Productivity Losses of Chronic Diseases Among Canadian Labour Force in 1994 & 2005: Estimates from a Nationally Representative Samples

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Objective: To Estimate the Productivity Labour-Related Losses from:

- 22 Chronic Disorders including:
  - Diabetes Mellitus (DM),
  - DM-Related Comorbidities (DRCOM),
  - Other non-DM related Chronic disorders (e.g., arthritis, cancer),
  - Some risk factors: BMI, smoking, # of regular drinkers (> 3 drinks/week), and physical exercise.

Motivations: Burden of DM Projected to Grow

- WHO: worldwide prevalence of DM is increasing from 4.0% in 1995 to 5.4% in 2025
- ADA: Economic cost of DM is increasing from $132B in 2002 to $192B in 2020, in the US
- Reason:
  - Growing prevalence, decreasing age of onset, aging population, changes in diabetes-related service utilization, and a greater understanding of the wide range of diabetes-related comorbidities (DRCOM)

Previous Studies:Economic Burden of DM

"...no standard method has been established.."Ettaro et al, 2004

- Economic cost of DM in US. In 2002: $132B (ADA)
  - Direct medical costs: US$91.8B
  - Indirect costs: $US40B (lost workdays, restricted activity & early mortality)
- Decreasing age of onset & increasing rate of DRCOM among teenagers suggests even greater burden of DM on productivity in future
  - Accurately estimating the social costs hampered by the unavailability of good data.
  - Non-representative samples or impute key data, which can introduce bias (e.g., Kraut et al. 2001 (Manitoba), ADA))

Hypothesis

DM, DRCOM increase the probability of having disability days, the number of disability days, and earnings, ceteris paribus.

The multivariate labor supply model:

$D = f(X, DM, DRCOM, \text{other chronic disorders } \xi i)$

H_0: $\partial D / \partial DM \text{ related disorders} \geq 0$

H_1: $\partial D / \partial DM \text{ related disorders} < 0$

Data: NPHS 1994 & CCHS 2005
National Population Health Survey
Canadian Community Health Survey

- Ages between 20-65, excluding students & retired
- NPHS: 5,627 women and 4,867 men
- CCHS: 32,637 women and 30,119 men
  - If Disability days > 0 = 1, else = 1(0,1), #Disability days/year, annual earnings
  - Socio-demographics (age, sex, education, marital status, #kids, regional economic conditions)
  - DM, DRCOM, Other chronic disorders, #drinking, smoking

Research Design and Methods
Econometrical Model

- A two-part model is used to estimate the impact of DM on labour market outcomes:
  - Part I: logistic regression for probability of having disability day
  - part II: log-transformed OLS regression to estimate
    # of disability days and annual earnings, for workers
- Part I x Part II: to estimate #disability days & earnings losses for all sample

Empirical Model: Annual Productivity Loss (PL), per Diabetic

$PL_i = (DisD_{i,NDM}E_{i,NDM}) - (DisD_{i,DM}E_{i,DM})$

where:

i = individual i with DM

$DisD_{i,DM}$=predicted disability days/yr for person i if has DM

$DisD_{i,\ NDM}$ = predicted disability days/yr for i if didn't have DM

$E_{i,DM}$= predicted annual earnings of person i if has DM

$E_{i,NDM}$ = predicted annual earnings of person i if didn't have

- These individual-level costs are then inflated to national costs using the survey population weights.

