Prevalence of known diabetes in German adults aged 25–69 years: results from national health surveys over 15 years

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Abstract

Aims: The few studies examining the secular trend in diabetes prevalence in Germany have yielded conflicting results. Therefore, using nationally representative samples of adults, we investigated whether the prevalence of known diabetes has changed over 15 years.
Methods: Study participants were 25- to 69-year-old residents participating in nationally representative health surveys performed in the following time periods: 1990–1992, 1997–1999, 2002–2003, 2003–2004 and 2004–2005. Prevalences of diabetes, standardized to the population structure of 2004, and trends over time were assessed for the total study population as well as by gender and other diabetes-associated factors.
Results: Between 1990–1992 and 2002–2005, no statistically significant trend in the total (5.16 and 5.34%,Ptrend = 0.68)or sex-specific diabetes prevalence (men: 5.43 and 5.73, P trend = 0.62; women: 4.88 and 4.95%, P trend = 0.94) was observed. For each time period, prevalence rose substantiallywith increasing age, increasing body mass index, lower sporting activity and lower education.
Conclusions: Our findings reflect no temporal increase in the total prevalence of known diabetes in German adult men and women. However, prevalence estimateswere relatively highwhen comparedwith other European studies and call for continued efforts for the prevention and management of diabetes.

Introduction

The global prevalence of diabetes has increased in the last decades and is expected to further increase, from 2.8%in 2000 to 4.4% in 2030 [1].Alarge part of this increase has been attributed to improved longevity and amorewesternized, sedentary lifestyle facilitating overweight and obesity. Other factors which may influence diabetes prevalence include improved screening methods and changed diagnostic criteria.

Demographic changes [2] and reported increases in the prevalence of obesity [3] lead to the assumption of an increasing overall prevalence of diabetes in Germany also.
However, so far, German studies investigating the recent secular trend in diabetes prevalence included secondary routine health insurance data [4] or regionally confined surveys [5] and yielded conflicting results.

Therefore, we contribute data from nationally representative health surveys consecutively conducted over 15 years to determine whether a temporal change in diabetes prevalence has occurred in German adults overall, and by gender and levels of diabetes-associated factors including age, body mass index, sporting activity and educational attainment.

Subjects and methods

Subjects

Nationally representative health interview and examination surveys were conducted in time periods 1990–1991 (25- to 69- year-old West German population; response rate: 69.0%), 1990–1992 (18- to 79-year-old East German population; 70.2%) and 1997–1999 (18- to 79-year-old population of the unified Germany; 61.4%) using similar, standardized selfadministered questionnaires [6,7]. Subsequently, nationally representative health surveys were performed based on standardized computer-assisted telephone interviews within close sequence, in 2002–2003 (response rate: 52.3%), 2003– 2004 (56.1%) and 2004–2005 (57.3%) (German population aged 18 years or over) [8].

To ensure population-representativeness, two-stage sampling procedures were used in all surveys. In the interview and examination surveys, sample points of communities reflecting community size and structure of (East or West) Germany were drawn. Random samples of adult residents stratified by age (5- year intervals) and sex were then drawn from local population registries in proportion to the age and gender structure of the German adult population. In the telephone surveys, a pool of telephone numbers from complete listings of conventional telephone extensions belonging to private households was randomly generated, assuring that households with unregistered telephone extensions were included in the sample. Random sampling at the individual level was then achieved by the 'next-birthday method', i.e. only the adult whose next birthday fell closest to the date of first contact of the household was included in the target sample.

For the present study, we considered all participants of
comparable age groups (25–69 years) for three time periods: 1990–1992, 1997–1999 and 2002–2005. Surveys were approved by the Federal Office for the Protection of Data, Germany. Each participant gave informed consent before enrolment into the survey.

Assessment of diabetes and diabetes-associated factors

For each survey, definition of known diabetes was based on the participant's self-report of a history of diabetes. Wording of the diabetes question slightly differed between telephone surveys ('Have you ever been told by a doctor that you have diabetes?') and previous surveys ('Have you ever had diabetes?'). The Comparative Analysis of Social Mobility in Industrial Nations (CASMIN) educational classification that incorporates general and vocational training was chosen as an indicator of socioeconomic position [9]. Body mass index was calculated as the ratio of body weight to height squared based on standardized measurements by trained health professionals or, in telephone surveys, based on self-reports adjusted for potential reporting bias by an empirically derived factor [10].

Statistical analysis

Prevalences were calculated using survey-specific weighting factors that adjust for deviations in demographic characteristics (age, sex, region of residence) from the official German population at the time of each survey. For comparison over time, estimates were additionally standardized to the German population as of 31 December 2004. Confidence intervals were estimated based on robustHuber–White estimates [11,12].Time trends of the diabetes prevalence between 1990–1992 and 2002– 2005 were assessed by logistic regression, with time included as continuous variable (time since 1990 divided through the maximum time period, thus ranging from 0 to 1). All statistical analyseswere based on a pooled dataset including all participants and were performed using Stata 10.1 (Stata Corp., College Station, TX, USA).

