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

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Abstract

Background: No previous study, to the best of our knowledge, has examined both the time trend and impact of not having insurance or prescription medication cost coverage (PMCC) on the usage of type 2 diabetes and hypertension oral medications in Ontario and New Brunswick, Canada.

Methods: We used data from the Canadian Community Health Survey (CCHS) from 2007 to 2014 to examine the time trend and impact of PMCC. A multivariable-adjusted logistic regression model was fitted.

Results: The pseudo-cohort included 23,215 individuals representing a population of approximately 8.7 million people. Overall, 20.0% of respondents reported absence of PMCC. This proportion increased slightly from 19.6% (95% confidence interval [CI] 95% CI [17.5, 22.5]) to 20.7% (95% CI [16.9, 23.1]). Adjusted odds ratios (OR) showed that uninsured individuals were 23% less likely to use their medications (OR = 0.77, 95% CI [0.657, 0.911]).

Conclusion: There was a slight decline in PMCC over time and this decline was associated with reduced use of medications for type 2 diabetes and hypertension.

Résumé

Contexte : Aucune étude, à notre connaissance, n'a examiné à la fois la tendance temporelle et l'impact de l'absence de régime d'assurance ou de couverture du coût des médicaments d'ordonnance (CCMO) sur l'utilisation des médicaments oraux contre le diabète de type 2 et l'hypertension en Ontario et au Nouveau-Brunswick, au Canada.

Méthode : Nous avons utilisé les données de l'Enquête sur la santé dans les collectivités canadiennes (ESCC) de 2007 à 2014 pour examiner la tendance temporelle et l'impact de la CCMO. Un modèle de régression logistique ajusté à plusieurs variables a été employé.

Résultats : La pseudo-cohorte comprenait 23 215 individus représentant une population d'environ 8,7 millions de personnes. Dans l'ensemble, 20,0 % des répondants ont signalé ne pas avoir de CCMO. Cette proportion a légèrement augmenté, passant de 19,6 % (intervalle de confiance [IC] à 95% [17,5; 22,5]) à 20,7 % (IC à 95% [16,9; 23,1]). Les rapports de cote (RC) corrigés montrent que les personnes non assurées sont moins susceptibles, dans une proportion de 23 %, d'utiliser leurs médicaments (RC = 0,77, IC à 95% [0,657; 0,911]).

Conclusion : Il y a eu une légère baisse de la CCMO au fil du temps et cette baisse est associée à une réduction de l'utilisation des médicaments pour le diabète de type 2 et l'hypertension.

Background

Prescription medications are the cornerstone of hypertension and type 2 diabetes management (Canadian Diabetes Association Clinical Practice Guidelines Expert Committee et al. 2013; Daskalopoulou et al. 2015). These include oral medications that not only slow the progression of hypertension and type 2 diabetes but also reduce adverse clinical outcomes. Despite the availability of effective medications, there are barriers to optimizing therapy (Brown and Bussell 2011). Particularly important is poor medication adherence, which is the

main contributor to the poor management of these conditions (Burt et al. 1995; Canadian Diabetes Association Clinical Practice Guidelines Expert Committee et al. 2013).

Adherence is defined as "the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a healthcare provider" (Sabaté 2003). The World Health Organization (WHO) has estimated that in developed countries, almost half of the patients are non-adherent to their medications (Sabaté 2003). The WHO's theoretical framework conceptualized five main adherence barriers, including social and economic factors, healthcare team–related and system-related factors, condition-related factors, therapy-related factors and patient-related factors (Sabaté 2003).

Medication cost is one of the economic factors that can impact medication adherence (Law et al. 2012). In a national survey carried out by Angus Reid (2015), 23% of Canadians reported that they did not adhere to their prescription regimen due to the cost of the medication. Similarly, in a survey of Medicare beneficiaries in the US, 56% had not filled at least one prescription medication because they "thought it would cost too much," and 20% had chosen to not fill a prescription because the "medicine was not covered by insurance" (Kennedy et al. 2008). Notably, cardiovascular medications accounted for 18% of unfilled prescription medications, and endocrine/metabolic agents accounted for 7% (Kennedy et al. 2008). These and similar studies suggest that relieving patients from high medication cost through prescription medication cost coverage (PMCC) could help improve adherence (Viswanathan et al. 2012).

