Large increase in the prevalence of self-reported diabetes based on a nationally representative survey in Hungary

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Highlights

- Hungarostudy reported a prevalence of self-reported diabetes of 6.2% in 2002
- Our survey shows a prevalence of self-reported diabetes of 11.7% (95%CI 9.7-13.6%)
- The increase in prevalence was only modestly explained by population aging
- The largest increase (doubling) was found in the 55-64 years age group.
- We report an alarmingly increasing prevalence of self-reported diabetes in Hungary

Abstract

Aims: To estimate and compare the prevalence of self-reported diabetes based on nationally representative surveys of the Hungarian adult population in 2002 (published data – Hungarostudy) and a survey in 2012.

Methods: A cross-sectional computer-assisted telephone interview survey on a stratified representative sample of community-dwelling adults (n=1000) in 2012. To describe self-reported diabetes prevalence and its temporal changes generalized linear models were used and results were compared to figures from Hungarostudy.

Results: Age standardized prevalence of self-reported type 2 diabetes was 11.7% (95%CI 10.0-13.8%) without gender or rural-urban differences in 2012. People with self-reported diabetes were older than controls (mean [SE]: 63.9 [0.9] vs. 45.9 [0.3] years, $p<0.0001$). The prevalence of diabetes sharply increased after 40 years of age and peaked at age 70 (27.7% [2.5], $p_{age*age}<0.0001$). The prevalence of self-reported diabetes increased by 89% (OR 1.89, 95%CI 1.53-2.32) from 6.2 to 11.7% between the two surveys with the most pronounced increase in the age group 55-64 years (from 11.6 to 24.4%).

Conclusions: We reported an alarming increase in the prevalence of self-reported type 2 diabetes in the last decade that mostly affects working age people. If this trend continues, a major public health crisis in Hungary can be envisaged.

Keywords: Diabetes; Epidemiology; Prevalence; Adult; Population based, Caucasian

Introduction

Diabetes incidence has grown alarmingly for the last decades reflected by the yearly prevalence estimates by the World Health Organization (WHO) and the International Diabetes Federation (IDF). Based on the latest data, Diabetes Atlas estimated that the number of people with diabetes would grow from 366 million people to 552 million between 2011 and 2030, representing an increase of 50.7%. The IDF Atlas also reports country estimates, that are based on the latest available data from a given region if direct country data are not available.[1-3]

Although the most affluent countries in the world are in Europe, there is only limited population-based data on the prevalence of diabetes in Central Europe.[4-8] While these studies showed a clear rising trend of diabetes prevalence across countries, it should be noted that very little evidence was collected in the last decade.

Hungarostudy, a representative survey provided the first population-based, national estimates for diabetes prevalence in Hungary in 2002.[8] Hungarostudy reported a higher than expected diabetes prevalence of 6.2%. This figure was used as the basis for the IDF Atlas that estimated the prevalence of diabetes to be 7.7% in Hungary in 2011.[1,3,8] The above figures are similar or higher than those for other Eastern and Central European populations.[4-7] Earlier reports on diabetes prevalence from Hungary have several limitations: some of them are focused on specific age groups,[9,10] or specific geographical areas.[11,12] Comparisons are further hindered by the fact that the diagnostic criteria changed several times in the last decades.[8-14]

As no representative studies were conducted in the last decade, the change in the prevalence of the diabetes is unidentified. Thus our objectives were (1) to estimate current self-reported diabetes prevalence in the Hungarian adult population, (2) to investigate geographical, rural-urban, age and gender differences and (3) to compare our findings to previous Hungarian estimates and (4) to those of neighbouring countries.

