

Thesis submitted for the degree of Doctor of Philosophy (PhD)

The Economics of Diabetes in Middle-Income-Countries

Till Seuring

School of Medicine
University of East Anglia, UK

date

This copy of the thesis has been supplied on condition that anyone who consults it is understood to recognise that its copyright rests with the author and that use of any information derived there from must be in accordance with current UK Copyright Law.

In addition, any quotation or extract must include full attribution.

Abstract

This thesis focuses on the economic analysis of type 2 diabetes (T2D) in middle-income countries. Given its rising prevalence, in-depth country specific analysis is key for understanding the economic consequences of T2D in middle-income countries (MICs). I analyse the economic burden of T2D in terms of labour market consequences, taking into account the heterogeneity of the diabetes population, for both Mexico and China. For China I further investigate the effects of a diabetes diagnosis on health behaviours that may help to curb the adverse consequences of diabetes.

The thesis consists of four essays with the unifying theme of improving our understanding of the causal relationship between diabetes and economic outcomes. Essay (1) provides an updated overview, critically assesses and identifies gaps in the current literature on the economic costs of T2D using a systematic review approach; essay (2) studies the effect of self-reported diabetes on employment probabilities in Mexico, using cross-sectional data and making use of a commonly used instrumental variable approach; essay (3) extends the previous essay via the use of panel data and fixed effects and considering a broader range of outcomes, including wages and working hours; it also makes use of cross-sectional biomarker data that allows for the investigation of measurement error in self-reported diabetes; essay (4) investigates the effect of a diabetes diagnosis on employment and income as well as health behaviours in China, using longitudinal data and applying two distinct identification strategies: fixed effects and marginal structural model estimation.

The findings of the first paper document a considerable increase in studies on the economic costs of diabetes in MICs. It also illustrates that most of the evidence is based on cost-of-illness studies and the literature on labour market and potential earning effects of diabetes in MICs is scarce. The thesis fills part of this void and shows that self-reported diabetes has a considerable impact on employment probabilities of people living in Mexico and China. The findings are robust to the application of different estimation strategies. No consistent evidence of an adverse effect of diabetes on wages or working hours is found, suggesting that diabetes mainly affects the extensive margin. The findings for Mexico indicate that particularly people working in the informal or agricultural, hence less protected and often more physically demanding, sectors bear the brunt of the negative effects of diabetes. Taking into account the undiagnosed population, the adverse effect of diabetes is reduced because undiagnosed diabetes itself does not show an adverse association with any labour market outcome. This suggests that the undiagnosed population is distinctly different from the diagnosed population, likely due to differences in health information and health status. Therefore, research using self-reported diabetes information should limit its claims to the diagnosed population as economic effects are likely different for the undiagnosed. With regards to the effect of a diabetes diagnosis on

health behaviours, the results from China suggest that a diagnosis leads to moderate reductions in body mass index (BMI), waist circumference, alcohol and caloric consumption. Perhaps surprisingly, especially men appear to be able to lose weight and reduce their caloric consumption. Not accounting for unobserved heterogeneity leads to a change in the coefficient sign for the effect of a diagnosis on BMI and waist circumference, while the differences in estimates are less pronounced for other outcomes.

Contents

1	General Introduction	10
1.1	Background to the thesis	11
1.1.1	Types of diabetes	11
1.1.2	Diabetes complications	12
1.1.3	Diabetes prevention	13
1.1.4	The need for further economic research on diabetes	13
1.1.5	The labour market impact of type 2 diabetes	14

List of Figures

List of Tables

Abbreviations

BMI body mass index

COI cost-of-illness

HIC high-income country

LIC low-income country

LMIC low- and middle-income country

MIC middle-income country

MxFLS Mexican Family Life Survey

NCD non-communicable disease

Publications and statement of authorship

Publications arising from this thesis

Seuring, T., Archangelidi, O., and Suhrcke, M. (2015). “The Economic Costs of Type 2 Diabetes: A Global Systematic Review.” *PharmacoEconomics* 33 (8), 811–831.

This publication can be found at: <http://link.springer.com/article/10.1007%2Fs40273-015-0268-9>

Seuring, T., Goryakin, Y., and Suhrcke, M. (2015). “The impact of diabetes on employment in Mexico.” *Economics & Human Biology* 18, 85–100.

This publication can be found at: <http://www.sciencedirect.com/science/article/pii/S1570677X15000349>

Statement of jointly authored publications

The research reported is my own original work which was carried out in collaboration with others as follows:

Chapter 1: Written by Till Seuring.

Chapter ??: Till Seuring was the lead author of a paper published as:

Seuring, T., Archangelidi, O., and Suhrcke, M. (2015). “The Economic Costs of Type 2 Diabetes: A Global Systematic Review.” *PharmacoEconomics* 33 (8), 811–831.

Till Seuring, Marc Suhrcke and Olga Archangelidi designed the study. The search strategy was designed and executed by Till Seuring. Till Seuring and Olga Archangelidi screened the initial results and extracted the data from the primary studies. Till Seuring drafted the original manuscript which was critically reviewed by Olga Archangelidi and Marc Suhrcke.

Chapter ??: Till Seuring was the lead author of a paper published as:

Seuring, T., Goryakin, Y., and Suhrcke, M. (2015). “The impact of diabetes on employment in Mexico.” *Economics & Human Biology* 18, 85–100.

Till Seuring, Yevgeniy Goryakin and Marc Suhrcke designed the study. Till Seuring analysed the data. Till Seuring drafted the original manuscript which was critically reviewed by Yevgeniy Goryakin and Marc Suhrcke.

Chapter ??: Till Seuring, Pieter Serneels and Marc Suhrcke designed the study. Till Seuring analysed the data. Till Seuring drafted the original manuscript which was critically reviewed by Pieter Serneels and Marc Suhrcke.

Chapter ??: Till Seuring and Max Bachmann designed the study. Till Seuring analysed the data. Till Seuring drafted the original manuscript which was critically reviewed by Max Bachmann.

Chapter ??: Written by Till Seuring.

1 General Introduction

- Set stage describing burden of chronic disease/diabetes in world and MICs (Mexico/China) more specifically. (e.g. burden of disease study/high level studies).
- Describe general goal of thesis:

Identify gaps in literature on the economic burden of diabetes in terms of evidence but also methodology, particularly in MICs, and fill some of the gaps.
- Describe each of the chapters and the motivation behind it

1.1 Background to the thesis

Diabetes, and especially type 2 diabetes, has seen an unprecedented rise in prevalence in low- and middle-income countries (LMICs). This rise has been much greater than in high-income countries (HICs) such as the USA, UK or Western Europe and can only partly be explained by a shift in age structure towards older populations. Especially in LMICs it appears to be driven by rapid changes in levels of physical activity, in nutrition and other lifestyle related factors (Hu, 2011; NCD Risk Factor Collaboration, 2016).

The transition towards non-communicable diseases (NCDs) in LMICs, including diabetes, has taken place rapidly over the last three decades and has lead in many places to a double disease burden, i.e. health systems having to deal with both communicable and NCDs. So far countries have had little success in halting the increase in diabetes, so that by now the majority of people with diabetes lives in middle-income countries, in particular in China, India, Brazil, Indonesia, Pakistan, Russia, Egypt and Mexico (NCD Risk Factor Collaboration, 2016). Despite this increase in diabetes in less developed countries over the last decades, research on its economic consequences had been limited mainly to HICs.

1.1.1 Types of diabetes

Diabetes is a term used to describe various conditions characterised by elevated blood glucose levels. These either occur because the pancreas is not able to produce sufficient insulin or due to insulin resistance, where the body is not able to use the produced insulin effectively (World Health Organization, 2016). The different conditions themselves, however, have distinct origins, especially for the two most common types of type 1 diabetes and type 2 diabetes.

- **Type 1 diabetes** is an autoimmune disease with an important genetic component and whose triggers still remain largely elusive. It emerges when the insulin producing

cells on the pancreas are attacked and destroyed by the immune system, so that insulin has to be provided exogenously. About 10% of all global diabetes cases are type 1 diabetes and it is particularly prevalent in Northern European countries such as Finland, and generally exhibits large geographic variation. Its onset is mainly in early childhood, teenage years and early adulthood. Symptoms tend to appear rather quickly and can be quite severe leading to a relatively rapid diagnosis or death. People with type 1 diabetes will need to inject insulin to control their blood glucose levels. If access to insulin is not given type 1 diabetes leads to death within a short period of time (Tuomilehto, 2013).

- **Type 2 diabetes** results from the body's ineffective use of insulin and accounts for about 90% of all diabetes cases (World Health Organization, 2016). Albeit there is a considerable genetic component to the development of type 2 diabetes, there are many known risk factors that favour the development of type 2 diabetes, such as overweight and obesity, unhealthy diet, physical inactivity and smoking, among others (World Health Organization, 2016). Interestingly, the risk of developing type 2 diabetes varies also by population, with South-East Asian populations developing diabetes at lower body mass index (BMI) levels than populations of European decent (Ramachandran, Wan Ma, et al., 2010). Type 2 diabetes often remains undetected for several years due to its more gradual development compared with type 1 diabetes. Therefore, even in HICs and especially in LMICs, a considerable proportion of at least 1/4 of the population with type 2 diabetes is unaware of the condition (Beagley et al., 2014).

