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Chronic disease and labour force participation in Australia

Anthony Harris

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Policy background

- In 2006 COAG identified reducing the incidence of preventable chronic disease among the working age population as a priority in order to both improve health outcomes and also to reduce the proportion of the working age population not participating and/or under-participating in paid employment due to illness, injury or disability
- Research question is "How much greater participation could be achieved with programs that reduce the prevalence of cardiovascular disease, diabetes and other chronic diseases?"
- Part of the answer to this is the answer to: how much of the current non participation in the labour force is due to current chronic illness

Focus on cardiovascular disease and diabetes

- **Chronic disease is seen as both a major health problem for the future and a contributor to a decline in the available workforce**
- **Heart disease in particular is the largest single cause of death in Australia (19%) with considerable morbidity**
- **Diabetes is the cause of 2.7% of all deaths directly and associated with a further 6% from complications many of which have a major impact on quality of life**
- **Both are seen as preventable and also have potential for better management in those with the disease**

How might chronic disease lead to low labour force participation?

Individual effect of cardiovascular disease on employment

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Ill health and the supply of labour

- poorer health may raise the current disutility of work
- poorer health reduces productivity, and through demand, the return from work and consequently wages
- poor health may entitle the individual to non wage income such as disability benefits
- poorer health may lower life expectancy raising the present value of current wealth and induce earlier retirement.
- reverse causality is also possible through a number of mechanisms eg physical injury or mental health problems caused by work

How do we measure ill health in such studies?

- **We cannot accurately measure overall physical and mental health itself but we rely on proxies**
- **Most common measure is self reported health**
  - General misreporting but also individuals with poor labour outcomes may systematically misreport their health status (perhaps even as a justification or response to a labour supply decision)
- **Researcher responses have been to find an instrument or proxy for "latent" or underlying health that is a more direct measure**
  - E.g. use a health status measure like SF36 either directly or in an IV technique using predicted SRH
  - use an objective measure of health e.g. clinical measure of disease comparing diseased with non diseased (at best measured clinically)
- **We adopt the second approach here**
  - Common approach limited to one disease in a single equation ie estimate labour outcomes as a function of disease/non disease with a number of labour market related covariates

Is a single equation enough?

- **Simplest approach with just one or more disease of interest in a single equation ie estimate labour outcomes as a function of disease/non disease with a number of labour market related covariates**
- **L=L(H, X, θ) where H is the health (disease(s)) status, X are observed characteristics and θ are unobserved household characteristics both of which affect labour outcomes**
- **The single equation approach provides unbiased estimates of the effect on labour outcomes as long as θ are not correlated with H ie as long as there are not "missing confounding factors" that bias the effect of H on L (as long as H is exogenous)**
- **Another potential source of bias arises if there is a causal relationship between diseases H_1 and H_2 independently of observed (and unobserved) risk factors**
  - Eg diabetes and cardiovascular disease

Example: why we need to test a multiple equation approach to labour outcomes and diabetes

- **Estimating the effect of diabetes on labour market outcomes in a single equation with covariates such as education and age but excluding CVD might be biased because**
  - It attributes to diabetes the impact of CVD on labour outcomes through the common risk factors like diet
- **Including CVD and diabetes together in a single labour outcome equation might be biased because**
  - It ignores the impact of unobserved individual or household factors (e.g. peer groups, attitudes to risk) that are common to labour outcomes and disease

AND

  - diabetes is an independent risk factor for CVD

Statistical model

Labour participation (Y_1^*)=$x_1\beta_1+a_1Y_2^*+a_2Y_3^*+e_1$ Y_1=1 if Y_1^*>0, 0 otherwise (1)

Cardiovascular Disease (Y_2^*)=$x_2\beta_2+a_3Y_3^*+e_3$ Y_2=1 if Y_2^*>0, 0 otherwise (2)

Diabetes (Y_3^*)=$x_3\beta_3+e_3$ Y_3=1 if Y_3^*>0, 0 otherwise (3)

Y^*_i are the underlying latent desire to participate and level of disease that if greater than some cut-off value will result in a positive actual observation of Y_i

Estimation strategy 1

- **Assume that e_1, e_2, and e_3 are independent and estimate equations 1to 3 as three separate probit equation**
- **Assume that e_1, e_2, and e_3 are joint normally distributed with means zero, and covariance matrix $\sum$. Estimate all 3 equations as a recursive multivariate system of probit equations**
  - Exclusion restrictions
  - Endogeneity of Y_3

Estimation strategy 2

- **Estimated by simulated maximum likelihood implemented in STATA10.0 with the MVPROBIT routine.**
- **The variance-covariance matrix of the cross-equation error terms was estimated and the null hypothesis that $\rho_{12}=\rho_{13}=\rho_{23}=0$ was tested with a Wald test at the 10% level.**
  - If the null hypothesis cannot be rejected the model consists of independent probit equations that can be estimated separately.

