Routine data sources challenge international diabetes Federation extrapolations of national diabetes prevalence in Switzerland

Bopp, Matthias; Zellweger, Ulrich; Faeh, David

Abstract: OBJECTIVE Information on diabetes prevalence in the general population is scarce and often based on extrapolations. We evaluated whether prevalence could be estimated from routine data sources. RESEARCH DESIGN AND METHODS The sources were 1) hospital discharges (2008, n = 828,171), 2) death registry (2007/2008, n = 118,659), and 3) Swiss Health Survey (SHS; 2007, n = 18,665). Persons without diabetes as underlying cause of death (death registry) or principal diagnosis (hospital discharges) were regarded as surrogate for a general population random sample. RESULTS In those aged 20-84 years, 4.5% of men and 3% of women were expected to have diabetes. By source, estimations were 4.4 and 2.8% (hospital discharges), 3.8 and 3.1% (death registry), and 4.9 and 3.7% (SHS) for men and women, respectively. Among sources, age-sex patterns were similar. CONCLUSIONS In countries with adequate data quality, combination of routine data may provide valid and reliable estimations of diabetes prevalence. Our figures suggest that International Diabetes Federation extrapolations substantially overestimate diabetes prevalence in Switzerland.

DOI: https://doi.org/10.2337/dc11-0157

Posted at the Zurich Open Repository and Archive, University of Zurich
ZORA URL: https://doi.org/10.5167/uzh-50865
Journal Article
Published Version

Originally published at:
Bopp, Matthias; Zellweger, Ulrich; Faeh, David (2011). Routine data sources challenge international diabetes Federation extrapolations of national diabetes prevalence in Switzerland. Diabetes Care, 34(11):2387-2389.
DOI: https://doi.org/10.2337/dc11-0157
Routine Data Sources Challenge International Diabetes Federation Extrapolations of National Diabetes Prevalence in Switzerland

Matthias Bopp, MPH, PhD
Ueli Zellweger, MA
David Faeh, MPH, MD

OBJECTIVE—Information on diabetes prevalence in the general population is scarce and often based on extrapolations. We evaluated whether prevalence could be estimated from routine data sources.

RESEARCH DESIGN AND METHODS—The sources were 1) hospital discharges (2008, \(n = 828,171\)), 2) death registry (2007/2008, \(n = 118,659\)), and 3) Swiss Health Survey (SHS, 2007, \(n = 18,665\)). Persons without diabetes as underlying cause of death (death registry) or principal diagnosis (hospital discharges) were regarded as surrogate for a general population random sample.

RESULTS—In those aged 20–84 years, 4.5% of men and 3% of women were expected to have diabetes. By source, estimations were 4.4 and 2.8% (hospital discharges), 3.8 and 3.1% (death registry), and 4.9 and 3.7% (SHS) for men and women, respectively. Among sources, age–sex patterns were similar.

CONCLUSIONS—In countries with adequate data quality, combination of routine data may provide valid and reliable estimations of diabetes prevalence. Our figures suggest that International Diabetes Federation extrapolations substantially overestimate diabetes prevalence in Switzerland.

In most countries, information on diabetes prevalence is scarce and, as in Switzerland, often based on extrapolations from other countries (1–5). We explored whether the combination of three routine data sources (hospital discharges, death registry, health survey) allows a more valid prevalence estimation. We hypothesize that in Switzerland diabetes remains rarely undetected in inpatients and that the risk of persons with diabetes dying or being hospitalized for a reason other than diabetes (e.g., accident, cancer) is approximately the same as that of persons without diabetes. In that sense, hospitalized or deceased persons with another underlying cause/principal diagnosis other than diabetes may be regarded as a surrogate for a general population sample. In contrast, persons with diabetes as an underlying cause/principal diagnosis are likely to have a substantially increased risk of hospitalization and death compared with persons without diabetes and should thus not be part of the surrogate sample.

RESEARCH DESIGN AND METHODS

Swiss Health Survey
The Swiss Health Survey (SHS) provides nationally representative information on the population aged \(\geq 15\) years (6).

Hospital discharges
Inpatient hospital admissions in Switzerland are routinely registered (7). Although anonymous, hospitalizations of the same individual can be merged. One principal diagnosis (generally corresponding to the main reason for hospitalization) and up to 29 additional diagnoses (previously known or detected during hospitalization) are assessed, resulting in approximately 4 million diagnoses relating to 1.0 million persons (2008). Diagnoses are coded according to International Statistical Classification of Diseases, 10th Revision (ICD-10; Diabetes: E10–E14). We excluded individuals with principal diagnoses of ICD-10 Chapters “Z,” “R,” and “O,” leaving 1,146,203 hospitalizations from 828,171 individuals with Swiss residence. Only persons with diabetes as an additional (but not principal) diagnosis were included.

Death registry
In principle, the same concept was used as for hospital discharges. Only persons with diabetes as concomitant (but not underlying) cause of death were included. In Switzerland, death is certified by a physician, including information on the underlying cause and up to two concomitant diseases (8). By excluding ICD-10 Chapter “R,” 118,659 deaths in 2007–2008 could be analyzed. For 28.3% of these, one concomitant cause of death was registered, and for 41.7%, two concomitant causes of death were registered.