Recently, an earlier onset of type 2 diabetes has been observed, especially in minorities in HIC, such as Mexicans and Asian populations, while data is limited for LMIC (Fazeli Farsani et al., 2013). Further, the increasing numbers of obesity and overweight in childhood and early adulthood have also likely caused an earlier onset of type 2 diabetes (Chen et al., 2012). Hence, type 2 diabetes increasingly affects people in the middle of their productive lifespan, extending the time they have to live with the disease and probability of developing debilitating complications.

1.1.2 Diabetes complications

The most common complications for all types of diabetes and often already present at diagnosis is retinopathy being present in 35% of people with diabetes and responsible for 2.6% of blindness globally. Further, up to 50% of cases of end stage renal disease are a direct result of diabetes, especially in countries where access to dialysis is restricted. People

with diabetes also have a 2–3 times higher risk to experience cardiovascular disease compared to people without diabetes. A further, very debilitating, complication is amputation of lower limbs due to impaired wound healing, being 10–20 higher than for people without diabetes (World Health Organization, 2016). There is also a growing literature suggesting a—potentially bidirectional—relationship between diabetes and depression (Dooren et al., 2013; Nouwen, Winkley, et al., 2010; Roy and Lloyd, 2012). In addition, there seems to be a link between diabetes and the development of certain types of cancer, (Nead et al., 2015; Tsilidis et al., 2015), as well as an array of other of other infectious diseases, intentional self-harm and degenerative disorders diseases (Seshasai et al., 2011).

1.1.3 Diabetes prevention

While a causal relationship between type 2 diabetes, depression and cancer has not yet been established, most of the other complications are a result of consistently elevated blood glucose levels. Hence many diabetes cases could be prevented if recommended treatment goals were achieved. However, limited resources and access to healthcare make it difficult to properly treat type 2 diabetes in LMICs, and even in HICs, a large part of the diabetes population does not achieve treatment goals. Further, even after the diagnosis in many cases blood glucose levels are not successfully managed as to prevent further complications (Diabetes UK, 2012; Villalpando et al., 2010).

Further, there is also scope for the primary prevention of diabetes, in particular of type 2 diabetes, by reducing the prevalence of the known risk factors such as obesity, an unhealthy diet, smoking and sedentary behaviour (World Health Organization, 2016). However, so far most approaches to prevent type 2 diabetes have not had the desired effect and may not always be realistic in very resource constrained settings (White, 2016). In particular, efforts to reduce the biggest type 2 diabetes risk factors of obesity and overweight have mostly fallen flat (Roberto et al., 2015).

1.1.4 The need for further economic research on diabetes

To provide good research to aid qualified decision about the use of primary and secondary prevention strategies of diabetes, researchers and policy makers need information about the current burden of disease, both in terms of health and economically, that is caused by diabetes and could be realistically prevented. Information on all aspects of economic costs and the quality of the estimates has optimally to be available. However, at the start of this thesis, little was known about the global economic impact of diabetes, and especially in developing countries. There had never been a comprehensive systematic review of studies

assessing the costs related to diabetes, both in terms of direct and indirect costs. Only one (non-systematic) review existed by Ettaro et al. (2004), including studies on the cost-of-illness (COI) until the year 2001. They did, however, not find research from LMICs. Further, the methodological quality of existing research had not been comprehensively assessed and areas of future research remained unidentified. Also missing was a review on studies not using a COI approach but using quantitative methods to estimate the impact of diabetes on labour market outcomes, such as employment and wages.

These gaps in evidence form research question one and are addressed in Chapter ??: *The Economic Costs of Type 2 Diabetes: A Global Systematic Review*. The review had several goals. One was to provide a first comprehensive global picture of the economic burden of type 2 diabetes, not limited to traditional COI studies but also including studies on the labour market effects of diabetes. It was also expected to find evidence on the economic costs of diabetes in developing countries. Together, the aim was to provide information on the economic costs of diabetes for as many countries as possible. Another goal was the identification of areas, both in terms of methodology and topic, where evidence was lacking and/or current methodologies could be improved upon. This should help me determining the subsequent chapters of my thesis as well as other researchers interested in researching the economics of diabetes.

1.1.5 The labour market impact of type 2 diabetes

The review identified the labour market impact of diabetes in LMICs as a topic that had not received much attention. Apart from the lack of evidence from developing countries, there was also scope for methodological improvements compared to the existing HIC evidence. Further, information on the effect on sub-populations, i.e. comparisons between rich and poor and the formal and informal labour market were non-existent.

However, in order to carry out such an analysis, appropriate data needed to be identified. To this end I carried out an internet search, using general search engines as well as specialized engines such as the World Bank Central Microdata Catalog <http://microdata.worldbank.org/>, the Demographic and Health Survey Database <http://dhsprogram.com/data/>, the Global Health Data Exchange Database <http://ghdx.healthdata.org/>, and the International Household Survey Network Catalog <http://catalog.ihnsn.org/index.php/catalog> in particular searching for datasets containing information on self-reported or measured diabetes. Specialized websites providing an overview on household survey data in developing countries were also searched to identify relevant data (such as http://ipl.econ.duke.edu/dthomas/dev_data/index.html and <https://sites.google.com/site/medevecon/development-economics/devecondata/micro>

for household survey from developing countries, and an overview on data sets containing biomarker information provided by The Biomarker Network at <http://gero.usc.edu/CBPH/network/resources/studies/>). An overview of the identified studies is provided in Table ??.

Given the availability of data and the extend of diabetes in middle-income countries (MICs) compared to low-income countries (LICs), a decision was made to focus on MICs for the remained of the thesis. In particular, Mexico shall be the country of interest for Chapters ?? and ??. The main reason to chose Mexico is the availability of data, provided by the Mexican Family Life Survey (MxFLS). It allows for the investigation of the impact of diabetes on labour market outcomes by providing high quality information on a rich set of important covariates, including family background and diabetes itself, not available in other surveys. Further, Mexico is a country with particularly high obesity and diabetes rates making it an interesting case to study. Chapter ?? therefore investigates *The impact of diabetes on employment in Mexico*. The goal was to provide an answer to research question two, what is the causal effect of self-reported diabetes on employment probabilities in a MIC, here in the case of Mexico?

TALK ABOUT PREVENTION POSSIBILITIES. NAME OTHER TYPES OF DIABETES SHORTLY. GO OVER TO THE ECONOMIC BURDEN ASSOCIATED WITH DIABETES (MAINLY KNOWN IN HICS AND ONLY FOR HEALTHCARE COSTS. TO PREVENT AND TREAT DIABETES IT IS IMPORTANT TO IDENTIFY MOST AFFECTED, ALSO ECONOMICALLY SET STAGE FOR REVIEW.

Therefore, elevated blood glucose levels can cause damage to organs and blood vessels long before a diagnosis.

write about increase in child obesity and type 2 diabetes common complications of diabetes, differences in population susceptibility to type 2 diabetes

Bibliography

- Aaronson, S. (2010). "Comment on "Measuring Labor Composition. A Comparison of Alternate Methodologies" Chapter." *Labor in the New Economy*. Ed. by K. G. Abraham, J. R. Spletzer, and M. Harper. University of Chicago Press. Chap. Comment on, 485–491.
- Abdulkadri, A. O., Cunningham-Myrie, C., and Forrester, T. (2009). "Economic Burden of Diabetes and Hypertension in CARICOM States." *Social and Economic Studies* 58 (3-4), 175–197.
- Adler, A. I., Stevens, R. J., Manley, S. E., Bilous, R. W., Cull, C. A., and Holman, R. R. (2003). "Development and progression of nephropathy in type 2 diabetes: The United Kingdom Prospective Diabetes Study (UKPDS 64)." *Kidney International* 63 (1), 225–232.
- Agardh, E., Allebeck, P., Hallqvist, J., Moradi, T., and Sidorchuk, A. (2011). "Type 2 diabetes incidence and socio-economic position: a systematic review and meta-analysis." *International Journal of Epidemiology* 40 (3), 804–818.
- Aguila, E., Diaz, C., Fu, M. M., Kapteyn, A., and Pierson, A. (2011). *Living longer in Mexico: Income security and health*. RAND Corporation.
- Angrist, J. and Pischke, J. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
- Antillón, M., Lauderdale, D. S., and Mullahy, J. (2014). "Sleep behavior and unemployment conditions." *Economics & Human Biology* 14, 22–32.
- Arredondo, A. and Barcelo, A. (2007). "The economic burden of out-of-pocket medical expenditures for patients seeking diabetes care in Mexico." *Diabetologia* 50 (11), 2408–2409.
- Arredondo, A., Zúñiga, A., and Parada, I. (2005). "Health care costs and financial consequences of epidemiological changes in chronic diseases in Latin America: evidence from Mexico." *Public health* 119 (8), 711–720.
- Arredondo, A. and De Icaza, E. (2011a). "Costs of diabetes in Latin America: Evidences from the Mexican case." *Value in Health*. Costos de la Diabetes en America Latina: Evidencias del Caso Mexicano 14 (5 Suppl 1), S85–88.

