

BMI body mass index

CHNS China Health and Nutrition Survey

DAG direct acyclic graph

FE fixed effects

IV instrumental variable

LMIC low- and middle-income country

MSM marginal structural model

MIC middle-income country

OLS ordinary least squares

RE random effects

Abstract

A diabetes diagnosis entails important consequences for its recipients. They obtain health information but also face the challenge of having to manage the condition via lifestyle adjustments, with potential consequences for—among other things—their economic activity. We investigate the causal effect of a diabetes diagnosis on behavioural risk-factors as well as on employment chances, two potentially intertwined factors. We used longitudinal data from the China Health and Nutrition Survey (CHNS), covering the years 1997 to 2011. Two complementary statistical techniques—marginal structural models and fixed effects panel estimation—were used to estimate the causal effect of a diabetes diagnosis on a series of behavioural risk-factors and employment probabilities. Both models suggest female employment chances to decline significantly as a result of a diabetes diagnosis (over 11 percentage points), but no adverse effects for men. Chinese men appear to respond to a diagnosis by significantly reducing their body mass index (BMI), waist circumference and calorie consumption, in ways that are sustained over time. The effects on behavioural outcomes for women are smaller and less consistent. In light of the results it may be worthwhile for the Chinese healthcare system to focus efforts on addressing the needs of women with diabetes as it is them who have particular difficulties in improving their behavioural risk factors and who—perhaps as a consequence—pay the biggest price in terms of loss of employment chances. Future research is needed to unravel the mechanism behind these sex differences.

0.1 Introduction

Diabetes risk factors such as alcohol consumption, weight gain, smoking or caloric consumption are all related to the onset of diabetes as well as ensuing diabetes complications. They may further be influenced by the diabetes diagnosis itself as well as by a person’s employment status. Research shows for instance that behaviour changes after a diabetes diagnosis can have positive health effects and reduce the risk of subsequent cardiovascular events (Long et al., 2014), may help in effectively managing blood glucose levels and achieving further treatment goals (Zhou, Ji, et al., 2016). As a consequence, such changes may also affect the economic impact of diabetes if they cause a delay in or even prevent the onset of complications. Further, employment status may itself be related to diabetes risk factors, for example by affecting the time spend on physical activity or by increasing stress levels due to unemployment or due to challenges at the workplace, affect other risk behaviours such as smoking or alcohol consumption. In an effort to longitudinally investigate the impact of unemployment on health behaviours, Colman and Dave (2014) found

heterogeneous effects of unemployment, with it leading to slight weight gain, a decrease in smoking and decreases in fast-food consumption. Macroeconomic evidence also indicates that job loss can lead to changes in health, especially in mental health (Charles and Decicca, 2008), which may have further downstream effects on health behaviours.

Research on the impact of diabetes on labour market outcomes has so far ignored the potentially simultaneous relationship of diabetes, employment and behavioural diabetes risk factors due to the danger of over-adjusting, as standard regression techniques, such as ordinary least squares (OLS) or fixed effects (FE), assume that the investigated independent variables are unaffected by prior values of the dependent variable. Similarly, there is a dearth of studies investigating longitudinally the impact of a diabetes diagnosis on behavioural diabetes risk factors, while taking into account the effect of employment status on both diabetes and diabetes risk factors. A further challenge faced by researchers investigating the effects of diabetes outcomes are unobserved variables that may be biasing the estimates. In particular time-invariant confounders, such as poor early life conditions or time stable personal character traits, may simultaneously increase the probabilities to develop diabetes and to be unemployed or to engage in unhealthy behaviours.

The goal of this study is therefore to assess the impact of a diabetes diagnosis on both employment probabilities and behavioural risk factors while accounting for the potentially intertwined relationships between diabetes, employment and health behaviours. This is done via the use of marginal structural models (MSMs), an estimation strategy that is able to account for time-dependent confounding across time (Robins et al., 2000) when estimating the impact of a treatment, here a diabetes diagnosis, on the outcome of interest. This is the first time this strategy is used to estimate the impact of diabetes on an individual’s employment status. We further complement this and test the robustness of the MSM to the potential violation of one of its crucial assumptions of no unmeasured confounding. To do this, we estimate FE models that—while unable to account for the potentially simultaneous relationships—are able to take into account any unobserved time-invariant confounding additionally to confounding due to observed variables. Very different results to the MSM may then suggest a violation the assumption of no unobserved confounding. To assess further how important unmeasured confounding may be, we additionally estimate random effects (RE) models to compare the results from the MSMs and FE models against. Apart from these methodological contributions, the study further extends the evidence base for the impact of diabetes on employment probabilities in middle-income countries (MICs), where currently empirical information is only available for Mexico (Seuring, Serneels, et al., 2016). At the same time the study provides first, as far as we are aware, longitudinal evidence for the effect of a diabetes diagnosis on be-

havioural risk factors for diabetes complications in China or any low- and middle-income country (LMIC) for that matter.

More information about the effects of a diabetes diagnosis may be particularly important for LMICs such as China, where diabetes prevalence has surged from 1% in the early 1980s to about 10% in recent years (Hu, 2011; NCD Risk Factor Collaboration, 2016). Confronting this diabetes epidemic puts a strain on healthcare systems (Seuring, Archangelidi, et al., 2015), increasing the need to find highly cost-effective prevention and treatment options in very resource constraint settings (Silink et al., 2010). However, to do this it is important to assess how successful people with diabetes currently are in preventing adverse economic effects and reducing their risk factors for diabetes complications.

The literature trying to identify a causal relationship between diabetes and employment has relied on instrumental variable (IV) strategies (Brown, Pagán, et al., 2005; Latif, 2009; Seuring et al., 2015) and individual FE models (Seuring, Serneels, et al., 2016). However, while an IV approach could potentially account for all forms of confounding, the validity of the used instruments is at least questionable (Seuring, Serneels, et al., 2016). The FE model, as discussed above, also relies on important assumptions that may be violated. Turning to the study of the relationship between a diabetes diagnosis and behavioural risk factors, only one study has intended to causally related a recent diabetes diagnosis with changes in health behaviours in the USA, finding positive behaviour changes shortly after diagnosis. However, the effects were mostly short lived and tended to dissipate over time, particularly considering weight loss (Slade, 2012). To isolate the causal effect Slade (2012) created an "at risk" control group without diabetes that intended to be similar to the treatment group with diabetes, apart from not having received a diagnosis. He used information on diabetes biomarkers to estimate the propensity score of those without a diabetes diagnosis to be above a specific at risk threshold, so that everybody above a certain propensity score was used to form the control group. He then estimated dynamic population averaged as well as FE models to identify a causal relationship. While this approach likely improves the control group by increasing its similarity in the diabetes risk profile to the diagnosed population, it may not have been able to sufficiently account for the potential predetermination of the diabetes diagnosis by earlier values of the dependent variable. Further, the study did not account for employment status as one of the control variables.

A different identification approach was used by Zhao, Konishi, et al. (2013) when investigating the effects of a hypertension diagnosis on nutritional outcomes in China. They used a regression-discontinuity design and biomarker information on blood pressure. A crucial assumption in the study was that people above the hypertension threshold were

indeed informed about their hypertension while those just below the threshold were not. These two groups were then compared to isolate the particular effect of the additional health information on food consumption in the following wave. The results indicated that a diagnosis leads to reductions in fat consumption, though only for those economically better off. Several caveats exist for this study and the used approach. According to Zhao, Konishi, et al. (2013) it was not always clear to what extent participants were informed about their hypertension status and whether they had received just the actual blood pressure measurement information, leaving the interpretation to the participants, or whether they were made explicitly aware of their hypertension (or also pre-hypertension) status. Further, the results may have limited generalisability, since the measured treatment effect is a very local one, applying only to the population around the hypertension threshold. Finally, the study only provides information for a relatively short period until the first wave after diagnosis.

Accordingly, there is a need to provide new evidence on the effects of a diabetes diagnosis on employment status as well as behavioural risk behaviours that could affect the development of diabetes complications, using longitudinal data and alternative estimation strategies. Thereby this study adds in several ways to the existing literature. First, it shows the impact of diabetes diagnosis on labour outcomes in China, not only over the short term, but for a period covering the entire decade of the 2000s, allowing for a more long term investigation of the effects. This both confirms and extends earlier evidence for other settings and using different methods. Second, it provides information on the effect of a diabetes diagnosis on health behaviours. Third, by considering the effects over time on both employment and health behaviour simultaneously, the results shed light on potential pathways through which the impact on employment may work. Fourth, the study provides a methodological innovation by using both MSM and FE estimation methods, offering insights not only on the robustness of the MSM results, but also on the validity of some of its assumptions.

0.2 Methods

0.2.1 Study sample

The CHNS is an international collaborative project led by the Carolina Population Center at the University of North Carolina at Chapel Hill investigating nutrition and health behaviours in nine provinces of China (Zhang, Zhai, et al., 2014). We use data from 1997 onwards, which was the first time survey participants provided diabetes information.

In total we use six waves (1997, 2000, 2004, 2006, 2009 and 2011) obtained from the longitudinal dataset released in 2015. The data provide extensive information on nutrition and health, including anthropometric measures of weight and height, reducing potential measurement issues. It further provides socioeconomic information, most importantly for this study about employment. The sample is limited to the adult population from age 18–64. The sample is not nationally representative and as such does not provide sampling weights (Popkin et al., 2010).

Overall, between 84% to 90% of the survey participants are followed up in the consecutive wave, with attrition being highest after 2006. Attrition in the CHNS due to mortality is around 1% (Popkin et al., 2010). Other reasons mentioned by Popkin et al. (2010) are loss in follow up due to migration, natural disasters and redevelopment of housing in the urban centres leading to relocations. We analysed if any of our variables of interest was significantly related to attrition at any wave and did only find lower calorie consumption to exhibit an association. Further, attrition was related to urbanization, a higher level of education and being of younger age, suggesting that mostly younger, more urbanized participants tended to leave the survey.

0.2.2 Assessment of diabetes

We used self-reported information on a diabetes diagnosis to construct our diabetes indicator. We only rely on incident cases of self-reported diabetes, excluding individuals with self-reported diabetes at baseline. Given the chronic nature of diabetes, we assume that after the initial diagnosis diabetes persists for the rest of one’s life. To construct a measure of diabetes duration for incidence cases we used self-reported information on the year of diagnosis. If we found that the year of diagnosis was reported to be before the last wave without a reported diagnosis, we used the midpoint between the last wave without diagnosis and the first wave with a diagnosis as the year of diagnosis.¹

0.2.3 Assessment of outcomes

The economic outcome we focus on is employment status, based on a self-reported measure of if the person is currently working. People who reported to not be working due to being students were excluded. We do include those that are not working due to any other reason such as doing housework, being disabled or being retired.

¹The number of observations replaced at each wave was: 21 (2000), 44 (2004), 51 (2006), 78 (2009), 59 (2011). Overall it affected 43% of the self-reports of the year of diagnosis.

The behavioural outcomes we estimate are current smoking status, if alcohol was consumed equal to or more than three times per week, BMI, waist circumference in centimetres and daily calorie consumption. Smoking status and alcohol consumption were self-reported, while BMI and waist circumference are based on anthropometric measurements, minimizing potential reporting errors. Waist circumference was reported in centimetres. Finally, daily calorie consumption is a constructed variable available in the CHNS, based on the average daily consumption of carbohydrates, protein and fat of every individual in the survey, measured on three consecutive days. We also estimate models using overweight and obesity indicators instead of a continuous weight measurements. We do, however, not include them in our primary analysis as there is considerable discussion about the correct thresholds to use for Asian populations (He et al., 2015; WHO, 2004; Zeng et al., 2014). We applied thresholds suggested by the China Obesity Task Force of a BMI ≥ 24 to define overweight and a BMI ≥ 28 to define obesity (China Obesity Task Force, 2004). The results are presented in the appendix.

0.2.4 Statistical analysis

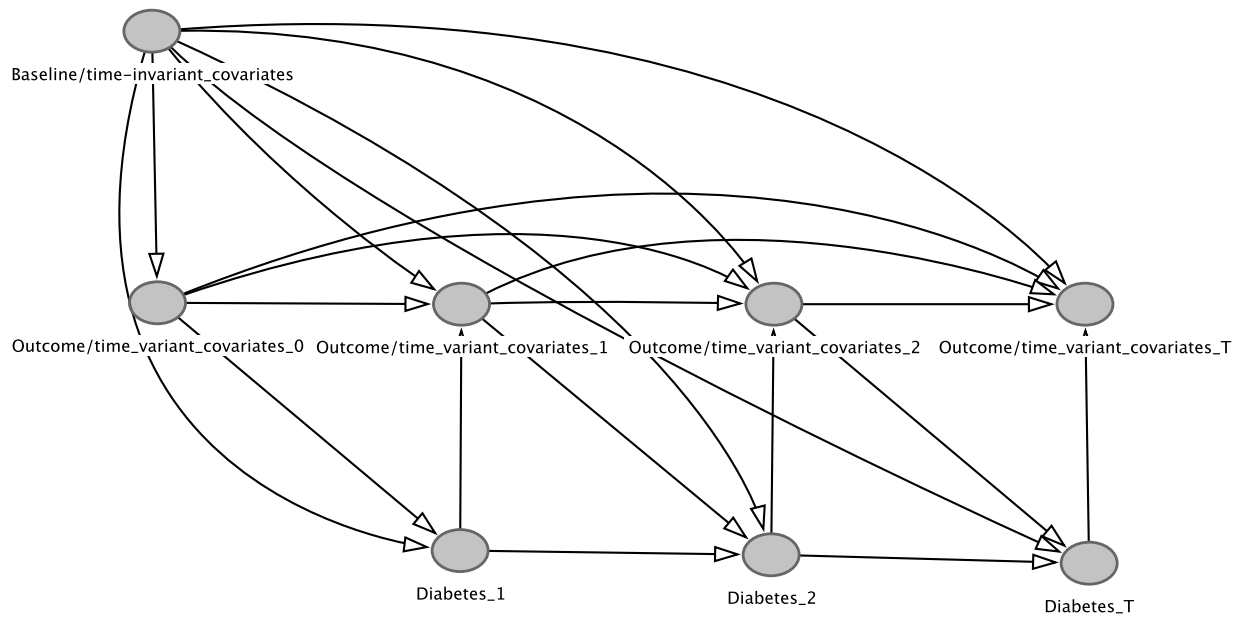
We use two statistical approaches to account for potential confounding: marginal structural models (MSMs) and fixed effects (FE).