Results

The overall standardized prevalences of known diabetes for the 25- to 65-year-old population were 5.16% [95% confidence interval (CI) 4.58–5.73%] in 1990–1992, 4.64% (4.04–5.23%) in 1997–1999 and 5.34% (4.94–5.74%) in 2002–2005 [surveyspecific weighted prevalences: 4.77% (4.21–5.33%), 4.45% (3.88–5.02%) and 5.14% (4.76–5.52%)]. Table 1 shows the standardized prevalence estimates by gender and further stratified by region of residence, age group, level of body mass index, sporting activity and educational attainment.

We did not observe a statistically significant trend in the total or sex-specific diabetes prevalence between 1990–1992 and 2002–2005. However, for the subgroups of women who were aged 25–39 years, or had a secondary education, an increasing temporal trend was evident. For each time period, prevalence rose substantially with increasing age, increasing body mass index, lower sporting activity and lower education.

Discussion

In this study, including data from consecutively conducted and representative population surveys covering a period of 15 years, we did not observe an increased overall prevalence of known diabetes in German adult men and women. Nevertheless, there were indications of an increase in prevalence in some subgroups of women. According to known risk factor–disease associations, diabetes prevalence was particularly high in subjects aged 50 years or older and in those with obesity, low sporting activity or low education.

Data from the diabetes register of the former German Democratic Republic (East Germany) reflect a clear rise in the prevalence of diagnosed diabetes between 1961 and 1987, from 0.7 to 4.0% [13]. Studies examining the subsequent secular trend of diabetes prevalence in Germany provide conflicting results [4,5,14]which might be explainable by variations in study design, target population and definition of diagnosed diabetes. In particular, secondary data analyses of regional routine health insurance data indicated an increased trend of physiciandiagnosed diabetes between 1998 and 2004 among the insured individuals [4]. In line with our results, data from the MONICA/KORA–Augsburg surveys conducted within southwest Germany yielded a relatively stable prevalence of selfreported physician-diagnosed diabetes between 1989–1990 and 1999–2001 for 25- to 74-year-old men and women [5]. Further, an earlier analysis of the German national health interview and examination surveys in 1990–1992 and 1997–1999 suggested a decrease in self-reported diabetes [14]. However, this decrease was not significant [14], and could also not be further corroborated by the prolonged time series of the present study. Apart from the rising global trend [1], Swedish studies have also found no increased prevalence of diagnosed diabetes over the last decade [15,16]. The absent upward trend might, at least in Germany, be associated with the rather moderate increase in obesity over the period of our study [10,17,18] and with favourable changes in other risk factors, including sporting activity [19].

A major strength of the present study lies in the unique source of comprehensive data from continuously performed, independent and standardized national health surveys, whose comparability and generalizability to population level was assured by specific weighting factors. However, despite the carefully conducted design, several limitations that might have biased the results or evenmaskedan existing secular trend need to be acknowledged. The definition of known diabetes relied solely on self-reports of participants, without the possibility to consistently distinguish between Type 2, Type 1 or other forms of diabetes, such as gestational diabetes. In addition, response rates decreased across surveys, so that, despite the abovementioned efforts to achieve population representativeness, selection bias cannot be ruled out. Further, data collection methods partly varied between the surveys, including slight differences in question phrasing for defining diabetes and the change from self-administered questionnaires to computerassisted telephone interviews for the last survey period. Finally, our study was restricted to 25- to 69-year-old adults. Thus, it cannot be excluded that an increase in diabetes prevalence during the study period has occurred in the remaining age groups, particularly because of improved survival in the aged or an increased incidence in the very young [20].

In summary, results from this study complement findings from earlier or regionalized representative surveys and show no increase in the total prevalence of known diabetes in the adult German population over a period of 15 years. Nevertheless, prevalences of diagnosed diabetes for the included age groups seem to be higher than reported for several other European countries [21] and only moderately lower than in the USA [22]. However, comparisons between different studies are restricted by variations in design. Continued population-based monitoring of diagnosed as well as undiagnosed diabetes is necessary to further assess the development of the burden of diabetes.

Competing interests

Nothing to declare.

Author contributions

CH, LK and CSN conceptualized the study design. CH drafted the article. LK performed the statistical analyses. All authors interpreted the data, critically revised the manuscript, read and approved the final manuscript.

