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Correlates of partner and family violence among older Canadians: a life-course approach

M. Miszkurka, PhD (1, 2); C. Steensma, MSc (1, 2); S. P. Phillips, MD (3)

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Abstract

Introduction: Knowledge about individual and interpersonal correlates of violence in Canadian seniors is limited. This study identifies correlates of current and past violence by intimate partner and family member(s) in community-dwelling Canadian seniors, while accounting for childhood adverse circumstances.

Methods: We performed logistic regression analysis of baseline data from a longitudinal study of community-dwelling individuals aged 65 to 74 years and living in Kingston (Ontario) and Saint-Hyacinthe (Quebec). Domestic violence was assessed using the Hurt-Insult-Threaten-Scream (HITS) screening tool. Odds ratios (ORs) are reported with 95% confidence intervals (CIs).

Results: Current violence of a psychological nature was reported by 18% of the sample. Women were at greater risk of current and lifetime violence perpetrated by a family member (current violence: adjusted OR = 1.83; 95% CI: 1.02–3.30) as well as experiencing violence from their intimate partner in their lifetime than were men (adjusted OR = 2.48; 95% CI: 1.40–4.37). Risk factors have accumulated over the life course that were found to be consistently associated with both current and lifetime violence included having witnessed violence at home in childhood (lifetime violence by family member: adjusted OR = 9.46; 95% CI: 5.11–17.52), as well as poor quality of relationships with intimate partners, family and friends.

Conclusion: Our research documents the ongoing impact of early adversity on subsequent partner and family violence in Canada. Findings identify some preventable factors associated with current psychological violence and past violence among community-dwelling Canadian seniors.

Keywords: *Interpersonal violence, seniors, life course, adversity*

Highlights

- Knowing what leads to elder abuse can help in developing programs that identify, prevent and minimize this violence. This will be increasingly important as the Canadian population ages.
- 9.6% of 65- to 74-year-old seniors who lived in the community said a family member had been violent towards them in the last 6 months. 18% reported psychological violence by a partner in the same period of time (past 6 months).
- More women than men said that a partner or family member had been psychologically or physically violent towards them.
- People who witnessed violence at home when they were children or had poor relationships with their intimate partner or family or friends were more likely to experience short-term and long-term domestic violence.
- Preventive policies should aim at breaking the circle of violence in the earliest possible stages.

Introduction

The World Health Organization definition of violence includes all types of physical and psychological abuse that present a substantial burden on individuals, families and communities.[1] Common types of abuse include physical violence as well as neglect, verbal and financial abuse[2] and, in the case of intimate partner violence, emotional abuse.[3] Older people constitute a susceptible group for partner and family violence. Approximately 7% of non-institutionalized older Canadian adults report some form of maltreatment.[4] This violence has serious health consequences for older adults and is a public health issue for communities.

Interpersonal violence is both predicted by and has a negative impact on development, family relationships and support.[5] Health- and age-related characteristics such as cognitive impairment, chronic disease and needing assistance with daily living activities are strong predictors of abuse as are interpersonal issues such as conflict with family and friends.[6] Women are at greater risk of violence by a partner, and women with disabilities are at particular risk for severe violence.[7]

Exposure to violence early in life can contribute to subsequent poor health, alcohol dependence and conjugal violence.[8] Similarly, experiences of violence across the lifespan are associated with

Author references:

1. Health Promotion and Chronic Disease Prevention Branch, Public Health Agency of Canada, Montreal, Quebec, Canada
2. Department of Social Science and Preventive Medicine, Université de Montréal, Montreal, Quebec, Canada
3. School of Medicine, Queen's University, Kingston, Ontario, Canada

Correspondence: Malgorzata Miszkurka, 200 boul. René-Levesque Ouest, Tour Est Bureau 1102, Montréal, QC H2Z 1X4; Tel: 514-283-4081; Fax: 514-496-7012; Email: malgorata.goshia.miszkurka@phac-aspc.gc.ca

poorer mental and physical well-being[9] and can predict current victimization.[10] However, few studies of elder abuse have taken a life-course approach that investigates early exposures to adversity and/or violence as predictors of violence in seniors. In addition, there is a dearth of original research on correlates of violence in older Canadian adults in general and on comparative analyses examining seniors' experiences of interpersonal violence by an intimate partner or family member in particular. Such information can help inform policies and interventions that prevent, identify and minimize elder abuse—which will be of increasing importance as the Canadian population ages.

Our study examines both individual (behavioural, health and socioeconomic) and interpersonal (partner/family relationships) correlates of lifetime and current physical and psychological violence experienced by older Canadians while also accounting for the long-term impact of childhood adversities.

Methods

We analyzed baseline data (2012) from the two Canadian sites of the International Mobility in Aging Study (IMIAS) of community-dwelling individuals aged 65 to 74 years old. Participants were recruited to the IMIAS study by letter from their family physician. Approximately 30% of those who received invitations contacted the research team in Kingston, Ontario (n = 398 total, n = 186 men, n = 212 women) and Saint-Hyacinthe, Quebec (n = 401 total, n = 191 men, n = 210 women), with a 95% rate of participation following that initial contact. Participants were excluded if they presented a higher risk for dementia on standardized testing. All modules embedded within the questionnaire were previously validated and translated from English to French. Interviewer training and protocol instructions were identical for both locations.

We obtained ethics approvals from Queen's University and the University of Montréal.

Measures

Outcome variable: We assessed domestic violence using the screening tool Hurt-Insult-Threaten-Scream (HITS), which had been previously validated in both female and male samples.[11] Participants were asked if they ever or in the past six months had had a partner or family member who screamed at, insulted, threatened, cursed, talked down to or physically hurt them. Responses were summarized separately for current and lifetime physical and psychological violence according to the perpetrator (intimate partner or family member). For the present study, responses were dichotomized as follows: answers of ''sometimes,'' ''fairly often'' and ''frequently'' were coded as ''yes'' for physical violence; for psychological violence, answers of ''fairly often'' and ''frequently'' were collapsed into the ''yes'' category. Four separate outcomes were subsequently defined: current psychological intimate partner violence; current psychological family member violence; and by combining lifetime physical and lifetime psychological violence for each, lifetime intimate partner violence and lifetime family member violence.

Individual characteristics. Sociodemographic characteristics included age, immigrant and marital status, sex, education, occupation, annual income and self-reported income sufficiency for basic needs. Two measures of health status were used: body mass index and the average cumulative number of key chronic conditions (high blood pressure, arthritis, osteoporosis, lung disease, cancer, heart disease, cerebrovascular disease or diabetes). An activities of daily living indicator identified those unable to independently bathe, dress, toilet hygiene, transfer, or feed.[12] The Nagi questionnaire was used to quantify self-rated mobility limitation,[13] while the number of falls in the previous 12 months was documented using the Falls Efficacy Scale International (FES-I).[14] We assessed health behaviours using alcohol consumption, smoking and body mass index.

Interpersonal characteristics. IMIAS data included living arrangements (alone, only with partner, with children and/or partner and/or others). We created a social activities score based on the frequency of visits to community/recreation centres, seniors' associations, stores/malls or religious activities in the preceding 12 months, and quantified relationship quality based on satisfaction with relationships with friends and family. A partnership quality score summarized responses to questions about feeling loved and appreciated by, and listened to and important to one's intimate partner.

Life course adverse experiences. IMIAS assessed adverse experiences during the first 15 years of life based on the Survey on Health, Well-Being and Aging (SABE).[15] We included measures of childhood poverty, hunger, prolonged parental unemployment, witnessing violence at home, parental alcohol or drug abuse, and divorce.

