National Institute for Health and Care Research

The impact of diabetes on the use of long-term care

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Disclaimer

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Background

- Diabetes is one of the most common long-term conditions in the UK
  - More than 4.7 million people affected; to exceed 6.5 million by 2035
- Significant implications for health care costs
  - 10% of the NHS budget; 80% of that is due to diabetes complications
- However, people with diabetes are also more likely to have:
  - Physical disability with mobility/ADLs/IADLs
  - Cognitive complications
  - Low psychological wellbeing
  - Serious complications such as amputation and blindness
- Thus, diabetes is also likely to impact on social care costs

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Motivation

- But so far, the evidence on the impact of diabetes on social care is limited
- With an ageing population, the number of people with diabetes in social care is set to grow
- Understanding the effect of diabetes on social care becomes important
  - Improve projections of future rises in demand for social care
  - Help services and local authorities prepare
  - Understand possible efficiencies associated with the prevention/management of diabetes

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Aims

- Estimate the effect of having diabetes on the use of long-term care: (i) formal (community) social care services, (ii) informal care
- Possible causality
  - Try to estimate the effect of diabetes separate from other factors (e.g. comorbidities, socioeconomic factors)

Conceptual framework

- We can think of the probability of future long-term care use as a function of diabetes and other factors

$$P(Y_{ijt+1}) = f(D_{ijt}, n_{ijt}, X_{ijt}, u_{ijt})$$

For person i at time t using type of care j:

❖ Y_{ijt+1} = use of long-term care in future period

❖ D_{ijt} = has diabetes

❖ n_{ijt} = vector of needs-related comorbidities (e.g., heart disease, arthritis)

❖ X_{ijt} = vector of individual level characteristics (e.g., education, income, obesity)

❖ u_{ijt} = unobserved characteristics (factors we cannot measure)

Association and Causation

- We would like to estimate the *causal* effect of diabetes
  - effect of diabetes distinct from other factors
- Diabetes is characterized by comorbidities (e.g., heart disease, arthritis, high blood pressure) and is influenced by socioeconomic status and environmental factors (e.g., education, income, diet)
- If uncontrolled, these factors will be part of the estimated diabetes effect (biased estimates)
- We cannot randomize people between diabetes and non-diabetes
- With observational data some of these factors will be measured (n_{ijt}, X_{ijt}) and some will be unobserved (u_{ijt})

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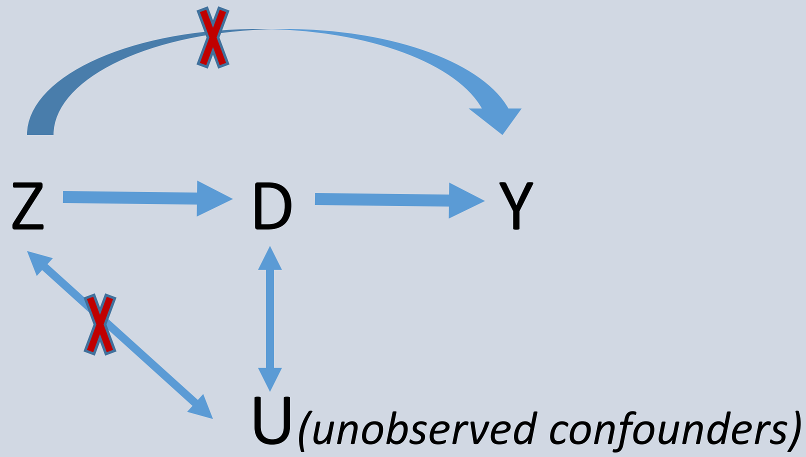
Empirical strategy: The Instrumental Variables (IV) Method (1)

- The IV method suggests that variation in D can be caused by a third variable Z (the instrumental variable) which is exogenous to unobserved characteristics (u_{ijt}) and affects the outcome Y only through D



Within this framework, the effect of D on Y is now distinct from other factors (causal)

Empirical strategy: The Instrumental Variables (IV) Method (2)

