Research Paper

Unionization rates and health in Canadian provinces, 2000 - 2020

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This paper examines one possible, but understudied, institution that might have an impact on health: unionization. We outline four distinct, although complementary, pathways through which unions might influence population health outcomes based on two axes: the levers that unions can potentially pull to influence any policy environment (collective bargaining and political action) and the manner in which health can be influenced in a society (the Social Determinants of Health and health care). We test whether unionization rates have an impact on total, preventable, and treatable mortality using panel data on Canadian provinces between 2000 and 2020. We find that unionization rates are negatively associated with all three measures of mortality.

Introduction

This paper examines one possible, but understudied, institution that might have an impact on health: unionization. The understudied element is particularly true in the Canadian context, in which Muller and Raphael lament the 'neglect of an issue with significant implications for health.' (Muller & Raphael 2023, p. 2) This is an oversight, since there are a number of potential pathways through which unionization might impact the health of a region. We present a model using panel data from Canadian provinces between 2000 and 2020 to evaluate the associations between unionization rates and three age-standardized health indicators: the overall mortality rate, and the mortality rates from preventable and treatable causes.

Unions and Health: Potential Pathways

The extent to which workers are unionized might impact people's health in a region through a variety of pathways. It might be helpful to place those pathways on two axes that are summarized in Figure 1. In each quadrant produced by the axes, we identify representative examples of outcomes produced through the relevant pathway.

Treatment and Prevention through
Improved Health Care Provisions

Collective Bargaining Impacts:

Contractual Improvements for Union Members

Spillover Effects in Non-Union Workplaces

Employment-tied health benefits for workers

Government health care funding (value and scope)

Universality of health services

Workplace safety and health provisions

Employment insurance

Career advancement

Anti-poverty policy and programming

Higher wages

Minimum wage/living wage campaigns

Political Impacts:

Lobbying

Electoral Activism and Influence

Influence on Public Opinion and Perspectives
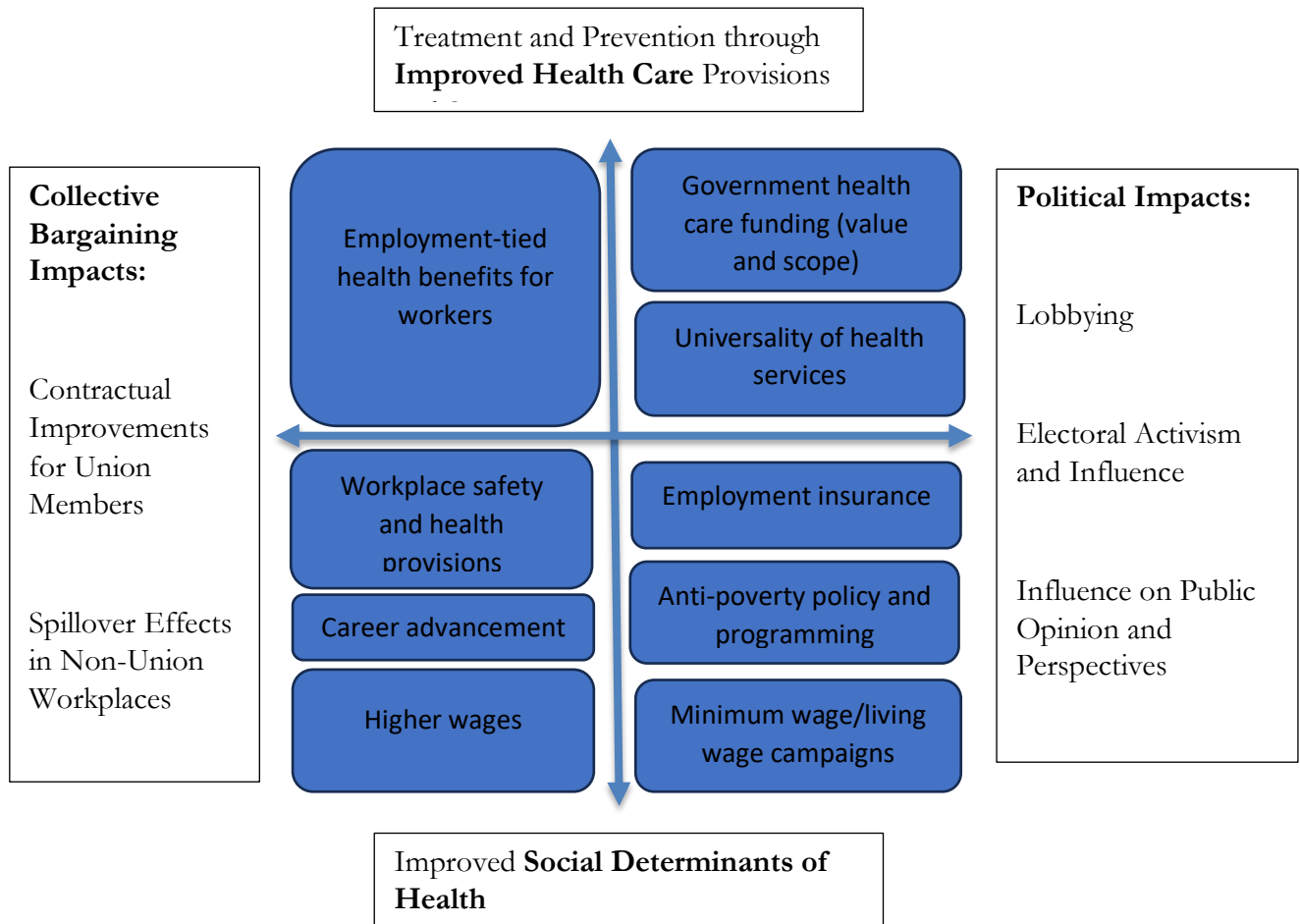
Improved **Social Determinants of Health**