Marginal structural models

MSMs apply inverse probability weights to adjust for confounding and selection bias as a result of time-varying confounders being affected by prior exposure to the treatment (Robins et al., 2000). Under the assumption of the MSM (Robins et al., 2000)—the reported treatment is the treatment that has actually been received (consistency), there are no unmeasured confounders (exchangeability) and every person in the sample has a non-zero chance of receiving the treatment (positivity) (see Section 0.4 for a discussion of the validity of these assumptions in our case)—the causal direct acyclic graph (DAG) shown in Figure 0.1 displays the association between confounders and outcomes and a diabetes diagnosis.

In our context it seems possible that, for example, BMI could affect the probability of being diagnosed with diabetes which then itself may affect subsequent BMI levels, confounding the relationship between a diabetes diagnosis and BMI due to non-random selection. Similarly, employment history and current employment could affect the probability of a diabetes diagnosis through their impact on lifestyle and hence diabetes risk factors such as increases weight or smoking. For example, an increase in disposable income

Figure 0.1: DAG for marginal structural model



Notes MSMs assume the absence of unobserved time-invariant and unobserved time-variant confounders but allow the past treatments to affect the current outcomes (arrows going from Diabetes to time-variant covariates) and the past outcomes to affect the current treatment (arrows going from time-variant covariates to Diabetes). Lagged time-variant covariates, baseline and time-invariant covariates predict current diabetes status.

or a reduction in leisure time as a result of a new job and the subsequent effect on risk behaviours could confound the relationship between a diabetes diagnosis and employment status. MSM accounts for this by calculating weights based on the potential risk of a person being diagnosed at each time point.

To calculate these weights we first construct unstabilized weights using baseline values of time-variant confounders, time-invariant confounders as well as time-variant confounders lagged by one period to predict the probability of developing diabetes at each wave. We use lagged time-variant confounders because current diabetes status as reported in the survey was determined at some point within the current and the previous wave that were determined before the current diabetes status, to prevent reverse causality. The used predictors are age and age squared to account for changes in risk with increasing age, an index of urbanization pre-constructed within the CHNS data, ranging from 1 to 120 as the level of urbanization increases (Zhang, Zhai, et al., 2014), to account for the impact of urbanization on diabetes risk (Attard et al., 2012). We also use secondary and university education, being married, having any medical insurance, being of Han ethnicity, living in a rural area, dummies for the different Chinese regions and the respective survey waves as predictors. Further we use inflation adjusted per-capita household income to adjust for effects of household wealth on diabetes. Finally, all outcome variables (employment status, alcohol consumption, smoking status, BMI, waist circumference and average daily calorie consumption) are used as predictors.

Because unstabilized weights can be highly variable it is recommended to stabilize the weights (Cole and Hernan, 2008). Using the unstabilized weights as the denominator, stabilized weights are calculated by dividing the denominator by the predicted treatment propensity from a model using only time-invariant confounders and baseline information of the time-variant confounders as predictors. Because our analysis is stratified by males and females, we create weights separately for both groups.

The MSMs are estimated using OLS for the continuous and a logistic model for the binary outcomes. For the logistic model we calculate average marginal effects for greater comparability with the results of the FE models. All models are weighted by the stabilized weights constructed beforehand while adjusting for all baseline and time-invariant covariates used in the calculation of the stabilized weights, except for the respective outcome of interest. Robust standard errors to account for intra-class correlation of repeated outcome measurements in individuals are used throughout. In our primary analysis, we present the results of the MSM with untruncated stabilized weights, as these provide theoretically unbiased estimates, albeit they likely are less efficient than truncated weights (Cole and Hernan, 2008). The distribution of the inverse probability weights supports this decision

as there are no extreme values and the mean weight is 1 (see Table 0.5).

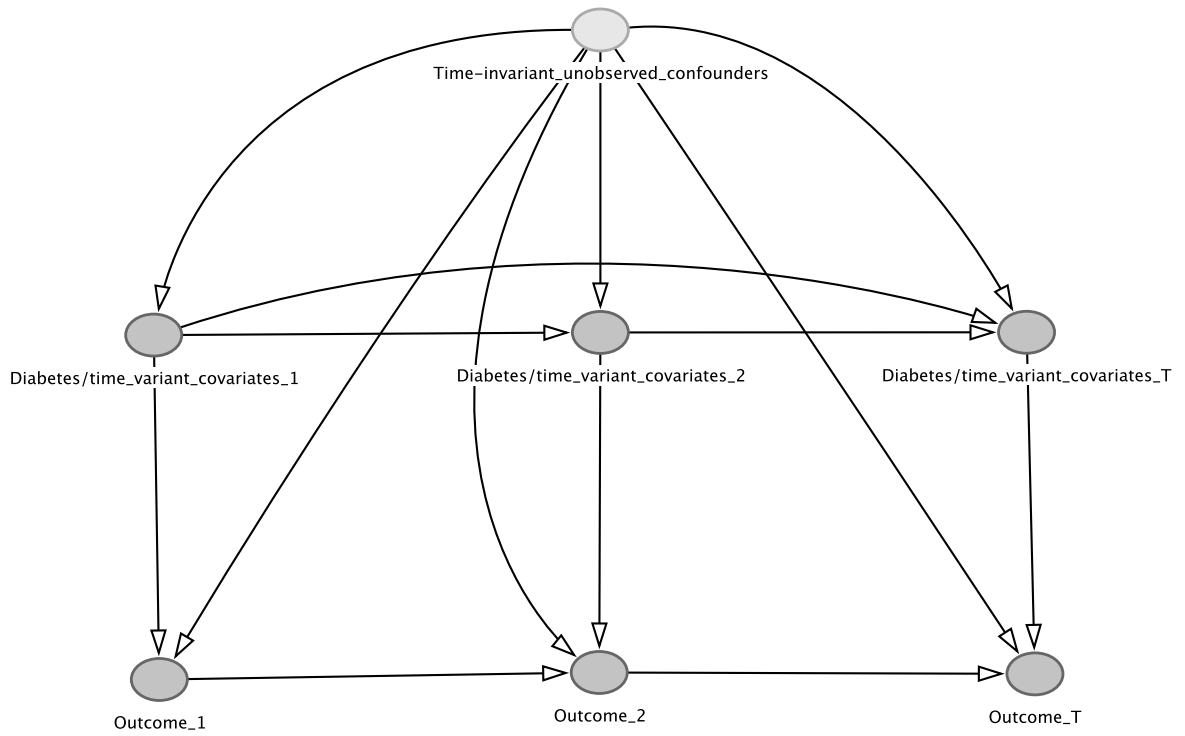
Fixed effects

While the MSM can account for pre-treatment selection on observable and time-variant confounders, it assumes that there are no unobserved time-invariant confounders such as family background, cognitive abilities, and other personal characteristics. This is a strong assumption that may be violated. The individual level FE model can help remedy this problem as it is able to account for both observed time-variant and invariant variables as well as time-invariant unobserved variables as shown in the DAG in Figure 0.2. It does so by demeaning the confounding variables at each time point by the overall individual mean across all observed time points. It then uses solely the within-person variation for identification, thereby accounting for any time-invariant observed or unobserved as well as observed time-variant effects.

This comes at a price: due to the demeaning, time-invariant variables such as Han ethnicity, are dropped from the model and cannot not be estimated. Further, because the FE model is not able to account for any treatment effects on other time-variant confounders, only a more limited set of confounders could be included compared to the MSM. Otherwise our estimate of the effect of a diabetes diagnosis would likely be biased due to the inclusion of 'bad controls' (Angrist and Pischke, 2008). Bad controls are those that have been affected by the treatment itself—such as BMI or smoking status after a diabetes diagnosis—and therefore likely capture part of the causal effect of diabetes on our outcome of interest, biasing the diabetes coefficient (Angrist and Pischke, 2008). The FE models thus only includes controls for age, age squared, the level of urbanization, education, being married, having any medical insurance, living in a rural area, and dummies for the different Chinese regions and the respective survey waves. For the estimation of the effect of time since diagnosis, the linear age variable is dropped. In FE models, two or more variables that change at the same rate between waves cannot be separately identified. Here this is the case with age and time-dummies, as both variables increase by one each additional year (Wooldridge, 2012). To identify the effect of diabetes duration we have to rely on the presence of people without diabetes in the sample, for which diabetes duration does not increase at the same rate as time.

Because it is not possible to retrieve marginal effects from a logistic FE model, we use a linear FE model instead. It generally produces very similar estimates compared to non-linear models (Angrist and Pischke, 2008).

Figure 0.2: DAG for fixed effects model



Notes FE models account for time-invariant unobserved confounding (light grey circle), but still assume the absence of unobserved time-variant confounding. They further do not allow for past outcomes to affect the current treatment, i.e. diabetes status.

Multiple imputation

To deal with missing data, we used chained multiple imputation to impute the missing values in Stata 13 using the user written ICE command (Royston and White, 2009) and used the resulting data for all our estimated models. Overall, thirty imputed datasets were created. Imputation models included all variables used in the MSMs. We imputed missing data in the same wave for which some data were recorded; we did not impute completely missing waves. Further, we did not impute missing diabetes information and instead assumed that once a diabetes diagnosis was reported, the individual had diabetes in every ensuing wave, even when the observation was missing. If diabetes was never reported in any wave, we assumed that the individual never had diabetes. We then only imputed missing values for those observations that had a non-missing diabetes status. For the calculation of the marginal effects in the MSM logit models, Rubin's rules were applied using the user written Stata command `mimrgns` (Klein, 2014).

Numbers of observations

Because we used lagged variables to construct the stabilized weights for the MSMs, the number of observations used in the MSMs is lower than those used in the FE models, where we do not use lagged variables. The summary statistics shown in Table 0.1 are based on the observations used in the FE models.

Sensitivity analyses

We conduct three additional sensitivity analyses in order to test the robustness of our results to different assumptions and estimation strategies. First, we estimate all models using only covariate adjustment in a RE model, to investigate in how far this 'naive' approach diverges from the "causal" estimates of the FE and MSMs. These results are presented and discussed together with those of the MSM and the FE model. Second, we truncate weights at the 1st and 99th percentile to investigate the sensitivity of the MSMs to the most extreme weights. While untruncated weights provide unbiased estimates under the assumptions of the MSM, they may not be the most efficient and tend to have larger standard errors (Cole and Hernan, 2008). Third, we estimate the FE and MSMs using the original non-imputed data to ascertain the extent to which multiple imputation affected the results.

0.3 Results

From the descriptive statistics, we can observe that people with diabetes in any wave are less likely to be employed. Looking at health behaviours, it is mainly men that smoke and report alcohol consumption while very few women do so. The prevalence of smoking and drinking is lower for men with diabetes; they also consume fewer calories compared to men without diabetes. Further, the diabetes group has both higher BMI and waist circumference levels. They are also older, live in more urbanized areas, are more likely to have insurance and men are somewhat better educated while women are less educated compared to their counterparts without diabetes. Both men and women report an average time since diagnosis of around 4.5 years. Looking at per capita household income, men and women with diabetes come from household with higher income levels than those without a diabetes diagnosis. Further it appears that in China it is less educated women that report a diagnosis, while men with diabetes are better educated compared to those without diabetes.

Predicting the denominator for the stabilized weights we find that for men a higher baseline BMI increases the risk of a diabetes diagnosis. Further, increases in age, waist circumference as well as urbanization levels are associated with higher chances for men to be diagnosed with diabetes throughout the survey. Interestingly becoming employed may decrease the chances of being diagnosed with diabetes slightly, justifying the use of the MSM in our employment models as well (Table 0.2). Because these are not causal estimates, it may be that it is more likely for men with a lower risk of diabetes to select into employment. Interestingly, we do not find that higher household income levels are predictive of a diagnosis for men or women, despite what the descriptive statistics indicated. For women, higher age at baseline, increases in BMI and waist circumference as well as living in a non-rural environment predict a diabetes diagnosis.

The results of our regression analysis are presented in Table 0.3. Both the FE model and the MSM indicate that women with a diabetes diagnosis have reduced probabilities of being employed than their counterparts without diabetes, with a reduction of 11 percentage points in the FE model and 12 percentage points in the MSM. This translates into a relative reduction in employment probabilities between 16–17%. For men no such effect is observed.

