3.2%; Men: 4.3%)</td>
<td>31 Dec 2010</td>
</tr>
<tr>
<td>GNHIES98: 18-79-year-olds; N=5,275 [29]</td>
<td>1997-1999</td>
<td>HbA1c &gt;6.1% and either serum glucose ≥126mg/dl or glucose in urine ≥50mg/dl</td>
<td>Women: 2.0%; Men: 2.1%</td>
<td>31 Dec 1997</td>
</tr>
<tr>
<td><strong>Regional studies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KORA F4 (Augsburg): 35-79-year-olds; N=2,617;</td>
<td>KORA: 2006-2008</td>
<td>Fasting glucose ≥7.0mmol/l or 2h-OGTT glucose ≥11.1mmol/l</td>
<td>KORA: 3.9%</td>
<td>31 Dec 2007</td>
</tr>
<tr>
<td>SHIP-TREND (Vorpommern): 35-79-year-olds; N=1,980 [48]</td>
<td>SHIP: 2008-2012</td>
<td>Fasting glucose ≥7.0mmol/l or 2h-OGTT glucose ≥11.1mmol/l</td>
<td>SHIP: 7.1%</td>
<td></td>
</tr>
<tr>
<td>KORA F4 (Augsburg): 35-59-year-olds; N=1,653 [47]</td>
<td>2006-2008</td>
<td>Fasting glucose ≥7.0mmol/l or 2h-OGTT glucose ≥11.1mmol/l</td>
<td>Total: 2.0% (Women: 1.6%; Men: 2.4%)</td>
<td>31 Dec 2007</td>
</tr>
<tr>
<td>Screening participants in routine health examinations of BASF employees: ≥16-64-year-olds; N=13,086 [106]</td>
<td>2004-2005</td>
<td>Fasting glucose ≥7.0 mmol/l or random glucose ≥11.1mmol/l</td>
<td>Total: 0.7%</td>
<td></td>
</tr>
<tr>
<td>Screening participants of a sample of people insured by Techniker Krankenkasse (Thüringen, Düsseldorf) ≥55-year-olds; N=4,314 [107]</td>
<td>2003</td>
<td>Physician-diagnosed ‘manifest diabetes mellitus type 2’ and no self-report of diabetes diagnosis</td>
<td>Total: 2.8%</td>
<td></td>
</tr>
<tr>
<td>HNR (Essen, Bochum, Mülheim): 45-74-year-olds; N=4,595 [108]</td>
<td>2000-2003</td>
<td>Fasting glucose ≥7.0mmol/l or random glucose ≥11.0mmol/l</td>
<td>Women: 3.2%; Men: 7.6%</td>
<td></td>
</tr>
<tr>
<td>Sample of randomly selected cities/rural districts in 5 federal states in Germany: 18-70-year-olds; N=2,150 [99]</td>
<td>1993-1996</td>
<td>HbA1c &gt;6.0%</td>
<td>Total: 1.6%</td>
<td></td>
</tr>
<tr>
<td>Diabetes screening programme in Munich: All ages, N=789,289 [23]</td>
<td>1967/1968</td>
<td>Urine test strip discoloration and medical confirmation in follow-up examination</td>
<td>Total: about 0.7-1.1%</td>
<td></td>
</tr>
</tbody>
</table>

* for age-standardisation

Table 1: Studies providing data on the prevalence of unknown diabetes among adults in Germany

**Abbreviations:**
- GNHIES98: German National Health Interview and Examination Survey 1998
- DEGS1: German Health Interview and Examination Survey for Adults
- EPIC: European Prospective Investigation into Cancer and Nutrition
- HNR: Heinz Nixdorf Recall Study
- HbA1c: glycated haemoglobin
- KORA: Cooperative Health Research in the Region of Augsburg
- OGTT: oral glucose tolerance test
- SHIP: Study of Health in Pomerania

Continued on next page
Studies providing data on the prevalence of unknown diabetes among adults in Germany