Statistical analyses

The selection of potential factors associated with violence in seniors was guided by a social-ecological framework for violence prevention[16] that considers the complex interplay between factors at the individual, relationship, community and societal level. The categorization of some variables may differ slightly across our constructed models as multiple categories were occasionally collapsed.

We used Student's *t* test and chi-square testing to examine the differences in distribution between men and women for all individual, interpersonal and violence characteristics. To test the relevance of life-course experiences of violence, we cross-tabulated current and past violence to examine the portion of the sample that reported past and current violence. Collinearity testing between independent variables was performed using linear regression by requesting collinearity diagnostics for each multiple regression model. The model building consisted of four major steps. First, bivariate logistic regression analyses were performed to assess the associations between individual independent variables and each of the four violence outcomes. Variables that were associated with violence ($p < .05$) were subsequently entered in multivariable models. Age as a covariate was assessed but was not included in any of the bivariate or multivariable models because it did not significantly influence any of the models and was of minimal interest in this study population due to the narrow age range. Three different multivariable logistic regression models were constructed for each of the four categories of violence. The first model included all significant individual and interpersonal characteristics. Variables for life-course experiences of violence were then progressively introduced into the second model, followed by indicators

of childhood adverse circumstances in the third. To examine differences in men's and women's experiences of violence, interaction terms between sex and factors included in each model were tested for their statistical significance: we found no significant interactions. All models were adjusted for place of birth, annual income, education and occupation. P values under .05 were considered statistically significant. Odds ratios (ORs) and adjusted odds ratios (aORs) were calculated with 95% confidence intervals (CIs). Analyses were undertaken using SPSS version 21 (IBM, Chicago, IL, USA).

Results

Sex differences in Canadian IMIAS participants'characteristics and circumstances are shown in Table 1.

In total, 18% of participants reported violence by an intimate partner in the past six months (Table 2). There were no sex differences in reporting recent partner violence. However, women reported more lifetime psychological (16.6% versus 10.3%, $p < .01$) and physical violence by a partner (7.1% versus 0.8%, $p < .0001$) than did men. Psychological lifetime violence by a family member was more than twice as frequent among women than men (12.1% versus 4.8%, $p < .0001$).

Tables 3 to 6 show the unadjusted and adjusted associations for each of the four violence experiences: current psychological violence by a partner, lifetime violence by a partner, current psychological violence by a family member, and lifetime violence by a family member.

Current psychological violence by a partner

Significant problems walking 400 metres, having had two or more falls in the previous 12 months, and drinking every day were strongly associated with psychological violence by a partner in the previous six months (see Table 3). Life-course experience of violence by an intimate partner and witnessing violence at home during childhood were also strongly associated with current psychological partner violence. On the other hand, living only with a partner/spouse rather than with children or others appeared to be protective, as was higher relationship quality.

In multivariable models, with the exception of falls, all of the correlates remained independently associated with the outcome. Life-course experience of violence by a partner and difficulties with walking were the strongest independent correlates of current psychological partner violence. Individuals who reported experiencing violence in their lifetime from an intimate partner were more than five times more likely to experience intimate partner violence of a psychological nature in the previous six months (aOR = 5.29; 95% CI: 2.71–10.33). Compared to those without mobility limitations, difficulty walking 400 m was associated with a five times higher likelihood of current partner violence (aOR = 5.00; 95% CI: 1.53–16.29). Previous experience of intimate partner violence had only a small explanatory value with respect to the link between heavy alcohol consumption and current psychological partner violence. Inclusion of witnessing violence at home in childhood did not significantly change other associations but remained significant in and of itself.

Lifetime violence by a partner

Being female, daily alcohol consumption, obesity, living with children, problems with mobility or activities of daily living, falls, and early experiences of parental drug/alcohol abuse and parental divorce were all individually associated with intimate partner violence across one's life, as was earlier abuse by a family member (OR = 4.16; 95% CI: 2.52–6.85) (Table 4).

In multivariable analyses, sex, daily alcohol consumption (aOR = 6.83; 95% CI: 2.30–20.23), obesity, and early experiences of violence by a family member or parental divorce remained independently associated with lifetime violence by a partner. Experiencing lifetime violence by a family member appeared to partially explain the association between daily alcohol use and lifetime partner violence (see difference between multivariable models 1 and 2). Adverse childhood experiences (parental divorce or drinking/drug use) also partially explained the association between earlier violence by a family member and lifetime partner violence (see difference between multivariable models 2 and 3).

Current psychological violence by a family member

Individual correlates of psychological violence in the previous six months by a family member included being female, self-perceived insufficient income, living with a child, poor relationships with family members and/or friends, and witnessing physical violence between family members in childhood (Table 5). Lifetime violence also increased the likelihood of current psychological violence by a family member (OR = 2.68; 95% CI: 1.54–4.61). The association between living with a child/others and the outcome was substantially reduced in a multivariable model adjusted for individual/interpersonal characteristics (model 1) and was no longer significant in the final model. The inclusion of past violence and adverse childhood circumstances did not change associations between current characteristics and the outcome.

Lifetime violence by a family member

Being female, being widowed or separated/divorced, self-perceived insufficient income, problems with mobility or activities of daily living, and smoking each increased the likelihood of violence across the lifespan by a family member, as did low quality and quantity of relationships (Table 6). Early circumstances such as hunger, parental divorce, parental substance abuse, and witnessing violence at home were strong predictors of lifetime violence by family members. In the multivariable model including all current characteristics (model 1), being female and having few friends, poor relationships with family and friends, and limitations in activities of daily living were each independently associated with lifetime violence by a family member. Similarly, lifetime experience of violence by a partner was strongly linked to lifetime violence by family members (aOR = 3.58; 95% CI: 1.88–6.83). Witnessing physical violence at home during childhood remained the strongest factor associated with lifetime violence by a family member (aOR = 9.46; 95% CI: 5.11–17.52).

Discussion

In this Canadian study of community-dwelling seniors we report on individual

TABLE 1
Distribution of individual and interpersonal characteristics by sex

Characteristic	Percentage (n)			*p* value
	Total (n = 799)	Men (n = 377)	Women (n = 422)	
Individual				
Marital status				
Single (never married)	4.6% (37)	3.2% (12)	5.9% (25)	.000
Married/common law	66.1% (528)	77.5% (292)	55.9% (236)	
Widow/widower	10.6% (85)	4.2% (16)	16.4% (69)	
Separated/divorced	18.6% (149)	15.1% (57)	21.8% (92)	
Perceived income				
Insufficient	6.4% (51)	4.0% (15)	8.5% (36)	.009
Suitable	41.1% (328)	39.3% (148)	42.7% (180)	
Sufficient	52.6% (420)	56.8% (214)	48.8% (206)	
Chronic diseases (mean number)	1.79	1.65	1.92	.004
Problem walking 400 m	14.3% (114)	11.5% (43)	16.9% (71)	.056
Fall during last year	30.5% (244)	28.6% (108)	32.2% (136)	.154
Daily living activities: one limitation or more	19.3% (154)	16.2% (61)	22.0% (93)	.087
Alcohol consumption				
None	22.2% (177)	16.8% (63)	27.1% (114)	.000
Less than weekly	29.4% (234)	24.5% (92)	33.6% (142)	
Weekly	45.3% (361)	53.5% (201)	38.0% (160)	
Daily	3.1% (25)	5.3% (20)	1.2% (5)	
Severity of drinking (mean number of drinks/sitting)	3.58	4.08	3.13	.000
Current Smoking	7.3% (58)	7.7 % (29)	6.9% (29)	.661
Body Mass Index				
Underweight	2.8% (22)	1.3% (5)	4.0% (17)	.016
Normal	28.2% (225)	24.9% (94)	31.0% (131)	
Overweight	31.4% (251)	34.2% (129)	28.9% (122)	
Obese	37.7% (301)	39.5% (149)	36.0% (152)	
Adverse childhood circumstances				
Poverty	27.8% (222)	29.4% (111)	26.3% (111)	.181
Hunger	5.0% (40)	4.8% (18)	5.2% (22)	.453
Parents out of work	8.4% (67)	9.3% (35)	7.6% (32)	.443
Parental divorce	3.4% (27)	3.2% (12)	3.6% (15)	.846
Parental substance abuse	14.6% (117)	13.0% (49)	16.1% (68)	.230
Witnessed violence at home	13.5% (108)	9.3% (35)	17.3% (73)	.001
Interpersonal				
Living situation				
Living alone	28.9% (231)	17.5% (66)	39.1% (165)	.000
With spouse	55.4% (443)	58.9% (222)	52.4% (221)	
With spouse & child	12.5% (100)	21.5% (81)	4.5% (19)	
With child	1.8% (14)	0.5% (2)	2.8% (12)	
With others	1.4% (11)	1.6% (6)	1.2% (5)	
Interpersonal relations (mean)	12.06	12.28	11.90	.039
Partnership quality score (mean)	17.73	18.05	17.33	.006
Social activities score (mean)	5.18	4.99	5.35	.035