Figure 1: Pathways of union impact on health

The vertical axis represents two distinct ways in which health is influenced. First, via what the literature variously refers to as the social determinants of health (SDOH) or the political economy of health, which focus on 'how personal, household, social, political, and economic conditions interrelate at various levels to produce particular health circumstances and outcomes' (Birn et al. 2009, p. 140; see also Chernomas & Hudson 2013; Reeves 2021). These are conditions in which people live their lives, many of which are based on important power relationships in the economy, that can have positive or negative impacts on their health (Reynolds & Buffel 2020). Second, health can be impacted on by the health care systems that deal with the 'end of pipe' issues that are the result of the SDOH. These two impacts are represented on the vertical axis of Figure 1, with health care on the upper and SDOH on the lower. The horizontal axis of Figure 1 shows the two ways in which unionization might impact on the health of a population. On the left side of the axis, unions could impact on health through the collective bargaining process. Unionized workers can, and have, negotiated a wide range of benefits that might affect both their access to health care and conditions on the job that would in turn affect the SDOH. These benefits may extend beyond the unionized workforce because non-unionized employers may have to offer comparable benefit packages to compete for labour or head off unionization drives. Unions can also have an important political role, counteracting the forces that make politics 'the preserve of the educated upper

classes' (Greer 2018 p. 36), by working to educate, organize, and mobilize workers for political projects (the right side of the horizontal axis).