Acknowledgements

We thank Burkhard Haastert for his valuable comments on the statisticalmethods.Theworkwas funded by the German Federal Ministry of Education and Research (formerly German FederalMinistry of Research and Technology) and the German FederalMinistry of Health.

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Table 1 Standardized prevalence (95% CI)* and trend of known diabetes in German adults aged 25–69 years according to national health surveys

	Men				Women			
Characteristic	1990–1992 (n = 3.630)	1997–1999 (n = 2.831)	2002–2005 (n = 7.202)	P-value for trend	1990–1992 (n = 3.818)	1997–1999 (n = 2.994)	2002–2005 (n = 8.396)	P-value for trend
Total	5.43 (4.58–6.29)	5.04 (4.16–5.91)	5.73 (5.13–6.33)	0.62	4.88 (4.11–5.65)	4.23 (3.42–5.04)	4.95 (4.42–5.48)	0.94
Region of residence								
Western Germany	5.51 (4.51–6.51)	4.51 (3.50–5.51)	5.35 (4.73–5.96)	0.73	4.40 (3.55–5.25)	3.85 (2.92–4.79)	4.62 (4.07–5.17)	0.72
Eastern Germany	5.15 (3.58–6.73)	7.01 (5.27–8.76)	7.18 (5.52–8.84)	0.08	6.68 (4.91–8.45)	5.67 (4.08–7.26)	6.20 (4.73–7.66)	0.66
Age								
25–39 years	0.75 (0.24–1.25)	0.98 (0.30–1.65)	0.86 (0.49–1.22)	0.72	0.84 (0.33–1.35)	1.54 (0.73–2.36)	2.27 (1.68–2.85)	0.002
40–49 years	2.55 (1.46–3.65)	1.61 (0.57–2.65)	2.45 (1.75–3.14)	0.82	2.35 (1.25–3.44)	2.73 (1.42–4.04)	2.75 (2.10–3.41)	0.54
50–59 years	9.16 (7.09–11.24)	7.45 (5.38–9.52)	9.44 (7.72–11.16)	0.90	6.21 (4.49–7.94)	3.75 (2.13–5.38)	5.25 (4.06–6.44)	0.44
60–69 years	13.49 (10.30–16.68)	14.17 (10.86–17.48)	14.96 (12.83–17.10)	0.46	12.92 (10.19–15.65)	10.69 (7.90–13.48)	11.53 (9.70–13.36)	0.38
Body mass index								
< 25.0 kg/m^2	3.49 (2.28–4.70)	3.26 (1.92–4.59)	2.46 (1.69–3.22)	0.16	2.04 (1.32–2.77)	2.09 (1.29–2.89)	2.29 (1.78–2.81)	0.60
25.0–29.9 kg/m^2	5.01 (3.83–6.19)	5.06 (3.80–6.32)	5.04 (4.26–5.82)	0.97	5.37 (3.92–6.82)	4.66 (3.10–6.22)	4.00 (3.17–4.83)	0.10
≥ 30.0 kg/m^2	9.65 (7.13–12.17)	7.40 (5.20–9.60)	12.92 (10.91–14.92)	0.08	10.12 (7.80–12.44)	7.84 (5.53–10.15)	13.34 (11.39–15.30)	0.08
Sporting activity								
< 2 h/week	5.93 (4.96–6.91)	5.90 (4.83–6.97)	6.67 (5.83–7.51)	0.33	5.12 (4.29–5.95)	4.61 (3.69–5.53)	5.48 (4.77–6.18)	0.67
≥ 2 h/week	3.22 (1.61–4.83)	2.06 (0.88–3.25)	4.36 (3.53–5.20)	0.14	2.84 (0.95–4.74)	2.27 (0.76–3.79)	3.93 (3.16–4.70)	0.20
Education								
Primary	7.16 (5.86–8.46)	6.98 (5.48–8.48)	8.52 (7.21–9.83)	0.25	6.67 (5.51–7.84)	6.43 (4.96–7.90)	7.99 (6.75–9.24)	0.25
Secondary	3.08 (1.82–4.34)	3.69 (2.35–5.03)	4.18 (3.36–5.00)	0.17	2.20 (1.31–3.09)	2.44 (1.56–3.32)	3.86 (3.21–4.51)	0.006
Tertiary	3.52 (1.83–5.22)	3.12 (1.61–4.63)	5.20 (4.14–6.62)	0.10	2.16 (0.52–3.81)	0.96 (–0.24 to 2.15)	3.20 (2.25–4.15)	0.20

Data are per cent (95% CI) unless otherwise specified. Total numbers of subjects in the respective stratified analyses slightly vary because of
few missing data in the strata variables for body mass index, sporting activity and education (> 97% of subjects had complete data).
*Prevalences (95% CI) are standardized to the German population as of 31 December 2004.
CI, confidence interval.