- Arredondo, A. and De Icaza, E. (2011b). "The cost of diabetes in Latin America: evidence from Mexico." *Value in health: the journal of the International Society for Pharmacoeconomics and Outcomes Research*. Costos de la Diabetes en America Latina: Evidencias del Caso Mexicano 14 (5 Suppl 1), S85–8.
- Arredondo, A. and Zúñiga, A. (2004). "Economic consequences of epidemiological changes in diabetes in middle-income countries: The Mexican case." *Diabetes Care* 27 (1), 104–109.
- Ayyagari, P., Grossman, D., and Sloan, F. (2011). "Education and health: evidence on adults with diabetes." *International Journal of Health Care Finance and Economics* 11 (1), 35–54.
- Baird, S., Gong, E., McIntosh, C., and Özler, B. (2014). "The heterogeneous effects of HIV testing." *Journal of Health Economics* 37, 98–112. URL: <http://linkinghub.elsevier.com/retrieve/pii/S0167629614000836>.
- Ballesta, M., Carral, F., Oliveira, G., Girón, J. A., and Aguilar, M. (2006). "Economic cost associated with type II diabetes in Spanish patients." *The European journal of health economics* 7 (4), 270–5.
- Barceló, A., Aedo, C., Rajpathak, S., and Robles, S. (2003). "The cost of diabetes in Latin America and the Caribbean." *Bulletin of the World Health Organization* 81 (1), 19–27.
- Barquera, S., Hotz, C., Rivera, J., Tolentino, L., Espinoza, J., and Campos, I. (2006). "Food consumption, food expenditure, anthropometric status and nutrition-related diseases in Mexico. The double burden of malnutrition. Case studies from six developing countries." Rome.
- Barquera, S., Campos-Nonato, I., Aguilar-Salinas, C., Lopez-Ridaura, R., Arredondo, A., and Rivera-Dommarco, J. (2013). "Diabetes in Mexico: cost and management of diabetes and its complications and challenges for health policy." *Globalization and Health* 9 (1), 3.
- Barquera, S., Hernandez-Barrera, L., Tolentino, M. L., Espinosa, J., Ng, S. W., Rivera, J. A., and Popkin, B. M. (2008). "Energy Intake from Beverages Is Increasing among Mexican Adolescents and Adults." *Journal of Nutrition* 138 (12), 2454–2461.
- Bastida, E. and Pagán, J. A. (2002). "The impact of diabetes on adult employment and earnings of Mexican Americans: Findings from a community based study." *Health Economics* 11 (5), 403–413.
- Bastida, J. L., Aguilar, P. S., and Gonzalez, B. D. (2002). "The social and economic cost of diabetes mellitus." *Atencion primaria / Sociedad Española de Medicina de Familia y Comunitaria*. Los costes socioeconomicos de la diabetes mellitus 29 (3), 145–150.

- Basu, S., Yoffe, P., Hills, N., and Lustig, R. H. (2013). “The relationship of sugar to population-level diabetes prevalence: an econometric analysis of repeated cross-sectional data.” *PloS ONE* 8 (2), e57873.
- Batis, C., Mendez, M. a., Sotres-Alvarez, D., Gordon-Larsen, P., and Popkin, B. (2014). “Dietary pattern trajectories during 15 years of follow-up and HbA1c, insulin resistance and diabetes prevalence among Chinese adults.” *Journal of epidemiology and community health* 29 (6), 773–779. arXiv: NIHMS150003. URL: <http://www.ncbi.nlm.nih.gov/pubmed/24729424>.
- Baum, C., Schaffer, M., and Stillman, S. (2007). “Enhanced routines for instrumental variables/generalized method of moments estimation and testing.” *Stata Journal* 7 (4), 465–506.
- Beagley, J., Guariguata, L., Weil, C., and Motala, A. a. (2014). “Global estimates of undiagnosed diabetes in adults.” *Diabetes Research and Clinical Practice* 103 (2), 150–160.
- Bell, A. and Jones, K. (2015). “Explaining Fixed Effects: Random Effects Modeling of Time-Series Cross-Sectional and Panel Data.” *Political Science Research and Methods* 3 (01), 133–153.
- Bellamy, L., Casas, J.-P., Hingorani, A. D., and Williams, D. (2009). “Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis.” *Lancet* 373 (9677), 1773–9.
- Bergemann, A., Grönqvist, E., and Gudbjörnsdóttir, S. (2011). “The effects of job displacement on the onset and progression.”
- Biorac, N., Jakovljević, M., Stefanović, D., Perović, S., and Janković, S. (2009). “[Assessment of diabetes mellitus type 2 treatment costs in the Republic of Serbia].” *Vojnosanitetski pregled. Military-medical and pharmaceutical review* 66 (4), 271–276.
- Birnbaum, H., Leong, S., and Kabra, A. (2003). “Lifetime medical costs for women: Cardiovascular disease, diabetes, and stress urinary incontinence.” *Women’s Health Issues* 13 (6), 204–213. URL: <http://www.ncbi.nlm.nih.gov/pubmed/14675789>
<http://ovidsp.ovid.com/ovidweb.cgi?T=JS%7B%5C%7DPAGE=reference%7B%5C%7DD=emed6%7B%5C%7DNEWS=N%7B%5C%7DAN=2003507923>.
- Bjegovic, V., Terzic, Z., Marinkovic, J., Lalic, N., Sipetic, S., and Laaser, U. (2007). “The burden of type 2 diabetes in Serbia and the cost-effectiveness of its management.” *The European journal of health economics: HEPAC: health economics in prevention and care* 8 (2), 97–103.

- Bolin, K., Gip, C., Mörk, A.-C., and Lindgren, B. (2009). “Diabetes, healthcare cost and loss of productivity in Sweden 1987 and 2005—a register-based approach.” *Diabetic Medicine* 26 (9), 928–934.
- Boll, C., Leppin, J. S., and Schömann, K. (2016). “Who is overeducated and why? Probit and dynamic mixed multinomial logit analyses of vertical mismatch in East and West Germany.” *Education Economics* (661), 1–24.
- Boutayeb, A. and Boutayeb, W. (2014). “Estimation of the direct cost of diabetes in the Arab region.” *Mediterranean Journal of Nutrition and Metabolism* 7 (1), 21–32.
- Brandle, M., Zhou, H., Smith, B. R. K., Marriott, D., Burke, R., Tabaei, B. P., Brown, M. B., and Herman, W. H. (2003). “The direct medical cost of type 2 diabetes.” *Diabetes care* 26 (8), 2300–2304.
- Bratti, M. and Mendola, M. (2014). “Parental health and child schooling.” *Journal of Health Economics* 35 (1), 94–108.
- Brown, H. S., Pagán, J. A., and Bastida, E. (2005). “The Impact of Diabetes on Employment: Genetic IVs in a Bivariate Probit.” *Health Economics* 14 (5), 537–544.
- Brown, H. S., Perez, A., Yarnell, L. M., Pagan, J. a., Hanis, C. L., Fischer-Hoch, S. P., and McCormick, J. B. (2011). “Diabetes and employment productivity: does diabetes management matter?” *American Journal of Managed Care* 17 (8), 569–576.
- Brown, T. T. (2014). “How effective are public health departments at preventing mortality?” *Economics and human biology* 13, 34–45.
- Bruno, G., Picariello, R., Petrelli, A., Panero, F., Costa, G., Cavallo-Perin, P., Demaria, M., and Gnani, R. (2012). “Direct costs in diabetic and non diabetic people: the population-based Turin study, Italy.” *Nutrition, metabolism, and cardiovascular diseases : NMCD* 22 (8), 684–90.
- Buescher, P. A., Whitmire, J. T., and Pullen-Smith, B. (2010). “Medical care costs for diabetes associated with health disparities among adult Medicaid enrollees in North Carolina.” *North Carolina medical journal* 71 (4), 319–324.
- Camilo González, J., Walker, J. H., Einarson, T. R., and González, J. C. (2009). “Cost-of-illness study of type 2 diabetes mellitus in Colombia.” *Revista panamericana de salud pública = Pan American journal of public health* 26 (1), 55–63.
- Cawley, J., Maclean, J. C., Hammer, M., and Wintfeld, N. (2015). “Reporting error in weight and its implications for bias in economic models.” *Economics & Human Biology* 19, 27–44.
- Chan, B. S. W., Tsang, M. W., Lee, V. W. Y., and Lee, K. K. C. (2007). “Cost of Type 2 Diabetes mellitus in Hong Kong Chinese.” *International journal of clinical pharmacology and therapeutics* 45 (8), 455–468.