TABLE 2
Current and lifetime physical and psychological violence distribution according to sex

Type of physical and psychological violence	Percentage (number)			*p* value
	Total n = 799	Men n = 377	Women n = 422	
Experienced ≥ 1 violent episode in previous 6 months				
Psychological violence by partner ($n_{have\ partner}$ = 533)	18.0% (96)	18.2% (54[a])	17.8% (42[b])	.1
Physical violence by partner ($n_{have\ partner}$ = 533)	0.4% (1)	0.6% (1[a])	0% (0[b])	—
Psychological violence by family member	9.6% (77)	7.2% (27)	11.8% (50)	.030
Physical violence by family member	0.4% (3)	0.8% (3)	0% (0)	—
Experienced ≥ 1 violent episode in lifetime				
Psychological violence by partner (often/frequent)	13.6% (109)	10.3% (39)	16.6% (70)	.010
Physical violence by partner (sometimes/often/frequent)	4.1% (33)	0.8% (3)	7.1% (30)	.000
Psychological violence by family member (often/frequent)	8.6% (69)	4.8% (18)	12.1% (51)	.000
Physical violence by family member (sometimes/often/frequent)	6.4% (51)	5.0% (19)	7.6% (32)	.150

Note: The proportion of physical and psychological violence by intimate partner in last 6 months is calculated for those who indicated currently having a partner: N total = 533; N men[a] = 297; N woman[b] = 236.

and interpersonal correlates of violence using a life-course approach. To the best of our knowledge, this is the first study to use a wide range of indicators of early adversity to assess correlates of elder abuse. Our results help identify potentially modifiable risk factors for violence. Our violence frequency estimates suggest that significant numbers of people who experienced physical and psychological violence in the past continue to be at risk into old age. Our rates of violence were similar to those reported in the literature,[6] with psychological violence being more common than physical. Also, lifetime violence by a family member was more prevalent than lifetime violence by a partner, whereas current violence by a partner was higher than current violence by a family member.

We identified several factors that were consistently associated with both current psychological violence and lifetime violence along with a number of factors associated with either one or the other. With the exception of current psychological violence by a partner, women were at greater risk than men in our study, findings comparable to other studies that found women to be at greater risk for all types of abuse[17] as well as verbal and physical abuse.[18,19] While two studies found men to have a higher risk for abuse[20,21] and another found no difference by sex,[22] it is difficult to interpret these results as one study[20] did not control for potentially confounding factors such as living situation and health status and the other study[22] may have been unable to detect an effect due to the small proportion of men in the study population. Interestingly, of the outcomes we studied, the one where being female was *not* associated with risk was current psychological partner violence. Perhaps this is because conflictual relationships are increasingly resolved through divorce/separation or death as we age. It has also been hypothesized that certain risks associated with current intimate partner violence are either sex-neutral or more common among men (e.g. stress related to cohabitation of caregiver and victim, social isolation, substance abuse in perpetrator, mental or physical impairments).[23]

TABLE 3
Odds ratios for bivariate and multivariable models for personal and interpersonal factors correlated with current psychological violence by intimate partner

	Odds ratio (95% Confidence interval)			
	Bivariate (Unadjusted models)	Adjusted multivariable model 1	Adjusted multivariable model 2	Adjusted multivariable model 3
Living with spouse and children/others	1.82** (1.09–3.03)	2.13** (1.21–.3.76)	2.16** (1.19–3.86)	2.07** (1.14–3.76)
Partnership quality	0.88** (0.83–0.94)	0.83** (0.77–0.90)	0.84** (0.77–0.91)	0.84** (0.78–0.91)
Daily alcohol consumption	2.35* (1.13–4.88)	2.65* (1.14–6.20)	2.63* (1.10–6.31)	2.25** (1.07–6.15)
Problems walking 400 m	4.13** (1.46–11.7)	5.45** (1.81–16.38)	5.01** (1.56–16.09)	5.00** (1.53–16.29)
Two or more falls in the past 12 months	2.02* (1.05–3.90)	1.25* (0.66–2.38)	1.67 (0.79–3.47)	1.71 (0.82–3.60)
Lifetime violence by partner	5.87** (3.22–10.70)		5.36** (2.76–10.38)	5.29** (2.71–10.33)
Witnessed violence at home as a child	2.06* (1.13–3.75)			2.10* (1.06–4.17)

Notes: Reference categories are: living with spouse only; no problems with walking 400 m; no alcohol consumption; no falls in last 12 months; no violence by partner during lifetime; did not witness violence at home during childhood. Multivariable model 1 includes significant sociodemographic, health status and health behaviour correlates; model 2 builds on model 1 by adding lifetime violence by partner and/or family member; model 3 builds on model 2 by adding early childhood circumstances. All multivariable models are adjusted for immigrant status (born outside of Canada), education, occupation and income.

*$p < .05$; **$p < .01$.

TABLE 4
Odds ratios for bivariate and multivariable models for personal and interpersonal factors correlated with lifetime violence by intimate partner

	Odds ratio (95% confidence intervals)			
	Bivariate (Unadjusted models)	Adjusted multivariable model 1	Adjusted multivariable model 2	Adjusted multivariable model 3
Woman	1.67* (1.10–2.54)	2.61** (1.49–4.53)	2.42** (1.38–4.25)	2.48** (1.40–4.37)
Living with child	3.81* (1.28–11.39)	2.17* (1.13–4.18)	1.92 (0.99–3.75)	1.85 (0.95–3.63)
Problems walking 400 m	6.57** (1.86–23.13)	0.70 (0.27–1.13)	0.67 (0.22–2.02)	0.70 (0.23–2.09)
At least one ADL limitation	3.08** (1.58–6.01)	2.72* (1.12–6.62)	2.30 (0.92–.5.75)	2.14 (0.85–5.39)
Two or more falls	2.51* (1.17–5.38)	1.38 (0.74–2.57)	1.40 (0.75–2.64)	1.40 (0.74–2.65)
Daily alcohol consumption	4.70** (1.88–11.74)	7.02** (2.43–20.29)	6.53** (2.21–19.26)	6.83** (2.30–20.23)
BMI obese	2.16** (1.23–3.80)	2.25** (1.27–4.00)	2.26** (1.97–6.40)	2.22** (1.23–4.00)
Lifetime violence by family member	4.16** (2.52–6.85)		3.55** (1.97–6.40)	3.07** (1.66–5.67)
Parental substance abuse	2.16** (1.33–3.52)			1.48 (0.82–2.67)
Parental divorce in childhood	3.32** (1.45–7.59)			2.79* (1.06–7.31)

Abbreviations: ADL, activity of daily living; BMI, body mass index.