Estimation strategy 3

- **Choose variables on the basis of labour supply and clinical literature**
- **Exclude some on the basis of their correlation with included variables but less likely in principle to have an impact eg overweight vs obese, past smoking vs current smoking, diagnosed hypertension vs treated hypertension**
  - Test joint exclusion using Wald test

Data: Ausdiab survey

- **AusDiab survey, a population stratified survey across Australia in people aged ≥25 years, May 1999 to December 2000**
- **initial household interview, followed by a biomedical examination**
- **20,347 eligible people completed a household interview of whom 11,247 (55.3%) attended for biomedical interview**
- **Key advantage is that includes a rich set of clinically measured risk, disease and treatment status variables for CVD and diabetes**

Descriptive statistics from Ausdiab

Observed proportions in labour force by disease status all persons aged 25 years and over

	Labour force participation	Cardiovascular disease	Diabetes
P(.)	0.66	0.08	0.07
P(.|CVD=1)	0.30	1	0.23
P(.|Diab=1)	0.22	0.23	1
P(.|CVD=1,Diab=1)	0.09	1	1

Proportion in labour force by age and gender

Age group	Proportion with diabetes	Proportion without diabetes who are in labour force	Percent with diabetes who are in labour force	Proportion with CVD	Percent without CVD in labour force	Percent with CVD in labour force
Males						
35-44	0.026	0.956	0.859	0.019	0.956	0.871
45-54	0.066	0.926	0.879	0.047	0.935	0.678
55-64	0.166	0.683	0.392	0.136	0.676	0.360
65-74	0.207	0.186	0.076	0.246	0.185	0.098
All 25+	0.080	0.801	0.362	0.080	0.808	0.265
Female						
35-44	0.021	0.775	0.596	0.009	0.776	0.269
45-54	0.058	0.781	0.695	0.033	0.781	0.802
55-64	0.095	0.417	0.296	0.053	0.417	0.320
65-74	0.156	0.055	0.033	0.196	0.056	0.094
All 25+	0.068	0.584	0.238	0.070	0.592	0.171

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55-64	0.095	0.417	0.296	0.053	0.417	0.320
65-74	0.156	0.055	0.033	0.196	0.056	0.094

Predicted effect of diabetes and CVD on labour market outcome

- **We calculate the "average effect" of diabetes, CVD and both as the difference in the predicted probability of being in the labour force between**
  - D=1 and D=0;
  - CVD=1 and CVD=0;
  - (CVD=1,D=1) and (CVD=0, D=0)
- calculated with all exogenous variables at their mean via multivariate normal distributions using the estimated correlation coefficients with standard errors calculated using the Delta method

Marginal effect of risk factors on the probability of labour force participation, cardiovascular disease and diabetes: univariate regressions in males aged 25 and over

Males 25+						
	Participation		**CVD**		**Diabetes**	
	Marginal effect	p	Marginal effect	p	Marginal effect	p
CVD	-0.143	0.000				
Diabetes	-0.122	0.003	0.011	0.177		
High school	0.076	0.002				
University	0.085	0.002				
Age	0.344	0.000	0.027	0.000	0.035	0.000
Age^2	-0.05	0.000				
Married	0.077	0.01				
Children	0.035	0.237				
Treated hypertension			0.024	0.020		
Lipid therapy			0.128	0.000		
Sufficient exercise			-0.001	0.878	-0.012	0.177
Obesity			0.01	0.059	0.059	0.000
Current smoking			0.007	0.334	0.024	0.098
Parent diabetic					0.036	0.003
Prob.(LFP=1|CVD=1,Diab=1) - P(LFP=1|CVD=0,Diab=0)	0.289	0.000				

CVD=Cardiovascular disease p is statistical significance (prob. t > critical value)

Marginal effect of risk factors on the probability of labour force participation, cardiovascular disease and diabetes: univariate regressions in females aged 25 and over

Females 25+	**Participation**		**CVD**		**Diabetes**	
	Marginal effect	p	Marginal effect	p	Marginal effect	p
CVD	-0.029	0.726				
Diabetes	-0.109	0.001	0.023	0.098		
High school	0.122	0.039				
University	0.224	0.000				
Age	0.924	0.000	0.024	0.000	0.021	0.000
Age^2	-0.115	0.000				
Married	-0.067	0.058				
Children	-0.143	0.002				
Treated hypertension			0.025	0.019		
Lipid therapy			0.072	0.018		
Sufficient exercise			-0.014	0.146	-0.005	0.345
Obesity			0.007	0.301	0.06	0
Current smoking			0.008	0.397	-0.009	0.316
Parent diabetic					0.035	0.002
Prob.(LFP=1|CVD=1,Diab=1) - P(LFP=1|CVD=0,Diab=0)	-0.322	0.000				

Marginal effect of risk factors on labour force participation in males and females aged 25 and over: results from multivariate regressions