<table>
<thead>
<tr>
<th>Study population</th>
<th>Study period</th>
<th>Definition of unknown diabetes</th>
<th>Prevalence</th>
<th>Reference time point*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes screening programme of employees of administrations and of a pharmaceutical-chemical company (West Berlin) 16–65-year-olds, N=4,187 [109]</td>
<td>1965/1966</td>
<td>2h-OGTT glucose ≥7.8 mmol/l during screening and ‘manifest unknown diabetes’ in follow-up examination</td>
<td>Total: 1.0%</td>
<td></td>
</tr>
<tr>
<td>Serial examination of the population of the town of Herrenberg: all ages, N=7,976 [24]</td>
<td>1964</td>
<td>Urine test strips with glucosuria &gt;0.5% or urine test strips with glucosuria &gt;0.5% plus medical confirmation in follow-up examination</td>
<td>Total: 0.6%</td>
<td></td>
</tr>
<tr>
<td>Serial examination of the population in 5 areas of the district of Magdeburg: ≥14-year-olds (≥18-year-olds in one district), N=164,896 [41]</td>
<td>1964/1965</td>
<td>Abnormal result of urine glucose test and confirmation in follow-up examination</td>
<td>Total: 0.5%</td>
<td></td>
</tr>
<tr>
<td>Serial examination of the population of the district of Schwerin: ≥14 years (1961/1962) or ≥12 years (1964/1965), N=je 380.000 [103]</td>
<td>1964/1965, 1961/1962</td>
<td>Urine test strip discolouration and blood glucose 7.2-11.1 mmol/l 2 hours after the main meal with confirmation in follow-up examination</td>
<td>1964/1965: 0.2% 1961/1962: 0.3%</td>
<td></td>
</tr>
<tr>
<td>Serial examination of the population in 10 out of 14 areas of the districts of Neubrandenburg: 6-80-year-olds, N=318.687 [110]</td>
<td>1961/1962</td>
<td>Urine test strip discolouration and confirmation in follow-up examination</td>
<td>Total: 0.3%</td>
<td></td>
</tr>
</tbody>
</table>

### Patient data

<table>
<thead>
<tr>
<th>Study population</th>
<th>Study period</th>
<th>Definition of unknown diabetes</th>
<th>Prevalence</th>
<th>Reference year</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEMCAS (nationwide patient sample from general practices): ≥18 years, N=35,869 (N=1,511 practices) [89]</td>
<td>2005</td>
<td>Random glucose ≥11.1 mmol/l or fasting glucose ≥7.0 mmol/l</td>
<td>Total: 0.9%</td>
<td>2003</td>
</tr>
<tr>
<td>Diabetes screening programme of the German Medical Association of the former Federal Republic of Germany (West Germany) N=1,474,827 (N=25,000 doctors) [111]</td>
<td>1964/1965</td>
<td>Urinary glucose test</td>
<td>Total: 1.8%</td>
<td></td>
</tr>
</tbody>
</table>

Major systematic diabetes screening activities during the 1960s are exemplarily listed in Table 1; numerous other screenings have already been summarised elsewhere [4, 19, 20, 41]. Further studies not listed in Table 1 or Figure 1 or Figure 2 provide results on the total prevalence of known and unknown diabetes [112-114].

* for age-standardisation

**Table 1 (continued)**

**Abbreviations:**
- GEMCAS: German Metabolic and Cardiovascular Risk Project
- OGTT: oral glucose tolerance test
Prevalence, incidence and mortality of diabetes mellitus in adults in Germany

<table>
<thead>
<tr>
<th>Study population</th>
<th>Follow-up period</th>
<th>Definition of diabetes incidence at follow-up</th>
<th>Incidence per 1,000 person-years</th>
<th>Method for consideration of bias</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nationwide surveys</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>GNHIES98 re-participants with an examination: 18-79-year-olds, N=2,750 (own calculation)</td>
<td></td>
<td></td>
<td>Known or unknown diabetes 18-79-year-olds: 7.9 (Women: 9.0; Men: 6.8) 45-79-year-olds: 12.8 (Women: 12.4; Men: 13.3)</td>
<td></td>
</tr>
<tr>
<td><strong>Register data</strong></td>
<td></td>
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<tr>
<td>GDR diabetes register, district of Neubrandenburg: all ages, entire population [115]</td>
<td></td>
<td></td>
<td>Known diabetes 1980: 3.4 (Women: 2.2; Men: 4.5) 1976: 3.4 (Women: 2.4; Men: 4.3) 1972: 2.5 (Women: 1.9; Men: 3.4) 1970: 2.5 (Women: 2.0; Men: 3.0) 1964: 1.2 (Women: 0.9; Men: 1.5) 1960: 0.8 (Women: 0.5; Men: 1.0)</td>
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</tr>
<tr>
<td><strong>Regional studies</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>DIAB-CORE Consortium with SHIP (Western Pomerania), CARLA (Halle/Saale), DHS (Dortmund), HNR (Essen, Bochum, Mülheim), KORA (Augsburg): 45-74-year-olds</td>
<td>N=8,787</td>
<td>N=7,250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-report of physician-diagnosed diabetes for the first-time</td>
<td>Known diabetes Total: 11.8 (Women: 11.7; Men: 21.9)</td>
<td>SHIP: 13.0 (Women: 10.0; Men: 16.3) CARLA: 16.2</td>
<td>Weighting for loss of non-returnees to follow-up; standardised to population structure of Germany as of 31 Dec 2007</td>
<td></td>
</tr>
<tr>
<td>Known diabetes</td>
<td></td>
<td>(Women: 15.0; Men: 17.8) HNR: 11.8 (Women: 8.6; Men: 15.3) KORA: 9.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Known diabetes</td>
<td></td>
<td>(Women: 7.2; Men: 11.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total: 12.6 (Women: 9.2; Men: 16.1)</td>
<td></td>
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</tr>
</tbody>
</table>

