RESEARCH PAPER

The Impact of Prescription Medication Cost Coverage on Oral Medication Use for Hypertension and Type 2 Diabetes Mellitus

Impact de la couverture du coût des médicaments d'ordonnance sur l'utilisation des médicaments oraux pour l'hypertension et le diabète sucré de type 2

RAZAN AMOUD, KELLY GRINDROD, MARTIN COOKE AND MHD WASEM ALSABBAGH

TABLE 1. Characteristics of the study sample (weighted)

Variable name	Category	No insurance (*n* = 1,735,362)	Insurance (*n* = 6,961,158)	Total (*n* = 8,696,520)	*p*-value from χ^2 or *t* test
		***n* (%)**	***n* (%)**	***n* (%)**	
Medication use (outcome)	Yes	1,135,543 (65.44)	5,112,279 (73.44)	6,247,822 (71.84)	<0.0001
	No	599,818 (34.56)	1,848,880 (26.56)	2,448,698 (28.16)	
Year	2007–2008	530,789 (30.59)	2,182,171 (31.35)	2,712,960 (31.20)	0.0994
	2013	585,180 (33.72)	2,401,508 (34.50)	2,986,688 (34.34)	
	2014	619,393 (35.69)	2,377,479 (34.15)	2,996,872 (34.46)	
Age	Mean (*SD*)	58.34 (2829429)	60.5 (4874214)	60.07 (5328763)	
	18–29	81,559 (4.70)	169,245 (2.43)	250,804 (2.88)	<0.0001
	30–44	232,957 (13.42)	797,236 (11.45)	1,030,193 (11.85)	
	45–64	828,879 (47.76)	3,135,195 (45.04)	3,964,074 (45.58)	
	65+	591,967 (34.11)	2,859,482 (41.08)	3,451,449 (39.69)	
	Minimum age	18.00			
	Maximum age	102.00	104.00		

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		***n* (%)**	***n* (%)**	***n* (%)**	
Sex	Male	862,618 (49.71)	3,588,107 (51.54)	4,450,725 (51.18)	0.2725
	Female	872,744 (50.29)	3,373,051 (48.46)	4,245,795 (48.82)	
Education level	Less than secondary school graduation	491,818 (28.34)	1,549,046 (22.25)	2,040,864 (23.47)	0.0001
	Secondary school graduation	330,784 (19.06)	1,441,849 (20.71)	1,772,633 (20.38)	
	Post-secondary school graduation	912,759 (52.60)	3,970,263 (57.03)	4,883,022 (56.15)	
Household income (national level quintiles)	First 20% (lowest income)	620,885 (35.78)	1,358,475 (19.52)	1,979,360 (22.76)	<0.0001
	Second 20%	497,474 (28.67)	1,472,436 (21.15)	1,969,910 (22.65)	
	Third 20%	274,700 (15.83)	1,402,885 (20.15)	1,677,585 (19.29)	
	Fourth 20%	188,737 (10.88)	1,394,726 (20.04)	1,583,463 (18.21)	
	Fifth 20% (highest income)	153,565 (8.85)	1,332,636 (19.14)	1,486,201 (17.09)	
Number of chronic diseases	Hypertension or diabetes	1,492,682 (86.02)	5,714,627 (82.09)	7,207,309 (82.88)	0.0001
	Having both hypertension and diabetes	242,680 (13.98)	1,246,531 (17.91)	1,489,211 (17.12)	
Province	Ontario	1,579,895 (91.04)	6,382,477 (91.69)	7,962,372 (91.56)	0.2310
	New Brunswick	155,467 (8.96)	578,681 (8.31)	734,148 (8.44)	0.2310
Smoking status	Smoker	356,442 (20.54)	1,160,917 (16.68)	1,517,359 (17.45)	0.0017
	Non-smoker	1,378,920 (79.46)	5,800,242 (83.32)	7,179,162 (82.55)	