- Chan, J. C. N., Zhang, Y., and Ning, G. (2014). “Diabetes in China: a societal solution for a personal challenge.” *The Lancet Diabetes & Endocrinology* 2 (12), 969–979. URL: <http://linkinghub.elsevier.com/retrieve/pii/S2213858714701445>.
- Chang, K. (2010). “Comorbidities, quality of life and patients’ willingness to pay for a cure for type 2 diabetes in Taiwan.” *Public health* 124 (5), 284–294.
- Chatterjee, S., Riewpaiboon, A., Piyauthakit, P., Riewpaiboon, W., Boupajit, K., Panpuwong, N., and Archavanuntagul, V. (2011). “Cost of diabetes and its complications in Thailand: a complete picture of economic burden.” *Health & social care in the community* 19 (3), 289–298.
- Chen, L., Magliano, D. J., and Zimmet, P. Z. (2012). “The worldwide epidemiology of type 2 diabetes mellitus—present and future perspectives.” *Nature reviews. Endocrinology* 8 (4), 228–36. URL: <http://www.ncbi.nlm.nih.gov/pubmed/22064493>.
- Chi, M.-j., Lee, C.-y., and Wu, S.-c. (2011). “The prevalence of chronic conditions and medical expenditures of the elderly by chronic condition indicator (CCI).” *Archives of gerontology and geriatrics* 52 (3), 284–289.
- Chiburis, R. C., Das, J., and Lokshin, M. (2012). “A practical comparison of the bivariate probit and linear IV estimators.” *Economics Letters* 117 (3), 762–766.
- Chodick, G., Heymann, A. D., Wood, F., and Kokia, E. (2005). “The direct medical cost of diabetes in Israel.” *The European journal of health economics : HEPAC : health economics in prevention and care* 6 (2), 166–71.
- Colchero, M. A., Popkin, B. M., Rivera, J. A., and Ng, S. W. (2016). “Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study.” *British Medical Journal* 352, h6704.
- Cole, S. R. and Hernan, M. A. (2008). “Constructing Inverse Probability Weights for Marginal Structural Models.” *American Journal of Epidemiology* 168 (6), 656–664. URL: <http://aje.oxfordjournals.org/cgi/doi/10.1093/aje/kwn164>.
- Condliffe, S. and Link, C. R. (2014). “Racial differences in the effects of hypertension and obesity on health expenditures by diabetes patients in the US.” English. *Applied economics letters* 21 (4), 280–283. URL: http://search.proquest.com/docview/1468568489?accountid=10637&url=http://mlsfx.lib.uea.ac.uk:8888/sfx%7B%5C_%7Dlocal?url%7B%5C_%7Dver=Z39.88-2004%7B%5C%7Ddrft%7B%5C_%7Dval%7B%5C_%7Dfmt=info:ofi/fmt:kev:mtx:journal%7B%5C%7Dgenre=article%7B%5C%7Dsid=ProQ:ProQ:ibssshell%7B%5C%7Datitle=Racial+differences+in+the+effects+of+hyperten.
- Crimmins, E., McDade, T., Rubalcava, L., Seeman, T., Teruel, G., and Thomas, D. (2015). “Health of the Mexican population: Results from the Mexican Family Life Survey

- (MxFLS).” URL: http://gero.usc.edu/CBPH/files/4%7B%5C_%7D30%7B%5C_%7D2014%7B%5C_%7DPAA/Thomas%7B%5C_%7DHealth%7B%5C_%7Dof%7B%5C_%7Dthe%7B%5C_%7DMexican%7B%5C_%7Dpopulation%7B%5C_%7Din%7B%5C_%7DMxFLS.pdf.
- Currie, J. and Vogl, T. (2013). “Early-Life Health and Adult Circumstance in Developing Countries.” *Annual Review of Economics* 5 (1), 1–36.
- Dall, T., Mann, S., Zhang, Y., Martin, J., Chen, Y., Hogan, P., and Petersen, M. (2008). “Economic costs of diabetes in the U.S. In 2007.” *Diabetes care* 31 (3), 596–615.
- Dall, T., Nikolov, P., and Hogan, P. (2003). “Economic costs of diabetes in the US in 2002.” *Diabetes care* 26 (3), 917–932.
- Dall, T. M., Zhang, Y., Chen, Y. J., Quick, W. W., Yang, W. G., and Fogli, J. (2010). “The economic burden of diabetes.” *Health Affairs* 29 (2), 297–303.
- Davis, W. A., Knuiman, M. W., Hendrie, D., and Davis, T. M. E. (2006). “The obesity-driven rising costs of type 2 diabetes in Australia: projections from the Fremantle Diabetes Study.” *Internal medicine journal* 36 (3), 155–161.
- Dawson, K. G., Gomes, D., Gerstein, H., Blanchard, J. F., and Kahler, K. H. (2002). “The economic cost of diabetes in Canada, 1998.” *Diabetes care* 25 (8), 1303–7.
- De Fine Olivarius, N., Siersma, V. D., Køster-Rasmussen, R., Heitmann, B. L., and Waldorff, F. B. (2015). “Weight changes following the diagnosis of type 2 diabetes: The impact of recent and past weight history before diagnosis. Results from the Danish Diabetes Care in General Practice (DCGP) Study.” *PLoS ONE* 10 (4), 1–14.
- Denny, K. and Oppedisano, V. (2013). “The surprising effect of larger class sizes: Evidence using two identification strategies.” *Labour Economics* 23, 57–65. URL: <http://linkinghub.elsevier.com/retrieve/pii/S0927537113000468>.
- Diabetes UK (2012). “State of the Nation 2012: England,” 1–35.
- Dillon, A., Friedman, J., and Serneels, P. M. (2014). “Health information, treatment, and worker productivity: Experimental evidence from malaria testing and treatment among Nigerian sugarcane cutters.” World Bank Policy Research Working Paper 7120.
- Dooren, F. E. P. van, Nefs, G., Schram, M. T., Verhey, F. R. J., Denollet, J., and Pouwer, F. (2013). “Depression and Risk of Mortality in People with Diabetes Mellitus: A Systematic Review and Meta-Analysis.” *PLoS ONE* 8 (3).
- Drichoutis, A. C., Nayga, R. M., and Lazaridis, P. (2011). “Food away from home expenditures and obesity among older Europeans: are there gender differences?” *Empirical Economics* 42 (3), 1051–1078.
- Druss, B., Marcus, S., and Olfson, M. (2001). “Comparing the national economic burden of five chronic conditions.” *Health Affairs* 20 (6), 233–241.

- Durden, E. D., Alemayehu, B., Bouchard, J. R., Chu, B.-C., and Aagren, M. (2009). "Direct health care costs of patients with type 2 diabetes within a privately insured employed population, 2000 and 2005." *Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine* 51 (12), 1460–1465.
- Elrayah-Eliadarous, H., Yassin, K., Eltom, M., Abdelrahman, S., Wahlström, R., and Ostenson, C.-G. (2010). "Direct costs for care and glycaemic control in patients with type 2 diabetes in Sudan." *Experimental and clinical endocrinology & diabetes : official journal, German Society of Endocrinology [and] German Diabetes Association* 118 (4), 220–5.
- Emran, M. S. and Shilpi, F. (2012). "The extent of the market and stages of agricultural specialization." *Canadian Journal of Economics/Revue canadienne d'économique* 45 (3), 1125–1153.
- Eriksson, A.-K., Donk, M. van den, Hilding, A., and Ostenson, C.-G. (2013). "Work Stress, Sense of Coherence, and Risk of Type 2 Diabetes in a Prospective Study of Middle-Aged Swedish Men and Women." *Diabetes Care* 36 (9), 2683–2689.
- Esteghamati, A., Khalilzadeh, O., Anvari, M., Meysamie, A., Abbasi, M., Forouzanfar, M., and Alaeddini, F. (2009). "The economic costs of diabetes: a population-based study in Tehran, Iran." *Diabetologia* 52 (8), 1520–1527.
- Ettaro, L., Songer, T. J., Zhang, P., and Engelgau, M. M. (2004). "Cost-of-illness studies in diabetes mellitus." *Pharmacoeconomics* 22 (3), 149–164.
- Ewijk, R. van (2011). "Long-Term Health Effects on the Next Generation of Ramadan Fasting during Pregnancy." *Journal of Health Economics* 30 (6), 1246–1260.
- Fazeli Farsani, S., Van Der Aa, M. P., Van Der Vorst, M. M. J., Knibbe, C. A. J., and De Boer, A. (2013). "Global trends in the incidence and prevalence of type 2 diabetes in children and adolescents: A systematic review and evaluation of methodological approaches." *Diabetologia* 56 (7), 1471–1488.
- Filmer, D. and Pritchett, L. (2001). "Estimating wealth effects without expenditure data—Or tears: An application to educational enrollments in states of India." *Demography* 38 (1), 115–132.
- Frankenberg, E., Ho, J. Y., and Thomas, D. (2015). "Biological Health Risks and Economic Development." NBER Working Paper 21277.
- Geishecker, I. and Siedler, T. (2011). "Job Loss Fears and (Extreme) Party Identification: First Evidence from Panel Data." cege Discussion Paper 129.
- Gong, E. (2015). "HIV Testing and Risky Sexual Behaviour." *The Economic Journal* 125 (582), 32–60.