- Finding a variable Z (instrument) that satisfies these characteristics can be challenging
- We use as an instrument a measure of one's genetic predisposition for developing diabetes
  - Randomization of genes during conception
  - Likely to be correlated with the development of diabetes in later life
  - Likely to affect long-term care utilization only through diabetes and not other channels
- Some of these assumptions can be tested and some not
  - We run several analyses to explore the validity of these assumptions

The instrument: Polygenic scores

- Genetic predisposition for diabetes is measured using recently released data on diabetes Polygenic Scores (PGS)
- PGSs are calculated as the weighted sum of individual allelic dosages for a set of genes
- The specific set of genes and their association with a given trait (e.g., diabetes) are drawn from recent large-scale Genome-Wide Association Studies (GWAS)
- These studies estimate the relationship between a given trait (e.g., diabetes) and known genetic variants
- They have identified many diabetes susceptibility genes and have shown that traits like diabetes are polygenic
    - Meaning that they are affected by a combination of genes rather than one single genetic variant

Data

- The English Longitudinal Study of Ageing (ELSA) is a longitudinal biennial survey of individuals aged 50 and over (and their spouses)
- Rich data on individual characteristics:
  - Prevalence of diabetes; Use of formal and informal care
  - Other characteristics (family structure, comorbidities, socioeconomics)
  - PGS data for diabetes
- 9 waves of data: 1998/2001-2016/17
- Sample: aged 65+; diabetes diagnosis after 35; available PGS data; *N*=20,810

Measures

- Self reported data on diabetes and the use of long-term care
- ***Diabetes***: binary indicator for whether respondent has ever been diagnosed with diabetes
- ***Formal care***: binary indicator for whether respondent received help from home care worker/home help/personal assistant, a member of the reablement, sheltered housing manager, council's handyman, member of staff at the care home, nurse/physiotherapist, day center staff
- ***Informal care***: binary indicator for whether respondent received help from partner, child, grandchild, sibling, relative, friend/neighbor

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Sample statistics

	Mean	SD
Diabetes	0.098	0.297
Formal care	0.073	0.261
Informal care	0.229	0.420
Age	73.64	0.0473
Female	0.556	0.0034
Married	0.555	0.0034
Number of children	0.122	0.0022
No qualification	0.365	0.0033
Household size	1.757	0.0045
Log household income per capita	9.341	0.0046
Number of comorbidities	1.380	0.0077
Obese	0.269	0.0032

Notes: Sample restricted to people aged over 65, with a diabetes diagnosis after age 35 and available PGS data. The count of comorbidities includes high blood pressure, cancer, lung disease, heart condition, stroke, psychiatric problems, arthritis and memory-related disease.

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Empirical specification

- We estimate the effect of diabetes on the probability of using formal and informal care using the extended probit estimator
  - Binary dependent variable, binary endogenous variable, IV setup
- As our instrument is randomized at conception, any observed characteristics could be affected by that instrument
  - Some of the effect of diabetes could be absorbed by those factors if controlled in the analysis
- We only control for a set of ‘exogenous’ characteristics in the baseline specification:
  - year of birth, gender, wave dummies, ancestry-informative principal components

Results

	Formal care		Informal care	
	Probit	Eprobit	Probit	Eprobit
	(1)	(2)	(3)	(4)
Diabetes	0.030***	0.104***	0.127***	0.343***
	(0.0068)	(0.0091)	(0.0132)	(0.0167)
First stage coef		0.0087***		0.00867***
		(0.0008)		(0.0008)
Fist stage Z-sq		120.56		122.32
Corr(ε, v)		-0.0037		-0.269**
		(0.217)		(0.134)
N	20,810	20,810	20,810	20,810

*Notes: ***p<0.01, **p<0.05, *p<0.1. Sample restricted to people aged over 65, with a diabetes diagnosis after age 35 and available PGS data. The excluded instrument is individual Type 2 Diabetes PGS. Reported marginal effects. Standard errors in parentheses (clustered at the individual level). All regressions control for year of birth, gender (female), wave fixed effects and ancestry-infomartive principal components. Stock-Yoko weak ID test critical values: 10% maximal IV size (8.96), 15% maximal IV size (8.96), 20% maximal IV size (6.66).*