Canada is the only developed country with a universal health insurance system that does not offer universal coverage for medications (Morgan et al. 2015). Although provincial governments generally cover the cost of prescription medications for people who meet certain criteria (such as people who are on social assistance or people whose medication cost exceeds a certain percentage of their income; Lewis 2020), this coverage does not include the whole Canadian population. Previous research has identified a medication coverage gap in Canada, whereby a significant number of Canadians do not have the needed support for the cost of their prescription medications through their employment (Health Canada 2019). As such, the Advisory Council on the Implementation of National Pharmacare recommended implementing universal prescription coverage to all Canadians (Health Canada 2019). It is estimated that about two thirds of Canadian households face out-of-pocket expenses for their prescription medications and that about one in 10 Canadians have cost-related medication non-adherence (Law et al. 2012). Although previous research has looked at this issue at single points in time (Gee et al. 2012), trends in PMCC in Canada, and their impact on medication use and adherence, are still unknown. Examining the changes in PMCC over time is essential for understanding whether the medication-coverage gap is widening in Canada.

The aims of this study were to measure the recent trends in PMCC and to examine the association between absence of PMCC and the use of oral hypertension and type 2 diabetes

medications among adults in Ontario and New Brunswick. Because it seems that fewer Canadians are employed as full-time employees with health benefits, we hypothesized that the percentage of Canadians without PMCC had increased over the study period (Evans 2019; Morissette 2015). This increase may balance out the aging population that becomes eligible for PMCC (i.e., becoming eligible for drug plan coverage because of their age). Measuring the magnitude of association between PMCC and non-medication use helps us understand whether lack of insurance has a significant impact on Canadians and their medication use behaviour. Shedding light on this trend and association can contribute to the national discussion of the potential benefits of providing universal medication coverage.

Method

Study design

To perform this study, we examined the self-reported medication use of a large sample of respondents with two specific chronic diseases (hypertension and type 2 diabetes) from the provinces of Ontario and New Brunswick, using cycles from the Canadian Community Health Survey (CCHS). We included data from a seven-year period (2007–2014) and used a repeated cross-sectional study design.

Data source

The CCHS is a cross-sectional survey of a representative sample of community-dwelling Canadians 12 years of age and older. The collection period for the CCHS is divided into 12 two-month periods and spans two years. This facilitates the option of combining cycles and examining time trends. The risk of respondents' re-inclusion (appearing in more than one annual cycle) is very low (Thomas and Wannell 2009). The CCHS excludes populations living on First Nations reserves in the provinces, full-time members of the Canadian Armed Forces, institutional residents and persons living in the Inuit and Cree regions of Quebec. Altogether, these excluded populations account for less than 3% of the Canadian population (Statistics Canada 2011).

This survey uses a complex sampling design (stratified and clustered) to provide estimates at the health region (sub-provincial) level. To calculate accurate estimates of variance and to account for design effects, Statistics Canada provides a set of weights to be used with bootstrap re-estimation procedures (Chatrchi et. al 2015).

The design of the CCHS allows provinces to purchase or opt in to its optional modular content. The PMCC question was available for patients of Ontario and New Brunswick in the years 2007, 2008, 2013 and 2014. This combination of provinces/years allowed us to examine the trend over the longest available period.

Cohort

Respondents were included in this study if they were 18 years of age or older on the date of

the survey, had type 2 diabetes or hypertension and had answered the questions about oral medication use and PMCC status. Type 2 diabetes was identified using the derived variable specifications provided by Statistics Canada (Ng et al. 2008). Respondents who were pregnant at the time of diagnosis with hypertension or diabetes, had Alzheimer's disease or did not respond to the questions regarding hypertension or type 2 diabetes or their PMCC status were excluded.

Measurements and confounding variables

In the CCHS survey, the exposure of interest was absence of PMCC. This was assessed using the question "Do you have insurance that covers all or part of the cost of your prescription medications?" Respondents who answered "no" were considered exposed, while respondents who answered "yes" were considered not exposed. The outcome of interest was the use of oral hypertension and type 2 diabetes medications. Medication use for hypertension was assessed using the following question: "In the past month, have you taken any medicine for high blood pressure?" For type 2 diabetes oral medication, the question was as follows: "In the past month, did you take pills to control your blood sugar?" Respondents who answered "yes" were considered to be using their medication, while respondents who answered "no" were considered to not be using their medication. The validity of these questions has been previously established (Allin et al. 2013). For respondents who had both hypertension and type 2 diabetes, they were classified as not using their medication if they indicated they were not using medications for either disease (hypertension or type 2 diabetes). A sensitivity analysis was also conducted to examine the robustness of this consideration by requiring a "no" answer to both questions in order for the respondent to be classified as not using medication.