Combining these axes creates four different pathways through which unions can potentially impact on health. The left-side quadrants are the most straightforward, both intuitively and empirically. These represent what are commonly understood to be the basic functions of a union: bargaining and enforcing better terms and conditions of employment for their members. Bargaining can, for members (and where there is a spillover, possibly for some non-members), improve the quality of health care when workers are injured or sick. The northwest quadrant represents the connection between unionization and health. This effect is likely to be largest in places, like the USA, where health insurance is largely tied to employment. Indeed, the coordination and administration of health insurance schemes, and sometimes the direct provision of health care, were among the core functions of workers' associations and unions in both artisanal and industrial trades (Boeri et al. 2001, Krajcinovic 1997, Widdershoven et al. 2009). Today, in the USA, unionized workers are more likely to have health insurance through their employer than their non-union counterparts (Leigh & Chakalov 2021). Across government and private industries, 95% of union workers in the US had access to medical care benefits, compared with 71% of non-union workers (Bureau of Labor Statistics 2023). Petach and Wyant (2023) show that the 'union advantage' on access to health care is greatest among low-income workers. One study estimated that declining unionization rates explained somewhere between 25% and 35% of the reduction in health insurance provided by employers in the US (Buchmueller et al. 2002). The percentage of the population without insurance is 4.5 percentage points lower in states with the highest unionization rates compared with those with lower union densities (Banerjee et al. 2021). While the effect of unionization on health care access and quality is likely to be highest in places without universal public healthcare, even in countries with it, unions regularly negotiate a wide range of health benefits for their members that are additional to the public system, from dental and vision services to drugs, mental health services, or physiotherapy. The difference in Canada is substantial, where 81% of unionized workers across all industries have supplemental medical or dental care, relative to 57% of non-unionized workers (Poirier & Stevens 2023).

Through bargaining, unions also affect the SDOH. This aspect of the connection between health and unionization is captured by our southwest quadrant. Most obviously, unions bargain for higher wages for their members, and income is a key SDOH. The union wage premium arrived at through collective bargaining (measured at between 10% and 22% in Canada across full- and part-time workers in all industries between 2020 and 2022 (Poirier & Stevens 2023)) will have positive health implications for union members. However, there are other ways in which collective bargaining can improve health at the 'front end,' through its social determinants. Kim et al. (2012) argue that unions contribute to securing professional pathways for career advancement that may explain health variations between unionized and non-unionized workers. One of the factors in Case and Deaton's 'deaths of despair' hypothesis in the United States is the dearth of meaningful, well-paid employment, which has led to growing drug and alcohol abuse as workers attempt to self-medicate out of their desperation (Case & Deaton 2017, 2021). States in the USA with higher unionization rates, have greater equality of market income, which has been associated with reduced rates of excess mortality, and infant health outcomes (Muller & Raphael 2023). Unionized workplaces fare better than those without unions on a number of factors that are positively linked with better SDOH, including firm-level wage inequality, better pensions, reduced discrimination, improved on-the-job training, and family leave (Leigh & Chakalov 2021, Muller & Raphael 2023, Poirier & Stevens 2023, Reynolds & Buffel 2020). Unions also provide more voice for workers on the shopfloor, which can create institutional structures in the workplace that allow workers to recognize, speak out, and correct for dangerous or unhealthy job environments (Greer 2018). Perhaps more directly, unionized workplaces are associated with more healthy work arrangements. Holman et al. (1998) found that unions were associated with healthier catering, better sun protection, and worksite health promotion. On the other hand, unions have been reluctant to engage in employer based anti-smoking programs (Malinowski et al. 2015). Compared to non-union workers, unionized workers enjoy more paid sick leave, which allows workers to take better care of their and their co-workers' health by staying home from work when ill

(MacIsaac 2023). The literature on this front is not unequivocal. Avendano and Berkman (2014) argue that the institutions surrounding the labour market have less of a health impact than has been made out by many SDOH proponents.

The righthand side of Figure 1 is less intuitive, and less empirically straightforward to establish, because effects from political action are more heavily mediated. It is here that the health effects of unionization beyond the direct benefits going to members appear, and these are primarily produced through union political activity—public campaigns, electoral involvement, lobbying, and coalitional organizing. The northeast quadrant represents unions' impact on health care *systems*. Struggles for universal public health care, for its funding, and for extensions in coverage, are a key case in point. In Canada, for example, nurses' unions and unions of other public employees in health care have been, and continue to be, vocal advocates of increased public funding of government-run health care. The Québec-based Alliance du Personnel Professionnel et Technique de la Santé et des Services Sociaux, launched a 'Strong Union for a Strong Public System' campaign in 2022 that pushed for a 'budgetary shield' against underfunding. These actions are understandable within a framework that sees unions as acting primarily in the self-interest of members. But private-sector industrial unions, non-health public sector unions, and union federations have engaged politically for universal benefits that advance public health overall. The Canadian Labour Congress launched a cross-union campaign in support of universal pharmacare in 2017 and continue to push for it. In Australia, during the battles over Medicare in the 1970s and 1980s, the Australian Congress of Trade Unions, along with individual trades unions, were strong advocates of universal public health care (Byrne 2022). Lowe (1981) shows in detail the powerful influence of unions in the formation of the UK's National Health Service. More generally, as Vincent Navarro et al. (2006) argued, strong labour unions were crucial in the political fight to implement universal public health insurance in Europe. This advocacy continued and gained traction in the wake of the COVID-19 pandemic, as the International Trade Union Confederation's 5th world congress produced a manifesto that rejuvenated a demand for universal, free, quality public health care.