Instrument balance tests

	IV above median (a)		IV below median (b)		Standardized mean difference $\frac{\bar{X}_a - \bar{X}_b}{SD_a}$
	Mean	SD	Mean	SD	
Age	73.39	6.64	73.88	7.00	-0.074
Female	0.57	0.49	0.54	0.50	0.059
Married	0.54	0.50	0.57	0.50	-0.049
Number of children	2.06	1.57	2.02	1.54	0.028
No qualification	0.38	0.49	0.35	0.48	0.074
Household size	1.76	0.67	1.76	0.64	-0.002
Log hh income per ca	9.33	0.61	9.35	0.64	-0.041
Count of comorbidities	1.41	1.13	1.35	1.11	0.057
Obese	0.30	0.46	0.24	0.43	0.122
N	10,235		10,575		

Notes: Sample restricted to people aged over 65, with a diabetes diagnosis after age 35 and available PGS data. The instrument is the Type2 Diabetes PGS. The count of comorbidities includes high blood pressure, cancer, lung disease, heart condition, stroke, psychiatric problem, arthritis and memory-related disease.

Robustness checks

- We control for several covariates to understand the sensitivity of our results to the inclusion of additional observable characteristics
  - Control for omitted variables
  - Understand whether our instrument is possible to affect outcome through other channels
  - Understand whether some of these covariates work as mechanisms
- Three model specifications – step-wise including measures for:
  a. Supply of informal/formal care
  b. Socioeconomics and comorbidities
  c. Obesity

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Robustness checks results

	Formal care			Informal care		
	(1)	(2)	(3)	(4)	(5)	(6)
Diabetes	0.109***	0.099***	0.089***	0.34***	0.30***	0.27***
	(0.009)	(0.008)	(0.008)	(0.016)	(0.015)	(0.016)
First stage coef	0.008***	0.008***	0.008**	0.008***	0.008***	0.008***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
First stage Z-sq	115.3	108.7	98.4	117.9	110.6	100.8
N	18,805	18,501	16,870	18,805	18,501	16,870

Notes: ***p<0.01, **p<0.05, *p<0.1. Sample restricted to people aged over 65, with a diabetes diagnosis after age 35 and available PGS data. The excluded instrument is individual Type 2 Diabetes PGS. Eprobit reported marginal effects. Standard errors in parentheses (clustered at the individual level). All regressions control for year of birth, gender (female), wave fixed effects and ancestry-informative principal components. Models (1), (4) additionally control for being married, number of children, household size and regional fixed effects. Models (2), (5) additionally control for being married, number of children, household size, regional fixed effects, no educational qualification, log of household income per capita and count of comorbidities. Count of comorbidities include high blood pressure, cancer, lung disease, heart condition, stroke, psychiatric problem, arthritis and memory-related disease. Models (3), (6)) additionally control for being married, number of children, household size, regional fixed effects, no educational qualification, log of household income per capita, count of comorbidities and an obesity indicator. Count of comorbidities include high blood pressure, cancer, lung disease, heart condition, stroke, psychiatric problem, arthritis and memory-related disease. Stock-Yoko weak ID test critical values: 10% maximal IV size (8.96), 15% maximal IV size (8.96), 20% maximal IV size (6.66).

Discussion

- Having diabetes predicts a 10% higher probability of using formal care and 34% higher probability of using informal care
- Partialling out the mediating effect of socioeconomic factors, comorbidities and obesity, diabetes predicts a 9% higher probability of using formal care and 27% higher probability of using informal care
  - These estimates are a lower bound of the estimated effect
- Direct and indirect tests give us enough reassurance that the instrument works well and satisfies the assumptions for identification

Future steps

- Work in progress
- Further sensitivity analysis to conduct (subgroups, estimators, specification)
- Analyze the impact on costs

Thank you!

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