Table 1: Sample Descriptive Statistics, Means (T-Test between women & men)						
Data / Variable	**NPHS 1994**			**CCHS 2005**		
	Full Sample (N = 10494) *	Women (N = 5627)	Men (N = 4867))	Full Sample (N = 62756)*	Women (N = 32637)	Men (N =30119)
Dependent variables						
Disability days status (0,1)	0.15(0.003)	.165[a](0.005)	0.12(0.005)	0.185a(0.002)	0.216(0.002)	0.15 (0.002)
Disability days	0.85(0.03)	0.961[a](.039)	0.727 (0.04)	0.968a(0.011)	1.12(0.017)	0.80(0.015)
Annual income	44,206(264)	42302 [a](359)	46410 (388)	54,099a(148)	50,944(206)	57,518(210)
Income(C$93&$04)	27,432(311)	21,674[a](404)	34088 (462)	46,575a(159)	40988(220)	5,230 (225)
Independent Variables						
DM	0.020 (0.001)	.022 (0.002)	.019 (0.002)	0.037a(0.001)	0.035(0.001)	0.04 (0.001)
DRCOM	0.091 (0.003)	.096 (0.004)	.08 (0.004)	0.150b(0.001)	0.147(0.002)	0.15 (0.002)
Other Chronic †	0.40 (0.005)	.451 (0.007)	.33 (0.007)	0.596a(0.002)	0.665(0.003)	.522 (0.003)
BMI	25.45 (0.041)	24.83 (0.06)	26.16(0.05)	26.28a(0.021)	25.73(0.031)	26.88 (0.03)
Age	6.44 (0.022)	6.45 (0.030)	6.42 (0.032)	38.2a (3.80)	39.0 (4.10)	37.8 (4.2)
Married	0.64 (0.310)	0.63 [a] (0.18)	0.64 (0.28)	0.620a(0.002)	0.638(0.003)	0.60 (0.003)
< Secondary	0.219 (0.004)	0.212 (0.005)	.227 (0.006)	0.07b (0.001)	0.073 (0.001)	0.08 (0002)
Secondary	0.167 (0.004)	0.174 (0.005)	.159 (0.01)	0.12 b (0 .001)	0.12 (0.002)	0.12 (0.002)
Post-Secondary	0.378 (0.005)	0.369 (0.006)	.388 (0.007)	0.80 a (0.002)	0.81 (0.002)	0.79 (0.002)
Kids < 11 years	0.194 (0.004)	0.22 (0.005)	.167 (0.005)	0.28 a (0.002)	0.309 (0.003)	0.26 (0.003)
Smokers	0.368 (0.005)	0.35 (0.006)	.387 (0.007)	0.30 a (0.002)	0.283 (0.002)	0.32 (0.003)
Drinkers(>3/week)	0.308 (0.005)	0.39 (0.007)	.21 (0.006)	0.11 a (0.001)	0.07 (0.001)	0.16 (0.002)
Physical Exercise	0.40a (.01)	0.41 (.01)	0.38 (0.004)	0.50 (0.002)	0.51 (0.003)	0.50 (0.003)
Unemployment Rate	11.77 (0.028)	11 (0.036)	12.4 (0.041)	7.50 a (0.009)	7.18 (0.010)	7.80 (0.014)

Table 2. Impact of Diabetes on Labour Market Outcomes in Canada, in 1994 & 2005, women (SE)

	NPHS 1994			CCHS 2005		
	Disability status : Logistic Analysis, Odds Ratio	Ln Disability day among those with Disability days > 0	Ln Annual income among those with Disability	Disability status : Logistic Analysis, Odds Ratio	Ln Disability day among those with Disability days > 0	Ln Annual income among those with Disability
DM	2.92 ***(0.848)	0.23 (0.18)	0.03 (0.09)	1.5 *** (0.15)	0.11 (0.069)	-.002 (0.19)
DRCOM	1.69 ***(0.281)	0.35*** (0.11)	0.04 (0.09)	1.37 ***(0.088)	0.17 ***(0.05)	0.02 (0.12)
Depression	2.20 ***(0.29)	0.226** (0.10)	-0.03 (0.08)	2.17 *** (0.15)	0.29 *** (0.05)	-0.22 (0.17)
Other Chronics	3.29***(0.73)	0.202 (0.13)	0.055 (0.07)	2.85 *** (0.15)	0.12 *** (0.04)	0.07 (0.17)
Smoking Daily/occasio	1.15 (0.12)	0.16* (0.08)	-0.03 (0.07)	1.35 *** (0.064)	0.06 * (0.03)	0.03 (0.1)
Regular Drinker > 3 / week	1.09 (0.11)	-0.09 (0.08)	-0.11 (0.08)	0.79 *** (0.07)	-0.01 (0.07)	0.34 ***(0.13)
Sample size	5627	931	358	32634	7065	7065

***Represents P-Value < 0.01, ** represents P-value < 0.05, * represents P-value < 0.10
Reference Categories are single, divorced, less than high school education, and healthy women.