Variable name	Category	No insurance (*n* = 1,735,362)	Insurance (*n* = 6,961,158)	Total (*n* = 8,696,520)	*p*-value from χ^2 or *t* test
		***n* (%)**	***n* (%)**	***n* (%)**	
Disease of interest	Hypertension	1,317,199 (75.90)	5,129,435 (73.69)	6,446,634 (74.13)	0.0043
	Diabetes	175,482 (10.11)	585,192 (8.41)	760,674 (8.75)	
	Both type 2 diabetes and hypertension	242,680 (13.98)	1,246,531 (17.91)	1,489,211 (17.12)	
Cardiovascular disease (heart disease/stroke)	Yes	216,279 (12.46)	1,175,563 (16.89)	1,391,842 (16.00)	<0.0001
	No	1,519,082 (87.54)	5,785,596 (83.11)	7,304,678 (84.00)	
Cancer	Yes	184,295 (10.62)	888,076 (12.76)	1,072,371 (12.33)	0.0532
	No	1,551,066 (89.38)	6,073,082 (87.24)	7,624,148 (87.67)	
Has taken a flu shot	Yes	1,147,902 (66.15)	5,215,517 (74.92)	6,363,419 (73.17)	<0.0001
	No	587,460 (33.85)	1,745,641 (25.08)	2,333,101 (26.83)	
Has a regular medical doctor	Yes	1,613,692 (92.99)	6,692,340 (96.14)	8,306,032 (95.51)	<0.0001
	No	121,670 (7.01)	268,818 (3.86)	390,488 (4.49)	
Sub sample: Health insurance plan	Government-sponsored	–	2,269,571 (32.60)	2,269,571 (26.10)	<0.0001
	Employer-/private-sponsored	–	4,321,788 (62.08)	4,321,788 (49.70)	
	Mixed	–	350,227 (5.03)	350,227 (4.03)	

TABLE 2. Results of full model output for measuring the odds of medication use versus non-medication use

Effect	OR estimates	95% Wald Confidence limits		*p*-value
No insurance vs. insurance	0.774	0.657	0.911	0.0021
Ontario vs. New Brunswick	1.016	0.891	1.159	0.8095
Female vs. male	0.844	0.742	0.96	0.0098
2013 vs. 2007–2008	0.998	0.844	1.18	0.9795
2014 vs. 2007–2008	1.053	0.908	1.221	0.4965
Secondary education vs. lower than secondary	1.131	0.922	1.388	0.2385
Postsecondary education vs. lower than secondary	0.829	0.693	0.992	0.0408
30–44 vs. 18–29	4.449	2.575	7.689	<0.0001
45–64 vs. 18–29	12.795	7.595	21.556	<0.0001
65+ vs. 18–29	25.479	15.078	43.056	<0.0001
Second vs. first quintile	1.150	0.953	1.388	0.1458
Third vs. first quintile	1.012	0.817	1.255	0.9104
Fourth vs. first quintile	0.896	0.71	1.132	0.3573
Fifth vs. first quintile	0.984	0.791	1.225	0.8881
Smoking vs. non-smoking	0.696	0.586	0.827	<0.0001
No flu shot vs. flu shot	0.725	0.625	0.841	<0.0001
No regular doctor vs. regular doctor	0.486	0.364	0.649	<0.0001
One disease (hypertension/type 2 diabetes) vs. both	1.273	1.071	1.513	0.0061
No cancer vs. cancer	1.205	1.021	1.423	0.0272
No cardiovascular disease vs. cardiovascular	0.601	0.509	0.709	<0.0001