Table 0.1: Sample means for males and females, by diabetes status

	Males			Females		
	No diabetes	Diabetes	p-value (t-test)	No diabetes	Diabetes	p-value (t-test)
Employed	82%	68%	<0.001	67%	29%	<0.001
Smokes	58%	47%	<0.001	3%	4%	0.409
Any alcohol consumption	63%	53%	<0.001	9%	4%	<0.001
Daily Kcal eaten (3-day average)	2422	2166	<0.001	2068	1931	0.001
BMI	22.99	24.90	<0.001	23.10	25.80	<0.001
Waist circ. (cm)	82.02	88.81	<0.001	78.80	87.55	<0.001
Age	42.27	52.76	<0.001	43.24	55.32	<0.001
Han ethnicity	87%	89%	0.292	87%	93%	0.002
Rural area	69%	52%	<0.001	68%	51%	<0.001
Married	83%	93%	<0.001	88%	87%	0.392
Secondary education	65%	68%	0.439	50%	43%	0.007
University education	5%	11%	<0.001	4%	1%	0.017
Any health insurance	51%	82%	<0.001	50%	71%	<0.001
Urbanization Index	60.87	74.48	<0.001	61.77	68.68	<0.001
Per capita household income (Yuan (2011))	8617	16328	<0.001	8581	11101	<0.001
Years since diabetes diagnosis	—	4.5	—	—	4.65	—
Observations	23159	284		23369	333	

There is a more ambiguous picture for the effect of a diabetes diagnosis on behavioural outcomes. There is no consistent—and only marginally significant evidence in the MSM—that men reduced their smoking rate, however, a diabetes diagnosis led to a reduction in alcohol consumption as according to either model, though particularly so for the MSM. For waist circumference, BMI and calorie consumption, the FE and MSM both indicate reductions in BMI of close to 0.7, of about 2 cm in waist circumference and of up to almost 170 calories per day for men. Results for women look different in that while the point estimates indicate a reduction in all outcomes, these tend to be smaller than those for men and only exhibit strong statistical significance in the FE model for BMI, waist circumference. There is also some evidence may stop smoking and reduce their alcohol consumption, but given the already low prevalence of these risk behaviours in women this may be of less importance.

The results of the RE models appear to overestimate the impact of diabetes on female employment probabilities and to underestimate the impact of a diabetes diagnosis on reductions in BMI and waist circumference. For the other outcomes, results are very similar to those from the MSMs and FE models.

Exploring the effect of a diabetes diagnosis over time, we first estimate a specification using time since diagnosis as a continuous variable. The results of the MSMs (Table 0.4) indicate a steady reduction of female employment probabilities of almost two percentage points per year and of male alcohol consumption, BMI, waist circumference and calorie consumption. The FE model again supports the finding of the MSM, showing very similar, though somewhat larger, effects in terms of size and statistical significance. The evidence for changes in risk factors for females is less consistent across models and outcomes, with the MSM suggesting almost no effects while the FE models indicate a reduction in BMI. The effect sizes for changes in health behaviours in women are consistently lower than those found for men.

The results of the RE models again likely overestimate the adverse impact of diabetes on female employment probabilities and to underestimate the impact of a diabetes diagnosis on reductions in BMI and waist circumference.

In a second step we estimated a specification using year dummies to capture the potential non-linearity in the relationship between time since diagnosis and our outcomes. The results for both estimation methods are visualized in Figures 0.3, 0.4 and 0.5 and presented in Tables 0.6, 0.7 and 0.8 for the MSM, FE and RE model, respectively. Despite the reduced sample size in each group and hence lower precision, the MSM model still indicates a reduction in female employment chances and male BMI, waist circumference and calorie consumption, especially in the first 8 to 10 years after diagnosis. A similar effect is found

Table 0.2: Time variant and invariant predictors of a diabetes diagnosis (denominator of stabilized weights)

	Males		Females	
	(1) β	(2) SE	(3) β	(4) SE
Age (bl)	-.000	0.001	0.004**	0.002
Age squared (bl)	0.000	0.000	-.000**	0.000
BMI (bl)	0.001***	0.000	0.001	0.000
Waist circumference (cm) (bl)	0.000	0.000	0.000*	0.000
3-Day Ave: Energy (kcal) (bl)	-.000	0.000	0.000	0.000
Smoking (bl)	0.001	0.002	0.003	0.006
Alcohol consumption (bl)	0.003*	0.002	0.000	0.005
Urbanization index (bl)	-.000	0.000	-.000	0.000
Secondary educ. (bl)	-.001	0.003	0.003	0.003
University educ. (bl)	-.000	0.006	—	
Married (bl)	-.002	0.004	-.000	0.004
Any medical insurance (bl)	0.002	0.002	-.000	0.002
Employed (bl)	0.002	0.003	0.001	0.002
Han ethnicity	0.001	0.003	-.002	0.003
Rural	-.001	0.002	-.005***	0.002
Per capita household income (2011 Yuan) (bl)	-.000	0.000	-.000	0.000
Survey year				
2004	0.002	0.002	-.001	0.002
2006	0.003	0.002	-.003	0.003
2009	0.009***	0.003	-.001	0.004
2011	0.001	0.003	0.001	0.004
Age	0.003**	0.001	-.002	0.002
Age squared	-.000**	0.001	0.000	0.000
BMI	-.001	0.000	0.001**	0.000
Waist circumference (cm)	0.000	0.000	-.000	0.000
3-Day Ave: Energy (kcal)	-.000	0.000	-.000	0.000
Smoking	-.003	0.002	0.000	0.006
Alcohol consumption	-.004**	0.002	-.003	0.006
Urbanization index	0.000	0.000	0.000	0.000
Secondary education	0.001	0.003	0.000	0.003
University education	0.001	0.006	—	
Married	-.000	0.004	-.003	0.004
Any medical insurance	0.001	0.002	-.001	0.002
Employed	-.004**	0.002	-.003	0.002
Per capita household income (2011 Yuan) (2011 Yuan)	0.000	0.000	-.000	0.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results for province dummies omitted to preserve space. No observations for women with university education and diabetes.

Table 0.3: Analysis of the effect of a diabetes diagnosis on employment status and behavioural outcomes using MSM, FE and RE

	(1) Employment	(2) Smoking	(3) Alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
<i>Marginal structural model</i>						
Male sample						
Diabetes	-.009 (.026)	-.070** (.032)	-.094*** (.036)	-.735*** (.180)	-1.887*** (.574)	-135.061** (58.593)
Female sample						
Diabetes	-.117*** (.029)	-.015* (.008)	-.029** (.012)	-.388 (.240)	-.335 (.631)	-45.630 (33.530)
<i>Fixed effects</i>						
Male sample						
Diabetes	0.022 (.030)	-.023 (.032)	-.104*** (.036)	-.715*** (.183)	-2.217*** (.610)	-168.297*** (62.115)
Female sample						
Diabetes	-.112*** (.035)	-.027** (.013)	-.012 (.010)	-.644** (.263)	-1.251** (.616)	-61.175 (47.420)
<i>Random effects</i>						
Male sample						
Diabetes	-.022 (.028)	-.064** (.029)	-.104*** (.029)	-.379** (.177)	-.756 (.542)	-172.467*** (48.768)
Female sample						
Diabetes	-.152*** (.027)	-.021** (.011)	-.019*** (.006)	-.263 (.247)	0.459 (.570)	-39.267 (34.256)

Notes Standard errors in parentheses. Other control variables: age (only MSM), age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, per capite household income. Fixed/random effects: N=23443 (male sample), N=23702 (female sample); MSM: N=16047 (male sample), N=16658 (female sample).

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 0.4: Analysis of the effect of time since diabetes diagnosis on employment status and behavioural outcomes using MSM, FE and RE

	Odds ratios			Beta coefficients		
	(1) Employment	(2) Smoking	(3) Any alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
<i>Marginal structural model</i>						
Male sample						
Time since diagnosis	-.003 (.004)	-.010* (.005)	-.014** (.007)	-.127*** (.031)	-.340*** (.099)	-21.770** (9.842)
Female sample						
Time since diagnosis	-.017*** (.005)	-.002 (.001)	-.004 (.003)	-.066* (.040)	-.072 (.109)	-8.735 (5.589)
<i>Fixed effects</i>						
Male sample						
Time since diagnosis	-.001 (.007)	-.003 (.006)	-.017** (.007)	-.150*** (.037)	-.520*** (.121)	-22.286** (11.083)
Female sample						
Time since diagnosis	-.019*** (.007)	-.003 (.002)	-.000 (.001)	-.102*** (.039)	-.215* (.117)	-6.747 (7.028)
<i>Random effects</i>						
Male sample						
Diabetes	-.006 (.006)	-.009* (.006)	-.015*** (.005)	-.099*** (.035)	-.269*** (.096)	-24.703*** (8.655)
Female sample						
Diabetes	-.023*** (.006)	-.002 (.002)	-.002** (.001)	-.056 (.039)	0.013 (.114)	-6.444 (5.670)

Notes Standard errors in parentheses. Other control variables: age (only MSM), age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. Fixed/random effects: N=23443 (male sample), N=23702 (female sample); MSM: N=16047 (male sample), N=16658 (female sample)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

for females, especially for years 3 to 8 after diagnosis. Interestingly, female employment already decreases rapidly in the first to second year after diagnosis and it does not appear that females are able to increase their employment probabilities later on. Using the MSM, all point estimates suggest similar effects, but due to the lower sample size, we were not able to estimate the effects for females on smoking and alcohol consumption.

We conducted two sensitivity analyses. First, we truncated weights at the 1st and 99th percentile to investigate the sensitivity of the MSMs to the most extreme weights. The estimated effects are very similar to those using the untruncated weights (Table 0.9 and 0.10), suggesting no important loss in efficiency and supporting the decision to use untruncated weights. Second, we estimated the FE and MSMs using the original non-imputed data. The results are broadly similar (Tables 0.11, 0.12, 0.15 and 0.13), in particular for the FE model, still indicating a reduction in female employment chances and male alcohol consumption, BMI and waist circumference. The coefficients of the MSM still point into the same direction as those using the imputed data, but the estimated effects are smaller in size and confidence intervals are relatively large.

Figure 0.3: Analysis of the effect of time since diabetes diagnosis on employment status and behavioural outcomes (duration groups, marginal structural model)

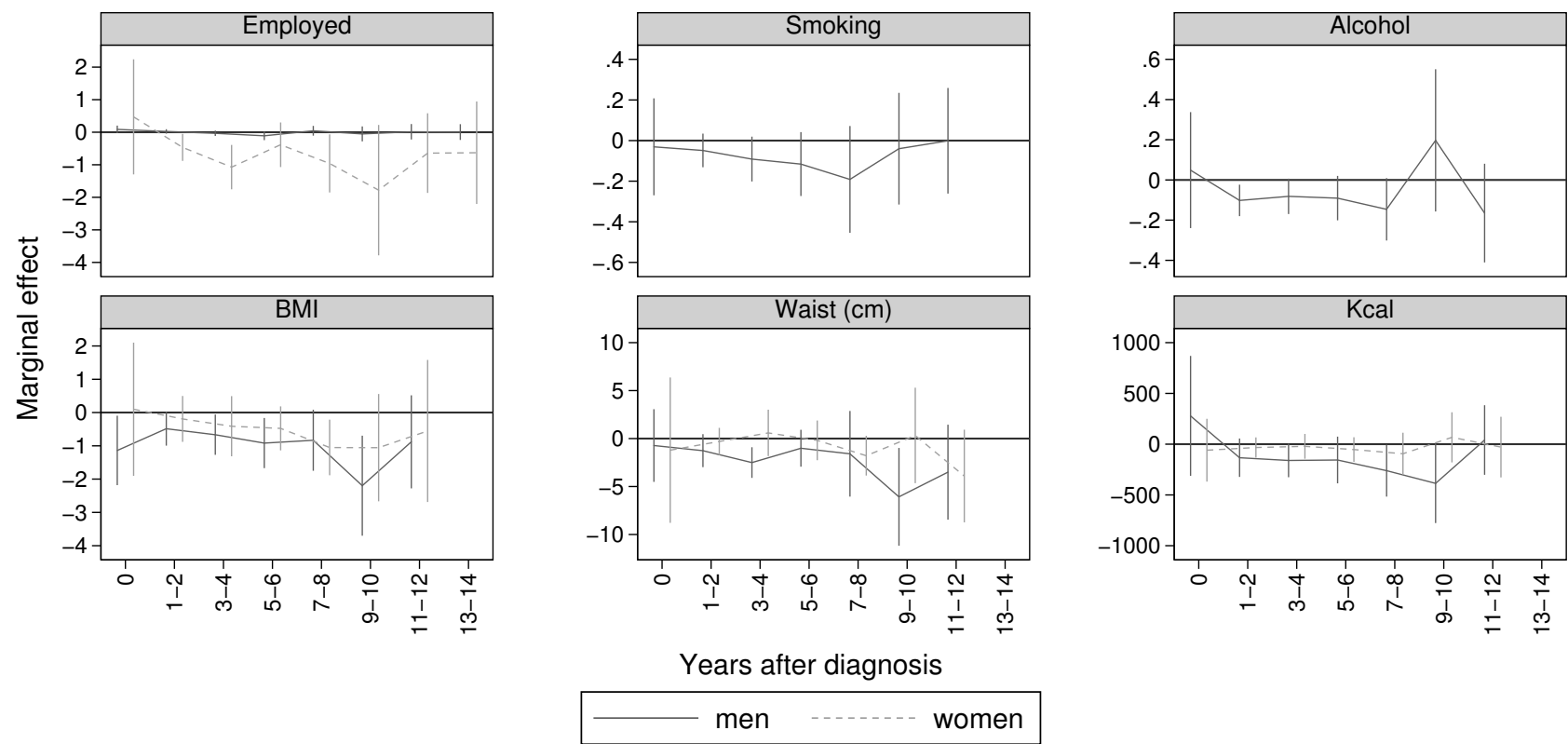


Figure 0.4: Analysis of the effect of time since diabetes diagnosis on employment status and behavioural outcomes (duration groups, fixed effects)