The United States is a key outlier here, with unions fluctuating historically, and divided internally, between support for universal public health care, and a preference for employment-based insurance (Finkel 2010, Gottschalk 2018). Despite sporadic efforts for universal public health care abetted by unions (Medicare and Medicaid victories in the 60s, adoption of national insurance in Democratic platforms in the 1970s and 1990s, the Affordable Care Act's reduction of uninsured Americans) US unions have not coalesced strongly in favour of universal health care.

The southeast quadrant represents how unions might affect the SDOH through their political activities. Labour market institutions, such as the industrial relations system that regulates how wages are set and labour organized, labour market regulation that governs rules around hiring and firing, and the scope and generosity of the welfare state all have a large impact on the extent of inequality, precarity, workforce participation, and unemployment in society. Improvements to each of these are associated with improved SDOH (Greer 2018, Muller & Raphael 2023). For example, in attempting to explain the growing deaths of drugs and despair, Miller and Estes (2018) argue that they 'are derived from the collapse of community support systems that protect residents and foster well-being'. This could involve important social programs like employment insurance benefits, for which unions have campaigned. Higher rates of unemployment insurance benefits, for example, are associated with better self-reported health for those unemployed (Cylus et al. 2015). Studies have also shown that internationally (Baccaro 2011), nationally (Card 2001), and sub-nationally in Canada (Das et al. 2024, Haddow 2014) higher levels of unionization are, through union political activity, associated with greater redistribution and regulation surrounding the labour market. In the USA between 2015 and 2019, the 17 states with the highest union densities had higher minimum wages, higher median annual incomes, and a higher percentage of unemployed collecting benefits compared to the national average (Banerjee et al. 2021).

This is no accident. Unions have funded and supported campaigns for boosting legislated minimum wages. For example, in the US, a campaign for 'full, fair, minimum wage' (One Fair Wage 2024) for all workers in the service sector received significant funding from Service Employees International

Union (SEIU) 775NW (InfluenceWatch 2024). The SEIU also underwrote the very successful *Fight for $15 campaign* across states in the US, which helped 26 million workers win $150bn per year in additional wages (Lathrop et al. 2021). Public Services International, a global federation of public service unions, engages in ongoing campaigns for a fair tax system, including urging global-level coordination and cooperation on tax avoidance and tax havens (People Over Profit 2023). Western and Rosenfeld's (2011) research suggests that unions' political, cultural, and institutionalizing work help create and reproduce (to varying degrees) a moral economy, including distributional norms that have implications for wage levels across the union/non-union divide (2011, p. 518). These researchers emphasize the relative strength of European unions in this regard, but also claim that this work has been historically effective at reducing inequality in the US (Western & Rosenfeld 2011, p. 518).

Unequal societies, even affluent ones, have higher rates of stress, anxiety, depression, and addiction, which are caused by people's reduced sense of control over their own lives and an overall decreased level of social coherence and security, compared to those in more egalitarian nations (Wilkinson & Pickett 2019). In an overt recognition that unions' roles extend beyond the workplace, some UK unions have been working to reestablish the close connection that historically existed between trade unions and the communities in which their members live. Across the UK, unions have engaged, to varying degrees, to address non-workplace community issues, including organizing students, the unemployed, and 'others not in work' (Holgate 2015). The idea of 'whole worker organizing' (McAlevey 2016) emphasizes that workers lives are better when their conditions of life inside and outside of the factory, office, hospital, school, or other workplace, are better. This means fighting to improve the SDOH directly through community organizing and political action.