Methods

Study Population and Design

The study was a cross-sectional computer-assisted telephone interview (CATI) survey performed in September 2012. The fieldwork was outsourced to a commercial market research organization (Gfk Hungária Kft.). Based on random digit dialling, a stratified representative sample of the Hungarian adult (>18 years old), community dwelling population with access to a landline phone (penetration rate: 62.5% of households) was collected.[15] Phone calls were made by trained interviewers until the predefined participation in a given strata was reached. The overall refusal rate was 23.2%. The sample included n=1038 people and was weighted to correct sampling errors and to reflect the sex/age/geographic distribution of the target population leading to a final sample of n=1000. To create the sample the following strata were used: sex – male/female, age – 18-29/30-39/40-49/50-64/65+ years, region – Central/Central Transdanubia/Western Transdanubia/Southern Transdanubia/Northern Hungary/Northern Great Plain/Southern Great Plain.

To investigate temporal changes in known diabetes prevalence, results of the current survey were compared to published figures from Hungarostudy, a clustered, stratified nationally representative cross-sectional survey of the community dwelling population of Hungary >18 years of age that used the National Population Register as the sampling frame and was conducted between January and June 2002. The overall refusal rate at the home interviews was 17.7% with each refusal supplemented by a person with similar sampling characteristics. [8,16]

Covariates

During the CATI interview all participants were considered to have self-reported type 2 diabetes if they answered positively to the following question: “Have you ever been diagnosed with type 2 or adult-onset diabetes mellitus?” People with gestational diabetes were excluded. The following demographical details were ascertained: gender, age (in years), type of settlement (collapsed to groups of urban/rural), and geographical region (collapsed to groups Western/Central/Eastern Hungary). In Hungarostudy, known diabetes was defined as current or past treatment for diabetes mellitus (including lifestyle treatment). From Hungarostudy, we collected tabulated data by age groups and diabetes status.[16]

Statistical analysis

All analyses were done using IBM Statistical Package for the Social Sciences (SPSS) version 22.0, a two-sided p value <0.05 was considered statistically significant.

All analyses of the current survey took into account study design using *Complex Samples Procedures*.[17] Descriptive statistics are given as means, standard deviations for continuous variables and counts, percentages for categorical variables. Comparisons between controls and diabetes participants are performed by independent sample t-tests and $\chi 2$ tests as appropriate. To describe diabetes prevalence on a continuous age scale, generalized linear models were built with a logit link with diabetes prevalence as the outcome and sex, age, and higher order terms of age (age*age, and age*age*age) as predictors. Finally, terms were removed to reach the best fit. To further clarify regional differences similar models were built by adding a categorical regional variable to the previous model. For data representation estimated marginal means were calculated for age groups and for a population with a mean age of 47 years.

Temporal changes between the two surveys were compared by $\chi 2$-tests and by generalized linear models adjusted for the reported age categories (and age category-study interaction) using Hungarostudy as the reference.

Results

The prevalence of self-reported type 2 diabetes mellitus was 11.7% (95% CI [confidence interval] 10.0-13.8%) of the Hungarian, community-dwelling, adult population. Self-reported type 2 diabetes patients were older by 18.1 (95%CI 15.9-20.2) years compared to controls. Almost 90% of self-reported type 2 diabetes patients were older than 50 years compared to 39% among controls. Self-reported type 2 diabetes prevalence was similar among males and females (11.6% vs. 11.8%, p=0.51) and between rural and urban settlements (11.6 vs. 11.9%, p=0.94). A non-significant decreasing gradient of diabetes prevalence was found from Western Hungary through Central to Eastern Hungary after age and sex adjustment (estimated prevalence by region: Western 11.6 [SE 2.1], Central 9.6 [1.5], Eastern 8.0 [1.6]%, p_{trend}=0.103).(**Table 1**)

The prevalence of diabetes sharply increased after 40 years of age and peaked at age 70 (27.7% [2.5], $p_{age*age}<0.0001$) and decreased slightly thereafter.(**Figure 1**)