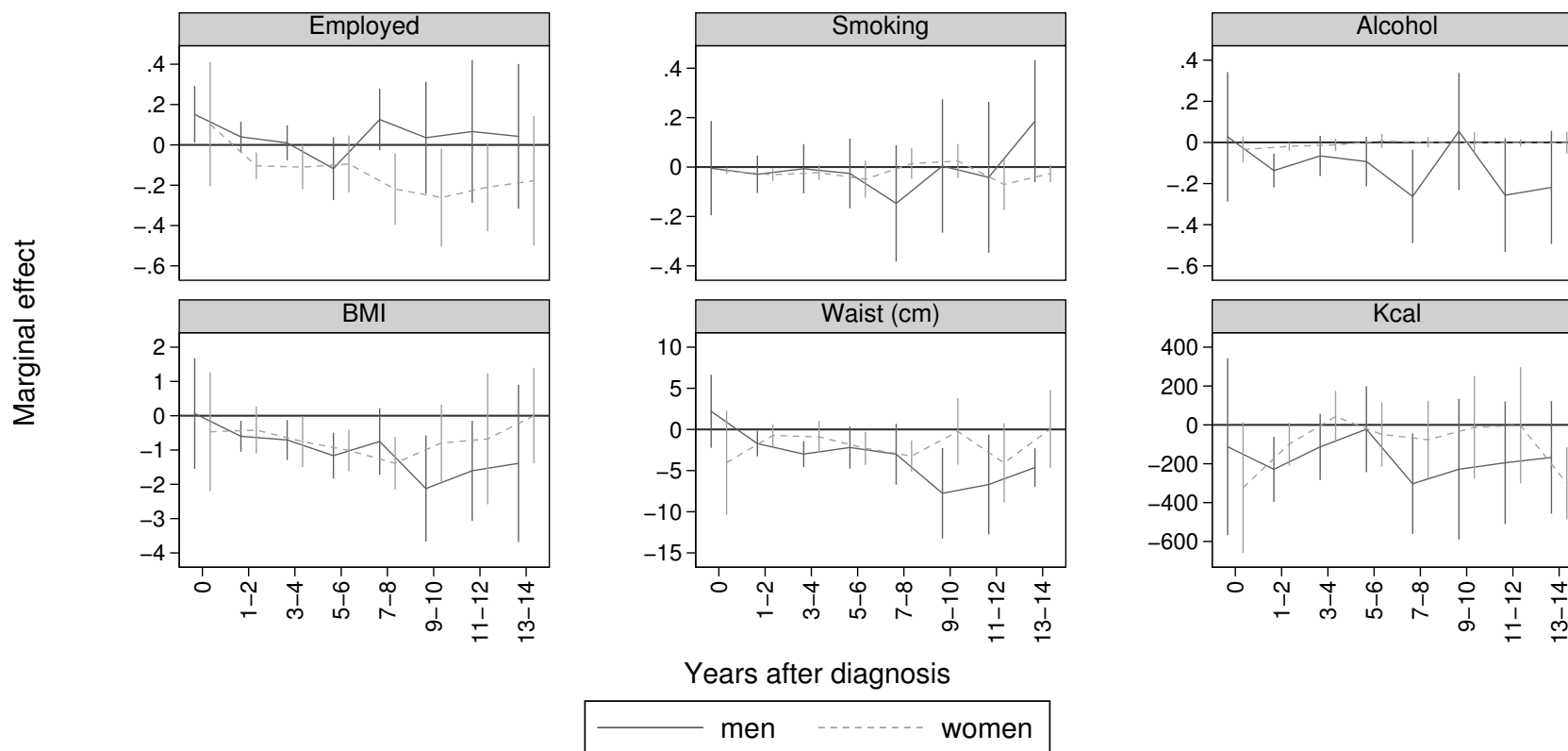
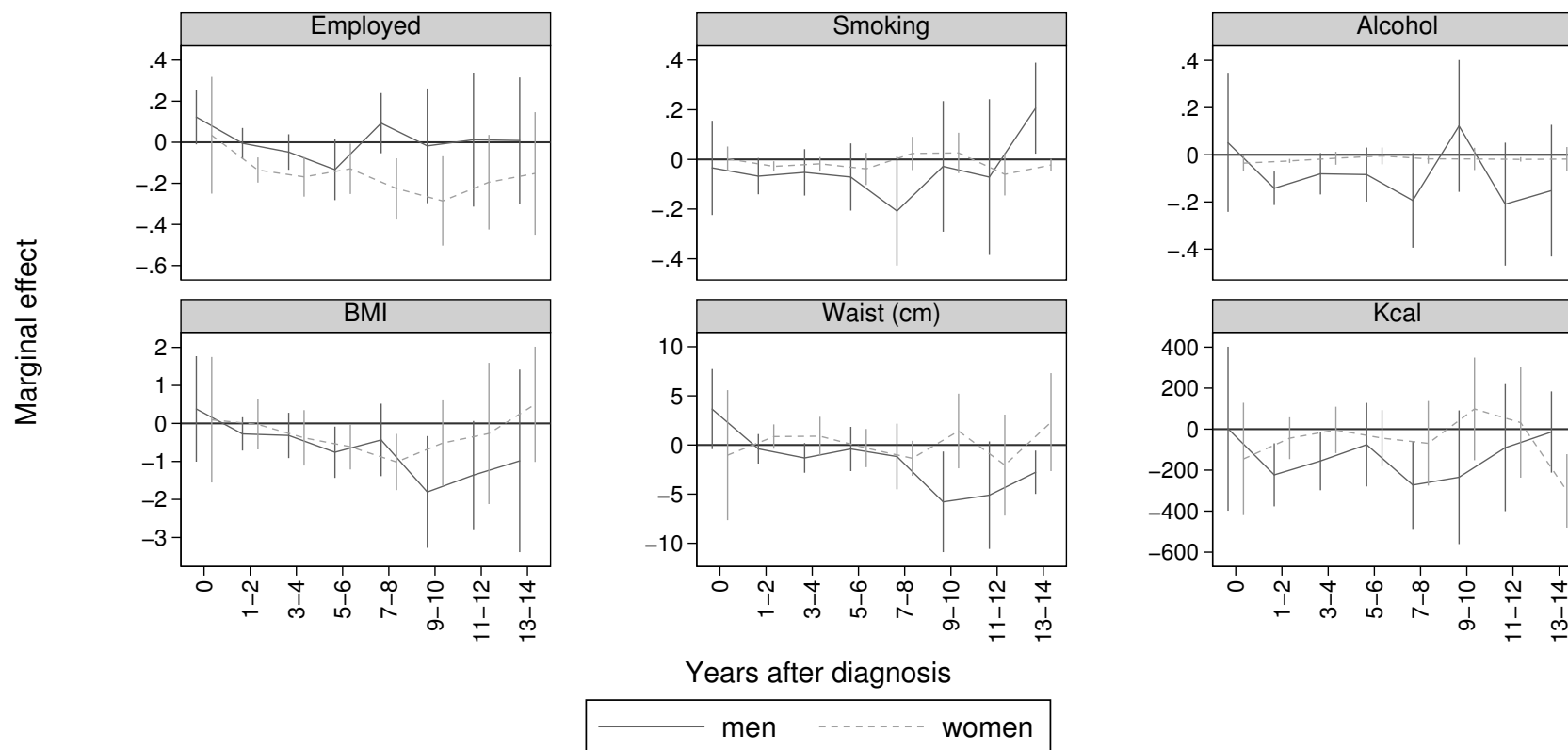


Figure 0.5: The effect of time since diabetes diagnosis on employment status and behavioural outcomes (duration groups, random effects)



0.4 Disussion

Our results suggest that receiving a diabetes diagnosis in China led to a strong and lasting reduction in female, but not male employment probabilities. Looking at the behavioural risk factor outcomes, BMI and waist circumference as well as risk behaviours such as alcohol and calorie consumption and potentially smoking were found to be reduced for men. For females, our primary results did not find as strong indications for changes in behavioural risk factors. Accordingly, it appears that women in China have to endure stronger adverse labour market effects and at the same time are less successful then men at making risk behaviour changes to reduce their risk of diabetes complications.

The MSM models and FE models indicated very similar results suggesting that they are robust and that time-invariant confounding factors may play a limited role over and above baseline and time varying confounding factors. The MSM results suggest that in particular high baseline BMI and waist circumference levels help explain selection into a diabetes diagnosis, and thus need to be taken into account. Further, becoming employed appears to decrease the risk of being diagnosed with diabetes. The robustness checks using 'naive' regression in the form of RE models further indicated that in this setting insufficiently accounting for confounding leads to an overestimation of the impact of diabetes on employment status and an underestimation of the effects of a diagnosis on weight measures (BMI and waist circumference). However, confounding may only be of limited relevance after adjusting for observable covariates for risk behaviours (smoking and alcohol consumption) and caloric intake.

0.4.1 Limitations

While we used two estimation methods to reduce the influence of selection bias due to unobserved confounding, one limitation of the used approaches is their inability to account for all forms of selection simultaneously. Therefore a causal interpretation is only possible under restrictive assumptions, namely no unobserved time-variant confounding for the FE model and positivity, exchangeability and consistency for the MSM. The assumption of positivity is likely to hold, given that every person should have at least a small chance of receiving a diabetes diagnosis. This is also supported by the relatively small range of stabilized weights and absence of zero-weights. Exchangeability, or no unmeasured confounding, is not testable and could potentially be violated if not all time-invariant or time-variant confounders were accounted for. We tested for part of this assumption by estimating a FE model, which suggested that unobserved time-invariant confounding may be of limited relevance. Consistency would have been violated if a diabetes diagnosis had

been reported but the person had actually not been diagnosed with diabetes. This is likely only violated in very rare cases of misreporting, given that specificity of diabetes self-report is very high in China (Yuan et al., 2015). Because we were interested in the effect of a diabetes diagnosis, unobserved diabetes did not violate the consistency assumption.

A limitation of the FE model is the possibility of time-variant confounding causing selection into a diabetes diagnosis based on changes in pre-treatment values of our outcomes of interest. Given that the FE estimates were close to those of the MSMs, it is likely that there was no strong confounding due to pre-treatment changes. Rather, the similarity of results suggests that it is important to account for some form of baseline values, be it via demeaning as in the FE model or by using baseline values in the MSM. Further, the FE model is unable to account for the effect of confounders that are causally related with diabetes such as BMI or waist circumference but may also have an effect on the outcome themselves. This may lead to an over- or underestimation of the effect of diabetes if the diabetes variable captures parts of the effect of very high BMI levels (obesity). This may be the reason for some of the, albeit small, differences in point estimates between the FE model and MSM.

Finally, an important limitation is that a diabetes diagnosis entails a variety of 'treatments' that are difficult to disentangle and may each have a distinct effect on the explored outcomes. Currently, we are only able to observe the combined effect of these treatments. Firstly, there is the provision of information at diagnosis, potentially causing increases in stress and anxiety, but may also providing an explanation for the experienced symptoms, both potentially affecting productivity. Secondly, a diagnosis also is the starting point for medical treatment, potentially alleviating symptoms and helping with weight loss, but also posing new challenges, in particular if treatment entails the exogenous provision of insulin or strict meal plans, potentially adding to the burden of diabetes in daily life. Thirdly, adherence to medical treatment may be heterogeneous across people with diabetes, with non-adherence likely leading to a further worsening of risk factors for complications, while good adherence may be able to prevent or delay debilitating complications. Fourthly, a diagnosis may also introduces lifestyle changes such as increasing exercise levels, eating healthier and reducing smoking or alcohol consumption, all potentially affecting the risk to develop further complications and to experience changes in productivity. In the current study, it is not possible to ascertain which of these factors and to what extend are affecting employment chances, but also the observed changes in weight loss. Only for the reductions in smoking and alcohol consumption, it seems reasonable to attribute them to diagnosis induced awareness to reduce these risk factors.

0.4.2 Potential mechanisms

The permanent reduction in male BMI and waist circumference we have found has also been observed in a cohort of Danish patients (De Fine Olivarius et al., 2015), where weight increased the years preceding diagnosis, while after diagnosis weight decreased. The exact reasons for this decrease were unknown but attributed to motivation changes as a result of the diagnosis, concluding that time around the diagnosis may represent a window of opportunity to obtain long lasting weight change. Nonetheless, reductions in weight, as already eluded to in the limitations, may also be the result of treatment initiation with metformin or other diabetes drugs that have been shown to lead to weight reductions (Yang and Weng, 2014). Importantly, the reduction in BMI in our study was accompanied by a reduction in waist circumference and energy intake. Given that in China diabetes incidence has been especially attributed to a high accumulation of visceral fat and central obesity (Ma et al., 2014), reductions in waist circumference therefore may have a particular positive effect on diabetes control and the prevention of comorbidities. This also allows for the interpretation that the changes in BMI are due to reductions in fat and not lean body mass (Klein et al., 2007). The reduction in energy intake further suggest that the changes in weight are at least partly the result of changes in food consumption.