We considered several independent variables as potential confounders based on the WHO's theoretical framework that includes sociodemographic characteristics, healthcare-system use, condition-related and therapy-related factors and patient-related factors (Sabaté 2003). Table A1 in Appendix 1 (available online at longwoods.com/content/26351) shows the definition of each variable and the corresponding CCHS coding considered for this study.

Sociodemographic characteristics included age (18–29, 30–44, 45–64, or 65+), sex (male or female), education level (less than secondary school graduation, secondary school graduation and post-secondary school graduation), household income quintile, main source of household income (employment, government support or other) and province (Ontario or New Brunswick). In addition, because racial inequalities affect health behaviour beyond socioeconomic factors (Ramraj et al. 2016), we also included race (Aboriginal, White, other) as a potential confounder. Indicators for healthcare-system use included whether the respondent had a regular medical doctor (yes or no) and had taken a flu shot (yes or no). Condition-related and therapy-related factors included smoking status (smoker/non-smoker) and alcohol consumption (regular drinker, occasional drinker or did not drink in the last

12 months), diagnosis of the diseases of interest (hypertension alone, type 2 diabetes alone or hypertension and type 2 diabetes together). Our analysis also considered including self-reported presence of other health problems, including asthma (yes/no), arthritis (yes/no), back problems (yes/no), migraine (yes/no), cardiovascular disease (heart disease/stroke or none), cancer (yes/no), gastrointestinal disease (yes or no), mental health issues (yes or no) and having stayed overnight in hospital in the past 12 months (yes or no). For patient-related factors, hospital stay in the past 12 months and self-reported general health were included. General health was categorized as a three-level indicator where "excellent," "very good" and "good" were considered as "good" and collapsed into one category, and the other two categories were "fair" and "poor."

Statistical analyses

First, we examined relationships between each independent variable and PMCC status, using χ^2 tests of independence. Then, a multivariable logistic regression model was constructed to examine the relationship between PMCC and hypertension/type 2 diabetes medication use following a stepwise forward-selection approach (Bursac et al. 2008).

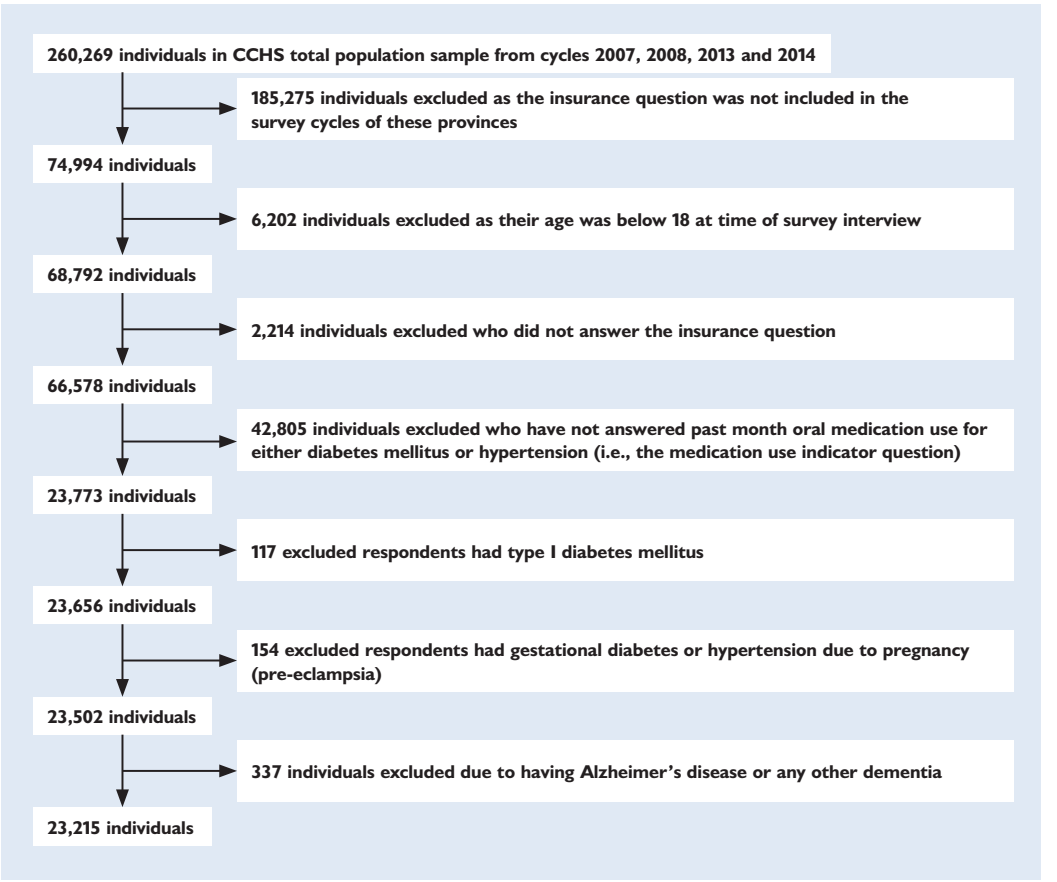
All of the independent variables mentioned were included based on goodness of fit in the full model. However, variables including province, year and household income were forced into the model to control for potential confounding imposed by geographical, time and income factors. To factor total household income as a potential confounder, we used the imputed and derived national-level deciles income variable, which provide a relative measure of a respondent's household income to that of all other respondents' household income on a national level, and is adjusted each year based on the consumer product index (Yeung and Thomas 2013). This income variable is derived by adjusting respondents' reported household income by the low-income cut-off corresponding to their household size and population size. If a respondent's household income was not reported, it was imputed based on the characteristics of respondents. The respondents' adjusted income is then categorized into deciles within all respondents (Statistics Canada 2014). Deciles were collapsed to quintiles to simplify analyses and inferences. The year (of survey) variable was coded as 2007 to 2008 (combined), 2013 and 2014. While the PMCC question was asked in New Brunswick in all years, it was only asked in Ontario starting in 2008. Therefore, combining 2007 and 2008 simplified comparison and inference and balanced the sample size in the three periods. Models were estimated using the bootstrap weights and re-estimation procedure provided by Statistics Canada, to account for the complex design of the survey and to produce more conservative confidence intervals (Shao 2003). We handled independent variables missingness using three strategies and compared the results (Appendix 2, [Amoud 2018]). First, we calculated the percentage of missing data and conducted regression analyses by including only the respondents who had complete data (Sterner 2011). Second, we followed the educated guessing approach for imputation of missing data (Allison 2002). For example, if the smoking status was unknown, we assumed the respondent as a non-smoker. Third, we carried out