Table 2 A- (continued): Impact of Diabetes on Labour Market Outcomes, in Canada, for Women (standard error using bootstrap weights)

	NPHS1994			CCHS2005		
	Disability DAYS STATUS : Logistic Analysis, Odds Ratio	LN Disability day among those with Disability days > 0	LN Annual income AMONG those with Disability days > 0	work Status : Logistic Analysis, Odds Ratio	LN Disability day among those with Disability days > 0	LN Annual income AMONG those with Disability days > 0
Age	1.33** (0.189)	0.156 (0.183)	0.118 (0 .111)	0.945 (0.075)	0.039 (0.056)	0.456** (0.187)
Age^2	0.979 **(0.010)	0.004 (0.008)	0.006 (0.008)	1.00 (0.005)	0.0002 (0.004)	-0.028** (0.012)
Married	0.833* (0.088)	-0.030 (0.080)	0.403*** (0.067)	0.822*** (0.039)	-0.031 (0.034)	0.551 ***(0.098)
Less Than High school	0.957 (0.131)	0.408*** (0.098)	-0.453*** (.089)	0.930 (0.100)	0.0003 (0.072)	-0.181 (0.509)
College	1.08 (0.120)	0.093 (0.091)	-0.168** (0.084)	1.146 * (0.081)	-0.177*** (0.049)	1.005** (0.375)
Any Kids < 11 years in House-Hold	0.835 (0.110)	-0.059 (0.102)	0.008 (0067)	1.01 (0.054)	-0.046 (0.038)	-0.017 (0.129)
Unemployment Rate	0.901*** (0.023)	-0.010 (0.019)	0.009 (0.016)	0.959 *** (0.012)	0.001 (0.008)	-0.018 (0.037)
Intercept		1.139*** (0.390)	10.09*** (0.382)		0.897*** (0.212)	7.52*** (0.836)
Observations	5627	931	358	32634		
Wald Chi2 (17)	138.79	0.115		695.46	7065	4292
Log-pseudo-likelihood	-2349			-15773		
Pseudo R2	0.0463			0.0539		
R-Squared					0.0504	0.0479
Root MSE		.87265	.47539		.86904	2.0916

Table 3. Impact of Diabetes on Labour Market Outcomes in Canada in 1994 & 2005, Men (SE)

	NPHS 1994			CCHS 2005		
	Disability status : Logistic Analysis, Odds Ratio	Ln Disability day among those with Disability days > 0	Ln Annual income AMONG those with Disability days > 0	Disability status : Logistic Analysis, Odds Ratio	Ln Disability day among those with Disability days > 0	Ln Annual income AMONG those with Disability days > 0
DM	0.68 (0.27)	. 0.03 (0.31)	0.10 (0.23)	1.15 (0.14)	0.13 (0.10)	-.32 (0.27)
DRCOM	2.0 *** (0.38)	0.22 (0.17)	0.07 (0.10)	1.55*** (0.11)	0.15 ***(0.06)	0.02 (0.11)
Greater than 2 weeks Depression	2.10 *** (0.43)	0.57 ***(0.17)	-.05 (0.10)	2.77 ***(0.26)	0.36 (0.07)	.56 *** (0.21)
Other Chronics	2.47*** (0.74)	0.18 (0.20)	-.02 (0.12)	2.38*** (0.13)	.17 (0.04)	-0.13 (0.10)
Smoking Daily/occasionally	1.22 (0.16)	.01 (0.11)	-.05 (0.08)	1.23 ***(0.07)	.12*** (0.04)	-0.25 ***(0.10)
Regular Drinker > 3 / week	1.11 (0.15)	0.06 (0.11)	-.16* (0.08)	0.97 (0.07)	-.06 (0.06)	.14 (0.12)
Sample size	4867	600	340	30116	4525	3244

***Represents P-Value < 0.01, ** represents P-value < 0.05, * represents P-value < 0.10
Reference Categories are single, divorced, less than high school education, and healthy men.