- Gregg, E. W., Chen, H., Wagenknecht, L. E., Clark, J. M., Delahanty, L. M., Bantle, J., Pownall, H. J., Johnson, K. C., Safford, M. M., Kitabchi, A. E., Pi-Sunyer, F. X., Wing, R. R., Bertoni, A. G., and Look AHEAD Research Group, for the (2012). "Association of an Intensive Lifestyle Intervention With Remission of Type 2 Diabetes." *Journal of the American Medical Association* 308 (23), 2489.
- Gyldmark, M. and Morrison, G. C. (2001). "Demand for health care in Denmark: results of a national sample survey using contingent valuation." *Social Science and Medicine* 53 (8), 1023–1036.
- Hemminki, K., Li, X., Sundquist, K., and Sundquist, J. (2010). "Familial Risks for Type 2 Diabetes in Sweden." *Diabetes Care* 33 (2), 293–297.
- Heraclides, A. M., Chandola, T., Witte, D. R., and Brunner, E. J. (2012). "Work Stress, Obesity and the Risk of Type 2 Diabetes: Gender-Specific Bidirectional Effect in the Whitehall II Study." *Obesity* 20 (2), 428–433.
- Herder, C. and Roden, M. (2011). "Genetics of type 2 diabetes: pathophysiologic and clinical relevance." *European Journal of Clinical Investigation* 41 (6), 679–692.
- Honeycutt, A. A., Segel, J. E., Hoerger, T. J., and Finkelstein, E. A. (2009). "Comparing cost-of-illness estimates from alternative approaches: an application to diabetes." *Health services research* 44 (1), 303–320.
- Honkasalo, M. T., Linna, M., Sane, T., Honkasalo, A., and Elonheimo, O. (2014). "A comparative study of two various models of organising diabetes follow-up in public primary health care - the model influences the use of services, their quality and costs." *BMC health services research* 14, 26.
- Horak, P. (2009). "[Pharmacoeconomy of diabetes mellitus—trends in the Czech Republic]." *Vnitr Lek* 55 (4), 331–340.
- Hu, F. B. (2011). "Globalization of diabetes: the role of diet, lifestyle, and genes." *Diabetes care* 34 (6), 1249–57.
- Huang, H.-C. (, Lin, Y.-C., and Yeh, C.-C. (2009). "Joint determinations of inequality and growth." *Economics Letters* 103 (3), 163–166.
- Huxley, R. (2006). "Excess risk of fatal coronary heart disease associated with diabetes in men and women: meta-analysis of 37 prospective cohort studies." *British Medical Journal* 332 (7533), 73–78.
- International Diabetes Federation (2014). *Diabetes Atlas 2014 Update*. 6th ed. International Diabetes Federation.
- Javanbakht, M., Baradaran, H. R., Mashayekhi, A., Haghdooost, A. A., Khamseh, M. E., Kharazmi, E., and Sadeghi, A. (2011). "Cost-of-illness analysis of type 2 diabetes mellitus in Iran." *PloS one* 6 (10), e26864.

- Johnson, J. A., Pohar, S. L., and Majumdar, S. R. (2006). "Health care use and costs in the decade after identification of type 1 and type 2 diabetes: a population-based study." *Diabetes care* 29 (11), 2403–2408.
- Jönsson, B. (2002). "Revealing the cost of Type II diabetes in Europe." *Diabetologia* 45 (7), S5–12.
- Kapteyn, A., Smith, J. P., and Van Soest, A. (2009). "Work disability, work, and justification bias in Europe and the United States."
- Kelly, I. R., Dave, D. M., Sindelar, J. L., and Gallo, W. T. (2014). "The impact of early occupational choice on health behaviors." *Review of Economics of the Household* 12 (4), 737–770.
- Khowaja, L. A., Khuwaja, A. K., and Cosgrove, P. (2007). "Cost of diabetes care in outpatient clinics of Karachi, Pakistan." *BMC health services research* 7, 189.
- Kirigia, J. M., Sambo, H. B., Sambo, L. G., and Barry, S. P. (2009). "Economic burden of diabetes mellitus in the WHO African region." *BMC international health and human rights* 9, 6.
- Klein, S., Allison, D. B., Heymsfield, S. B., Kelley, D. E., Leibel, R. L., Nonas, C., and Kahn, R. (2007). "Waist circumference and cardiometabolic risk: A consensus statement from Shaping America's Health: Association for Weight Management and Obesity Prevention; NAASO, the Obesity Society; the American Society for Nutrition; and the American Diabetes Association." *Diabetes Care* 30 (6), 1647–1652.
- Knapp, L. G. and Seaks, T. G. (1998). *A Hausman test for a dummy variable in probit*.
- Knaul, F. M., González-Pier, E., Gómez-Dantés, O., García-Junco, D., Arreola-Ornelas, H., Barraza-Lloréns, M., Sandoval, R., Caballero, F., Hernández-Avila, M., Juan, M., Kershenovich, D., Nigenda, G., Ruelas, E., Sepúlveda, J., Tapia, R., Soberón, G., Chertorivski, S., and Frenk, J. (2012). "The quest for universal health coverage: achieving social protection for all in Mexico." *Lancet* 380 (9849), 1259–79.
- Köster, I., Ferber, L. von, Ihle, P., Schubert, I., and Hauner, H. (2006). "The cost burden of diabetes mellitus: the evidence from Germany—the CoDiM study." *Diabetologia* 49 (7), 1498–1504.
- Köster, I., Huppertz, E., Hauner, H., and Schubert, I. (2011). "Direct costs of diabetes mellitus in Germany - CoDiM 2000-2007." *Experimental and Clinical Endocrinology and Diabetes* 119 (6), 377–385.
- Köster, I., Schubert, I., and Huppertz, E. (2012). "Follow up of the CoDiM-Study: Cost of diabetes mellitus 2000-2009." *Deutsche Medizinische Wochenschrift*. Fortschreibung der KoDiM-Studie: Kosten des Diabetes mellitus 2000-2009 137 (19), 1013–1016.

- Latif, E. (2009). "The impact of diabetes on employment in Canada." *Health Economics* 18 (5), 577–589.
- Lau, R. S., Ohinmaa, A., and Johnson, J. A. (2011). "Predicting the Future Burden of Diabetes in Alberta from 2008 to 2035." *Canadian Journal of Diabetes* 35 (3), 274–281.
- Lee, J.-A., Liu, C.-F., and Sales, A. E. (2006). "Racial and ethnic differences in diabetes care and health care use and costs." *Preventing chronic disease* 3 (3), A85.
- Lesniowska, J., Schubert, A., Wojna, M. M., Skrzekowska-Baran, I., Fedyna, M., Leśniowska, J., Schubert, A., Wojna, M. M., Skrzekowska-Baran, I., and Fedyna, M. (2014). "Costs of Diabetes and Its Complications in Poland." *The European journal of health economics*. ISPOR 14th Annual European Congress Madrid Spain. Conference Start: 20111105 Conference End: 20111108 15 (6), 653–660.
- Lewbel, A. (2007). "Estimation of Average Treatment Effects with Misclassification." *Econometrica* 75 (2), 537–551.
- (2012). "Using Heteroscedasticity to Identify and Estimate Mismeasured and Endogenous Regressor Models." *Journal of Business & Economic Statistics* 30 (1), 67–80.
- Li, Y., He, Y., Qi, L., Jaddoe, V. W., Feskens, E. J. M., Yang, X., Ma, G., and Hu, F. B. (2010). "Exposure to the Chinese Famine in Early Life and the Risk of Hyperglycemia and Type 2 Diabetes in Adulthood." *Diabetes* 59 (10), 2400–2406.
- Lim, E. L., Hollingsworth, K. G., Aribisala, B. S., Chen, M. J., Mathers, J. C., and Taylor, R. (2011). "Reversal of type 2 diabetes: Normalisation of beta cell function in association with decreased pancreas and liver triacylglycerol." *Diabetologia* 54 (10), 2506–2514.
- Lin, S. (2011). "Estimating the impact of diabetes on employment in Taiwan." *Economics Bulletin* 31 (4), 3089–3102.
- Lin, T., Chou, P., Tsai, S.-T., Lee, Y.-C., and Tai, T.-Y. (2004). "Predicting factors associated with costs of diabetic patients in Taiwan." *Diabetes research and clinical practice* 63 (2), 119–125.
- Linden, M. W. van der, Plat, A. W., Erkens, J. A., Emneus, M., and Herings, R. M. C. (2009). "Large impact of antidiabetic drug treatment and hospitalizations on economic burden of diabetes mellitus in The Netherlands during 2000 to 2004." *Value in health* 12 (6), 909–14.
- Liu, X. and Zhu, C. (2014). "Will knowing diabetes affect labor income? Evidence from a natural experiment." *Economics Letters* 124 (1), 74–78.
- Liu, Z., Fu, C., Wang, W., and Xu, B. (2010). "Prevalence of chronic complications of type 2 diabetes mellitus in outpatients - a cross-sectional hospital based survey in urban China." *Health and quality of life outcomes* 8, 62.