five multiple imputations by fitting a logistic regression to predict the missing variable's value, using all other covariates and following the fully conditional specification method (Berglund 2015).

All results presented are weighted. We performed several sensitivity and subgroup analyses within the province of residence, age group, income level, and insurance type.

SAS®, version 9.4 (SAS Institute Inc, Cary, NC) was used. Main model outputs were reproduced using STATA® version 14. Data were provided by Statistics Canada through the South-West Ontario Research Data Centre at the University of Waterloo. Because these are anonymous secondary data subject to the confidentiality procedures of Statistics Canada, no research ethics board approval was necessary.

FIGURE 1. Steps taken to achieve study respondents



Results

Descriptive statistics

Our study sample included 23,215 records, from a total of 74,994 responses in CCHS cycles

2007, 2008, 2013 and 2014 in Ontario and New Brunswick. This translates to 31% of the sample from Ontario and New Brunswick combined. Figure 1 illustrates the steps taken in forming the study sample. Using the population weights provided on the data sets, this final sample represents a weighted population of 8,696,520 Canadians in Ontario and New Brunswick. Overall, 20.0% of the study population indicated that they did not have any drug insurance that covered all or part of the cost of their prescription medication.

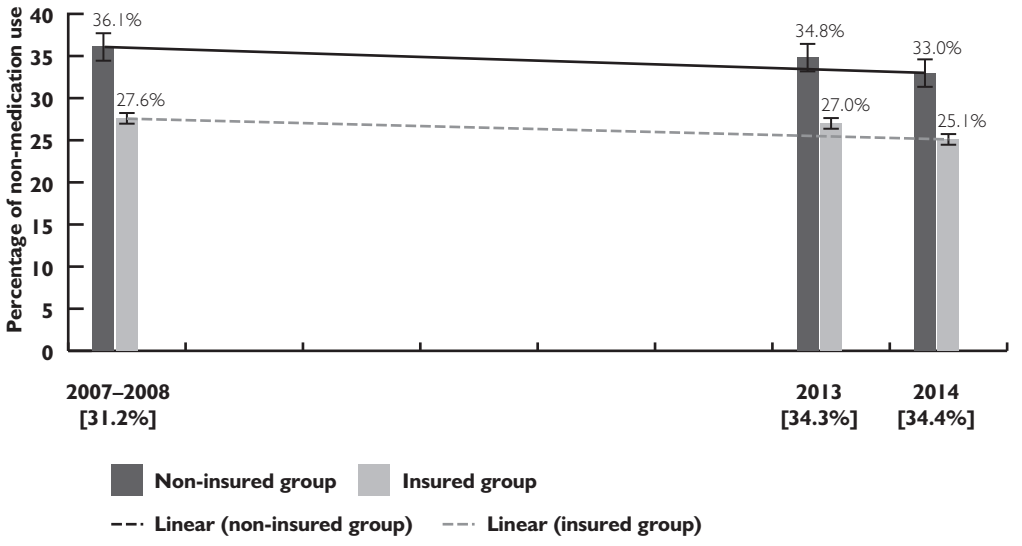
Table 1 (available online at longwoods.com/content/26351) illustrates the characteristics of the sample, weighted to population. Over half of the study population was male (51.2%), and 39.7% were 65 years of age or older. The prevalence of non-medication use was 28.2%. Respondents who did not have insurance had a significantly higher rate of non-medication use compared to those who had insurance (34.6% vs. 26.6%, $p < 0.0001$).