Notes: Reference categories are: man; never married/single; living with spouse only; no problems with walking 400 m; no problems with daily living activities; no falls in last 12 months; no alcohol consumption; normal BMI; no violence by family member during lifetime; did not witness parents abusing alcohol or drugs; parents did not divorce during childhood.

Multivariable model 1 includes significant sociodemographic, health status and health behaviour correlates; model 2 builds on model 1 by adding lifetime violence by family member; model 3 builds on model 2 by adding early childhood circumstances. All multivariable models are adjusted for immigrant status (born outside of Canada), education, occupation and income.

*$p < .05$; **$p < .01$.

Several factors were consistently associated with both current psychological violence and lifetime violence. The older people in our study were at greater risk of experiencing a physical or psychological violent episode involving a family member if they had a previous experience of violence involving their intimate partner, had witnessed violence between family members in childhood, and had poor quality relationships with family and friends. These risks for family-related violence were present regardless of whether the violent episode was experienced in the previous six months or within one's lifetime. With respect to partner-related violence, daily alcohol consumption was the only consistent factor associated with both current and lifetime violent episodes of this nature. However, previous experience of violence was also a common factor, as previous partner-related violence was associated with current partner-related violence, while previous family-related violence was associated with lifetime partner-related violence.

We also found that creating and maintaining close relationships throughout the life course was associated with less intimate-partner and family violence.

To our knowledge, this is the first study to address the role of the quality of the intimate partner relationship in elder abuse. Several small studies of older caregivers that did not differentiate between types of caregiver (i.e. intimate partner or other), found that those engaging in verbal abuse

TABLE 5
Odds ratios and 95% CI for bivariate and multivariable models for personal and interpersonal factors correlated with current psychological violence by family member

	Odds ratio (95% confidence intervals)			
	Bivariate (Unadjusted models)	Adjusted multivariable model 1	Adjusted multivariable model 2	Adjusted multivariable model 3
Woman	1.74* (1.07–2.84)	2.00* (1.12–3.56)	1.84* (1.03–3.30)	1.83* (1.02–3.30)
Perceived insufficient income	2.76** (1.31–5.83)	2.30 (0.97–5.48)	2.16 (0.90–5.18)	2.17 (0.90–5.24)
Living with child or others	4.79** (1.48–15.47)	2.04* (1.06–3.92)	1.88 (0.97–3.64)	1.80 (0.92–3.50)
Poor quality relationships	2.11** (1.30–3.42)	2.06** (1.24–3.42)	2.01** (1.21–3.36)	1.95* (1.16–3.26)
Lifetime violence by partner	2.68** (1.54–4.61)		2.34** (1.31–4.20)	2.29** (1.27–4.12)
Witnessed violence at home as a child	2.33** (1.33–4.09)			2.20* (1.19–4.07)

Notes: Reference categories are: man; perceived sufficient income; living with partner only; very good quality of relationships; no experience of lifetime violence by partner; never witnessed violence at home. Multivariable model 1 includes significant sociodemographic, health status and health behaviour correlates; model 2 builds on model 1 by adding lifetime violence by family member; model 3 builds on model 2 by adding early childhood circumstances. All multivariable models are adjusted for immigrant status (born outside of Canada), education, occupation and income.

*$p < .05$; **$p < .01$.

TABLE 6
Odds ratios and 95% CI for bivariate and multivariable models for personal and interpersonal factors correlated with lifetime violence by family member

	Odds ratio (95% confidence intervals)			
	Bivariate (Unadjusted models)	Adjusted Multivariable model 1	Adjusted Multivariable model 2	Adjusted Multivariable model 3
Woman	2.28** (1.41–3.69)	2.12** (1.17–3.82)	1.90* (1.05–3.45)	1.96* (1.02–3.78)
Widowed	2.34* (1.22–4.51)	1.64 (0.79–3.40)	1.61 (0.76–3.37)	1.79 (0.79–4.05)
Divorced/separated	2.63** (1.55–4.44)	1.62 (0.89–2.96)	1.23 (0.65–2.32)	1.17 (0.58–2.36)
Suitable income	2.46** (1.51–4.01)	2.28** (1.31–3.97)	2.22** (1.27–3.88)	2.24* (1.19–4.22)
Insufficient income	3.41** (1.55–7.53)	1.95 (0.71–5.31)	1.95 (0.71–5.36)	2.39 (0.76–7.46)
Few relationships	4.51** (1.97–10.34)	4.22** (1.65–10.78)	4.28** (1.64–11.17)	3.92* (1.34–11.42)
Poor quality relationships	2.47** (1.54–3.97)	2.27** (1.34–3.84)	2.22** (1.30–3.78)	2.11* (1.15–3.86)
Problems walking 400 m	3.01** (1.41–6.41)	1.07 (0.35–2.95)	1.01 (0.34–2.98)	1.08 (0.31–3.77)
At least one ADL limitation	4.70** (2.44–9.05)	2.48* (1.05–5.84)	2.13 (0.89–5.10)	1.53 (0.58–4.05)
Current smoker	2.90** (1.52–5.54)	2.15 (1.00–4.63)	2.16 (1.00–4.69)	1.94 (0.82–4.62)
Lifetime violence by partner	4.16** (2.52–6.85)		3.48** (1.96–6.19)	3.58** (1.88–6.83)
Hunger in childhood	4.46** (2.20–.9.01)			1.61 (0.58–4.44)
Parental substance abuse	4.03** (2.46–6.60)			1.57 (0.81–3.04)
Parental divorce in childhood	3.69** (1.57–8.71)			1.89 (0.60–5.97)
Witnessed violence at home as a child	12.54** (7.63–20.6)			9.46** (5.11–17.52)

Abbreviation: ADL, activity of daily.

Notes: Reference categories are: man; being married; sufficient income; very good quality of relationships; no problems with walking 400 m; no problems with daily living activities; no experience of lifetime violence by partner; no hunger in childhood; no parental divorce; did not witness parents abusing alcohol or drugs; never witnessed violence at home.

Multivariable model 1 includes significant sociodemographic, health status and health behaviour correlates; model 2 builds on model 1 by adding lifetime violence by family member; model 3 builds on model 2 by adding early childhood circumstances. All multivariable models are adjusted for immigrant status (born outside of Canada), education, occupation and income.

*$p < .05$; **$p < .01$.

were more likely to report a poor relationship with the victim prior to disability than those not engaging in abuse.[24] Partnership quality in our study was determined by questions that addressed issues of perceived respect, appreciation and understanding by the intimate partner, and was among the strongest correlates of current violence by a partner. This is consistent with other studies that demonstrated large increases in risk for physical, psychological and overall abuse when the older person reports frequent arguing or poor relations with their family.[6,17,21] This result underlined that interpersonal relations between partners remain a central factor of concern when addressing and tackling violence between partners, especially considering this association was independent of individual behaviour and health-related functional status.

Our results demonstrate the importance of the life course in explaining correlates of partner and family violence among older Canadians. In fact, previous experience of violence and adverse circumstance in childhood appeared as the strongest independent correlates of current psychological violence in elder adults. Two other Canadian studies that addressed elder abuse using a life-course perspective found that previous experiences of violence significantly increased risk for present abuse. A study of those aged 55 years and older reported that those who were abused before the age of 18 had a greater risk of abuse in older adulthood, independent of all other factors.[22] Similarly, a more representative sample of household-dwelling Canadians aged 65 to 80 years found that those reporting an incident of sexual assault prior to the age of 60 were at greatest risk for recent physical assault.[7] Existing research indicates that, for women in particular, childhood victimization influences future intimate relationships and increases the likelihood of victimization.[25] As significant numbers of older people are now experiencing or have experienced violence perpetuated by their family and/or partner, preventive efforts and policies should aim at breaking the circle of violence in the earliest possible stages.