- Long, G. H., Cooper, A. J., Wareham, N. J., Griffin, S. J., and Simmons, R. K. (2014). “Healthy Behavior Change and Cardiovascular Outcomes in Newly Diagnosed Type 2 Diabetic Patients: A Cohort Analysis of the ADDITION-Cambridge Study.” *Diabetes Care* 37 (6), 1712–1720. URL: <http://care.diabetesjournals.org/lookup/doi/10.2337/dc13-1731>.
- Lucioni, C., Garancini, M. P., Massi-Benedetti, M., Mazzi, S., and Serra, G. (2003). “The costs of type 2 diabetes mellitus in Italy: A CODE-2 sub-study.” *Treatments in Endocrinology* 2 (2), 121–133.
- Luo, X., Liu, T., Yuan, X., Ge, S., Yang, J., Li, C., and Sun, W. (2015). “Factors Influencing Self-Management in Chinese Adults with Type 2 Diabetes: A Systematic Review and Meta-Analysis.” *International Journal of Environmental Research and Public Health* 12 (9), 11304–11327. URL: <http://www.embase.com/search/results?subaction=viewrecord%7B%5C%7Dfrom=export%7B%5C%7Ddid=L605963199%5Cbackslash%5Cnhttp://dx.doi.org/10.3390/ijerph120911304%5Cbackslash%5Cnhttp://sfx.metabib.ch/sfx%7B%5C%7Dlocator?sid=EMBASE%7B%5C%7Dissn=16604601%7B%5C%7Ddid=doi:10.3390/ijerph120911304%7B%5C%7Datitle=Factors+influencing+self-manag>.
- Ma, R. C. W., Lin, X., and Jia, W. (2014). “Causes of type 2 diabetes in China.” *The Lancet Diabetes & Endocrinology* 2 (12), 980–991. URL: <http://linkinghub.elsevier.com/retrieve/pii/S2213858714701457>.
- Maahs, D. M., West, N. A., Lawrence, J. M., and Mayer-Davis, E. J. (2010). “Epidemiology of Type 1 Diabetes.” *Endocrinology and Metabolism Clinics of North America* 39 (3), 481–497.
- Maciejewski, M. and Maynard, C. (2004). “Diabetes-related utilization and costs for inpatient and outpatient services in the Veterans Administration.” *Diabetes Care* 27 (SUPPL.2), B69–B73.
- Marchesini, G., Forlani, G., Rossi, E., Berti, A., and De Rosa, M. (2011). “The direct economic cost of pharmacologically-treated diabetes in Italy-2006. The ARNO observatory.” *Nutrition, metabolism, and cardiovascular diseases : NMCD* 21 (5), 339–46.
- Martin, S., Schramm, W., Schneider, B., Neeser, K., Weber, C., Ludwig, V., Heinemann, L., Scherbaum, W. A., and Kolb, H. (2007). “Epidemiology of complications and total treatment costs from diagnosis of Type 2 diabetes in Germany (ROSSO 4).” *Experimental and clinical endocrinology & diabetes* 115 (8), 495–501.
- Al-Maskari, F., El-Sadig, M., and Nagelkerke, N. (2010). “Assessment of the direct medical costs of diabetes mellitus and its complications in the United Arab Emirates.” *BMC public health* 10 (1), 679.

- Mata, M., Antoñanzas, F., Tafalla, M., and Sanz, P. (2002). “[The cost of type 2 diabetes in Spain: the CODE-2 study].” *Gaceta sanitaria / S.E.S.P.A.S* 16 (6), 511–520.
- Meza, R., Barrientos-Gutierrez, T., Rojas-Martinez, R., Reynoso-Noverón, N., Palacio-Mejia, L. S., Lazcano-Ponce, E., and Hernández-Ávila, M. (2015). “Burden of type 2 diabetes in Mexico: past, current and future prevalence and incidence rates.” *Preventive Medicine*.
- Minor, T. (2011). “The effect of diabetes on female labor force decisions: new evidence from the National Health Interview Survey.” *Health economics*. 15th Annual International Meeting of the International Society for Pharmacoeconomics and Outcomes Research, ISPOR 2010 Atlanta, GA United States. Conference Start: 20100515 Conference End: 20100519 20 (12), 1468–86.
- (2013). “An investigation into the effect of type I and type II diabetes duration on employment and wages.” *Economics & Human Biology* 11 (4), 534–544.
- Minor, T. and MacEwan, J. P. (2016). “A comparison of diagnosed and undiagnosed diabetes patients and labor supply.” *Economics & Human Biology* 20, 14–25.
- Morsanutto, A., Berto, P., Lopatriello, S., Gelisio, R., Voinovich, D., Cippo, P. P., and Mantovani, L. G. (2006). “Major complications have an impact on total annual medical cost of diabetes: results of a database analysis.” *Journal of Diabetes and its Complications* 20 (3), 163–169.
- Mundlak, Y. (1978). “On the Pooling of Time Series and Cross Section Data.” *Econometrica* 46 (1), 69–85.
- Nakamura, K., Okamura, T., Kanda, H., Hayakawa, T., Murakami, Y., Okayama, A., and Ueshima, H. (2008). “Medical expenditure for diabetic patients: a 10-year follow-up study of National Health Insurance in Shiga, Japan.” *Public health* 122 (11), 1226–1228.
- NCD Risk Factor Collaboration (2016). “Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4 · 4 million participants.” *The Lancet* 387, 1513–1530.
- Nead, K. T., Sharp, S. J., Thompson, D. J., Painter, J. N., Savage, D. B., Semple, R. K., Barker, A., Perry, J. R. B., Attia, J., Dunning, A. M., Easton, D. F., Holliday, E., Lotta, L. A., O’Mara, T., McEvoy, M., Pharoah, P. D. P., Scott, R. J., Spurdle, A. B., Langenberg, C., Wareham, N. J., and Scott, R. A. (2015). “Evidence of a Causal Association between Insulinemia and Endometrial Cancer: A Mendelian Randomization Analysis.” *Journal of the National Cancer Institute* 107 (9), 1–7.
- Nolan, J. J., O’Halloran, D., McKenna, T. J., Firth, R., and Redmond, S. (2006). “The cost of treating type 2 diabetes (CODEIRE).” *Irish medical journal* 99 (10), 307–310.

- Norlund, A., Apelqvist, J., Bitzén, P. O., Nyberg, P., and Scherstén, B. (2001). "Cost of illness of adult diabetes mellitus underestimated if comorbidity is not considered." *Journal of Internal Medicine* 250 (1), 57–65.
- Nouwen, A., Winkley, K., Twisk, J., Lloyd, C. E., Peyrot, M., Ismail, K., and Pouwer, F. (2010). "Type 2 diabetes mellitus as a risk factor for the onset of depression: A systematic review and meta-analysis." *Diabetologia* 53 (12), 2480–2486.
- Nouwen, A., Nefs, G., Caramlau, I., Connock, M., Winkley, K., Lloyd, C. E., Peyrot, M., and Pouwer, F. (2011). "Prevalence of depression in individuals with impaired glucose metabolism or undiagnosed diabetes: A systematic review and meta-analysis of the European Depression in Diabetes (EDID) research consortium." *Diabetes Care* 34 (3), 752–762.
- O’Connell, J. M., Wilson, C., Manson, S. M., and Acton, K. J. (2012). "The costs of treating American Indian adults with diabetes within the Indian Health Service." *American journal of public health* 102 (2), 301–308.
- Ohinmaa, A., Jacobs, P., Simpson, S., and Johnson, J. (2004). "The projection of prevalence and cost of diabetes in Canada: 2000 to 2016." *Canadian Journal of Diabetes* 28 (2), 116–123.
- Oliva, J., Lobo, F., Molina, B., and Monereo, S. (2004). "Direct health care costs of diabetic patients in Spain." *Diabetes care* 27 (11), 2616–2621.
- O’Neill, D. and Sweetman, O. (2013). "The consequences of measurement error when estimating the impact of obesity on income." *IZA Journal of Labor Economics* 2 (1), 3.
- Paddison, C. a. M., Eborall, H. C., French, D. P., Kinmonth, a. L., Prevost, a. T., Griffin, S. J., and Sutton, S. (2011). "Predictors of anxiety and depression among people attending diabetes screening: a prospective cohort study embedded in the ADDITION (Cambridge) randomized control trial." *British journal of health psychology* 16 (Pt 1), 213–226.
- Pan, X. (2015). "Gender Dissimilarity in Type 2 Diabetes Risk Factors: a Chinese Study." *International Journal of Behavioral Medicine* 22 (5), 614–624. URL: <http://link.springer.com/10.1007/s12529-015-9474-2>.
- Peele, P. B., Lave, J. R., and Songer, T. J. (2002). "Diabetes in employer-sponsored health insurance." *Diabetes care* 25 (11), 1964–1968.
- Perks, T. A. (2015). "Obesity and its relation to employment income: Does the bias in self-reported BMI matter?" *Canadian Studies in Population* 42 (3-4), 1–10.
- Pohar, S. L. and Johnson, J. A. (2007). "Health care utilization and costs in Saskatchewan’s registered Indian population with diabetes." *BMC health services research* 7, 126.