Trend in PMCC

Over the seven-year (2007–2014) study period, the proportion of respondents who did not have PMCC increased slightly by almost 1%, from 19.6% (95% CI [17.5, 22.5]) to 20.7% (95% CI [16.9, 23.1]). While the percentage of non-medication use among people with hypertension and type 2 diabetes decreased over the study period by 8.9% (29.3% to 26.7%), those without insurance showed less improvement in their medication use (8.3% change, from 27.6% to 25.1%) compared to those who had insurance (10.8%, change from 36.1% to 33.0%; Figure 2). In other words, medication use improved over time.

The final multivariable logistic regression model controlled for age, sex, household income, respondent's highest acquired level of education, having either or both diseases

FIGURE 2. Weighted percentage of Canadians with non-medication use by PMCC from 2007 to 2014

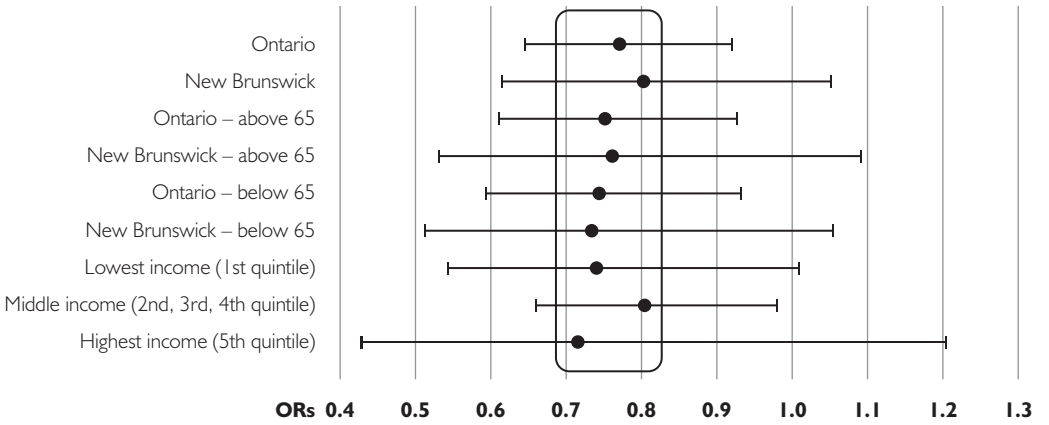


(hypertension/type 2 diabetes or both), smoking status, province of residence, the year the survey was taken as well as not having cancer, a cardiovascular disease, a flu shot or a regular medical doctor. Respondents who did not have PMCC had an adjusted odds ratio (OR) of 0.774 (95% CI [0.66, 0.91]) for either type 2 diabetes or hypertension oral medications use, compared to those who did have insurance. The factors controlled for in the model were statistically significant except for the forced variables (province, income and year). These include age, sex, education level, smoking status, not taking a flu shot, not having a regular medical doctor, not having stroke or heart disease (cardiovascular disease) and not having cancer. Other variables, such as race, were not statistically significant and hence were not included in the final model. The ORs of all included variables are shown in Table 2, available online at longwoods.com/content/26351.