Self-reported diabetes prevalence increased by 89% (OR 1.89, 95%CI 1.53-2.32) between the two surveys that was only minimally explained by the aging of the population (adjusted OR 1.68, 95%CI 1.35-2.08). The largest increase, a doubling in the prevalence of self-reported diabetes was observed in the 55-64 years age category from 11.6 [SE 0.8] to 24.4% [SE 3.3] ($p<0.0001$).(**Figure 2**)

Discussion

We found that the age standardized prevalence of self-reported type 2 diabetes was 11.7% without gender/rural-urban differences in 2012. This represents an 89% increase compared to the self-reported prevalence in 2002 that is only slightly explained by the ageing of the population. Our estimate is substantially higher than the one from the IDF Atlas (7.7%) for 2011.[3] People with self-reported diabetes were older than controls and the prevalence of diabetes sharply increased after 40 years of age and peaked at age 70 years when 1 in 4 people had diabetes.

The IDF Diabetes Atlas-2012 estimated that 366 million people had diabetes in 2011 (global prevalence: 8.3%), and it would increase by 59% to 552 million by 2030. According to the same estimates the number of European adults with diabetes is 52.6 million and is projected to increase only by 22% to 64 million people in 2030, corresponding to an increase in prevalence from 6.7 % to 6.9%. Similarly only mild increases of diabetes prevalence were reported for the last 30 years according to a recent modelling study.[18]

There is a paucity of evidence regarding known diabetes prevalence from the Central European Region where most surveys were conducted by more than 10 years ago. A Croatian survey reported a diabetes prevalence of 6.1% for 18-64 year old people (1995-1997), however this study excluded people with the highest diabetes prevalence (around age 70 in our study).[5] A Slovakian study (2003-2005) observed similar prevalence of diabetes among adults (5.3%) as the Hungarostudy (6.2%).[6,8]

Although the observed huge increase may be unexpected, a previous primary care-based survey from 4 Hungarian counties showed a prevalence of 7.5% (95%CI, 6.3-8.7) in 2005, what falls between the

observed prevalence in 2002 and 2012.[8,9] Descriptive epidemiology of known diabetes shows remarkable similarities between 2002 and 2012: neither surveys found differences by sex or type of settlement. Hungarostudy also described decreasing prevalence of diabetes over 75 years.[8,16] Our observation on a higher known diabetes prevalence in Western compared to Eastern Hungary is notable as similar (significant) difference was reported from the General Practitioners Programme in 1998 probably suggesting different levels of awareness and screening for diabetes in these regions.[10] With the ageing of the European population a parallel rising prevalence of diabetes is expected. Although this is true for the Hungarian population, according to our results only a small proportion of the increasing prevalence could be explained by this phenomenon.[19] Furthermore, screening programs for diabetes and other comorbidities (such as obesity, hypertension, hyperlipidaemia, cardiovascular disease) could have also increased the proportion of self-reported diabetes through increased awareness. Through similar mechanisms changes in educational level and deprivation could be associated with diabetes awareness, however secondary level education remained stable, while unemployment increase in the observation period, suggesting that these factors are not major drivers of the observed increase.[20,21] A similar increase in age-adjusted prevalence of diabetes in a 12-year period was reported from subsequent Turkish surveys based on biochemical diagnosis of diabetes, suggesting that the potential role of changing diagnostic criteria and increasing awareness of the diagnosis may less important.[22]

Furthermore, nutritional surveys in Hungary reported substantially increasing prevalence from 55 to 62% of overweight and obesity during the same period that may also contribute to our findings.[23,24] The validity of our findings is further supported by the fact that a similar overall increase in the prevalence of diabetes mellitus (from 0.6 to 1.1 million people) and its comorbidities (hypertension and ischaemic heart disease) were observed in the registry of the Hungarian Central Statistical Office during the same period.[25]

Although our survey was carefully designed, some limitations should be acknowledged. Our aim was to estimate the prevalence of type 2 diabetes, however this was solely based on self-reports. While most self-reported cases would also be diagnosed cases, there may be false positive self-reports and

unreported diagnosed cases that may limit the comparability of the proportion of self-reported and known diabetes prevalence. Furthermore, our focus on type 2 diabetes hinders comparisons with previous studies that didn't differentiate between diabetes subtypes. While this leads to some underestimation of diabetes prevalence, type 2 diabetes is far the most common form of this disease. Although current recommendations suggest immediate initiation of treatment with medication, the slightly differing definitions of known diabetes may have created some overestimation of diabetes prevalence in the current study compared to Hungarostudy.