Our study is one of the first to document the ongoing impact of early adversity on subsequent partner and family violence in older Canadians. In our cohort, those whose parents divorced during the victim's childhood were almost three times more likely to report lifetime violence by their partner, suggesting that early family disruption is a marker of childhood adversity and one with lifelong effects. In addition, although not significant when controlling for other factors, parental alcohol or drug abuse during the victim's childhood also seemed to have a subsequent impact, increasing the risk of exposure to both partner and family lifetime violence. Of particular note, witnessing violence between family members early in life was the strongest predictor of ongoing family violence in later adulthood. Other studies not specific to older populations appear to

reinforce this, reporting that childhood physical abuse or witnessing inter-parental violence are strongly and independently associated with recent intimate partner physical and emotional abuse.[26] Our findings are in keeping with a growing literature describing how adversity during childhood has an incremental, long-lasting and harmful impact on many aspects of adult physical and mental well-being.[27]

Our study also identified a number of other independent correlates of lifetime violence and current psychological violence, including living arrangements and having poorer health/functional status. Living with spouse and children and/or other cohabitants constituted an independent correlate of partner violence, suggesting tensions related to shared living space as well as economic dependence of older adults on others. In fact, marital, family/child and health stress were among the most cited stressors perceived as causes of aggression between partners.[28] In addition, functional problems such as falls (more than twice in last 12 months) and mobility issues (difficulty walking 400 metres) were strong correlates of current partner violence. These results suggest that the additional stresses related to incapacities arising as part of aging may add strain to a relationship. The literature supports these findings: individuals with disabilities, including older adults, are generally more at risk of victimization than are able-bodied persons. Thus seniors with disabilities or those needing assistance with daily living activities may be especially vulnerable to victimization at the hands of caregivers, in this case their current partners.[29] The connection between functional status and violence may mean that the stresses inherent in incapacity can translate into intimate partner violence. Finding ways to alleviate caregiver strain might therefore have a beneficial effect and reduce risk of violence.

Limitations

Sampling methods may have contributed to the presence of mild to moderate selection biases in the study, resulting in our under- or over-estimating the degree of association between some variables and violence outcomes. The study sample was a voluntary one and may not be representative of the population of community-dwelling older adults with respect to the variables measured. For example, exclusion criteria based on cognitive health status meant that more severely disabled older adults did not participate in the study. With regard to potential non-response bias, we believe that response rates in our study were higher in more educated individuals. Should violence be reported more frequently in individuals who are less educated, such differences in response rates would have biased our estimates. Retrospective reports of lifetime violence and adverse childhood experiences could also be subject to recall bias, although the exclusion of those at risk for dementia should minimize this. Social desirability leading to underreporting of violence cannot be excluded due to the real possibility that participants may not want to reveal negative behaviours of their partner or family members. Combining physical and psychological interpersonal violence was necessary in our study in order to increase the number of events for each of the outcomes. A recent systematic review suggests that, independent of type of violence (psychological, physical, sexual, financial, neglect), many risk factors are common to psychological and physical violence.[30] However, future studies should carefully examine the possible differences in violence correlates that are specific to each type of interpersonal violence. The low absolute prevalence of physical violence also suggests caution when interpreting results related to this experience.

In addition, because of the limited power of the study, we were unable to report on the effect of interactions between study correlates on the estimated association measures. Other key factors not addressed in this study include dependency of the victim on the perpetrator (or vice versa), characteristics of the perpetrator (e.g. mental health, stress related to care burden) as well as other personal and sociocultural characteristics.[31]

Conclusions

Very little Canadian research has specifically addressed interpersonal violence among older adults. We included an extensive list of possible individual and interpersonal correlates of interpersonal violence, and identified the most persistent associations with current and past self-reported violence in Canadian community-dwelling older adults. Identifying individual and interpersonal level factors could inform strategies for preventing current psychological violence such as those designed to promote attitudes, beliefs and behaviours aimed at reducing conflicts and fostering problem solving skills.[16] Some older adults experienced lifetime violence both by a partner and a family member, revealing trajectories of cumulative violence. As Johannesen and LoGiudice[32] suggested, the connections between types of violence at different stages of the life course and different patterns of abuse must be identified and better understood in order to develop appropriate prevention programs and interventions for children, women and families.

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Estimating the completeness of physician billing claims for diabetes case ascertainment using population-based prescription drug data

L. M. Lix, PhD (1); J. P. Kuwornu, MSc (1); K. Kroeker, BSc (1); G. Kephart, PhD (2); K. C. Sikdar, PhD (3); M. Smith, MSc (4); H. Quan, PhD (3, 5)

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Abstract

Introduction: Changes in physician reimbursement policies may hinder the collection of billing claims in administrative data; this can result in biased estimates of disease prevalence and incidence. However, the magnitude of data loss is largely unknown. The purpose of this study was to estimate completeness of capture of disease cases for Manitoba physicians paid by fee-for-service (FFS) and non-fee-for-service (NFFS) methods.

Methods: Manitoba's administrative data were used to identify a cohort (≥ 20 years) with a new diabetes medication between 1 April, 2007, and 31 March, 2009. Cohort members were classified by payment method of the prescribing physician (i.e. FFS vs. NFFS). The cohort was then classified as missing or not missing a diabetes diagnosis using physician claims and hospital records. Then, χ^2 statistics were used to test for differences in the characteristics of the two groups.

Results: The cohort consisted of 12 394 individuals; 86.4% had a prescription for a diabetes medication from an FFS physician. A total of 1172 physicians (81.8% FFS) prescribed these medications for the cohort. Cohort members with a prescription from an FFS physician were older and more likely to reside in the urban Winnipeg health region than those with a prescription from a NFFS physician. A greater percentage of NFFS physicians' cases were missing a diabetes diagnosis (18.7% vs. 14.9% for FFS physicians).

Conclusion: The results suggest minimal loss of physician claims associated with remuneration policies in Manitoba. This method of assessing data completeness could be applied to other chronic diseases and jurisdictions to estimate completeness.

Keywords: *chronic disease, medical records, surveillance, data quality*

Highlights

- Physician claims data are useful for research into and surveillance of the health of Canadians.
- More doctors are being paid in different ways, and many are moving from fee-for-service (FFS) payment to non-fee-for-service (NFFS) payment. Physician claims data may miss information on patient contacts from physicians receiving NFFS payments.
- We used population-based diabetes prescription drug records to estimate the completeness of physician claims in Manitoba.
- 14.9% of people with a diabetes prescription from an FFS doctor did not have a diabetes diagnosis for 2 years before and 2 years after getting the prescription.
- 18.7% of people with a diabetes prescription from a NFFS physician did not have a diabetes diagnosis for 2 years before and 2 years after getting the prescription.
- The loss of data due to missed claims is probably small. However, this loss of data means disease incidence is underestimated.

Introduction

Electronic administrative health data are used extensively in Canada and internationally to conduct population-based chronic disease research and surveillance.[1,2] These data are popular for several reasons: they are timely; they contain information about numerous individuals; and they are relatively inexpensive to access and use. Electronic physician claims data, which capture billing records or claims for outpatient physician contacts with patients, are a rich resource for research and surveillance because the vast majority of people with a chronic disease will maintain regular contact with a physician for disease management and treatment.