	Males n=4272		Females n=5251	
Variables	Marginal effect	p	Marginal effect	p
CVD	-0.106	0.060	-0.088	0.449
Diabetes	-0.058	0.319	-0.124	0.003
High school	0.047	0.071	0.119	0.089
University	0.059	0.010	0.211	0.054
Age	0.257	0.000	0.990	0.070
Age^2	-0.039	0.000	-0.124	0.031
Married	0.039	0.008	-0.046	0.336
Children	0.033	0.114	-0.163	0.055
Treated hypertension	-0.002	0.038	0.007	0.859
Lipid therapy	-0.007	0.010	0.018	0.860
Sufficient exercise	0.002	0.075	-0.002	0.958
Obesity	-0.010	0.000	-0.023	0.749
Current smoking	-0.006	0.102	0.008	0.362
Parent diabetic	-0.006	0.003	-0.015	0.763
Predicted prob. of participation	0.869	0.012	0.483	0.000
Prob.(LFP=1|CVD=1,Diab=1) - P(LFP=1|CVD=0,Diab=0)	-0.223	0.021	-0.476	0.620
	Correlation. Coefficient	p	Correlation. Coefficient	p
$\rho_{1,2}$	0.080	0.643	-0.281	0.366
$\rho_{1,3}$	0.364	0.050	0.157	0.359
$\rho_{2,3}$	0.117	0.463	-0.647	0.000
$\rho_{1,2}=\rho_{1,3}=\rho_{2,3}=0$		0.000		0.000

Comparison with other studies

Study	Diabetes		CVD	
	Male	Female	Male	Female
Current study age 25+ univariate mean age 47.5 m 49.0 female	-0.122 (0.003)	-0.109 (0.001)	-0.143 (0.00)	-0.029(0.726)
Current study multivariate age 25+	-0.058(0.32)	-0.124 (0.003)	-0.106 (0.06)	-0.088(0.50)
Brown et al univariate mean age 62	-0.075 (nr)	-0.075 (nr)		
Brown et al bivariate mean age 62	-0.106**	ns	-	-
Zhang et al 2007 age 18-49 mean	-0.07	-0.12	-0.043	-0.047
Zhang et al 2007 age 50-64	-0.182	-0.172	-0.145	-0.133
Khan JLE 1998 univariate mean age 55	-0.124**	-0.131**		
p values in brackets ** 5% sig *10% sig				

Brown, H., Shelton, III and J. A. Pagán Elena Bastida. 2005. The impact of diabetes on employment: genetic IVs in a bivariate probit. 14(5): 537-544.
X Zhang, X Zhao and A Harris Chronic Illnesses and Labour Force Participation in Australia paper presented at International Health Economics Association Conference Copenhagen 2007

Multivariate versus univariate: is it worth the effort in this case?

- **Differences in marginal effect on labour force participation compared to single participation equation**
  - Greater for women in diabetes by 2.5 % points in part due to effect on CVD
  - Less for men in CVD by 4 % points
  - Surprising non significant result for male diabetes
- **But**
  - correlation of error across equations are low
  - results of MVP are sensitive to specification

Severity of illness and labour force participation

		CVD=1, Sick=0	CVD=1, Sick =1	Diabetes=1, Sick =0	Diabetes=1, Sick =1
Males	Participation rate	0.800	0.453	0.778	0.613
	Difference	-0.346 (-0.213; -0.480)		-0.165 (-0.073, -0.257)	
Females	Participation rate	0.507	0.478	0.405	0.327
	Difference	-0.029 (0.233, -0.290)		-0.077 (0.059, -0.214)	

Sick=self reported poor health

The policy imperative

It has been suggested that the negative impact of population ageing in the next 40 years would lead to a decline in labour force participation in Victoria from around 64.7 per cent in 2005 to 55.6 per cent by 2035 (Victoria's Workforce Participation Taskforce 2005).

To maintain the size of the workforce they estimate that participation rates in 2035 would have to be 15 per cent higher across all age groups than they were in 2005

Can we reduce diabetes and CVD

- **The AusDiab survey data here shows that only 11.5% of those with elevated lipids were on medication. Only 50% of those with elevated blood pressure were on medication, and only 50% of either group got sufficient exercise.**
- **There seem to be gaps in both prevention and treatment that could have a substantial impact on mortality, quality of life and labour market outcomes**
- **There is a number of promising approaches to the primary and secondary prevention of diabetes and cardiovascular disease including behavioural social and environmental changes that impact on smoking reduction, weight reduction and physical activity, as well as pharmacological interventions.**
- **Some of these have been shown to be successful in experimental studies and to offer value for money in terms of health alone at least in simulations.**

Conclusions

- **The combined size of the effect of these two chronic diseases on reduced probability of labour force participation was 0.22 for men and at least 0.124 for women from diabetes alone.**
- **This means that preventing disease at the population level could increase the effective labour force into the future by more than 1.2% for men and 0.08% for women.**
  - A bit short of target but how does that compare with the net benefits of other policy alternatives?
- **Note that, particularly for men with cardiovascular disease or diabetes, being sick had a large effect on labour force participation**
  - Reducing the morbidity associated with the complications of these chronic diseases, through secondary prevention and effective treatment, would have an effect not only labour force participation but also on labour productivity
  - *An area for further research*