It can be assumed that physicians’ diagnosis of diabetes in all three sources was generally based on blood glucose only (random \(\geq 11.1\) mmol/L or fasting \(\geq 7\) mmol/L). Overall rates were age standardized using the World Health

From the Institute of Social and Preventive Medicine, University of Zurich, Zurich, Switzerland.

Corresponding author: Matthias Bopp, bopp@ifspm.uzh.ch.
Received 25 January 2011 and accepted 9 August 2011.
DOI: 10.2337/dc11-0157
This article contains Supplementary Data online at http://care.diabetesjournals.org/lookup/suppl/doi:10.2337/dc11-0157/-/DC1.
© 2011 by the American Diabetes Association. Readers may use this article as long as the work is properly cited, the use is educational and not for profit, and the work is not altered. See http://creativecommons.org/licenses/by-nc-nd/3.0/ for details.

care.diabetesjournals.org
Diabetes Care Publish Ahead of Print, published online September 16, 2011

Diabetes Care 1
Organization standard population “Europe.” The number of individuals with diabetes was obtained by multiplication of age- and sex-specific prevalence rates with the respective population counts in 2008.

A Poisson regression model including age, period, sex, and interaction of sex and period was calculated to obtain $P$ values for increase in diabetes prevalence in 1995–2008 and for the difference in increase between men and women.

RESULTS

SHS
In 2007, 4.9% of men and 3.7% of women aged 20–84 years reported a diagnosis of diabetes (Table 1). Prevalence peaked in men aged 75–84 years (16.1%) and women aged 85–94 years (12.0%). By projecting these rates to the general population aged 20–84 years in 2008, 279,000 people had diabetes.

Hospital discharges
Of 823,584 inpatients with principal diagnosis other than diabetes, there were 47,566 (5.8%) with diabetes as an additional diagnosis. Prevalence peaked at age 75–84 years (men: 14.8%, women: 11.1%). By extrapolating prevalence rates to the general population, 237,200 people had diabetes.

Death registry
Among the 118,659 individuals with an eligible underlying cause of death, a code for diabetes was found in 12,018 (10.1%). By limiting to diabetes coded exclusively as concomitant disease, the maximal prevalence was 9.9% in men (aged 65–74 years) and 9.3% in women (aged 75–84 years). Extrapolating prevalence rates to the general population resulted in 225,100 people with diabetes.

Trends
Death registry data showed a continuous increase in diabetes prevalence in 1995–2008 ($P < 0.001$ for both sexes), particularly in elderly persons and in men (increase 1995–2008, men vs. women: $P < 0.001$). A similar increase was also suggested by the SHS (Supplementary Fig. 1).

CONCLUSIONS—When no national diabetes prevalence figures are available, routine statistics from hospital discharges, death registry, and health survey can offer an alternative. The prevalence in

| Data source | Year | Estimated with diabetes (n)$^\text{‡}$ | Men | Women | Total |
|-------------|------|--------------------------------------|-----|-------|-------|
| 1. Hospital discharges, additional diagnosis | 2008 | 237,000 | 109,000 | 128,000 | 237,000 |
| 2. Death registry, concomitant cause | 2007/2008 | 225,000 | 113,000 | 112,000 | 225,000 |
| 3. SHS, ever diagnosed | 2007/2008 | 225,000 | 113,000 | 112,000 | 225,000 |

In the study population (men and women). $^\text{†}$Age-standardized. $^\text{‡}$In the general population.
Switzerland can be estimated at 3.5–4.3%, corresponding to 245,000–300,000 people with diabetes. The age–sex patterns were strikingly similar among the three data sources (Supplementary Fig. 1), e.g., a higher prevalence in men in virtually all age classes.

Our approach underestimates rather than overestimates diabetes prevalence. For inpatients, the proportion of undiagnosed diabetes was expected to be small. However, individuals with the highest risk of diabetes were not included in our analysis because these persons are likely to be hospitalized with diabetes as a principal instead of only additional diagnosis. In the death registry, multimorbidity may cause increased competition of mentions of concomitant causes of death in decedents aged ≥65 years, with diabetes not being mentioned in favor of other concomitant conditions. In addition, diabetes may not be captured in sudden deaths. Self-reporting individuals in the SHS may not be aware of the disease (9–12). From all three sources, underestimation could also be expected because an oral glucose tolerance test is not routinely administered in a clinical setting. Some overestimation of our figures could be expected because of the generally increased morbidity and mortality of diabetic patients increasing their likelihood of hospitalization and death also due to other conditions or a tendency of study participants to overreport disease (13).