However, the quality of administrative health data available for research and

Author references:

1. Department of Community Health Sciences, University of Manitoba, Winnipeg, Manitoba, Canada
2. Department of Community Health and Epidemiology, Dalhousie University, Halifax, Nova Scotia, Canada
3. Libin Cardiovascular Institute of Alberta, University of Calgary, Calgary, Alberta, Canada
4. Manitoba Centre for Health Policy, University of Manitoba, Winnipeg, Manitoba, Canada
5. Department of Community Health Sciences, University of Calgary, Calgary, Alberta, Canada

Correspondence: Lisa M. Lix, Department of Community Health Sciences, S113-750 Bannatyne Avenue, University of Manitoba, Winnipeg, MB R3E 0W3; Tel: 204-789-3573; Fax: 204-789-3905; Email: lisa.lix@med.umanitoba.ca

surveillance has been questioned, resulting in a number of studies on this topic. Most of these studies have examined the validity of diagnostic information[3-6] even though multiple aspects of quality must be assessed to ensure the data are fit for research and surveillance purposes. For example, complete capture of the population is essential to ensure unbiased research and surveillance results. Gaps in completeness can result in estimation problems similar to those encountered with non-response bias in survey data.[7]

The information in physician claims data is used to remunerate physicians on a fee-for-service (FFS) basis for the services they provide to patients. Non-FFS (NFFS) physicians, who are paid by salary or contract, often use a shadow-billing claims submission process in which they submit parallel claims. However, this process does not always consistently capture information on service encounters. A 2009 study reported underestimation of diabetes incidence due to incomplete capture of shadow-billed claims in Ontario.[8] However, it is not known how widespread this problem is. As national and international health care systems increasingly adopt new models for primary care service delivery and move physicians onto alternate payment plans, the comprehensive capture of physician encounter data is threatened.[9]

The purpose of our study was to estimate completeness of capture of chronic disease cases associated with missed NFFS physician shadow-billed claims in administrative health data. The specific focus of this study is diabetes because diagnosis codes in administrative data have demonstrated good sensitivity and specificity for diabetes case ascertainment and diabetes surveillance using electronic administrative data is of interest worldwide.[5]

Method

Data sources

We used data from the province of Manitoba, which has a population of approximately 1.2 million according to the 2011 Statistics Canada Census. The Manitoba Centre for Health Policy houses multiple electronic administrative databases that can be anonymously linked via a unique personal health identification number. Manitoba, like other Canadian provinces, has a universal health care system, which means that virtually the entire provincial population is registered to receive health care benefits.

Physicians paid via the FFS method submit all billing claims to the provincial ministry of health. Physicians paid by NFFS methods are required to submit parallel shadow-billed claims to the ministry of health, but the extent of compliance with this requirement is unknown given that the remuneration of NFFS physicians does not depend on the submitted claims and the shadow-billed claims are not normally audited. A single diagnosis is recorded on each claim using *International Classification of Diseases, 9th revision, Clinical Modification* (ICD-9-CM) codes. Hospital abstracts, which are completed when a patient is discharged from an acute care facility, contain diagnoses recorded using the *International Classification of Diseases, 10th revision, Canadian version* (ICD-10-CA) codes. Each record captures up to 25 diagnoses. Prescription drug records are from the Drug Programs Information Network (DPIN), a centralized, electronic, point-of-sale database connecting all retail pharmacies in Manitoba. For each dispensation, information is collected on the date, drug attributes such as dosage and drug identification number, and the prescriber identification number. The population registry contains dates of health insurance coverage as well as demographic information such as date of birth, sex and location of residence. The provider registry contains quarterly snapshots of physician characteristics, including date of birth, specialty, practice location, provider identification number and method of payment. The most recent update to the registry that we used in our study was the first quarter (i.e. January to March) of 2009.

Manitoba's administrative health data have been extensively used in chronic disease research and surveillance studies.[10-12]

Ethics approval was received from the Manitoba Health Research Ethics Board and permission to access the study data was provided by the Manitoba Health Information Privacy Committee.

Study cohort

We identified a cohort of incident adult diabetes cases from prescription drug records, which have demonstrated excellent sensitivity for diabetes case ascertainment.[13] The cohort inclusion criteria were (1) at least one prescription with an Anatomical Therapeutic Chemical (ATC) code of A10 (i.e. drugs for diabetes) in the two-year observation period from fiscal year 2007/08 to 2008/09 (a fiscal year extends from 1 April to 31 March); (2) continuous health insurance coverage during the two-year period before and two-year period after the index prescription date, that is the date that a diabetes prescription medication was first identified in the DPIN database during the observation period; and (3) at least 20 years of age at the index prescription date. Individuals were excluded from the study if they had a prescription with an ATC code of A10 within the 730 days prior to their index prescription date.

The ATC code A10 captures blood glucose-lowering drugs such as metformin and insulins and their analogues but not supplies such as glucose test strips. A 2009 study used a one-year period to exclude non-incident cases,[8] but to increase the likelihood that the cohort members were newly prescribed with a diabetes medication we extended this to two years.

The prescriber identification number associated with the index diabetes medication prescription was anonymously linked to the corresponding number in the provider registry to determine physician payment method (i.e. FFS, NFFS). Individuals were excluded if the payment method of the provider who made the index prescription was not recorded in the registry. The cohort members were stratified into two mutually exclusive groups: (1) individuals with an index prescription from an FFS physician, and (2) individuals with an index prescription from a NFFS physician.

Study variables

Diabetes diagnoses in administrative data were identified using the Canadian Chronic

Disease Surveillance System (CCDSS) diabetes case definition, which requires one hospitalization or two physician billing claims with an ICD-9 code of 250.00 or ICD-10-CA code of E10-E14 within a two-year period.[4,14] The diabetes diagnosis date was the date on which a diagnosis was recorded in hospital records or the date of the first diagnosis in physician billing claims. Cohort members who met the case definition requirements anywhere in the period that extended from two years before the index prescription date to two years after the index prescription date were classified as captured cases. All other cohort members were classified as missed cases.

The cohort was characterized in terms of its sociodemographic characteristics, including age group, sex, income quintile, and health region of residence. Age group was categorized as less than 65 years and 65 years and above. Income quintile was an area-level measure based on average household income from the Statistics Canada Census. Every individual's postal code extracted from the population registry was assigned to a dissemination area (DA), the smallest geographic unit for which census data are reported. The Manitoba population was then divided into five roughly equal groups according to the DA average household income;[15] this was done separately for urban and rural populations. Health region of residence was classified as Winnipeg and non-Winnipeg. The latter encompasses four rural health regions: Interlake-Eastern, Northern, Prairie Mountain, and Southern Health-Santé Sud. First Nations reserves are primarily located outside of the Winnipeg health region. All sociodemographic characteristics were measured at the index prescription date.

Because patients with more advanced diabetes (i.e. greater comorbidity) were more likely to be detected by the CCDSS case definition,[8] we investigated the prevalence of selected cardiovascular comorbid conditions in the cohort using diagnoses in hospital discharge abstracts. These conditions included hypertension (ICD-10-CA I10–I13, I15), congestive heart failure (ICD-10-CA I50), acute coronary syndromes (ICD-10-CA I21, I22, I23, I24.9, I20.0, I20.1), cerebrovascular disease (i.e. stroke: ICD-10-CA I60, I61, I63, I64) and atrial fibrillation (ICD-10-CA I48). However, given that the frequencies were quite small for some conditions, we classified them as "hypertension only" and "all cardiovascular comorbid conditions."

The physicians who prescribed diabetes medications for study cohort members were characterized by sex, age group (< 35 years, 35–60 years, or ≥ 61 years), health region of practice (Winnipeg vs non-Winnipeg), and specialty (specialist vs general practitioner). All physician characteristics were measured at the index prescription date.

Statistical analyses

We described the study cohort and their prescribing physicians using frequencies and percentages. A χ^2 statistic was used to test for differences in characteristics between the FFS and NFFS groups. We estimated the percentage of cohort members with a missing diabetes diagnosis; this was done for the entire cohort, as well as stratified by age group.