Table 2. B- (continued): Impact of Diabetes on Labour Market Outcomes, in Canada, for Men (standard error)

	NPHS1994			CCHS2005		
	Disability Days Status : Logistic Analysis, Odds Ratio	Ln Disability day among those with Disability days > 0	Ln weekly wage among those with Disability days > 0	work Status : Logistic Analysis, Odds Ratio	Ln Disability day among those with Disability days > 0	Ln weekly wage among those with Disability days > 0
Age	1.085 (0.181)	0.066 (0.138)	0.118 (0 .111)	0.945 (0.075)	0.039 (0.056)	0.456** (0.187)
Age^2	0.990 (0.012)	0.001 (0.010)	0.006 (0.008)	1.00 (0.005)	0.0002 (0.004)	-0.028** (0.012)
Married	1.193 (0.171)	-0.068 (0.114)	0.403*** (0.067)	0.822*** (0.039)	-0.031 (0.034)	0.551 ***(0.098)
Less Than High school	0.903 (0.151)	0.376*** (0.144)	-0.453*** (.089)	0.930 (0.100)	0.0003 (0.072)	-0.181 (0.509)
College	1.130 (0.165)	0.233* (0.123)	-0.168** (0.084)	1.146 * (0.081)	-0.177*** (0.049)	1.005** (0.375)
Any Kids < 11 years in House-Hold	1.041 (0.191)	-0.177 (0.162)	0.008 (0067)	1.01 (0.054)	-0.046 (0.038)	-0.017 (0.129)
Unemployment Rate	0 .949 (.029)	0.003 (0.019)	0.009 (0.016)	0.959 *** (0.012)	0.001 (0.008)	-0.018 (0.037)
Intercept		0.496 (0.487)	10.09*** (0.382)		0.897*** (0.212)	7.52*** (0.836)
Observations	4867	600	358	32634		
Wald Chi2 (17)	58..79			695.46	7065	4292
Log-pseudo-likelihood	-1749	0.126 0.929		-15773		
Pseudo R2	0.0223	.87265		0.0539		
R-Squared					0.0504	0.0479
Root MSE			.47539		.86904	2.0916

Limitations of Study

- In self reported survey many are unaware of having DM
- We assumed DM is determined exogenously of work conditions
- We assumed DRCOM are consequences of DM not preceded DM

Results

- The average # of disability days increased from 0.85 to 0.96 (during the past 2 weeks of the survey) for both men and women.
- While the average prevalence of DM, DRCOM, 16 non-DM related chronic disorders increased, depression decreased for men and women.
- Among risk factors, # of smokers dropped, # of regular drinkers and those who had physical exercise increased, however, BMI increased for both men and women.

Results

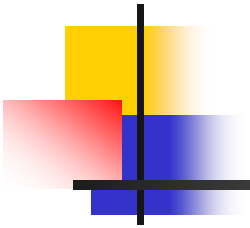
The productivity losses (probability of having disability days, number of disability days, and earnings) due to DM & DRCOM are significant in both 1994 and 2005 for women and men.

While the productivity losses associated with DM, DRCOM, depression, and sixteen other non-DM related disorders decreased in 1994 & 2005 for women, they increased for men during these years only for DM, but decreased for other chronic disorders.

Conclusion

Few studies suggest that people are behaving healthier. The number of deaths due to heart disease decreased during the past decade due to better risk factors, such as, decreased number of smokers, increased number of regular drinkers and those who exercise regularly.

This is the first study in our knowledge estimating the productivity losses of chronic disorders in 2 points of time by controlling for risk factors and socio-demographic characteristics using nationally representative sample. Our study results suggest that prevention through risk factors may decrease disability days beside rate of mortality and morbidity. This study especially could be replicated by longitudinal version of NPHS 1994 and 2009.



Thank You!

Questions?

Suggestions?