Published extrapolations of diabetes prevalence in Switzerland in 2010 suggested higher figures than our estimations: 350,000–630,000 (2–5). For 2010, the International Diabetes Federation predicted a number twice as high as our highest estimate, implying one of the highest prevalence rates in the Western world (2). Accordingly, Switzerland would have a higher diabetes prevalence than countries with a three times higher obesity prevalence and markedly higher cardiovascular disease mortality (14). Therefore, even considering the maximum extent of potential underestimation arising from our approach, our estimates appear more realistic. In fact, our highest estimates for Switzerland were in line with 2010 figures for European countries with a low prevalence of diabetes, such as France, Belgium, the Netherlands, and Sweden, and still somewhat higher than those of the U.K. (2,12), but definitively lower than those from neighboring Germany (2,9,15). In Switzerland, a proportion of undiagnosed diabetes can be expected to be similar to that of France (i.e., 20%), and a part of the increase in diabetes prevalence may relate to decreasing proportions of undiagnosed cases (12). Nevertheless, the magnitude of the increase in diabetes prevalence in 1993–2008 suggests that diabetes prevention should be reinforced in Switzerland, particularly in men.

Acknowledgments—This work was supported by the Swiss National Science Foundation (32473B-125710).

No potential conflicts of interest relevant to this article were reported.

M.B. conceived the study, conducted data analysis, sketched a first draft of the manuscript, and reviewed and edited the manuscript. U.Z. analyzed hospital discharge data and reviewed and edited the manuscript. D.F. wrote most parts of the manuscript, added background knowledge, substantially contributed to discussion, and reviewed and edited the manuscript.

The authors thank the Swiss Federal Statistical Office for providing data from the SHS and cause of death and hospital discharge statistics; and Julia Braun, Institute of Social and Preventive Medicine, University of Zurich, for statistical advice.

References
1. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diabetes Care 2004;27:1047–1053
2. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. Diabetes Res Clin Pract 2010;87:4–14
3. McCarty D, Zimmet P. Diabetes 1994 to 2010: Global Estimates and Projections. Melbourne, International Diabetes Institute, 1994
4. King H, Rewers M; WHO Ad Hoc Diabetes Reporting Group. Global estimates for prevalence of diabetes mellitus and impaired glucose tolerance in adults. Diabetes Care 1993;16:157–177
5. Amos AF, McCarty DJ, Zimmet P. The rising global burden of diabetes and its complications: estimates and projections to the year 2010. Diabetes Med 1997;14 (Suppl. 5):S1–S85
6. Neuchâtel Gesundheit und Gesundheitsverhalten in der Schweiz 2007. Schweizerische Gesundheitsbetrachtung [Internet]. 2010. Swiss Federal Statistical Office. Available from http://www.bfs.admin.ch/bfs/portal/de/index/news/publikationen. Document.137644.pdf. Accessed 27 May 2011
7. Statistik der Krankenhäuser [Internet]. Swiss Federal Statistical Office. Available from http://www.bfs.admin.ch/bfs/portal/de/index/infothek/erhebungen_quellen/blank/blank/mlkh/01.html. Accessed 27 May 2011
8. Todesursachenstatistik: Richtlinien für die ärztliche Bescheinigung der Todesursachen. Statistik der Schweiz, Fachbereich 14, Gesundheit [Internet], 1996. Bern, Switzerland, Swiss Federal Statistical Office, 1996. Available from http://www.bfs.admin.ch/bfs/portal/de/index/infothek/erhebungen_quellen/blank/blank/mlkh/01.html. Accessed 27 May 2011
9. Meisinger C, Strassburger K, Heier M, et al. Prevalence of undiagnosed diabetes and impaired glucose regulation in 35–59-year-old individuals in Southern Germany: the KORA F4 Study. Diabet Med 2010;27:360–362
10. Firma M, Mayor V, Vidal PM, et al. The Cola study: a population-based study to investigate the epidemiology and genetic determinants of cardiovascular risk factors and metabolic syndrome. BMC Cardiovasc Disord 2008;8:6
11. Yang W, Lu J, Weng J, et al., China National Diabetes and Metabolic Disorder Study Group. Prevalence of diabetes among men and women in China. N Engl J Med 2010;362:1090–1101
12. Bonalde C, Vernay M, Roudier C, et al. A first national prevalence estimate of diagnosed and undiagnosed diabetes in France in 18–to 74-year-old individuals: the French Nutrition and Health Survey 2006/2007. Diabet Med 2011;28:583–589
13. Puts MT, Deeg DJ, Hoeymans N, Nusselder WJ, Schellevis FG. Changes in the prevalence of chronic disease and the association with disability in the older Dutch population between 1987 and 2001. Age Ageing 2008;37:187–193
14. Health at a glance: Europe 2010 [Internet]. 2010. Organisation for Economic Cooperation and Development (OECD). OECD Publishing. Available from http://dx.doi.org/10.1787/health_glance-2010-en. Accessed 27 May 2011
15. Icks A, Rathmann W, Rosenbauer J, Giani G. Robert Koch Institut. Statistisches Bundesamt. Gesundheitsberichterstattung des Bundes. Diabetes mellitus. Heft 24 [Internet], 2005. Available from http://infomed.mds-ev.de/sindbad.nsf/88b1853631e8b66ecc125650036750b/3552b17b76c4e17dc1256cc027f9b9f5F5E1GBE24_Diabetes_2005.pdf. Accessed 27 May 2011