We estimated the crude diabetes incidence rate for the adult (≥ 20 years) Manitoba population in the period from 2007/8 to 2008/09 using the CCDSS case definition. The total adult registered population from the Manitoba population registry comprised the denominator. We calculated the observed rate, as well as rates adjusted for missed cases.

All analyses were conducted using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA).[16]

Results

A total of 73 719 individuals received a diabetes prescription in 2007/08 or 2008/09. After we applied our exclusion criteria (i.e. no continuous provincial health insurance coverage [8.0%]; diabetes medication use in the 730 days prior to the index prescription date [74.3 %]; < 20 years of age at the index date [0.4%]; index prescription written by a physician whose payment method could not be ascertained [0.5%]), 12 394 individuals were retained in the cohort.

The majority (86.4%) of study cohort members received their index prescription from an FFS physician (Table 1). In general, individuals who received their index prescription from FFS physicians were more likely than those who received their index prescription from NFFS physicians to be older, Winnipeg residents, and from the lowest urban income quintile (all $p < .001$).

A total of 1172 physicians prescribed diabetes medications to at least one cohort member during the observation period (Table 2). On average, each FFS physician prescribed to 11.2 cohort members and each NFFS physician prescribed to 7.9 cohort members. Compared to the NFFS physicians, FFS physicians were more likely to be older, specialists, and to practice in Winnipeg (all $p < .001$). There was no difference between FFS and NFFS physicians on sex ($p = .086$).

A higher percentage of cohort members with a missed diagnosis received their index prescription from a NFFS physician than those who received their prescription from an FFS physician (18.7% vs. 14.9%; $p < .001$; Table 3). When the analysis was stratified by age, a higher percentage of cohort members aged less than 65 years with a missed diagnosis were observed for the NFFS cohort than the FFS cohort (20.4% vs. 16.5%; $p < .001$). The percentages for those individuals aged 65 years or more were not significantly different ($p = .174$).

Cohort members with a missed diagnosis who had their index prescription from a NFFS physician were more likely to be male, non-Winnipeg residents, and in the lowest rural income quintiles than those who received their prescription from an FFS physician ($p < .001$; Table 4).

Of the cohort members who had their index prescription from an FFS physician, those whose diagnosis was captured in administrative data were more likely to be hospitalized for cardiovascular comorbid diseases than those whose diagnosis was missed ($p < .001$; Table 5). Similarly, those of the NFFS cohort whose diagnosis was captured were more likely to be hospitalized for cardiovascular comorbid diseases than those whose diagnosis was missed ($p < .001$).

Based on the CCDSS case definition for diabetes, 12 877 newly diagnosed adult (≥ 20 years) cases of diabetes were identified

TABLE 1
Characteristics of the study cohort, by method of remuneration for the prescribing physician

Characteristics	Cohort		
	FFS physicians, n (%)	NFFS physicians, n (%)	All physicians, n (%)
Total[a]	10 714 (86.4)	1680 (13.6)	12 394 (100.0)
Age group, years**			
20–64	7733 (72.2)	1305 (77.7)	9038 (72.9)
≥ 65	2981 (27.8)	375 (22.3)	3356 (27.1)
Sex*			
Male	5468 (51.0)	907 (54.0)	6375 (51.4)
Female	5246 (49.0)	773 (46.0)	6019 (48.6)
Health region**			
Winnipeg	6403 (59.8)	339 (20.2)	6742 (54.4)
Non-Winnipeg	4311 (40.2)	1341 (79.8)	5652 (45.6)
Income quintile**			
Urban Q1/Q2 (lowest)	3079 (28.7)	191 (11.4)	3270 (26.4)
Urban Q3	1206 (11.3)	58 (3.5)	1264 (10.2)
Urban Q4/Q5 (highest)	2136 (19.9)	76 (4.5)	2212 (17.8)
Rural Q1/Q2 (lowest)	1636 (15.3)	754 (44.9)	2390 (19.3)
Rural Q3	785 (7.3)	192 (11.4)	977 (7.9)
Rural Q4/Q5 (highest)	1085 (10.1)	347 (20.7)	1432 (11.6)
Missing	787 (7.4)	62 (3.6)	849 (6.8)

Abbreviations: FFS, fee-for-service; NFFS, non-fee-for-service.

[a] Percentages for this row are based on the row total; all other tabled percentages are based on column totals for each variable.

*$p < .05$.

**$p < .001$.

TABLE 2
Characteristics of physicians who prescribed diabetes medications to the study cohort, by method of remuneration

Characteristics	Cohort		
	FFS physicians, n (%)	NFFS physicians, n (%)	All physicians, n (%)
Total[a]	959 (81.8)	213 (18.2)	1172 (100.0)
Age group, years**			
< 35	124 (12.9)	38 (17.8)	162 (13.8)
35–60	689 (71.9)	167 (78.4)	856 (73.0)
≥ 61	146 (15.2)	8 (3.8)	154 (13.1)
Sex			
Male	664 (69.2)	134 (62.9)	798 (68.1)
Female	295 (30.8)	79 (37.1)	374 (31.9)
Specialty**			
Specialist	211 (22.0)	16 (7.5)	227 (19.4)
General practitioner	727 (75.8)	187 (87.8)	914 (78.0)
Missing	21 (2.2)	10 (4.7)	31 (2.6)
Health region**			
Winnipeg	645 (67.3)	76 (35.7)	721 (61.5)
Non-Winnipeg	314 (32.7)	137 (64.3)	451 (38.5)

Abbreviations: FFS, fee-for-service; NFFS, non-fee-for-service.

Note: A variable without asterisks indicates no statistically significant difference between the FFS and NFFS groups.

[a] Percentages for this row are based on the row total; all other tabled percentages are based on column totals for each variable.

**$p < .001$.

in Manitoba during fiscal years 2007/08 to 2008/09. This resulted in a crude observed incidence rate of 1.6 % (Figure 1). However, when this observed rate was adjusted for missed cases from NFFS physicians, the rate increased to 1.7%, and when it was further adjusted for missed cases from both FFS and NFFS physicians, it increased to 1.9%.

Discussion

Overall, compared to FFS physicians, fewer NFFS physicians prescribed diabetes medications in Manitoba during the study time period, and the two groups of physicians differed in age, specialty and health region of practice. A greater percentage of NFFS physicians practised in non-Winnipeg health regions than in the Winnipeg health region, probably because provincial programs providing physicians with alternative payment options to encourage them to work in rural and remote parts of the province.

When we used prescription drug records as the reference data source, we found incomplete diabetes diagnosis information for cohort members seen by both FFS and NFFS physicians, although NFFS physicians missed a greater percentage of diagnoses. Potential sources of missing diagnostic information include misclassification bias due to less-than-perfect sensitivity of diagnosis information and missing data bias due to few NFFS physicians shadow billing. Assuming that the sensitivity of diabetes diagnoses is the same for both FFS and NFFS physicians, the results suggest that 3.8% of physician billing claims were missing in Manitoba due to a lack of shadow billing. There were differences in the percentage of missed cases by age group for both FFS and NFFS physicians, suggesting that the sensitivity of ascertainment is different for younger and older cohort members.