Subgroup analyses

The subgroups analyses showed consistent results in all groups and yielded medication use ORs ranging from 0.7 to 0.8 as shown in Figure 3. The association between PMCC and medication use did not change significantly depending on province of residence, age group or income level. Among Ontarians who were 65 years of age or older (i.e., who are eligible for the public drug plan), the estimated OR of medication use with not having PMCC for this subgroup was 0.75 (95% CI [0.61, 0.93]). Having more than one plan was associated with better medication use. Those who had more than one type of insurance (private/employer with governmental) had a higher odds of medication use (OR = 1.44, 95% CI [1.12, 1.86]) as compared with having only governmental insurance. Additionally, results of further subgroup analyses are illustrated in Table A3 of Appendix 2 (available online at longwoods.com/content/26351).

FIGURE 3. ORs of medication use with no PMCC in subgroups with 95% CI



Sensitivity analyses

Unlike the main analysis, in which respondents who had both hypertension and type 2 diabetes had to have answered "yes" to using both medications to be classified as using their medication, we carried out sensitivity analyses with four different approaches to identifying medication use, to test the robustness of our definition of medication use (Models 2–5, Table 3, available online at longwoods.com/content/26351) (Lyles and Lin 2010). None of the analyses resulted in substantial changes to the ORs. Remarkably, 17.1% (n = 1,819) of Ontario seniors answered "no" to having PMCC, in spite of having an automatic PMCC through the Ontario provincial plan (Government of Ontario 2016). We carried out further sensitivity analyses by considering all Ontario seniors to have PMCC, and the odds did not shift substantially. The results of these analyses are illustrated in Table 3 (Models 6–7).

Misclassification of type 1 diabetes respondents as type 2 was suspected, as some respondents with diabetes reported using insulin at a very young age but also answered questions about their oral medication use. We observed that all respondents who answered "yes" to having type 2 diabetes were provided with the question for adhering to oral medication for diabetes, and the question was not restricted to those who had type 2 diabetes. Statistics Canada's algorithm to differentiate type 2 diabetes from type 1 classified respondents who answered "yes" to using oral anti-diabetic medications as being type 2. This misclassification was found to affect 1% (289) of the study population. We performed sensitivity analyses by removing those diagnosed with type 2 diabetes at an age less than 30 years (Shields et al. 2015). The resulting OR was very similar to the ORs in the main analysis. Model 8 in Table 3 shows the OR after this removal.

Considering the methods for addressing missing values, the ORs produced by the three different strategies did not differ substantially from the main analysis (OR = 0.77, 95% CI [0.66, 0.91]). See Table A2 in Appendix 2 (available online at longwoods.com/content/26351).

Discussion

Similar to previous studies (Law et al. 2012; Men at al. 2019; Tamblyn et al. 2014), we used regression analysis to adjust for confounding effects. Several other methods are available, such as propensity score matching (Kratzer et al. 2015) or utilizing instrumental variables (Angrist et al. 1996); however, no one method can be considered as the most advantageous in observational research (Elze et al. 2017; King and Nielsen 2019; Linden 2014).

We studied PMCC in a representative sample of two Canadian provinces, Ontario and New Brunswick, over seven years. Over that study period (2007–2014), the percentage of respondents without PMCC in these two provinces may have increased slightly, from 19.6% (95% CI [17.5, 22.5]) in 2007–2008 to 20.7% (95% CI [16.9, 23.1]) in 2014. As for the confounding variables, the results of the statistical model were consistent with previous research showing that smoking, not having a flu shot, not having a medical doctor and being female decreases the odds for medication use (Meichenbaum and Turk 1987; Sherman and Lynch

2014; World Health Organization 2014). On the other hand, increase in age increased the odds for medication use. Medication use was also found associated with having less disease burden such as one disease (hypertension or diabetes) instead of both, or no other cardiovascular diseases (heart disease or stroke), or not having cancer (Brown and Bussell 2011; Yang et al. 2009). People who did not have PMCC were 23% less likely to use their oral medications for type 2 diabetes and/or hypertension compared to people who had PMCC (medication use OR 0.77, 95% CI [0.66, 0.91]). This translates into an 8% absolute decrease in use of oral type 2 diabetes and hypertension medications. As such – assuming a causal relationship – providing PMCC to 13 patients, may help one patient use their medication. In a subgroup analysis, for those who had PMCC, having more than one type of insurance would increase the odds of medication use by 44%.