For women, however, we did not find similar strong evidence for reductions in BMI, waist circumference or energy intake. The relatively smaller effects for women could indicate a lower ability to change behaviours supportive of weight loss. This appears to be supported by the smaller reductions in energy intake. This could have—at least partly—contributed to a higher risk for further diabetes complications that then reduced employment probabilities. Apart from this, other explanations for the lower weight loss and larger employment penalty for women compared to men include their lower educational attainment, which has been indicated as a factor in preventing better glucose control (Luo et al., 2015) and may also affect the ability to successfully change behaviours. Lower income levels for females compared to men may also negatively affect the ability to receive adequate treatment following a diagnosis, limiting their ability to change health behaviours (Luo et al., 2015) and increasing the risk of complications. We found that women with diabetes lived in households with lower income levels compared to men with diabetes, however, these income levels were still higher than for those without diabetes. Nonetheless, it may still be the case that women are able to use fewer household revenues for their own healthcare. Further, there are likely biological factors that lead to worse health outcomes for women compared to men. There is some evidence that, due to different ways of fat storage between men and women, men tend to cross the diabetes threshold at an earlier point in time and at a comparatively healthier metabolic state than women (Peters,

Huxley, Sattar, et al., 2015; Peters, Huxley, and Woodward, 2014a,b). Women are more likely to have spend more time in a pre-diabetes stadium (Bertram and Vos, 2010) and to cross the threshold only once the metabolic has significantly deteriorated, leading to a greater risk of cardiovascular disease and stroke (Peters, Huxley, Sattar, et al., 2015). Supporting this, a study for China found a greater prevalence of diabetes comorbidities in Chinese women than men (Liu, Fu, et al., 2010). In this light it may not be surprising that we find more conclusive evidence of worsening employment probabilities for women than for men. If women are less likely to receive proper treatment and to change their health behaviours and at the same time have a greater risk for complications than men, the long term effects of diabetes on their health are likely more severe than for men and consequently affect their employment status.

The found adverse effect of diabetes on employment is in line with other studies on the labour market impact of diabetes that find adverse effects of diabetes on women employment probabilities (Harris, 2009; Latif, 2009; Minor, 2011b; Seuring, Serneels, et al., 2016)—often stronger than the effects experienced by men. Most comparable, due to the use of FE with data for a similar time period, a study from Mexico also found significant reductions for both males and females of about 5 percentage points (Seuring, Serneels, et al., 2016). Taking into account the lower overall employment rate of Mexican women compared to men, this translated into an about 16% reduction in employment probabilities, a figure comparable to what Chinese women experienced. However, in Mexico also men experienced adverse effects, unlike to what we found for China.

The found effects on changes in behavioural risk factors can partly be compared to a study by (Slade, 2012) that used population level observational data to investigate the effect of a diabetes diagnosis on health behaviours in the USA. Our findings are similar in some respects, as both studies suggest a response to the diabetes diagnosis 'shock' by reductions in dietary choices—Slade also found a reduction in alcohol consumption—but not to a similar extend curb smoking. In terms of the effect on weight, both studies cannot be directly compared because Slade investigated the effect to be overweight or obese, while we used continuous weight measures due to the discussed difficulties of defining cut-off values for Asian populations. Nonetheless, the results from the overweight and obesity models we estimated do—similarly to Slade—not indicate important reductions in obesity after a diabetes diagnosis. However, while Slade finds a stronger initial reduction in weight status, he also finds that people with diabetes tended to return to be obese or overweight after some time. Our results suggested that man may manage to consistently reduce their probabilities to be obese, but not overweight, at least according to the FE model. Importantly—and in concordance with our findings—he finds that simple covariate

adjustment leads to estimates indicating an increase in overweight and obesity, underlining the importance of accounting for unobserved heterogeneity.

0.5 Conclusion

Our results indicate changes in male health behaviours after a diabetes diagnosis in China. These findings are robust to the application of two distinct, but complementary econometric techniques. Further, women likely had to bear a larger diabetes burden also affecting their economic well-being, as evidenced by their reduction in employment probabilities. Potentially, one of the causes of these adverse economic effects is the lower ability of women to successfully change their behaviour as a result of the diagnosis. Further research should try to unravel the mechanisms behind these differential outcomes for men and women. Overall, given the large prevalence of undiagnosed diabetes, our results indicate that an early diagnosis may be a good way to foster early behaviour change that could lead to more positive health and economic outcomes for people with diabetes over time. It appears, however, that more emphasis on the adequate treatment options for women may be needed to reduce their burden of diabetes.

Stabilized weights

Table 0.5: Summary of stabilized weights

	Mean	Min	Max
Untruncated (men)	1.000515	.281853	2.642838
Untruncated (women)	.999907	.451526	2.053581
Truncated 1 and 99 percentile (men)	.999756	.945491	1.057514
Truncated 1 and 99 percentile (women)	1.000001	.960039	1.049472
Using overweight and obesity instead of BMI and waist circumference			
Untruncated (men)	1.000516	.232143	2.592925
Untruncated (women)	.999857	.251297	2.491703
Truncated 1 and 99 percentile (men)	.999794	.944632	1.058910
Truncated 1 and 99 percentile (women)	.999782	.932321	1.077095

Duration groups results

Table 0.6: Analysis of the effect of time since diabetes diagnosis on employment status and behavioural outcomes using marginal structural models (duration groups)

	(1) Employment	(2) Smoking	(3) Any alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
Male sample						
0	0.088 (.059)	-.031 (.122)	0.049 (.147)	-1.138** (.530)	-.728 (1.927)	278.504 (301.190)
1-2	0.024 (.034)	-.049 (.042)	-.102** (.040)	-.485* (.260)	-1.261 (.876)	-133.527 (96.402)
3-4	-.033 (.042)	-.091 (.056)	-.082* (.045)	-.665** (.309)	-2.505*** (.814)	-160.612* (84.241)
5-6	-.110 (.068)	-.116 (.080)	-.090 (.056)	-.917** (.384)	-1.009 (.980)	-156.064 (117.322)
7-8	0.044 (.076)	-.191 (.134)	-.146* (.079)	-.833* (.467)	-1.590 (2.276)	-260.923** (130.336)
9-10	-.052 (.117)	-.040 (.140)	0.197 (.181)	-2.198*** (.765)	-6.075** (2.591)	-386.292* (199.311)
11-12	0.013 (.120)	-.001 (.132)	-.165 (.125)	-.881 (.708)	-3.505 (2.522)	40.936 (174.858)
13-14	0.004 (.124)					
Female sample						
0	0.078 (.139)			0.099 (1.021)	-1.210 (3.866)	-59.570 (157.723)
1-2	-.085** (.040)			-.191 (.352)	-.303 (.724)	-32.947 (50.797)
3-4	-.202*** (.067)			-.411 (.461)	0.591 (1.232)	-21.502 (62.460)
5-6	-.070 (.066)			-.475 (.337)	-.187 (1.055)	-53.234 (61.737)
7-8	-.180** (.088)			-1.049** (.426)	-1.787* (1.057)	-94.532 (105.698)
9-10	-.329* (.168)			-1.054 (.822)	0.324 (2.538)	66.951 (125.902)
11-12	-.119 (.120)			-.554 (1.089)	-3.906 (2.464)	-29.022 (152.223)
13-14	-.117 (.154)					

Notes Other control variables: age, age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. N=16047 (male sample), N=16658 (female sample).

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

Table 0.7: Analysis of the effect of time since diabetes diagnosis on employment status and behavioural outcomes using fixed effects (duration groups)

	(1) Employment	(2) Smoking	(3) Any alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
Male sample						
0	0.151** (.072)	−.005 (.097)	0.027 (.161)	0.064 (.822)	2.200 (2.257)	−112.476 (232.264)
1-2	0.040 (.038)	−.029 (.038)	−.137*** (.042)	−.598*** (.230)	−1.714** (.784)	−228.738*** (85.913)
3-4	0.010 (.044)	−.007 (.051)	−.066 (.050)	−.706** (.296)	−2.992*** (.797)	−113.409 (86.909)
5-6	−.118 (.079)	−.026 (.072)	−.093 (.062)	−1.164*** (.341)	−2.191* (1.309)	−22.369 (112.692)
7-8	0.126 (.078)	−.147 (.120)	−.262** (.116)	−.750 (.493)	−3.009 (1.886)	−302.744** (131.910)
9-10	0.036 (.141)	0.004 (.138)	0.054 (.145)	−2.123*** (.788)	−7.756*** (2.799)	−228.356 (184.833)
11-12	0.066 (.180)	−.042 (.156)	−.256* (.141)	−1.604** (.742)	−6.693** (3.094)	−195.061 (160.761)
13-14	0.042 (.183)	0.186 (.126)	−.218 (.140)	−1.389 (1.168)	−4.626*** (1.190)	−167.675 (147.716)
Female sample						
0	0.102 (.157)	−.015** (.007)	−.035 (.032)	−.468 (.884)	−4.036 (3.229)	−322.767* (171.460)
1-2	−.104*** (.034)	−.031** (.013)	−.019* (.011)	−.419 (.349)	−.727 (.683)	−98.608* (56.443)
3-4	−.110** (.056)	−.022 (.015)	−.012 (.016)	−.756** (.378)	−.896 (1.000)	42.743 (67.154)
5-6	−.095 (.072)	−.049 (.038)	0.007 (.018)	−1.012*** (.309)	−2.293** (1.021)	−49.270 (84.604)
7-8	−.219** (.090)	0.014 (.032)	−.000 (.013)	−1.385*** (.391)	−3.238*** (.962)	−76.316 (102.021)
9-10	−.261** (.124)	0.024 (.035)	−.001 (.025)	−.794 (.572)	−.240 (2.056)	−12.562 (134.903)
11-12	−.209* (.111)	−.070 (.053)	−.002 (.009)	−.676 (.973)	−4.068* (2.462)	−2.327 (152.643)
13-14	−.178 (.164)	−.026 (.018)	−.001 (.027)	−.001 (.708)	0.056 (2.411)	−301.362*** (94.674)

Notes Other control variables: age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. N=23443 (male sample), N=23702 (female sample).

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

Table 0.8: Analysis of the effect of time since diabetes diagnosis on employment status and behavioural outcomes using random effects (duration groups)

	(1) Employment	(2) Smoking	(3) Any alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
Male sample						
0	0.123* (.068)	-.034 (.097)	0.051 (.150)	0.381 (.707)	3.652* (2.075)	2.069 (203.971)
1-2	-.005 (.038)	-.067* (.037)	-.142*** (.036)	-.276 (.224)	-.392 (.766)	-223.036*** (78.475)
3-4	-.048 (.044)	-.052 (.048)	-.081* (.045)	-.316 (.304)	-1.318* (.769)	-155.191** (72.913)
5-6	-.133* (.076)	-.071 (.069)	-.084 (.058)	-.759** (.344)	-.403 (1.148)	-75.706 (104.001)
7-8	0.093 (.075)	-.208* (.112)	-.194* (.102)	-.434 (.485)	-1.172 (1.703)	-272.523** (109.241)
9-10	-.018 (.142)	-.028 (.134)	0.122 (.142)	-1.804** (.749)	-5.786** (2.609)	-234.745 (166.358)
11-12	0.012 (.166)	-.071 (.160)	-.209 (.132)	-1.360* (.726)	-5.108* (2.790)	-90.369 (158.103)
13-14	0.008 (.157)	0.206** (.093)	-.152 (.142)	-.985 (1.225)	-2.776** (1.122)	-14.049 (101.033)
Female sample						
0	0.034 (.145)	0.003 (.025)	-.035** (.017)	0.097 (.842)	-1.037 (3.375)	-145.397 (139.781)
1-2	-.135*** (.031)	-.028*** (.011)	-.026*** (.004)	-.025 (.337)	0.857 (.631)	-44.182 (52.022)
3-4	-.169*** (.049)	-.018 (.014)	-.015 (.014)	-.379 (.372)	0.901 (1.005)	-3.834 (57.700)
5-6	-.129** (.063)	-.038 (.033)	-.005 (.018)	-.612** (.305)	-.317 (.992)	-43.769 (69.632)
7-8	-.225*** (.075)	0.024 (.034)	-.018* (.010)	-1.015*** (.377)	-1.357 (.908)	-69.287 (105.179)
9-10	-.286** (.111)	0.026 (.042)	-.018 (.024)	-.515 (.572)	1.421 (1.937)	98.605 (127.672)
11-12	-.195* (.117)	-.060 (.043)	-.020*** (.005)	-.265 (.948)	-2.043 (2.622)	31.945 (137.113)
13-14	-.152 (.152)	-.022* (.013)	-.018 (.026)	0.503 (.773)	2.325 (2.541)	-301.291*** (91.369)

Notes Other control variables: age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. N=23443 (male sample), N=23702 (female sample).