Abbreviations:
- GNHIES98: German National Health Interview and Examination Survey 1998
- GDR: German Democratic Republic
- DIAB-CORE: Diabetes-Collaborative Research of Epidemiologic Studies
- SHIP: Study of Health in Pomerania
- CARLA: Cardiovascular Disease, Living and Ageing in Halle
- DHS: Dortmund Health Study
- HNR: Heinz Nixdorf Recall Study
- KORA: Kooperative Health Research in the Region of Augsburg
- HbA1c: glycated haemoglobin

* Baseline – follow-up

Continued on next page
### Table 2 (continued)

Studies providing data on the incidence of diabetes among adults in Germany

<table>
<thead>
<tr>
<th>Study population</th>
<th>Follow-up period*</th>
<th>Definition of diabetes incidence at follow-up</th>
<th>Incidence per 1,000 person-years</th>
<th>Method for consideration of bias</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>KORA S4/F4</strong> (Augsburg): 55-74-year-olds, N=887 [58]</td>
<td>1999-2001, 2006-2008</td>
<td>Medically verified diabetes diagnosis after self-report of diabetes diagnosis for the first time or fasting glucose ≥7.0 mmol/l or 2h-OGTT glucose ≥11.1 mmol/l for the first time</td>
<td>Known or unknown diabetes Total: 15.5 (Women: 11.3; Men: 20.2)</td>
<td>Standardised to population structure of Germany as of 31 Dec 2007</td>
</tr>
<tr>
<td><strong>MONICA Augsburg:</strong> 35-74-year-olds, N=6,166 [52]</td>
<td>1984-1995, 1998</td>
<td>Self-report of diabetes diagnosis or of anti-diabetic medication for the first time</td>
<td>Known diabetes Women: 4.0; Men: 5.8</td>
<td>Standardised to population structure of Germany as of 31 Dec 1989</td>
</tr>
</tbody>
</table>

### Health insurance data

| Nationwide sample of insurees from all statutory health insurance funds: ≥40-year-olds [39] | 2009, 2010 | By differential equation calculated incidence based on the change in diabetes prevalence between 2009 and 2010 in the sample of insurees (physician-diagnosed diabetes [ICD-10 E10-E14, with the additional ICD-tag, ‘G’ (confirmed) in outpatient diagnoses]) and the mortality among people with and without diabetes in the Danish population | Known diabetes Women: 13; Men: 16 |  |

Sample of insurees from the AOK Baden-Württemberg: all ages, N=3.5 million per year [34]

| 2007-2009, the next year | Physician-diagnosed type 2 diabetes for the first time (ICD-10 E11, E12 or E14 in ≥3 of 4 quarters) or prescription of anti-diabetic medication for the first time (ATC A10A or A10B ≥2 per year or 1 per year plus type 2 diabetes diagnosis or plus glucose or HbA1c measurement in the same quarter) | Known diabetes 2010: 8.6 (Women: 8.3; Men: 9.2) 2009: 7.7 (Women: 7.3; Men: 8.3) 2008: 8.2 (Women: 7.8; Men: 8.9) | Standardised to population structure of Baden-Württemberg as of 31 Dec of the respective year |