An earlier study conducted using Ontario's physician claims data,[8] reported that 23.7% of diabetes diagnoses were missing from NFFS physician billing claims; we found 18.7% missing diagnoses in the NFFS physician billing claims in Manitoba. The Ontario study focussed exclusively on examining diagnoses missing by NFFS physicians,

TABLE 3
The study cohort with a captured and missed diabetes diagnosis by age group and method of remuneration of the prescribing physician

Age group	Cohort	
	FFS physician, n (%)	NFFS physician, n (%)
20–64 years**		
Captured diagnosis	6458 (83.5)	1039 (79.6)
Missed diagnosis	1275 (16.5)	266 (20.4)
≥ 65 years		
Captured diagnosis	2661 (89.3)	326 (86.9)
Missed diagnosis	320 (10.7)	49 (13.1)
All ages**		
Captured diagnosis	9119 (85.1)	1365 (81.3)
Missed diagnosis	1595 (14.9)	315 (18.7)

Abbreviations: FFS, fee-for-service; NFFS, non-fee-for-service.

Notes: Cases were classified as captured or missed based on the presence/absence of a diabetes diagnosis in physician billing claims and hospital discharge abstracts. Age group without asterisks indicates no statistically significant difference between the FFS and NFFS groups.

**$p < .001$.

TABLE 4
Characteristics of cohort members with a missed diabetes diagnosis in administrative data by method of remuneration of the prescribing physician

Characteristics	Cohort		
	FFS physicians, n (%)	NFFS physicians, n (%)	All physicians, n (%)
Total[a]	1595 (83.5)	315 (16.5)	1910 (100.0)
Age group, years			
20–64	1275 (79.9)	266 (84.4)	1541 (81.0)
≥ 65	320 (20.1)	49 (15.6)	369 (19.0)
Sex**			
Male	444 (27.8)	146 (46.3)	590 (30.9)
Female	1151 (72.2)	169 (53.7)	1320 (69.1)
Health region**			
Winnipeg	847 (53.1)	56 (17.8)	903 (47.3)
Non-Winnipeg	748 (46.9)	259 (82.2)	1007 (52.7)
Income quintile**			
Urban Q1/Q2 (lowest)	411 (25.8)	34 (10.8)	445 (23.3)
Urban Q3	174 (10.9)	10 (3.2)	184 (9.6)
Urban Q4/Q5 (highest)	269 (16.9)	7 (2.2)	276 (14.5)
Rural Q1/Q2 (lowest)	330 (20.7)	165 (52.4)	495 (25.9)
Rural Q3	112 (7.0)	37 (11.7)	149 (7.8)
Rural Q4/Q5 (highest)	176 (11.0)	53 (16.8)	229 (12.0)
Missing	123 (7.7)	9 (2.9)	132 (6.9)

Abbreviations: FFS, fee-for-service; NFFS, non-fee-for-service.

Note: A variable without asterisks indicates no statistically significant difference between FFS and NFFS groups.

[a] Percentages for this row are based on the row total; all other tabled percentages are based on column totals for each variable.

*$p < .05$.

**$p < .001$.

while our study compared FFS and NFFS physicians. Inclusion of FFS physicians allows for investigation about the effects of shadow billing on the proportion of missed diabetes diagnosis information in physician billing claims. The Ontario study also used varying follow-up periods to capture diabetes diagnosis before and after the diabetes prescription date, up to a maximum of nine years. In addition, unlike the Ontario study, which focussed only on the older population (i.e. ≥ 65 years), we included all individuals 20 years and older and investigated missing data in both younger and older age groups. We found a higher percentage of missed diagnoses in the younger age group than the older age group, an expected finding because older people are more likely to have a higher disease burden and therefore be hospitalized or have regular contact with a primary care physician.

Given that this study has demonstrated data loss associated with a lack of shadow billing by NFFS physicians, it is important to consider strategies for adjusting prevalence and incidence estimates for possible underestimation. One strategy is to use other population-based data such as electronic medical records, which are increasingly being adopted in population-based chronic disease research and surveillance studies,[17] and prescription drugs data sources to supplement physician claims records for disease surveillance. For example, based on the CCDSS case definition, we estimated a 1.6% crude diabetes incidence rate in the Manitoba population aged 20 years and over during the study period. However, when cases identified in the prescription drugs data were used to adjust for underestimation, the incidence rate increased to 1.9%.

Alternatively, simulation studies and predictive modelling could be used to produce adjusted estimates of disease prevalence, as has been done in previous research.[18,19] Specifically, we found that both patient and physician characteristics differed significantly between the FFS and NFFS groups. Also, we found that the presence of comorbid cardiovascular conditions was associated with whether a patient's diabetes diagnosis was captured by the CCDSS case definition. These factors could

TABLE 5
Selected comorbid conditions in individuals with a captured and missed diabetes diagnosis

Comorbid condition	Cohort	
	Captured diagnosis	Missed diagnosis
	FFS physicians, n (%)	
Hypertension**	662 (7.3)	75 (4.7)
Cardiovascular disease[a],**	839 (9.2)	94 (5.9)
	NFFS physicians, n (%)	
Hypertension**	100 (7.3)	6 (1.9)
Cardiovascular disease[a],**	122 (8.9)	9 (2.9)

Abbreviations: FFS, fee-for-service; NFFS, non-fee-for-service.

[a] Cardiovascular disease included congestive heart failure, hypertension, acute coronary syndromes, cerebrovascular disease (stroke) and atrial fibrillation.

**$p < .001$.

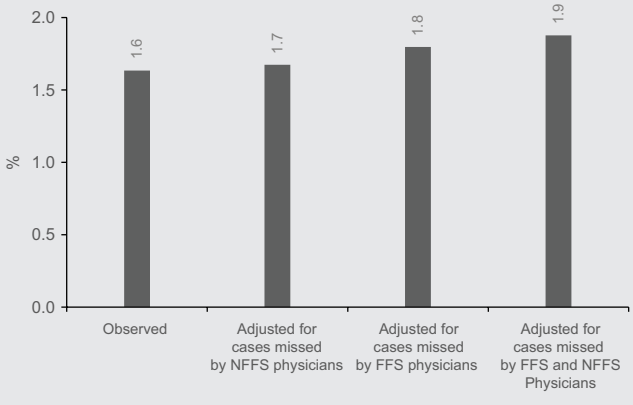
be included in predictive models to estimate disease prevalence. In a recent study,[20] we included physician characteristics in predictive models to adjust for underestimation of diabetes prevalence due to a loss of physician claims.

Strengths and limitations

Our study has some limitations. First, physicians were classified as either FFS or NFFS, but some physicians may receive both types of remunerations at the same time or change from one method to another. Given that we only used two fiscal years of diabetes prescription information, the possibility of physicians switching payment method during the study period is likely to be minimal, but the Manitoba provider registry does not allow us to make a clear distinction between physicians who may be receiving both types of remuneration.

Second, the results may be sensitive to the definitions used to ascertain missed and non-missed cases. We examined the two-year period pre- or post-index prescription date; this period was chosen to align with the CCDSS diabetes case definition from administrative health data. While it is possible that individuals without diabetes might receive a prescription for a diabetes drug, this is unlikely; previous research has shown excellent specificity and sensitivity of prescription drug records for diabetes case ascertainment.[13] Lastly, diabetes patients treated with lifestyle modification only would not be captured in prescription drug data. However, this represents a general problem of underestimation of any chronic condition treated with only lifestyle modification when using administrative data to estimate prevalence or incidence.

FIGURE 1
Crude diabetes incidence (%) for the Manitoba adult (20+ years) population, 2007/08–2008/09



Abbreviations: FFS, fee-for-service; NFFS, non-fee-for-service.

Conclusions

In this study, we adopted a population-based approach to assess the completeness of physician claims data for chronic disease studies. We relied on prescription drug data to evaluate completeness; this source is known to be sensitive for ascertaining diabetes cases.[13] Our study showed that the loss of data due to missed shadow-billed claims is small. At the same time, this loss of data contributes to an underestimation of disease incidence. The method we used can be readily applied over time and to data from other provinces or territories. The results obtained for diabetes could be compared to the results obtained for other chronic conditions to assess consistency of conclusions about data completeness.

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