The Canadian Institute for Health Information (CIHI [2019]) reported a continuous increase in household out-of-pocket health expenditure between 1988 and 2017; the annual growth rate for this expenditure – including prescription medication cost – for patients was 2.2%. Our findings of 1% more people not having PMCC cannot sufficiently explain this increase in out-of-pocket health expenditure. In fact, this increase in the percentage of respondents who did not have PMCC over the study period may be due to natural variability (i.e., noise). As such, the increase in chronic diseases prevalence (Public Health Agency of Canada 2019), the aging of the population and the availability of more new expensive medications may explain some of this trend (CIHI 2011). From 1988 to 2017, an increase of 4.1% in private insurance expenditure was reported (CIHI 2019). Increased cost of chronic medications may have contributed to this rise in expenditure. For example, between 2014 and 2015, spending for diabetes medications increased by 10.2% within private insurance (Welds 2017). Nevertheless, our findings confirm that financial burden is still a major obstacle that prevents patients from taking full advantage of chronic medications, including those for type 2 diabetes and hypertension (Law et al. 2018). Almost 20% of Canadians do not have PMCC. This represents a substantial number of Canadians without insurance.

PMCC in Canada is closely related to the state of the economy (Sanmartin et al. 2014), and therefore, economic conditions might offer some explanation for this trend of staying at the same level (Sutherland and Dinh 2017), if not increasing. Specifically, the "working poor," who are the most vulnerable to economic cycle changes (Bernard 2014), are also mostly affected by the burden of drug cost (Caldbick et al. 2015). Thus, it can be speculated that the economic crisis of 2008, which was associated with increased unemployment rates, might have trumped any improvement in PMCC. As such, a national Pharmacare program has been suggested as an effective intervention to fill gaps in PMCC while providing overall cost savings to the system.

Our results support previous studies that show that older Canadians who have hypertension use their medication more than their younger counterparts and that people with cardiovascular diseases (such as heart disease or stroke) have higher odds of using their

medication (Campbell et al. 2008; DiMatteo et al. 2007). Thus, the increase in age and chronic disease burden over time may explain increased medication use in people with a chronic disease such as hypertension or type 2 diabetes.

Matching with previous studies, we found that medication use is increasing over time (Fang 2020; Montvida et al. 2018; Tajeu et al. 2016; Tajeu et al. 2019). However, although we found a trend toward improvement in medication use over time, the extent of improvement among uninsured patients was lesser and may have been hindered by the absence of PMCC (Gai and Gu 2009). This is because not having PMCC can add to the financial struggle of cost-related non-adherence (Goldsmith et al. 2017; Gupta et al. 2018; Kennedy and Morgan 2009; Morgan and Lee 2017). The lack of PMCC may divest patients from fully benefiting from the positive improvement in medication use. As such, we suggest that PMCC is important for ensuring that Canadians have equitable access to treatments that can prevent some of the devastating clinical outcomes of hypertension and type 2 diabetes.

Consistent with previous findings, in the subgroup analysis of those who had PMCC, having two types of insurance, rather than only one type, increased the odds for medication use (Kratzer et al. 2015). This implies a dose–response or exposure–response relationship. That is, an increase in insurance coverage increases the odds for medication use. We think that this is evidence that public and private insurance programs can complement each other to provide patients with more comprehensive coverage. Universal public coverage could be seen as coverage that provides basic access to medication. Private insurance could extend medication access by working with public coverage to increase accessibility to a wider range of medications beyond the basic needs.

Policy implications

Universal coverage for medications was intended to be added to the Canadian universal healthcare system (Medicare; Brandt et al. 2018). Over the past 50 years, since the inception of the Canadian Medicare, the introduction of universal PMCC (i.e., Pharmacare) was discussed repeatedly in Canada. Recently, the final report of the Advisory Council on the Implementation of National Pharmacare, A Prescription for Canada: Achieving Pharmacare for All, recommended a PMCC in Canada that covers all essential medication to all Canadians (Health Canada 2019). On the other hand, in November 2019, 1,300 health professionals and public policy experts wrote a letter directed to members of the 43rd Parliament of Canada, advocating and asking for necessary legislation and budget commitments in 2020 for a comprehensive public Pharmacare plan (Pharmacare 2020).

The Canadian Pharmacists Association advised governments and policy makers to examine the evidence on financial barriers to medication adherence, to gain a better understanding of what is impeding optimal health outcomes of effective medications (Canadian Pharmacists Association 2015). Non-adherence is a significant problem for cardiovascular and diabetic patients. Quantifying the association between PMCC and non-medication helps explain the impact of the lack of PMCC on Canadians and their medication adherence