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

Robustness checks

MSMs using truncated weights

Table 0.9: Analysis of the effect of a diabetes diagnosis on employment status and behavioural outcomes using marginal structural models with truncated stabilized weights at 1st and 99th percentile

	(1) Employment	(2) Smoking	(3) Any alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
<i>Diabetes</i>						
Male sample						
Diabetes	-.022 (.023)	-.070** (.032)	-.094*** (.036)	-.732*** (.179)	-1.637*** (.532)	-175.662*** (51.574)
Female sample						
Diabetes	-.132*** (.029)	-.015* (.008)	-.029** (.012)	-.178 (.248)	0.186 (.638)	-47.980 (34.319)
<i>Years since diagnosis</i>						
Male sample						
Time since diagnosis	-.006 (.004)	-.010** (.005)	-.016** (.006)	-.133*** (.033)	-.326*** (.095)	-26.261*** (9.160)
Female sample						
Time since diagnosis	-.019*** (.006)	-.002 (.001)	-.004 (.003)	-.044 (.042)	-.016 (.112)	-9.096 (5.681)

Notes Standard errors in parentheses. Other control variables: age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. N=16047 (male sample), N=16658 (female sample).

Table 0.10: Effect of time since diabetes diagnosis on employment status and behavioural outcomes using MSM with truncated stabilized weights (1st and 99th percentile; imputed)

	(1) Employment	(2) Smoking	(3) Any alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
Male sample						
0	0.089 (.061)	-.047 (.135)	0.031 (.143)	-1.107** (.522)	-.326 (1.909)	83.518 (236.282)
1-2	-.002 (.034)	-.072* (.041)	-.121*** (.033)	-.472* (.254)	-.962 (.843)	-197.071** (82.739)
3-4	-.042 (.038)	-.073 (.050)	-.088** (.040)	-.654** (.299)	-2.113*** (.693)	-189.546** (77.787)
5-6	-.107* (.063)	-.091 (.074)	-.094* (.053)	-1.022*** (.360)	-.954 (1.013)	-151.346 (107.678)
7-8	0.054 (.063)	-.222* (.118)	-.127 (.078)	-.863* (.462)	-2.157 (2.034)	-264.374** (115.620)
9-10	-.075 (.117)	-.024 (.136)	0.122 (.148)	-2.270*** (.700)	-5.774** (2.424)	-289.988* (174.301)
11-12	-.024 (.126)	-.028 (.127)	-.167 (.112)	-.888 (.713)	-3.275 (2.467)	-8.651 (163.025)
13-14	-.053 (.142)					
Female sample						
0	0.068 (.134)			0.541 (1.136)	0.219 (4.359)	-102.210 (139.467)
1-2	-.114*** (.040)			0.130 (.359)	0.472 (.723)	-28.298 (53.113)
3-4	-.208*** (.064)			-.298 (.457)	0.866 (1.193)	-31.300 (61.496)
5-6	-.097 (.063)			-.319 (.347)	0.103 (1.084)	-60.088 (66.056)
7-8	-.184** (.089)			-.979** (.449)	-1.522 (1.074)	-94.059 (107.062)
9-10	-.344** (.168)			-.975 (.827)	0.637 (2.541)	71.060 (133.178)
11-12	-.119 (.113)			-.432 (1.070)	-3.355 (2.603)	-12.232 (141.560)
13-14	-.106 (.152)					

Notes Standard errors in parentheses. Other control variables: age squared, region, urban, education, Han, marital status, urbanization index, time dummies, health insurance status, household expenditures. N=16047 (male sample), N=16658 (female sample).

Results using non-imputed data

Table 0.11: Analysis of the effect of a diabetes diagnosis on employment status and behavioural outcomes using MSM, FE and RE (no imputation)

	(1) Employment	(2) Smoking	(3) Any alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
<i>Marginal structural model</i>						
Male sample						
Diabetes	0.049 (.043)	-.054 (.040)	-.118** (.053)	-.601*** (.229)	-1.290 (.859)	-205.746* (109.375)
Female sample						
Diabetes	-.087* (.047)	-.026* (.016)	0.000 (.)	-.637 (.402)	-1.043 (.865)	-45.166 (56.543)
<i>Fixed effects</i>						
Male sample						
Diabetes	0.024 (.030)	-.004 (.033)	-.103*** (.036)	-.844*** (.169)	-2.463*** (.508)	-152.316** (67.898)
Female sample						
Diabetes	-.110*** (.034)	-.024** (.012)	-.015 (.012)	-.634** (.288)	-1.105* (.636)	-81.340* (49.016)
<i>Random effects</i>						
Male sample						
Diabetes	-.023 (.027)	-.045 (.030)	-.109*** (.029)	-.569*** (.166)	-1.163** (.482)	-143.470*** (51.625)
Female sample						
Diabetes	-.164*** (.026)	-.020** (.009)	-.021*** (.005)	-.309 (.269)	0.494 (.583)	-59.269* (35.037)

Notes Standard errors in parentheses. Other control variables: age (only MSM), age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. FE/RE: N=22135 (male sample), N=23143 (female sample), MSM: N=10006 (male sample), N=11471 (female sample).

Table 0.12: Analysis of the effect of time since diabetes diagnosis on employment status and behavioural outcomes using MSM, FE and RE (non-imputed)

	(1) Employment	(2) Smoking	(3) Any alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
<i>Marginal structural model</i>						
Male sample						
Time since diagnosis	0.019 (.017)	−.019 (.015)	−.036* (.022)	−.203** (.081)	−.550* (.310)	−85.203** (38.378)
Female sample						
Time since diagnosis	−.028 (.017)	−.008 (.006)	0.000 (.)	−.338* (.178)	−.579* (.333)	−14.298 (21.193)
<i>Fixed effects</i>						
Male sample						
Time since diagnosis	−.001 (.007)	0.003 (.006)	−.016** (.007)	−.158*** (.039)	−.516*** (.118)	−18.202 (12.059)
Female sample						
Time since diagnosis	−.023*** (.008)	−.002 (.002)	−.001 (.001)	−.103** (.045)	−.177 (.127)	−9.987 (7.788)
<i>Random effects</i>						
Male sample						
Time since diagnosis	−.007 (.006)	−.003 (.006)	−.015*** (.006)	−.120*** (.038)	−.317*** (.101)	−20.749** (9.382)
Female sample						
Time since diagnosis	−.026*** (.006)	−.002 (.002)	−.003*** (.001)	−.065 (.044)	0.043 (.124)	−7.041 (6.479)

Notes Standard errors in parentheses. Other control variables: age (only MSM) age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. FE/RE: N=22117 (male sample), N=23130 (female sample), MSM: N=10028 (male sample), N=11465 (female sample).

Table 0.13: Analysis of the effect of time since diabetes diagnosis on employment status and behavioural outcomes using marginal structural models (duration groups) (non-imputed)

	(1) Employment	(2) Smoking	(3) Any alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
Male sample						
0	0.119* (.070)	0.053 (.170)	0.010 (.156)	−.942 (.589)	0.596 (.934)	459.443 (474.665)
1-2	0.026 (.044)	−.055 (.046)	−.137*** (.043)	−.571** (.273)	−1.270 (1.040)	−182.199 (121.087)
3-4	0.000 (.)	−.043 (.153)	0.131 (.156)	−1.013** (.450)	−3.347 (2.116)	−782.090*** (177.206)
Female sample						
0	0.123 (.188)	0.000 (.)	0.000 (.)	−.136 (1.488)	−1.772 (5.608)	−101.086 (203.293)
1-2	−.083 (.067)	−.018** (.009)	−.053* (.028)	−.613 (.489)	−.685 (1.026)	−40.447 (65.853)
3-4	0.000 (.)	0.000 (.)	0.000 (.)	−5.530* (3.260)	−8.510*** (1.787)	0.676 (257.875)

Notes Due to Standard errors in parentheses. Other control variables: Age, age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. N=10028 (male sample), N=11465 (female sample).

Table 0.14: Analysis of the effect of time since diabetes diagnosis on employment status and behavioural outcomes using fixed effects (duration groups) (non-imputed)

	(1) Employment	(2) Smoking	(3) Any alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
Male sample						
0	0.126* (.073)	-.013 (.084)	0.081 (.156)	-.013 (.704)	1.444 (1.883)	-268.541 (213.448)
1-2	0.046 (.039)	-.019 (.039)	-.135*** (.042)	-.817*** (.199)	-2.298*** (.637)	-225.905** (90.437)
3-4	0.013 (.046)	0.035 (.054)	-.052 (.055)	-.786** (.325)	-3.016*** (.819)	-107.317 (98.624)
5-6	-.134* (.079)	0.028 (.077)	-.134** (.065)	-1.159*** (.343)	-1.715 (1.178)	34.167 (117.774)
7-8	0.162** (.078)	-.138 (.117)	-.270** (.117)	-.692 (.429)	-2.555 (1.726)	-305.553** (133.202)
9-10	-.018 (.136)	0.044 (.123)	0.082 (.131)	-1.938*** (.667)	-8.278*** (2.262)	-196.802 (201.492)
11-12	0.063 (.178)	0.089 (.134)	-.177** (.082)	-1.743** (.736)	-5.843** (2.828)	-22.708 (140.771)
13-14	0.060 (.194)	0.222** (.113)	-.164 (.111)	-1.508 (1.202)	-4.207*** (1.063)	-119.852 (178.187)
Female sample						
0	0.101 (.154)	-.014** (.007)	-.046 (.040)	-.778 (.909)	-3.920 (3.420)	-358.037** (173.529)
1-2	-.100*** (.033)	-.029** (.012)	-.023* (.012)	-.329 (.363)	-.558 (.671)	-118.162** (56.839)
3-4	-.148** (.059)	-.017 (.013)	-.025* (.014)	-.822* (.442)	-.824 (1.148)	49.550 (82.984)
5-6	-.122* (.073)	-.043 (.041)	0.002 (.020)	-1.028*** (.325)	-1.616 (1.016)	-69.012 (96.779)
7-8	-.235*** (.090)	0.023 (.027)	-.004 (.008)	-1.327*** (.390)	-3.174*** (.978)	-90.185 (111.004)
9-10	-.247** (.118)	0.031 (.039)	-.010 (.009)	-.981 (.621)	-.260 (2.131)	-64.808 (134.146)
11-12	-.239** (.103)	-.070 (.056)	-.005 (.009)	-.715 (1.021)	-3.440 (2.512)	-25.527 (173.367)
13-14	-.199 (.166)	-.023 (.018)	-.008 (.009)	-.111 (.665)	0.693 (2.153)	-366.259*** (87.213)

Notes Standard errors in parentheses. Other control variables: age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. N=22117 (male sample), N=23130 (female sample).

Table 0.15: Analysis of the effect of time since diabetes diagnosis on employment status and behavioural outcomes using random effects (duration groups) (non-imputed)

	(1) Employment	(2) Smoking	(3) Any alcohol	(4) BMI	(5) Waist (cm)	(6) Calories (kcal)
Male sample						
0	0.094 (.069)	-.043 (.087)	0.065 (.144)	0.148 (.610)	2.276 (1.683)	-28.615 (188.201)
1-2	-.008 (.038)	-.053 (.038)	-.144*** (.036)	-.533*** (.195)	-1.045 (.658)	-203.986** (80.054)
3-4	-.041 (.045)	-.007 (.051)	-.070 (.051)	-.493 (.336)	-1.730** (.809)	-140.623 (87.834)
5-6	-.159** (.077)	-.012 (.073)	-.120** (.060)	-.866*** (.333)	-.330 (1.054)	-69.752 (115.094)
7-8	0.114 (.074)	-.213** (.108)	-.215** (.097)	-.473 (.431)	-1.072 (1.538)	-243.936** (105.320)
9-10	-.070 (.134)	0.001 (.118)	0.127 (.132)	-1.803*** (.620)	-7.021*** (2.127)	-173.366 (167.349)
11-12	0.005 (.159)	0.060 (.144)	-.160 (.100)	-1.446* (.767)	-4.339 (2.681)	92.244 (148.282)
13-14	0.029 (.161)	0.234*** (.083)	-.118 (.128)	-1.101 (1.263)	-2.531*** (.931)	38.227 (100.439)
Female sample						
0	0.025 (.145)	0.003 (.025)	-.039** (.016)	-.238 (.874)	-1.178 (3.554)	-123.300 (139.671)
1-2	-.142*** (.031)	-.028*** (.010)	-.028*** (.004)	0.001 (.349)	0.848 (.622)	-66.418 (49.483)
3-4	-.195*** (.052)	-.020* (.012)	-.028*** (.005)	-.481 (.433)	1.064 (1.090)	43.196 (68.580)
5-6	-.159** (.063)	-.034 (.035)	-.007 (.021)	-.647** (.315)	0.445 (.981)	-52.781 (77.715)
7-8	-.247*** (.070)	0.029 (.031)	-.022*** (.003)	-1.073*** (.368)	-1.501* (.886)	-90.408 (116.975)
9-10	-.286*** (.099)	0.029 (.046)	-.024*** (.003)	-.748 (.605)	1.422 (1.900)	124.263 (156.687)
11-12	-.214* (.114)	-.062 (.046)	-.022*** (.005)	-.335 (1.000)	-1.482 (2.752)	49.789 (155.171)
13-14	-.176 (.153)	-.022* (.012)	-.024*** (.006)	0.298 (.755)	2.665 (2.407)	-332.344*** (99.899)

Notes Standard errors in parentheses. Other control variables: age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. N=22117 (male sample), N=23130 (female sample).