Nationwide sample of insurees from the Techniker Krankenkasse: all ages, N=5.4 million [86]

| 2006-2007, 2008 | Inpatient type 2 diabetes diagnosis for the first time (ICD-10 E11 with additional ICD-tag ‘G’ (confirmed)) or two outpatient type 2 diabetes diagnoses in different quarters of 2008 or in/before 2008 | Known diabetes Total: 4.1 | Standardised to population structure of Germany as of 31 Dec 2008 |

* Baseline – follow-up

Abbreviations:
- AOK: Allgemeine Ortskrankenkasse (a large statutory health insurance company)
- ATC: Anatomical Therapeutic Chemical Classification
- DETECT: Diabetes Cardiovascular Risk-Evaluation: Targets and Essential Data for Commitment of Treatment
- EPIC: European Prospective Investigation into Cancer and Nutrition
- ICD-10: International statistical classification of diseases and related health problems, 10th revision
- KORA: Cooperative Health Research in the Region of Augsburg
- MONICA: Monitoring Trends and Determinants in Cardiovascular Disease
- OGTT: oral glucose tolerance test
- SHIP: Study of Health in Pomerania
- HbA1c: glycated haemoglobin

Continued on next page.
Prevalence, incidence and mortality of diabetes mellitus in adults in Germany

with and without known diabetes, which has been ‘borrowed’ from the neighbouring country of Denmark until now, could be frequently made available also for Germany if follow-up of RKI health survey participants for vital status (mortality follow-up) could be conducted on a regular basis [56, 57].

4.2 Overall incidence of unknown and known diabetes overall

The incidence rate of unknown and known diabetes combined has only recently been estimated by a number of studies. However, results from these studies are difficult to compare due to differences in study design, age range and reference region (Table 2).

Based on KORA S4/F4 cohort data (follow-up period: 1999-2001 to 2006-2008), the incidence rate for known diabetes and unknown diabetes (defined using fasting blood glucose level and 2h-OGTT glucose) combined was estimated to be 15.5 per 1,000 py among 55- to 79-year-olds from the Augsburg area [58]. A comprehensive analysis of data from the SHIP cohort in Western Pomerania (follow-up period: 1997-2001 to 2003-2006; 20- to 79-year-olds) and a nationwide sample of patient data (Diabetes Cardiovascular Risk-Evaluation: Targets and Essential Data for Commitment of Treatment, DETECT; follow-up period: 2003 to 2007/2008; people aged 18 years or above) revealed an incidence rate for known and (HbA1c-defined) unknown diabetes of 14.4 per 1,000 py [59]. Our own analyses of nationwide data from adults who participated in two RKI examination surveys spaced approximately 12 years apart (follow-up period: 1997-1999 to 2008-2011) resulted in an incidence rate of known and (HbA1c-defined) unknown diabetes of 7.9 per 1,000 py among persons aged 18 to 79 years at baseline and a rate of 12.8 per 1,000 py among those aged 45 to 79 years at baseline. Based on current population statistics in Germany [55], this corresponds to approximately 507,000 new cases of diabetes per year in the population 18 to 79 years of age.

Currently available data do not permit estimation of time trends in overall diabetes incidence rates among adults in Germany. In the future, the total incidence rate could be calculated using the differential equation mentioned above [39]. For this, estimates of the prevalence of known and unknown diabetes will be available, albeit

---

**Table 2 (continued)**

<table>
<thead>
<tr>
<th>Study population</th>
<th>Follow-up period</th>
<th>Definition of diabetes incidence at follow-up</th>
<th>Incidence per 1,000 person-years</th>
<th>Method for consideration of bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Further studies not listed in Table 2 provide cumulative incidences (percentages) [40, 84] or incidence rates (per 1,000 person-years) for subgroups of individuals with normal or impaired glucose metabolism [117].

* Baseline – follow-up

<table>
<thead>
<tr>
<th>Follow-up period*</th>
<th>Study population</th>
<th>Definition of diabetes incidence at follow-up</th>
<th>Incidence per 1,000 person-years</th>
<th>Method for consideration of bias</th>
</tr>
</thead>
</table>

Abbreviations:

SESAM Sächsische Epidemiologische Studien in der Allgemeinmedizin

Currently available data do not permit estimation of time trends in the prevalence and incidence of unknown diabetes.
### Study population