While both surveys had similar response rates, the interview methods were different. As our survey sampled only households with a current landline phone, this may have biased our estimates of diabetes prevalence and also of the change in diabetes prevalence. Persons and households without telephones represent a deprived group (small households, young adults, people that are unemployed or on low incomes, ethnic minorities).[26] While ethnic minorities and people from lower social grades in general have an increased risk of diabetes they may also be less likely to be diagnosed with the disease.[27] Given however that both financial status and education were inversely related to diabetes prevalence in Hungarostudy, our observed prevalence based on a phone survey is most likely an underestimation of the true proportions.[8]

The relatively low sample size is another relative limitation of our survey. While we have limited power to show differences in the smallest age strata, we had excellent power to show even minimal increases in diabetes prevalence (~2%) within the largest age groups (55-64 and 65-74 years).

A main limitation of our study is the lack of information on undiagnosed diabetes and potential covariates (BMI, education, co-morbidity, etc.) associated with the risk of diabetes. Without individual level data, it is impossible to entangle the major drivers of the observed increase (awareness bias or true increase) in self-reported diabetes prevalence.

A major strength of the present study is its representative design and similar methodology to the representative Hungarostudy.

Conclusion

Our results showed a higher prevalence of diabetes in Hungary than estimated by currently available European data. We reported an alarming increase in the self-reported prevalence of type 2 diabetes in the last decade that mostly affects working age people. If this trend continues, a major public health crisis in Hungary can be envisaged. This highlights the need for continuous monitoring the descriptive epidemiology of diabetes in Hungary and Europe.

Competing interest: The authors declare that they have no competing interests

Authors' contributions:

AGT, BAD, VF, TT ZSJ have made substantial contributions to conception and design, and acquisition of data. AGT, BAD have made the analysis and interpretation of data. All authors have been involved in drafting the manuscript and revising it critically for important intellectual content. All authors have given final approval of the version to be published

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Table 1 – Population characteristics by self-reported type 2 diabetes status.

	Controls	**Self-reported type 2 diabetes**	**p**
N	883	117	
Age (years)	63.7±11.2	45.7±18.1	<0.0001
Age groups n (%)			<0.0001
18-29 years	194 (22.0)	1 (0.8)	
30-39 years	191 (21.7)	4 (3.4)	
40-49 years	150 (17.0)	7 (5.9)	
50-64 years	195 (22.1)	55 (46.6)	
65+ years	152 (17.2)	51 (43.2)	
Female n (%)	472 (53.5)	63 (53.8)	0.51
Urban n (%)	289 (67.2)	39 (66.7)	0.92
Geographical region			0.14
Western Hungary	265 (30.0)	42 (35.6)	
Central Hungary	261 (29.6)	36 (30.5)	
Eastern Hungary	356 (40.4)	40 (33.9)	

Mean ± SD, p-values are for independent sample t-tests, $\chi 2$-tests (linear trends for multilevel variables).

Figure 1 –Estimated prevalence of self-reported type 2 diabetes and age in 2012.

Based on a generalized linear model with diabetes prevalence as the outcome and sex, age, and age*age interaction as covariates.

Error bars represent 95% confidence intervals.