Overweight and obesity results

Table 0.16: Analysis of the effect of a diabetes diagnosis on overweight and obesity

	Males		Females	
	(1)	(2)	(3)	(4)
	Overweight	Obese	Overweight	Obese
<i>Marginal structural model</i>				
Diabetes	−.000 (.031)	−.024 (.015)	−.031 (.034)	−.009 (.014)
<i>Fixed Effects</i>				
Diabetes	−.041 (.035)	−.035 (.025)	−.095*** (.036)	−.034 (.027)
<i>Random Effects</i>				
Diabetes	0.014 (.030)	−.006 (.023)	−.070** (.030)	0.028 (.024)

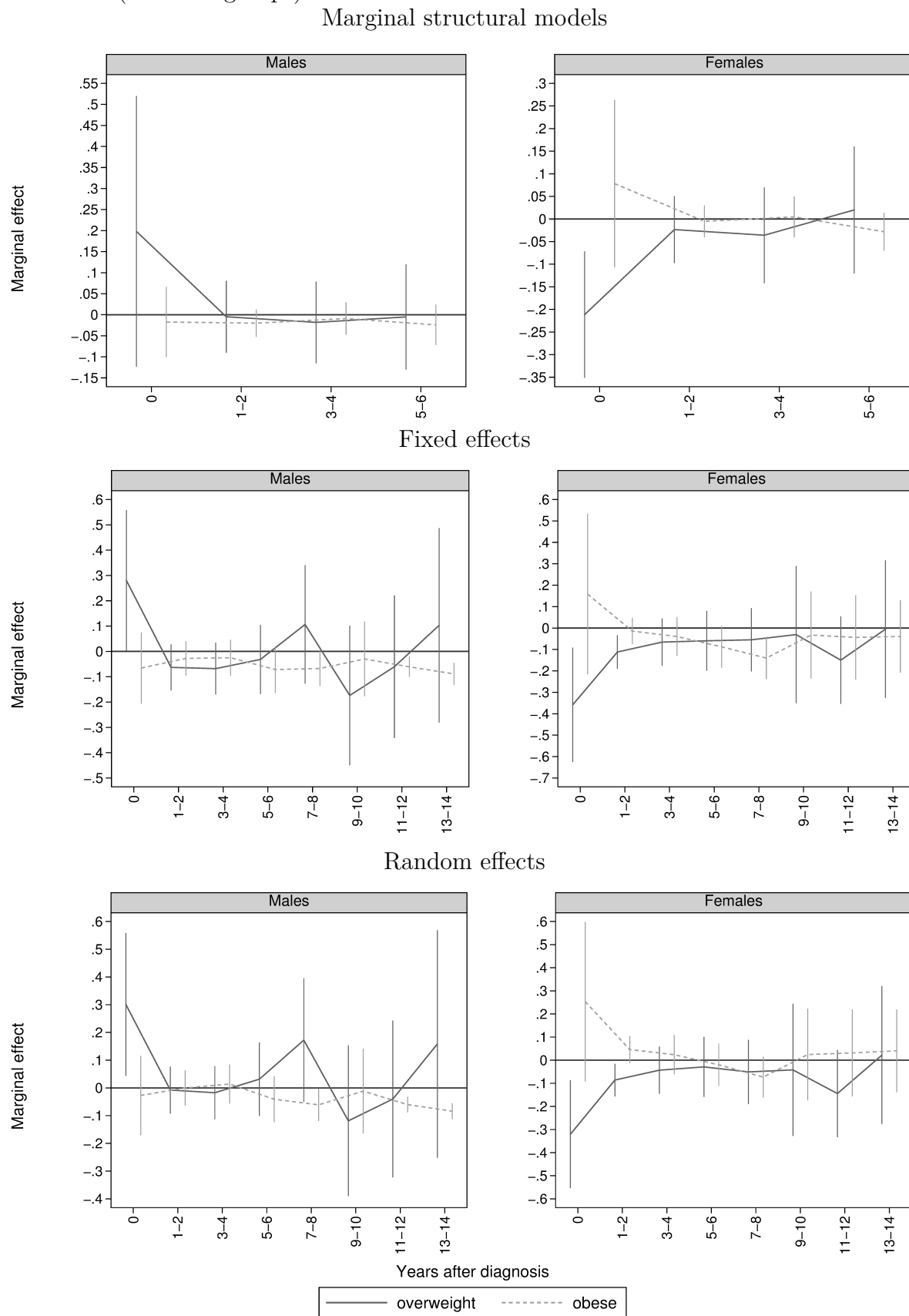
Notes Standard errors in parentheses. Other control variables: Age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. FE/RE: N=23443 (male sample), N=23702 (female sample). MSM: N=16047 (male sample), N=16658 (female sample).

Table 0.17: Analysis of the effect of time since diagnosis on overweight and obesity

	Males		Females	
	(1)	(2)	(3)	(4)
	Overweight	Obese	Overweight	Obese
<i>Marginal structural model</i>				
Time since diagnosis	−.001	−.005*	−.003	−.003
	(.005)	(.003)	(.005)	(.002)
<i>Fixed Effects</i>				
Time since diagnosis	−.006	−.007*	−.006	−.009*
	(.007)	(.004)	(.006)	(.005)
<i>Random Effects</i>				
Time since diagnosis	0.002	−.003	−.006	−.001
	(.006)	(.003)	(.005)	(.004)

Notes Standard errors in parentheses. Other control variables: Age squared, region, urban, education, han, marital status, urbanization index, time dummies, health insurance status, household expenditures. FE/RE: N=23443 (male sample), N=23702 (female sample). MSM: N=16047 (male sample), N=16658 (female sample).

Figure 0.6: Analysis of the effect of time since diabetes diagnosis on overweight and obesity (duration groups)



Notes: For MSM, effects after 6 years could not be estimated due to too few observations.

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.
- Akobundu, E., Ju, J., Blatt, L., and Mullins, C. D. (2006). "Cost-of-illness studies : a review of current methods." *PharmacoEconomics* 24 (9), 869–90.
- Alam, K. and Mahal, A. (2014). "Economic impacts of health shocks on households in low and middle income countries: a review of the literature." *Globalization and health* 10 (1), 21.
- Alavinia, S. M. and Burdorf, A. (2008). "Unemployment and retirement and ill-health: a cross-sectional analysis across European countries." *International Archives of Occupational and Environmental Health* 82 (1), 39–45.
- American Diabetes Association (2014). "Diagnosis and Classification of Diabetes Mellitus." *Diabetes Care* 37 (Supplement_1), S81–S90.
- 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.
- Antonakis, J., Bendahan, S., Jacquart, P., Lalive, R., and Day, D. V. (2012). “Causality and endogeneity: problems and solutions.” *The Oxford Handbook of Leadership and Organizations*. January. Oxford.
- Arnetz, L., Ekberg, N. R., and Alvarsson, M. (2014). “Sex differences in type 2 diabetes: Focus on disease course and outcomes.” *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy* 7, 409–420.
- 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.
- (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.
- Attard, S. M., Herring, a. H., Mayer-Davis, E. J., Popkin, B. M., Meigs, J. B., and Gordon-Larsen, P. (2012). “Multilevel examination of diabetes in modernising China: what elements of urbanisation are most associated with diabetes?” *Diabetologia* 55 (12), 3182–92.
- 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.
- 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., Rivera, J. A., Popkin, B. M., and Taillie, L. S. (2016). “First-Year Evaluation of Mexico’s Tax on Nonessential Energy-Dense Foods: An Observational Study.” *PLOS Medicine* 13 (7), e1002057.
- 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.
- Bazargani, Y. T., De Boer, A., Leufkens, H. G. M., and Mantel-Teeuwisse, A. K. (2014). “Selection of essential medicines for diabetes in low and middle income countries: A survey of 32 national essential medicines lists.” *PLoS ONE* 9 (9).
- 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.” *The Lancet* 373 (9677), 1773–1779.
- Bergemann, A., Grönqvist, E., and Gudbjörnsdóttir, S. (2011). “The effects of job displacement on the onset and progression.”
- Bertram, M. Y. and Vos, T. (2010). “Quantifying the duration of pre-diabetes.” *Australian and New Zealand journal of public health* 34 (3), 311–314.
- 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.
- 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.
- Breton, M.-C., Guénette, L., Amiche, M. A., Kayibanda, J.-F., Grégoire, J.-P., and Moisan, J. (2013). “Burden of diabetes on the ability to work: a systematic review.” *Diabetes care* 36 (3), 740–9.

- Brown, H. S., Estrada, J. K., Hazarika, G., and Bastida, E. (2005). "Diabetes and the Labor Market: The community-wide economic cost in the Lower Rio Grande Valley." *Diabetes Care* 28 (12), 2945–2947.
- 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.
- Cameron, A., Ewen, M., Ross-Degnan, D., Ball, D., and Laing, R. (2009). "Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis." *The Lancet* 373 (9659), 240–249.
- Cameron, A., Roubos, I., Ewen, M., Mantel-Teeuwisse, A. K., Leufkens, H. G. M., and Laing, R. O. (2011). "Differences in the availability of medicines for chronic and acute conditions in the public and private sectors of developing countries." *Bulletin of the World Health Organization* 89 (6), 412–421.
- 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.
- Catalan, M., Herreras, Z., Pinyol, M., Sala-Vila, A., Amor, A. J., Groot, E. de, Gilabert, R., Ros, E., and Ortega, E. (2015). "Prevalence by sex of preclinical carotid atherosclerosis in newly diagnosed type 2 diabetes." *Nutrition, Metabolism and Cardiovascular Diseases* 25 (8), 742–748.
- 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.

- Cawley, J. and Meyerhoefer, C. (2012). "The medical care costs of obesity: An instrumental variables approach." *Journal of Health Economics* 31 (1), 219–230. arXiv: [arXiv:1011.1669v3](#).
- Cefalu, W. T., Buse, J. B., Tuomilehto, J., Fleming, G. A., Ferrannini, E., Gerstein, H. C., Bennett, P. H., Ramachandran, A., Raz, I., Rosenstock, J., and Kahn, S. E. (2016). "Update and Next Steps for Real- World Translation of Interventions for Type 2 Diabetes Prevention: Reflections From a Diabetes Care Editors' Expert Forum." *Diabetes Care* 39 (July), 1186–1201.
- 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. and Luk, A. O. Y. (2016). "Diabetes: A Cinderella Subject We Can't Afford to Ignore." *PLOS Medicine* 13 (7), e1002068.
- 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.
- Charles, K. K. and Decicca, P. (2008). "Local labor market fluctuations and health: Is there a connection and for whom?" *Journal of Health Economics* 27, 1532–1550.
- Chatterjee, S., Riewpaiboon, A., Piyathakit, P., Riewpaiboon, W., Boupaijit, 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.
- 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.
- China Obesity Task Force (2004). "Body mass index reference norm for screening overweight and obesity in Chinese children and adolescents." *Chinese Journal of Epidemiology* 25 (2), 97–102.
- 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.
- Collins, J. J., Baase, C. M., Sharda, C. E., Ozminkowski, R. J., Nicholson, S., Billotti, G. M., Turpin, R. S., Olson, M., and Berger, M. L. (2005). “The Assessment of Chronic Health Conditions on Work Performance, Absence, and Total Economic Impact for Employers.” *Journal of Occupational and Environmental Medicine* 47 (6), 547–557.
- Colman, G. and Dave, D. (2014). “Unemployment and Health Behaviors Over the Business Cycle: a Longitudinal View.”
- 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.
- Craig, P., Cooper, C., Gunnell, D., Haw, S., Lawson, K., Macintyre, S., Ogilvie, D., Petticrew, M., Reeves, B., Sutton, M., and Thompson, S. (2012). “Using natural experiments to evaluate population health interventions: new Medical Research Council guidance.” *Journal of epidemiology and community health* 66 (12), 1182–6.
- 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).”
- 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.
- 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.
- Engelgau, M. M. and Gregg, E. W. (2012). “Tackling the global diabetes burden: Will screening help?” *The Lancet* 380 (9855), 1716–1718.
- Engelmann, J., Manuwald, U., Rubach, C., Kugler, J., Birkenfeld, A. L., Hanefeld, M., and Rothe, U. (2016). “Determinants of mortality in patients with type 2 diabetes: a review.” *Reviews in Endocrine and Metabolic Disorders*, 129–137.
- 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.
- Esterson, Y. B., Carey, M., Piette, J. D., Thomas, N., and Hawkins, M. (2014). "A Systematic Review of Innovative Diabetes Care Models in Low-and Middle-Income Countries (LMICs)." *Journal of Health Care for the Poor and Underserved* 25 (1), 72–93.
- 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.
- Galli, R. and Kucera, D. (2008). "Gender, Informality and Employment Adjustment in Latin America."
- 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.
- Guo, X.-H., Yuan, L., Lou, Q.-Q., Shen, L., Sun, Z.-L., Zhao, F., Dai, X., Huang, J., and Yang, H.-Y. (2012). "A nationwide survey of diabetes education, self-management and glycemic control in patients with type 2 diabetes in China." *Chinese Medical Journal* 125 (23), 4175–80.
- Guzmán, J. R., Lyra, R., Aguilar-Salinas, C. a., Cavalcanti, S., Escaño, F., Tambasia, M., Duarte, E., and ALAD Consensus Group (2010). "Treatment of type 2 diabetes in