<table>
<thead>
<tr>
<th>Nationwide surveys</th>
<th>Follow-up period</th>
<th>Definition of diabetes and reference group at baseline</th>
<th>Mortality among adults with diabetes compared to the reference group</th>
<th>Methods to account for bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNHIES98</td>
<td>1997-1999, 2008-2011</td>
<td>Known diabetes: Self-report of physician-diagnosed diabetes or of anti-diabetic medication</td>
<td>Crude mortality rate 27.4 Age-adjusted hazard ratio 1.7</td>
<td>Follow-up for vital status completed for 98%; Adjusted for age, sex</td>
</tr>
<tr>
<td>Mortality Follow-up: 18-79-year-olds, N=6,299 [57]</td>
<td>Unknown diabetes: HbA1c ≥6.5%</td>
<td>29.4 1.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prediabetes: HbA1c: 5.7-5.9%/6.0-6.4%</td>
<td>11.3/8.6 1.0/1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference: No known or unknown (pre-) diabetes</td>
<td></td>
<td>4.1 1 (reference)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Register data</th>
<th>Each year between 1961 and 1987</th>
<th>Known diabetes: Physician-diagnosed diabetes; Reference: general population</th>
<th>Mortality among adults with diabetes compared to the reference group</th>
<th>Methods to account for bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDR diabetes register: all ages, All people with known diabetes (compared to the general population) [60]</td>
<td>Known diabetes: Non-insulin-dependent diabetes 1961: 47 1987: 67</td>
<td>Crude mortality rate 1961: - 1987: -</td>
<td>Follow-up for vital status completed for nearly 100%; Standardised to age structure of the general population</td>
<td></td>
</tr>
<tr>
<td>Total diabetes</td>
<td></td>
<td>1961: 1.9 1987: 1.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Regional studies</th>
<th>1973-1975, 2003</th>
<th>Known diabetes: Self-report of physician-diagnosed diabetes</th>
<th>Mortality among adults with diabetes compared to the reference group</th>
<th>Methods to account for bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERFORT (Erfurt area): 40-59-year-olds, N=1,125 men [61]</td>
<td>Known diabetes: 10 years 20 years 30 years</td>
<td>Crude mortality rate 21.5 38.1 43.1 Age-adjusted hazard ratio 2.2 2.2 1.9</td>
<td>Follow-up for vital status completed for 98%; Adjusted for age</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unknown diabetes: 1h-OGTT glucose ≥200 mg/dl</td>
<td>Age-adjusted hazard ratio 10 years 20 years 30 years 17.0 24.5 31.5 1.8 1.5 1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference: No known or unknown diabetes</td>
<td></td>
<td>10 years 30 years 8.0 15.4 (reference) 20.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations:
- GNHIES98: German National Health Interview and Examination Survey 1998
- GDR: German Democratic Republic
- ERFORT: Erfurt Male Cohort Study
- HbA1c: glycated haemoglobin
- OGTT: oral glucose tolerance test

1 Baseline – follow-up
2 not age-adjusted or age-standardised
3 per 1,000 person-years
4 or age-standardised mortality ratio

Continued on next page
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5. Mortality

5.1 Mortality among people with known diabetes

Only a small number of studies have provided data on diabetes-related excess mortality (Table 3), in other words, the mortality rate of people with diabetes compared to the general population or people without diabetes (Info box 3). Results from these studies show that at larger intervals, from the national RKI health examination surveys [49]. Moreover, continued mortality follow-up of RKI health survey participants would permit periodically repeated estimates of mortality rates among people with and without known or unknown diabetes [56, 57]. In addition, ongoing cohort studies in Germany will continue to contribute point estimates of overall diabetes incidence.

Table 3 (continued)

Studies providing data on overall mortality among adults with diabetes compared to adults without diabetes in Germany

<table>
<thead>
<tr>
<th>Study population</th>
<th>Follow-up period</th>
<th>Definition of diabetes and reference group at baseline</th>
<th>Mortality among adults with diabetes compared to the reference group</th>
<th>Methods to account for bias</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Unknown diabetes:</strong> Fasting glucose ≥7.0 mmol/l or 2h-OGTT glucose ≥ 11.1 mmol/l</td>
<td>Age-adjusted hazard ratio&lt;sup&gt;4&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Prediabetes:</strong> Fasting glucose 6.1-6.9 mmol/l or 2h-OGTT glucose 7.8-11.0 mmol/l</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reference: No known or unknown (pre-) diabetes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Patient data**