behaviour. Non-adherence is significantly associated with all-cause hospitalization in older people (adjusted OR = 1.17, 95% CI [1.12, 1.21]) and mortality (adjusted hazards ratio = 1.24, 95% CI [1.14, 1.35]; Walsh et al. 2019). In fact, medication non-adherence can incur annual economic costs to the healthcare system. Costs attributed to non-adherence in cardiovascular diseases ranged from $3,347 to $19,472 per patient annually (Cutler et al. 2018), when all costs were added. Medication non-adherence also increases healthcare costs for diabetes patients (Kennedy-Martin et al. 2017). Thus, increasing the use of medications by removing patients' financial barriers is expected to be cost-saving. Although improved adherence increases drug costs, this adherence offsets non-drug costs (i.e., healthcare costs). Therefore, the net total costs are decreased as a result of medication adherence (Muszbek et al. 2008). Creating drug-coverage programs for treating chronic conditions such as diabetes and hypertension can be beneficial and cost-saving and a step forward toward including more Canadians with PMCC (Brandt et al. 2018; Lewis 2020). In Ontario, there are incentive fees for primary healthcare providers for chronic disease management, including diabetes and congestive heart failure (Ontario Ministry of Health 2020). This is because providing better care for patients with chronic diseases is a robust approach to improve health and save cost. As such, implementing PMCC, even if starting with chronic diseases (such as hypertension and diabetes), should complement systems already in place that aim to enhance chronic disease managements by primary healthcare providers. Finally, starting with provision of PMCC for patients with hypertension and diabetes is of best interest for the healthcare system offsetting dire consequences of non-adherence due to prescription cost barriers. Results from this study can assist policy makers and administrators in evaluating the pressing need for improvement of medication use. The results also convey the characteristics of people, within the population, at a disadvantage from lack of PMCC.

Our use of repeated cross-sectional survey data is an advantage over other designs for answering the questions ((Kelsey et al. 1986). First, this design provides a valuable glimpse of the real-world association between no PMCC and medication use in the Canadian population with type 2 diabetes and hypertension at multiple points in time. Second, this design provides a clear examination of the trend in the impact of lack of PMCC on medication use related to two of the most important chronic diseases in Canada.

Limitations

Despite these advantages, there are some limitations to this study. Most are related to the self-reported nature of the surveys. For example, some respondents with type 1 diabetes seem to have answered "yes" to adhering to oral medications, which they are unlikely to have been prescribed. This may have led to some respondents being misclassified as having type 2 diabetes. Also, some respondents might have also misreported their PMCC status by not considering copayment to be PMCC (Grootendorst et al. 2003). This potential misreported PMCC status represents 6.2% of the total study population who were classified as having no PMCC. In Ontario, the Ontario Drug Benefit plan is activated on the first day

of the month after residents turn 65 years (Government of Ontario 2016). As for people from New Brunswick, we were unable to quantify the potential misclassification. In New Brunswick, seniors turning 65 years or older have a 60-day mail notice notifying them to apply for provincial coverage for prescription medication (Government of New Brunswick 2018). Numerous sensitivity analyses were carried out and revealed that these possible misclassifications had minimal influence on our results. Furthermore, respondents could have been classified as not using their medication, while in reality they may have initially not been prescribed any. This limitation is challenging to quantify. However, this is probably non-differential misclassification and hence could not have affected the estimated OR of the association between PMCC and medication use. Due to the nature of this study in using self-reported data, some variables that could have an impact on the relationship between PMCC and medication use could have been missed. For example, according to the health belief model (Becker 1974; Glanz et al. 2008), patients' attitude and perception of the severity and susceptibility to diabetes and hypertension affect medication use (Harrison et al. 1992). However, such variables were unmeasured in the CCHS. Lastly, because the medication use question asked about past month use, some respondents might have overestimated their monthly use of medication. Arguably, this overestimation could have increased the odds for medication use, and our final results may be an underestimation of the actual underuse of medication due to the absence of PMCC. It is also possible that some respondents may have had hypertension and/or type 2 diabetes but were never prescribed any medication. The extent of this limitation could not have been sought out, although an update about the epidemiology of hypertension in Canada found that about 90% of respondents who reported having high blood pressure also indicated that they were receiving treatment (Padwal et al. 2016).

Conclusion

Our study found that people without PMCC are more likely to underuse their medications. We were able to quantify these odds, which we estimate are 23% less than for those who do have PMCC with hypertension and/or type 2 diabetes. Over a seven-year time period (2007–2014), the percentage of respondents without PMCC increased slightly. Medication use improved over time, yet, despite this improvement, respondents without PMCC had limited improvement in medication use compared with those with PMCC. Overall, this study provides evidence that a lack of PMCC is a barrier to proper medication use. In addition, this study provides necessary real-world evidence for the argument that PMCC is indeed likely to improve oral medication use for hypertension and type 2 diabetes in Canada.

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