TABLE 3. Sensitivity analyses

Model number	Criteria	Parameter effect	OR estimates	95% Wald Confidence limits	
1: Main analysis	Using their medication if response to using *both* hypertension and diabetes medications = yes	No PMCC vs. Insurance	0.774	0.657	0.911
2	Using their medication if response to *either* hypertension or diabetes medication = yes		0.739	0.618	0.883
3	Using their medication if answered yes to *at least one* type of medication (hypertension or diabetes). It is allowed for the other medication's answer to be "don't know/missing."		0.773	0.656	0.911
4	Using their medication if answered yes to using *at least one type* of medication (hypertension or diabetes). It is allowed for the other medication type's answer to be "no/don't know/missing."		0.738	0.616	0.883
5	Very lenient criteria for medication use: Respondent was considered not using medication, if the answer was confirmed to be "no" to medication use question. Respondents were only considered to be not using medication if they specifically answered "no" to hypertension or diabetes medication use and do not have the other disease or if they answered "no" to both.		0.736	0.615	0.881
6	It is assumed that all senior Ontarians have insurance regardless of whether they answered "yes" to having insurance or not		0.744	0.609	0.908
7	Assuming all seniors have insurance (all Ontario and New Brunswick seniors)		0.743	0.604	0.914
8	After removing respondents who were diagnosed with type 2 diabetes at age less than 30 years (n = 22,987)		0.784	0.664	0.926

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Appendix 1

TABLE A1. CCHS variables that were considered in building the final model

Definition	Variable code
Sociodemographic factors	
Age	DHH_AGE
Sex	DHH_SEX
Race	SDC_
Province	GEO_PRV
Derived variable for education level	EDUDR04
General health perception (self-reported health)	GEN_01
Distribution of household income – National level (quintiles)	INCDRCA
Main source of household income	INC_2
Healthcare-team and system-related factors	
Having a regular doctor	HCU_1AA
Year	_
Condition and therapy-related factors	
Smoking status: derived variable	SMKDSTY
Alcohol consumption: derived variable	ALCDTTM
Cardiovascular disease (stroke, heart disease)	CCC_121/ CCC_151, both
Hypertension/type 2 diabetes, both	CCC_071/ CCC_072/ CCC_101, both
Asthma	CCC_031

Definition	Variable code
Arthritis (arthritis, excluding fibromyalgia)	CCC_051
Back problems	CCC_061
Migraine	CCC_081
Cancer	CCC_031, CCC_031A
Gastrointestinal diseases: intestinal or stomach ulcer or have a bowel disorder such as Crohn's disease, ulcerative colitis, irritable bowel syndrome or bowel incontinence	CCC_171, CCC_141
Mental health: mood disorder such as depression, bipolar disorder, mania or dysthymia or anxiety disorder such as a phobia, obsessive-compulsive disorder or panic disorder	CCC_280, CCC_290
Patient-related factors	
Staying overnight in hospital, nursing home or convalescent home	HCU_01 (in 2007-2008) or CHP_01 (in 2013-2014)
Has taken a flu shot	FLU_160

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Appendix 2

Additional Information on Handling Missingness in Data

Because the pattern of missingness was arbitrary, we followed the fully conditional specification method (FCS) available in SAS® (Berglund 2015). The FCS method provides the possibility to factor in the complex sample selection design of strata and clusters. However, due to confidentiality reasons, analysts using the CCHS data are blinded from obtaining these strata and clusters from which the CCHS randomly selected the sample. Instead, analysts are provided with bootstrap weights that are generated 500 times with replacement. We used the bootstrap weights in place of strata and clusters to execute the FCS method. We confirmed the robustness of our method with a specialist from the Data Analysis Resource Centre at Statistics Canada, who confirmed that our proposed procedure was reasonable provided the imputation is capturing the variability due to imputation, which it did.