- Latin America: a consensus statement by the medical associations of 17 Latin American countries.” *Revista panamericana de salud pública = Pan American journal of public health* 28 (6), 463–71.
- 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.
- Harris, A. (2009). “Diabetes, Cardiovascular Disease and Labour Force Participation in Australia: An Endogenous Multivariate Probit Analysis of Clinical Prevalence Data.” *Economic Record* 85 (271), 472–484.
- He, W., Li, Q., Yang, M., Jiao, J., Ma, X., Zhou, Y., Song, A., Heymsfield, S. B., Zhang, S., and Zhu, S. (2015). “Lower BMI cutoffs to define overweight and obesity in China.” *Obesity* 23 (3), 684–691.
- 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.
- Herquelot, E., Guéguen, A., Bonenfant, S., and Dray-Spira, R. (2011). “Impact of diabetes on work cessation: data from the GAZEL cohort study.” *Diabetes care* 34 (6), 1344–9.
- Holmes, J., Gear, E., Bottomley, J., Gillam, S., Murphy, M., and Williams, R. (2003). “Do people with type 2 diabetes and their carers lose income? (T2ARDIS-4).” *Health policy* 64 (3), 291–296.
- 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.
- International Diabetes Federation (2014). *Diabetes Atlas 2014 Update*. 6th ed. International Diabetes Federation.
- (2015). *IDF Diabetes Atlas*. 7th ed.
- Jamison, D. T., Summers, L. H., Alleyne, G., Arrow, K. J., Berkley, S., Binagwaho, A., Bustreo, F., Evans, D., Feachem, R. G. A., Frenk, J., Ghosh, G., Goldie, S. J., Guo, Y., Gupta, S., Horton, R., Kruk, M. E., Mahmoud, A., Mohohlo, L. K., Ncube, M., Pablos-Mendez, A., Reddy, K. S., Saxenian, H., Soucat, A., Ulltveit-Moe, K. H., and Yamey, G. (2013). “Global health 2035: a world converging within a generation.” *The Lancet* 382 (9908), 1898–1955. arXiv: [arXiv:1011.1669v3](https://arxiv.org/abs/1011.1669v3).
- Javanbakht, M., Baradaran, H. R., Mashayekhi, A., Haghdoost, 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.
- Kahn, M. (1998). “Health and labor market performance: the case of diabetes.” *Journal of Labor Economics* 16 (4), 878–899.
- 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, D. (2014). *MIMRGNS: Stata module to run margins after mi estimate*. Statistical Software Components, Boston College Department of Economics.
- 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.” *The Lancet* 380 (9849), 1259–1279.
- 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.
- Kraut, A., Walld, R., Tate, R., and Mustard, C. (2001). “Impact of diabetes on employment and income in Manitoba, Canada.” *Diabetes care* 24 (1), 64–68.
- Larg, A. and Moss, J. R. (2011). “Cost-of-illness studies: a guide to critical evaluation.” *Pharmacoeconomics* 29 (8), 653–71.
- 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.
- Laugesen, M. J. and Glied, S. a. (2011). “Higher fees paid to US physicians drive higher spending for physician services compared to other countries.” *Health affairs (Project Hope)* 30 (9), 1647–56.
- 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.
- Leijten, F. R. M., Heuvel, S. G. van den, Ybema, J. F., Beek, A. J. van der, Robroek, S. J. W., and Burdorf, A. (2014). “The influence of chronic health problems on work ability and productivity at work: a longitudinal study among older employees.” *Scandinavian journal of work, environment & health* 40 (5), 473–82.
- Lenneman, J., Schwartz, S., Giuseffi, D. L., and Wang, C. (2011). “Productivity and health: an application of three perspectives to measuring productivity.” *Journal of occupational*

and environmental medicine / American College of Occupational and Environmental Medicine 53 (1), 55–61.

- 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. (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.
- Lorenzoni, L., Belloni, A., and Sassi, F. (2014). “Health-care expenditure and health policy in the USA versus other high-spending OECD countries.” *The Lancet* 384 (9937), 83–92.

- 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.
- 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.
- 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.
- Marmot, M., Friel, S., Bell, R., Houweling, T. A., and Taylor, S. (2008). “Closing the gap in a generation: health equity through action on the social determinants of health.” *The Lancet* 372 (9650), 1661–1669.
- Martin, S., Schramm, W., Schneider, B., Neeser, K., Weber, C., Lodwig, 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*.
- Mills, A. (2014). “Health care systems in low- and middle-income countries.” *The New England journal of medicine* 370 (6), 552–7.

- Minor, T. (2011a). “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.
- (2011b). “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), 1468–1486.
- (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.
- Moher, D., Liberati, A., Tetzlaff, J., and Altman, D. G. (2009). “Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement.” *PLoS medicine* 6 (7), e1000097.
- 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.
- Mytton, O. T., Clarke, D., and Rayner, M. (2012). “Taxing unhealthy food and drinks to improve health.” *Bmj* 344 (may15 2), e2931–e2931. arXiv: [bmj.e2931](https://arxiv.org/abs/10.1136/bmj.e2931) [10.1136].
- 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.
- Ng, Y. C., Philip, J., and Johnson, J. (2001). “Productivity Losses Associated With Diabetes in the U.S.” *Diabetes Care* 24 (2), 257–261.
- 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., Neefs, 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.
- Peele, P. B., Lave, J. R., and Songer, T. J. (2002). “Diabetes in employer-sponsored health insurance.” *Diabetes care* 25 (11), 1964–1968.
- Penno, G., Solini, A., Bonora, E., Fondelli, C., Orsi, E., Zerbini, G., Trevisan, R., Vedovato, M., Gruden, G., Laviola, L., Nicolucci, A., and Pugliese, G. (2013). “Gender differences

- in cardiovascular disease risk factors, treatments and complications in patients with type 2 diabetes: The RIACE Italian multicentre study.” *Journal of Internal Medicine* 274 (2), 176–191.
- 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.
- Peters, S. A. E., Huxley, R. R., Sattar, N., and Woodward, M. (2015). “Sex Differences in the Excess Risk of Cardiovascular Diseases Associated with Type 2 Diabetes: Potential Explanations and Clinical Implications.” *Current Cardiovascular Risk Reports* 9 (7), 1–7.
- Peters, S. A. E., Huxley, R. R., and Woodward, M. (2014a). “Diabetes as a risk factor for stroke in women compared with men: A systematic review and meta-analysis of 64 cohorts, including 775 385 individuals and 12 539 strokes.” *The Lancet* 383 (9933), 1973–1980.
- (2014b). “Diabetes as risk factor for incident coronary heart disease in women compared with men: A systematic review and meta-analysis of 64 cohorts including 858,507 individuals and 28,203 coronary events.” *Diabetologia* 57 (8), 1542–1551.
- 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.
- Policardo, L., Seghieri, G., Francesconi, P., Anichini, R., Franconi, F., Seghieri, C., and Del Prato, S. (2014). “Gender difference in diabetes-associated risk of first-ever and recurrent ischemic stroke.” *Journal of Diabetes and its Complications* 29 (5), 713–717.
- Popkin, B. M., Du, S., Zhai, F., and Zhang, B. (2010). “Cohort profile: The China Health and Nutrition Survey-monitoring and understanding socio-economic and health change in China, 1989-2011.” *International Journal of Epidemiology* 39 (6), 1435–1440.
- 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].
- 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.

- 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.
- Rivera-Hernandez, M., Rahman, M., Mor, V., and Galárraga, O. (2016). "The Impact of Social Health Insurance on Diabetes Outcomes in Older Adults." *Health Services Research*, 1323–1346.
- Roberto, C. A., Swinburn, B., Hawkes, C., Huang, T. T. K., Costa, S. A., Ashe, M., Zwickler, 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.
- Robins, J. M., Hernan, M. Á., and Brumback, B. (2000). "Marginal Structural Models and Causal Inference in Epidemiology." *Epidemiology* 11, 550–560.
- Roche, M. M. and Wang, P. P. (2013). "Sex differences in all-cause and cardiovascular mortality, hospitalization for individuals with and without diabetes, and patients with diabetes diagnosed early and late." *Diabetes Care* 36 (9), 2582–2590.
- 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. l. 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.
- Rojas, L. B. A. and Gomes, M. B. (2013). “Metformin: an old but still the best treatment for type 2 diabetes.” *Diabetology & Metabolic Syndrome* 5 (1), 6.
- Roy, T. and Lloyd, C. E. (2012). “Epidemiology of depression and diabetes: a systematic review.” *Journal of affective disorders* 142 Suppl, S8–21.
- Royston, P. and White, I. (2009). “Multiple imputation by chained equations (MICE): Implementation in Stata.” *Journal of Statistical Software* 45 (4), pages. arXiv: [arXiv: 1501.0228](https://arxiv.org/abs/1501.0228).
- 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.
- Segel, J. E. (2006). “Cost-of-Illness Studies — A Primer.” *RTI-UNC Center of Excellence in Health Promotion Economics*.
- Seghieri, C., Policardo, L., Francesconi, P., and Seghieri, G. (2015). “Gender differences in the relationship between diabetes process of care indicators and cardiovascular outcomes.” *European journal of public health* (November 2013).
- 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.
- 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. (2014). “The impact of diabetes on employment in Mexico.” *CHE Research Paper*. CHE Research Paper (100).
- (2015). “The impact of diabetes on employment in Mexico.” *Economics & Human Biology* 18, 85–100.
- Seuring, T., Serneels, P., and Suhrcke, M. (2016). “The Impact of Diabetes on Labor Market Outcomes in Mexico: A Panel Data and Biomarker Analysis.”
- Shemilt, I., Thomas, J., and Morciano, M. (2010). “A web-based tool for adjusting costs to a specific target currency and price year.” *Evidence & Policy: A Journal of Research, Debate and Practice* 6 (1), 51–59.
- Sicree, B. R., Shaw, J., and Zimmet, P. (2011). *The Global Burden: Diabetes and Impaired Glucose Tolerance*. Brussels, Belgium: International Diabetes Federation.
- Silink, M., Tuomilehto, J., Mbanya, J. C., Narayan, K. M. V., Fradkin, J., and Roglic, G. (2010). “Research priorities: Prevention and Control of Diabetes with A Focus on Low and Middle Income Countries.” *WHO Meetings on Development of A Prioritized Research Agenda for Development of Prevention and Control of Noncommunicable Disease* 6.
- 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.
- Squires, D. A. (2012). "Explaining High Health Care Spending in the United States: An International Comparison of Supply, Utilization, Prices, and Quality The." 10 (May), 1–14.
- 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.
- 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.
- Toscano, C. M., Zhuo, X., Imai, K., Duncan, B. B., Polanczyk, C. A., Zhang, P., Engellgau, M., and Schmidt, M. I. (2015). "Cost-effectiveness of a national population-based

- screening program for type 2 diabetes: the Brazil experience.” *Diabetology & metabolic syndrome* 7, 95.
- 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.
- Tunceli, K., Bradley, C. J., Nerenz, D., Williams, L. K., Pladevall, M., and Elston Lafata, J. (2005). “The impact of diabetes on employment and work productivity.” *Diabetes care* 28 (11), 2662–2667.
- Tunceli, K., Zeng, H., Habib, Z. A., and Williams, L. K. (2009). “Long-term projections for diabetes-related work loss and limitations among U.S. adults.” *Diabetes research and clinical practice* 83 (1), e23–25.
- 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.
- Valdmanis, V., Smith, D. W., and Page, M. R. (2001). “Productivity and economic burden associated with diabetes.” *American journal of public health* 91 (1), 129–30.
- 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, L., Zhou, M., Astell-Burt, T., Bi, Y., Feng, X., Jiang, Y., Li, Y., Page, A., Wang, L., Xu, Y., Zhao, W., and Ning, G. (2015). “Geographical variation in diabetes prevalence and detection in China: Multilevel spatial analysis of 98,058 adults.” *Diabetes Care* 38 (1), 72–81.
- 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.
- Wareham, N. J. and Herman, W. H. (2016). “The Clinical and Public Health Challenges of Diabetes Prevention: A Search for Sustainable Solutions.” *PLOS Medicine* 13 (7), e1002097.
- White, M. (2016). “Population Approaches to Prevention of Type 2 Diabetes.” *PLoS medicine* 13 (7), e1002080.
- WHO (2004). “Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies.” *The Lancet* 363, 157–163.
- Wilding, J. P. H. (2014). “The importance of weight management in type 2 diabetes mellitus.” *International Journal of Clinical Practice* 68 (6), 682–691.
- 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 Bank. *World Bank Analytical Classifications*.
- World Health Organization (2006). “Definition and Diagnosis of Diabetes Mellitus and Intermediate Hyperglycemia.”
- (2011). “Use of glycated haemoglobin (HbA1c) in the diagnosis of diabetes mellitus: abbreviated report of a WHO consultation.”
 - (2016). “Global Report on Diabetes.”
- 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.
- 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.
- 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.
- Zeng, Q., He, Y., Dong, S., Zhao, X., Chen, Z., Song, Z., Chang, G., Yang, F., and Wang, Y. (2014). “Optimal cut-off values of BMI, waist circumference and waist:height ratio for defining obesity in Chinese adults.” *The British journal of nutrition* 112 (10), 1735–44.
- Zhang, B., Zhai, F. Y., Du, S. F., and Popkin, B. M. (2014). “The China Health and Nutrition Survey, 1989-2011.” *Obesity Reviews* 15 (S1), 2–7. arXiv: NIHMS150003.
- 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, F.-L., Xie, F., Hu, H., and Li, S.-C. (2013). “Transferability of indirect cost of chronic disease: a systematic review and meta-analysis.” *Pharmacoeconomics* 31 (6), 501–8.
- 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.
- 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.