- Pohar, S. L., Majumdar, S. R., and Johnson, J. A. (2007). "Health Care Costs and Mortality for Canadian Urban and Rural Patients with Diabetes: Population-Based Trends from 1993-2001." *Clinical Therapeutics* 29 (6 PART 1), 1316–1324.
- Ramachandran, A., Ramachandran, S., Snehalatha, C., Augustine, C., Murugesan, N., Viswanathan, V., Kapur, A., and Williams, R. (2007). "Increasing expenditure on health care incurred by diabetic subjects in a developing country: a study from India." *Diabetes care* 30 (2), 252–256.
- Ramachandran, A., Wan Ma, R. C., and Snehalatha, C. (2010). "Diabetes in Asia." *The Lancet* 375 (9712), 408–418. arXiv: jama.2009.726 [10.1001]. URL: [http://dx.doi.org/10.1016/S0140-6736\(09\)60937-5](http://dx.doi.org/10.1016/S0140-6736(09)60937-5).
- Ramsey, S., Summers, K. H., Leong, S. A., Birnbaum, H. G., Kemner, J. E., and Greenberg, P. (2002). "Productivity and medical costs of diabetes in a large employer population." *Diabetes care* 25 (1), 23–29. URL: <http://www.ncbi.nlm.nih.gov/pubmed/11772896%20http://ovidsp.ovid.com/ovidweb.cgi?T=JS%7B%5C%7DPAGE=reference%7B%5C%7DD=emed5%7B%5C%7DNEWS=N%7B%5C%7DAN=11772896%20http://ovidsp.ovid.com/ovidweb.cgi?T=JS%7B%5C%7DPAGE=reference%7B%5C%7DD=emed5%7B%5C%7DNEWS=N%7B%5C%7DAN=2005342883>.
- Redekop, W. K., Koopmanschap, M. A., Rutten, G. E. H. M., Wolffenbuttel, B. H. R., Stolk, R. P., and Niessen, L. W. (2002). "Resource consumption and costs in Dutch patients with type 2 diabetes mellitus. Results from 29 general practices." *Diabetic medicine: a journal of the British Diabetic Association* 19 (3), 246–253.
- Reynoso-Noverón, N., Mehta, R., Almeda-Valdes, P., Rojas-Martinez, R., Villalpando, S., Hernández-Ávila, M., and Aguilar-Salinas, C. a. (2011). "Estimated incidence of cardiovascular complications related to type 2 diabetes in Mexico using the UKPDS outcome model and a population-based survey." *Cardiovascular Diabetology* 10 (1), 1.
- Ricordeau, P., Weill, A., Vallier, N., Bourrel, R., Schwartz, D., Guilhot, J., Fender, P., and Allemand, H. (2003). "The prevalence and cost of diabetes in metropolitan France: What trends between 1998 and 2000?" *Diabetes and Metabolism* 29 (5), 497–504.
- Ringborg, A., Martinell, M., Stålhammar, J., Yin, D. D., and Lindgren, P. (2008). "Resource use and costs of type 2 diabetes in Sweden - estimates from population-based register data." *International journal of clinical practice* 62 (5), 708–716.
- Rivera, J. a., Barquera, S., Campirano, F., Campos, I., Safdie, M., and Tovar, V. (2002). "Epidemiological and nutritional transition in Mexico: rapid increase of non-communicable chronic diseases and obesity." *Public Health Nutrition* 5 (1a), 113–122.

- Rivera, J. A., Barquera, S., González-Cossío, T., Olaiz, G., and Sepúlveda, J. (2004). “Nutrition Transition in Mexico and in Other Latin American Countries.” *Nutrition Reviews* 62 (2), S149–S157.
- Roberto, C. A., Swinburn, B., Hawkes, C., Huang, T. T. K., Costa, S. A., Ashe, M., Zwicker, L., Cawley, J. H., and Brownell, K. D. (2015). “Patchy progress on obesity prevention: Emerging examples, entrenched barriers, and new thinking.” *The Lancet* 385 (9985), 2400–2409. URL: [http://dx.doi.org/10.1016/S0140-6736\(14\)61744-X](http://dx.doi.org/10.1016/S0140-6736(14)61744-X).
- Robins, J. M., Hernan, M. Á., and Brumback, B. (2000). “Marginal Structural Models and Causal Inference in Epidemiology.” *Epidemiology* 11, 550–560.
- Rodbard, H. W., Green, A. J., Fox, K. M., and Grandy, S. (2010). “Impact of type 2 diabetes mellitus on prescription medication burden and out-of-pocket healthcare expenses.” *Diabetes research and clinical practice* 87 (3), 360–365.
- Rodríguez Bolaños, R. d. L. Á., Reynales Shigematsu, L. M., Jiménez Ruíz, J. A., Juárez Márquez, S. A., Hernández Ávila, M., and R., D. I. A. R. B. (2010). “Direct costs of medical care for patients with type 2 diabetes mellitus in Mexico: Micro-costing analysis.” *Revista Panamericana de Salud Publica/Pan American Journal of Public Health*. Costos directos de atención médica en pacientes con diabetes mellitus tipo 2 en México: análisis de microcosteo 28 (6), 412–420.
- Roy, T. and Lloyd, C. E. (2012). “Epidemiology of depression and diabetes: a systematic review.” *Journal of affective disorders* 142 Suppl, S8–21. URL: <http://www.ncbi.nlm.nih.gov/pubmed/23062861>.
- Rubalcava, L. and Teruel, G. (2008). “User’s Guide for the Mexican Family Life Survey Second Wave.”
- (2013). “User’s Guide for the Mexican Family Life Survey Third Round.”
- Salomon, J. a., Carvalho, N., Gutierrez-Delgado, C., Orozco, R., Mancuso, A., Hogan, D. R., Lee, D., Murakami, Y., Sridharan, L., Medina-Mora, M. E., and Gonzalez-Pier, E. (2012). “Intervention strategies to reduce the burden of non-communicable diseases in Mexico: cost effectiveness analysis.” *BMJ* 344, e355.
- Samb, B., Desai, N., Nishtar, S., Mendis, S., Bekedam, H., Wright, A., Hsu, J., Martiniuk, A., Celletti, F., Patel, K., Adshead, F., McKee, M., Evans, T., Alwan, A., and Etienne, C. (2010). “Prevention and management of chronic disease: a litmus test for health-systems strengthening in low-income and middle-income countries.” *The Lancet* 376 (9754), 1785–1797.
- Schaller, J. and Stevens, A. H. (2015). “Short-run effects of job loss on health conditions, health insurance, and health care utilization.” *Journal of Health Economics* 43, 190–203.

- Schmitt-Koopmann, I., Schwenkglenks, M., Spinass, G. A., and Szucs, T. D. (2004). "Direct medical costs of type 2 diabetes and its complications in Switzerland." *European journal of public health* 14 (1), 3–9.
- Schneiderman, N., Ironson, G., and Siegel, S. D. (2005). "Stress and Health: Psychological, Behavioral, and Biological Determinants." *Annual Review of Clinical Psychology* 1 (1), 607–628.
- Schneiderman, N., Llabre, M., Cowie, C. C., Barnhart, J., Carnethon, M., Gallo, L. C., Giachello, A. L., Heiss, G., Kaplan, R. C., LaVange, L. M., Teng, Y., Villa-Caballero, L., and Avilés-Santa, M. L. (2014). "Prevalence of Diabetes Among Hispanics/Latinos From Diverse Backgrounds: The Hispanic Community Health Study/Study of Latinos (HCHS/SOL)." *Diabetes Care* 37 (8), 2233–2239.
- Schroeter, C., Anders, S., and Carlson, A. (2012). "The Economics of Health and Vitamin Consumption." *Applied Economic Perspectives and Policy* 35 (1), 125–149.
- Seshasai, S. R. K., Kaptoge, S., Thompson, A., Di Angelantonio, E., Gao, P., Sarwar, N., Whincup, P. H., Mukamal, K. J., Gillum, R. F., Holme, I., Njølstad, I., Fletcher, A., Nilsson, P., Lewington, S., Collins, R., Gudnason, V., Thompson, S. G., Sattar, N., Selvin, E., Hu, F. B., and Danesh, J. (2011). "Diabetes Mellitus, Fasting Glucose, and Risk of Cause-Specific Death." *New England Journal of Medicine* 364 (9), 829–841. URL: <http://www.nejm.org/doi/abs/10.1056/NEJMoa1008862>.
- Seuring, T., Archangelidi, O., and Suhrcke, M. (2015). "The Economic Costs of Type 2 Diabetes: A Global Systematic Review." *Pharmacoeconomics* 33 (8), 811–831.
- Seuring, T., Goryakin, Y., and Suhrcke, M. (2015). "The impact of diabetes on employment in Mexico." *Economics & Human Biology* 18, 85–100.
- Sicree, B. R., Shaw, J., and Zimmet, P. (2011). *The Global Burden: Diabetes and Impaired Glucose Tolerance*. Brussels, Belgium: International Diabetes Federation.
- Simpson, S. H., Corabian, P., Jacobs, P., and Johnson, J. A. (2003). "The cost of major comorbidity in people with diabetes mellitus." *Canadian Medical Association Journal* 168 (13), 1661–1667.
- Slade, A. N. (2012). "Health Investment Decisions in Response to Diabetes Information in Older Americans." *Journal of Health Economics* 31 (3), 502–520.
- Smith-Spangler, C. M., Bhattacharya, J., and Goldhaber-Fiebert, J. D. (2012). "Diabetes, its treatment, and catastrophic medical spending in 35 developing countries." *Diabetes care* 35 (2), 319–326.
- Solli, O., Jenssen, T., and Kristiansen, I. S. (2010). "Diabetes: cost of illness in Norway." *BMC endocrine disorders* 10, 15.