About 5% (1,153) of the respondents had missingness in one or more covariates other than the exposure and outcome. We managed missingness in the data by implementing three strategies. First, in the main analysis, because missingness in the data did not exceed 5%, we concluded that the size of missingness was small to a relatively large sample size, we followed the educated-guessing approach as the form of imputation of any missing data (Allison 2002). Hence, when a variable had a missing value, we assumed that the answer to this question was "no" (i.e., variable value = 0). For example, for those who did not answer the smoking status question, the initial assumption was that they were non-smokers. When the variable was multileveled, we assumed that the missing value was the lowest value. For example, for missing education level, we assumed the participant had the lowest level of education achievable. By not following the mean/modal imputation approach (that is choosing to replace missing values according to the modal category), we were able to avoid this recently

unpreferred approach, as it has gained a growing concern for its cause of reduction of data variability (Sterner 2011).

Second, we managed missingness by removing participants with missing value in at least one variable. In this case, the OR produced did not differ substantially (0.77, 95% CI [0.60, 0.99]) as compared to the main analysis (0.77, 95% CI [0.66, 0.91]). The results before and after the removal of missing values are displayed in Table A2 below. Third, we carried out five multiple imputations by fitting a logistic regression to predict the missing variable's value by using all other covariates (Models 3–7, Table A2) following the assumption that missingness occurred at random. The five different imputations in Table A2 produced very similar ORs to the main analysis (Model 1).

TABLE A2. Missingness diagnostics

Model number	Criteria	Parameter effect	OR estimates	95% Wald Confidence limits	
1: Main analysis	Initial assumption for missingness to apply lowest level	No insurance vs. insurance	0.774	0.657	0.911
2	Removing missing data – (1,212 observations were removed)		0.769	0.596	0.991
3	Imputation number = 1		0.777	0.659	0.915
4	Imputation number = 2		0.777	0.660	0.915
5	Imputation number = 3		0.775	0.658	0.913
6	Imputation number = 4		0.776	0.659	0.914
7	Imputation number = 5		0.773	0.656	0.910

TABLE A3. Odds ratios of adherence with no insurance in subgroups in 95% CI

No Insurance vs. insurance		95% Wald	
Subgroups	**OR estimates**	**Confidence limits**	
Ontario	0.774	0.644	0.921
New Brunswick	0.802	0.612	1.051
Ontario ≥65	0.751	0.609	0.926
New Brunswick ≥65	0.76	0.529	1.092
Ontario – below 65	0.743	0.592	0.932
New Brunswick – below 65	0.733	0.51	1.055
Lowest income (first quintile)	0.739	0.541	1.01
Middle income (second, third, fourth quintile)	0.804	0.659	0.980
Highest income (fifth quintile)	0.715	0.425	1.205
Highest income and age ≥65 years	0.958	0.378	2.428
Highest income and age ≥65 years – Ontario	0.930	0.362	2.388
Highest income and age <65 years	0.599	0.356	1.006
Highest income and age <65 years – Ontario	0.592	0.344	1.019
Highest income and age <65 years – New Brunswick	1.121	0.075	16.775
Middle income and age ≥65 years	0.883	0.699	1.115
Middle income and age ≥65 years – Ontario	0.883	0.685	1.138
Middle income and age ≥65 years – New Brunswick	0.810	0.441	1.489
Middle income and age <65 years	0.805	0.632	1.026
Middle income and age <65 years – Ontario	0.803	0.616	1.047
Middle income and age <65 years – New Brunswick	0.817	0.521	1.280
Low income and age ≥65 years	0.844	0.564	1.264
Low income and age ≥65 years – Ontario	0.842	0.542	1.310
Low income and age ≥65 years – New Brunswick	0.864	0.463	1.612
Low income and age <65 years	0.783	0.516	1.187
Low income and age <65 years – Ontario	0.796	0.505	1.256
Low income and age <65 years – New Brunswick	0.697	0.349	1.394
Diabetics who use insulin	0.864	0.519	1.440
Diabetics who have been using insulin for <10 years	0.486	0.156	1.519
Diabetics who have been using insulin for ≥10 years	1.091	0.615	1.935
Odds after removing seniors, respondents with cancer history and the low-income class	0.795	0.635	0.995
Odds after removing Ontario seniors who denied having insurance	0.738	0.604	0.902