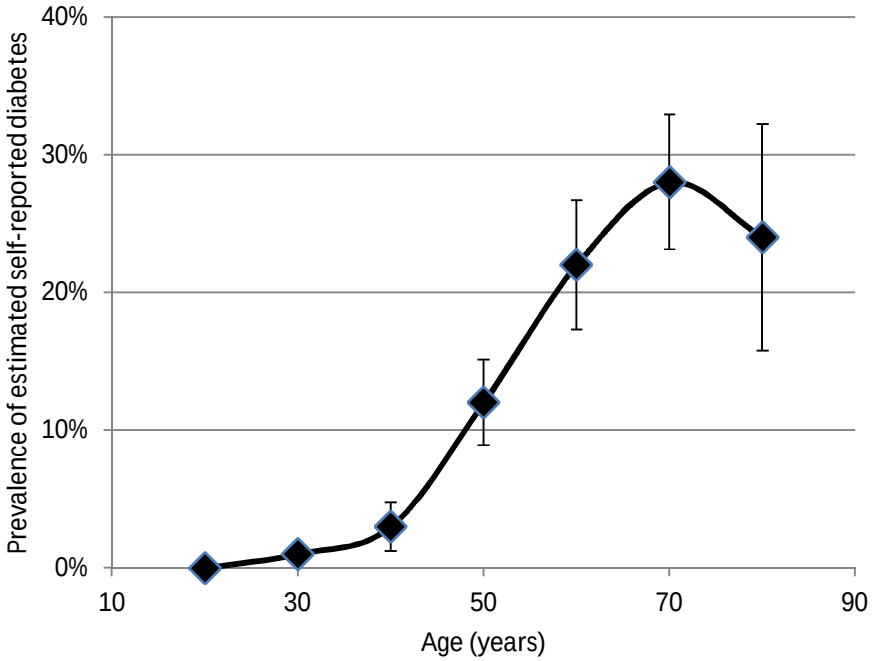
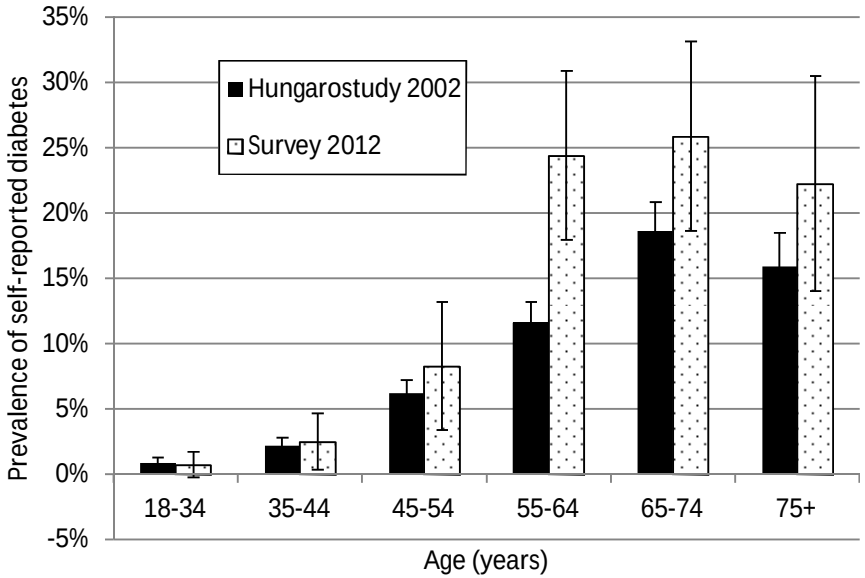

40%
30%
20%
10%
0%
Prevalence of estimated self-reported diabetes
10
30
50
70
90
Age (years)

Figure 2 – Prevalence of self-reported diabetes by age strata in 2002 (Hungarostudy) and 2012.

Error bars represent 95% confidence intervals.


35%
30%
25%
20%
15%
10%
5%
0%
-5%
Prevalence of self-reported diabetes
Hungarostudy 2002
Survey 2012
18-34
35-44
45-54
55-64
65-74
75+
Age (years)