- Sotomayor, O. (2013). “Fetal and infant origins of diabetes and ill health: Evidence from Puerto Rico’s 1928 and 1932 hurricanes.” *Economics & Human Biology* 11 (3), 281–293.
- Staiger, D. and Stock, J. (1997). “Instrumental variables regression with weak instruments.” *Econometrica* 65 (3), 557–586.
- Stevens, G., Dias, R. H., Thomas, K. J. A., Rivera, J. A., Carvalho, N., Barquera, S., Hill, K., and Ezzati, M. (2008). “Characterizing the Epidemiological Transition in Mexico: National and Subnational Burden of Diseases, Injuries, and Risk Factors.” *PLoS Medicine* 5 (6). Ed. by M. Tobias, e125.
- Strauss, J. and Thomas, D. (1998). “Health, Nutrition, and Economic Development.” *Journal of Economic Literature* 36 (2), 766–817.
- Suleiman, I., Fadeke, O., and Okubanjo, O. (2006). “Pharmacoeconomic Evaluation of Anti-Diabetic Therapy in A Nigerian Tertiary Health Institution.” *Annals of African Medicine* 5 (3), 132–137.
- Textor, J., Hardt, J., and Knüppel, S. (2011). “DAGitty: a graphical tool for analyzing causal diagrams.” *Epidemiology* 22 (5), 745.
- Tharkar, S., Devarajan, A., Kumpatla, S., and Viswanathan, V. (2010). “The socioeconomics of diabetes from a developing country: A population based cost of illness study.” *Diabetes Research and Clinical Practice* 89 (3), 334–340.
- The Interact Consortium (2013). “The link between family history and risk of type 2 diabetes is not explained by anthropometric, lifestyle or genetic risk factors: the EPIC-InterAct study.” *Diabetologia* 56 (1), 60–9.
- Thoolen, B. J., De Ridder, D. T., Bensing, J. M., Gorter, K. J., and Rutten, G. E. (2006). “Psychological outcomes of patients with screen-detected type 2 diabetes: The influence of time since diagnosis and treatment intensity.” *Diabetes Care* 29 (10), 2257–2262.
- Thornton, R. L. (2008). “The Demand for, and Impact of, Learning HIV Status.” *The American economic review* 98 (5), 1829–1863.
- Trogdon, J. G. and Hylands, T. (2008). “Nationally representative medical costs of diabetes by time since diagnosis.” *Diabetes care* 31 (12), 2307–2311.
- Tsilidis, K. K., Kasimis, J. C., Lopez, D. S., Ntzani, E. E., and Ioannidis, J. P. (2015). “Type 2 diabetes and cancer: umbrella review of meta-analyses of observational studies.” *BMJ (Clinical research ed.)* 350 (January), g7607. URL: <http://www.bmj.com/content/bmj/350/bmj.g7607.full.pdf>.
- Tunceli, O., Wade, R., Gu, T., Bouchard, J. R., Aagren, M., and Luo, W. (2010). “Cost of diabetes: comparison of disease-attributable and matched cohort cost estimation methods.” *Current medical research and opinion* 26 (8), 1827–34.

- Tuomilehto, J. (2013). “The emerging global epidemic of type 1 diabetes.” *Current Diabetes Reports* 13 (6), 795–804.
- Vijan, S., Hayward, R. A., and Langa, K. M. (2004). “The impact of diabetes on workforce participation: results from a national household sample.” *Health services research* 39 (6 Pt 1), 1653–69.
- Villalpando, S., Cruz, V. de la, Rojas, R., Shamah-Levy, T., Avila, M. A., Gaona, B., Rebollar, R., and Hernández, L. (2010). “Prevalence and distribution of type 2 diabetes mellitus in Mexican adult population: a probabilistic survey.” *Salud pública de México* 52 Suppl 1 (1), S19–26.
- Wang, W., Fu, C. W., Pan, C. Y., Chen, W., Zhan, S., Luan, R., Tan, A., Liu, Z., and Xu, B. (2009). “How do type 2 diabetes mellitus-related chronic complications impact direct medical cost in four major cities of urban China?” *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research* 12 (6), 923–9.
- Wang, W., Fu, C., Zhuo, H., Luo, J., and Xu, B. (2010). “Factors affecting costs and utilization of type 2 diabetes healthcare: a cross-sectional survey among 15 hospitals in urban China.” *BMC health services research* 10.
- Wang, W., McGreevey, W. P., Fu, C., Zhan, S., Luan, R., Chen, W., and Xu, B. (2009). “Type 2 diabetes mellitus in China: a preventable economic burden.” *The American journal of managed care* 15 (9), 593–601.
- White, M. (2016). “Population Approaches to Prevention of Type 2 Diabetes.” *PLoS medicine* 13 (7), e1002080. URL: <http://www.ncbi.nlm.nih.gov/pubmed/27404268>.
- Williams, A. L., Jacobs, S. B. R., Moreno-Macías, H., Huerta-Chagoya, A., Churchhouse, C., Márquez-Luna, C., García-Ortíz, H., Gómez-Vázquez, M. J., Burt, N. P., Aguilar-Salinas, C. a., González-Villalpando, C., Florez, J. C., Orozco, L., Haiman, C. a., Tusié-Luna, T., and Altshuler, D. (2014). “Sequence variants in SLC16A11 are a common risk factor for type 2 diabetes in Mexico.” *Nature* 506 (7486), 97–101.
- Wiréhn, A.-B., Andersson, A., Ostgren, C. J., and Carstensen, J. (2008). “Age-specific direct healthcare costs attributable to diabetes in a Swedish population: a register-based analysis.” *Diabetic medicine : a journal of the British Diabetic Association* 25 (6), 732–7.
- Wooldridge, J. (2012). *Introductory Econometrics. A Modern Approach*. 5th ed. Cengage Learning.
- Wooldridge, J. (2002). *Econometric Analysis of Cross Section and Panel Data*. The MIT press.
- World Health Organization (2011). “Use of glycated haemoglobin (HbA1c) in the diagnosis of diabetes mellitus: abbreviated report of a WHO consultation.”

- World Health Organization (2016). “Global Report on Diabetes,” 6. URL: http://apps.who.int/iris/bitstream/10665/204871/1/9789241565257%7B%5C_%7Deng.pdf.
- Wunder, C. and Riphahn, R. T. (2014). “The dynamics of welfare entry and exit amongst natives and immigrants.” *Oxford Economic Papers* 66 (2), 580–604.
- Yach, D., Stuckler, D., and Brownell, K. D. (2006). “Epidemiologic and economic consequences of the global epidemics of obesity and diabetes.” *Nature Medicine* 12 (1), 62–66.
- Yang, W. and Weng, J. (2014). “Early therapy for type 2 diabetes in China.” *The Lancet Diabetes & Endocrinology* 2 (12), 992–1002. URL: <http://linkinghub.elsevier.com/retrieve/pii/S2213858714701366>.
- Yang, W., Zhao, W., Xiao, J., Li, R., Zhang, P., Kissimova-Skarbek, K., Schneider, E., Jia, W., Ji, L., Guo, X., Shan, Z., Liu, J., Tian, H., Chen, L., Zhou, Z., Ji, Q., Ge, J., Chen, G., and Brown, J. (2012). “Medical care and payment for diabetes in China: enormous threat and great opportunity.” *PloS one* 7 (9), e39513. URL: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3458850%7B%5C%7Dtool=pmcentrez%7B%5C%7Drendertype=abstract>.
- Yu, C. H. and Zinman, B. (2007). “Type 2 diabetes and impaired glucose tolerance in aboriginal populations: A global perspective.” *Diabetes Research and Clinical Practice* 78 (2), 159–170.
- Yuan, X., Liu, T., Wu, L., Zou, Z.-Y., and Li, C. (2015). “Validity of self-reported diabetes among middle-aged and older Chinese adults: the China Health and Retirement Longitudinal Study.” *British Medical Journal Open* 5 (4), e006633–e006633.
- Zajacova, A., Dowd, J., Schoeni, R. F., and Wallace, R. B. (2010). “Consistency and precision of cancer reporting in a multiwave national panel survey.” *Population Health Metrics* 8 (1), 20.
- Zhang, X., Zhao, X., and Harris, A. (2009). “Chronic Diseases and Labour Force Participation in Australia.” *Journal of Health Economics* 28 (1), 91–108.
- Zhao, M., Konishi, Y., and Glewwe, P. (2013). “Does information on health status lead to a healthier lifestyle? Evidence from China on the effect of hypertension diagnosis on food consumption.” *Journal of Health Economics* 32 (2), 367–385. URL: <http://dx.doi.org/10.1016/j.jhealeco.2012.11.007>.
- Zhao, X., Zhu, X., Zhang, H.-s., Zhao, W., Li, J., Shu, Y., Li, S., Yang, M., Cai, L., Zhou, J., and Li, Y. (2012). “Prevalence of diabetes and predictions of its risks using anthropometric measures in southwest rural areas of China.” *BMC Public Health* 12 (1), 821. URL: [BMC%20Public%20Health](http://www.bmcpublichealth.com).

- Zhou, H., Isaman, D. J. M., Messinger, S., Brown, M. B., Klein, R., Brandle, M., and Herman, W. H. (2005). “A computer simulation model of diabetes progression, quality of life, and cost.” *Diabetes care* 28 (12), 2856–2863.
- Zhou, X., Ji, L., Ran, X., Su, B., Ji, Q., Pan, C., Weng, J., Ma, C., Hao, C., Zhang, D., and Hu, D. (2016). “Prevalence of Obesity and Its Influence on Achievement of Cardiometabolic Therapeutic Goals in Chinese Type 2 Diabetes Patients: An Analysis of the Nationwide, Cross-Sectional 3B Study.” *PLOS ONE* 11 (1). Ed. by J. Devaney, e0144179.