<table>
<thead>
<tr>
<th>Study population</th>
<th>Follow-up</th>
<th>Definition of diabetes</th>
<th>Mortality among adults with diabetes compared to the reference group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erfurt-Study (district of Erfurt): all ages, N=208 people with diabetes (compared to N=208 paired controls) [118]</td>
<td>1970, 1985</td>
<td><strong>Known diabetes:</strong> History of physician-diagnosed diabetes of ≥20 years;</td>
<td>2.1 Follow-up for vital status completed for 93%; Case-control pairing according to age, sex, body weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reference: paired metabolically healthy people</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations:
KORA Cooperative Health Research in the Region of Augsburg
OGTT oral glucose tolerance test

<sup>1</sup> Baseline – follow-up
<sup>2</sup> not age-adjusted or age-standardised
<sup>3</sup> per 1,000 person-years
<sup>4</sup> or age-standardised mortality ratio

A further study, which is not listed in Table 3, exclusively provides age- and gender-specific mortality ratios [102].
There is evidence that the risk of death among people with known diabetes is about twice as high as among people without the condition; the increased risk of death (excess mortality) among people with unknown diabetes appears to be about as high as among people with known diabetes.

5.2 Mortality among people with unknown diabetes

The only estimates of excess mortality among people with unknown diabetes that currently exist are from the three follow-up studies mentioned in the last section (Table 3). Therefore, it is currently impossible to estimate time trends in this regard.

The ERFORT study found that the risk of death among people with unknown diabetes was 1.5 times higher compared to people without diabetes [61]. The KORA S4 study identified the rate as 2.8 times higher [62] and the GNHIES98 study found a rate that was 1.9 times higher [57]. Thus, the risk of death among people with unknown diabetes is of a similar magnitude as the risk of death observed among people with known diabetes. In contrast, the studies found no increased risk of death among people with ‘prediabetes’ [57, 62] (Table 3).

The continuation of the mortality follow-up of people participating in the national RKI health examination surveys, therefore, would also be useful in order to gain regular estimates (albeit at larger intervals) of the excess mortality linked to unknown diabetes and diabetes overall [56, 57]. In addition, following up the vital statistics...
of participants from ongoing cohort studies could provide point estimates of excess mortality related to unknown diabetes.

6. Conclusion

Population-based estimates of the prevalence, incidence and excess mortality of known and unknown diabetes are key indicators in order to conduct a reliable evaluation of developments in diabetes epidemiology. Providing regular estimates of these indicators that are comparable over time, therefore, is a major goal of the national diabetes surveillance system that is currently being established in Germany. With the exception of the prevalence of known diabetes (where regularly collected primary and secondary data demonstrate an increase over the last few decades), the data being collected on these key indicators of diabetes epidemiology in Germany is currently fragmented. Estimates of incidence rates and the excess mortality associated with known diabetes that are currently available, mainly from cohort studies, only enable cautious conclusions to be drawn on time trends. Estimates of the prevalence, incidence and mortality of unknown diabetes in Germany are scarce and do not permit the evaluation of time trends.

An expansion of existing approaches is therefore needed in order to resolve the current issues with the data. Thus, the regular continuation of the mortality follow-up of people taking part in the RKI national health examination surveys would permit monitoring of the mortality rates among people with diabetes compared to those without the condition, albeit at larger intervals. This could reduce the large gaps that exist in recurrent estimates of excess mortality in relation to both known and unknown diabetes. As demonstrated by recent studies, improved access to secondary analysis of existing data would help produce more timely estimates of the prevalence, as well as the incidence of known diabetes. Routine data available within the statutory health insurance system are of particular importance in this respect.

While these routine data sources cover most of the population, certain groups of people (for example, people insured by private health insurers) are not represented in the sample. Moreover, indicators calculated based on routine data will be limited to known diabetes. The use of mathematical equations could therefore be considered as a further means of closing existing gaps in the data. As an example, population-based incidence rates of known and unknown diabetes could be derived from the mathematical relationships between the data on diabetes prevalence and excess mortality provided by the national RKI health examination surveys.

A national diabetes surveillance system is currently being established at the RKI. The various approaches and available data sources are currently being assessed with regard to their availability and whether they can be integrated into a continuous monitoring of dynamics in diabetes epidemiology as a means of providing a data-supported foundation for health policy decision-making in Germany [64, 65]. Taking into account demographic trends, a foundation could also be used for projections of burden of disease.
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References


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http://apps.who.int/iris/bitstream/10665/66040/1/WHO_NCD_NCS_99.2.pdf (As at 06.06.2017)

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