Finally, unions can and do push for legislation directly related to health outcomes that benefit the entire working population. States with greater unionization rates are more likely to have laws requiring paid sick and medical leaves, for example (Holgate 2015, pp. 433–34).

Empirical Literature Review

Having highlighted unions' efforts to intervene on health, we now turn to the empirical literature on associations between unions and health outcomes.

A few studies follow up Case and Deaton's (2017) concept of 'death by despair' in the US by investigating the connection between unionization rates and drug related deaths. Between 1999 and 2016 Defina and Hannon (2019) found that states with larger decreases in unionization rates had greater increases in deaths from drugs, controlling for other exogenous factors. Similarly, Eisenber-Guyot et al. (2020) estimated that between 1986 and 2016, an increase in union density of 10% in US states decreased deaths by overdose and suicide by 17% – although unionization had no noticeable effect on all-cause mortality.

Other studies focus on whether being a union member, or belonging to a unionized workplace, has an impact on health. Wels (2020) found that in Great Britain in the 2010s, working in a unionized workplace was associated with better self-reported mental and physical health. However, no such benefits were associated with being a union member. On the other hand, a US study found that between 1973 and 2006, after controlling for demographic and labour market characteristics, union membership had a strongly positive impact on self-reported health (Reynolds & Brady 2012).

Focusing on the SDOH impact of unions, Zoorob (2018) estimated that between 1992 and 2016 a 1% decline in state level unionization rates was associated with a 5% increase in occupational mortality rates.

In a study of European countries, Dolland and Neser (Dollard & Neser 2013) found that union density was positively related to workers' self-reported health and longevity. Reynolds and Buffel (2020) investigated the connection between union density and mental health in European countries using data from three European Social Surveys in 2006, 2012, and 2014. They discovered that populations in nations

with higher levels of unionization suffered from less depression, although reductions in union density in one nation over time did not impact on rates of depression. Further, they identified no differences in incidence of depression between workers who were members of unions and those who were not, which may suggest a greater political than collective bargaining impact, although the study does not distinguish between workers that are unions members and those that are under a collective agreement. Finally, Reeves (2021) studied 22 high income countries between 1960 and 2010, and found that lower mortality rates are associated with higher union densities. The study also investigated whether this was caused by the impact of unions on inequality (as measured by the Gini coefficient and income share of the top 1%) or by the growth of average wages, and found that the impact is through wage gains rather than greater equality.

Context: Unionization in Canadian Provinces

During the period of our study unionization rates in Canada have declined marginally, falling nationally by 3% (1 percentage point), from 30.1% in 2000 to 29.1% in 2020. However, this masks the extent of the decline, with the 2020 number artificially high since COVID-19 job losses were concentrated in the nonunionized sectors of the economy (Statistics Canada 2022b). In 2019, the last pre COVID-19 year, the unionization rate was 27.9%. This hides considerable differences in both level and trend across the Canadian provinces (Figure 2). In 2000, the difference between the high union density provinces, Quebec (36.3%) and Newfoundland (38.0%) for example, and the lowest density province, Alberta (21.4%), was around 15 percentage points. Alberta had a consistently lower rate than the other provinces but increased slightly between 2000 and 2020. Unionization rates increased in five provinces during the period of our study and fell in the other five – most dramatically in BC, where they fell from 34.4% to 29.6%.

In Canada, the policy environment that influences the strength of unions is determined at the national and provincial levels. At the national level, the Rand Formula ensures that, in a workplace with union certification, individual workers must pay union dues but have the right to opt out of the union. This judgement, which has stood up to several court challenges, eliminates the 'free rider' problem of workers receiving the benefits of union collective bargaining but not paying dues. Provinces do not have the option of following the lead of some US states by passing 'right to work' legislation that allows workers to opt out of paying union dues. Also enshrined nationally is the right of union certification – that when the majority of workers in a workplace vote for a union, the employer must engage in collective bargaining.
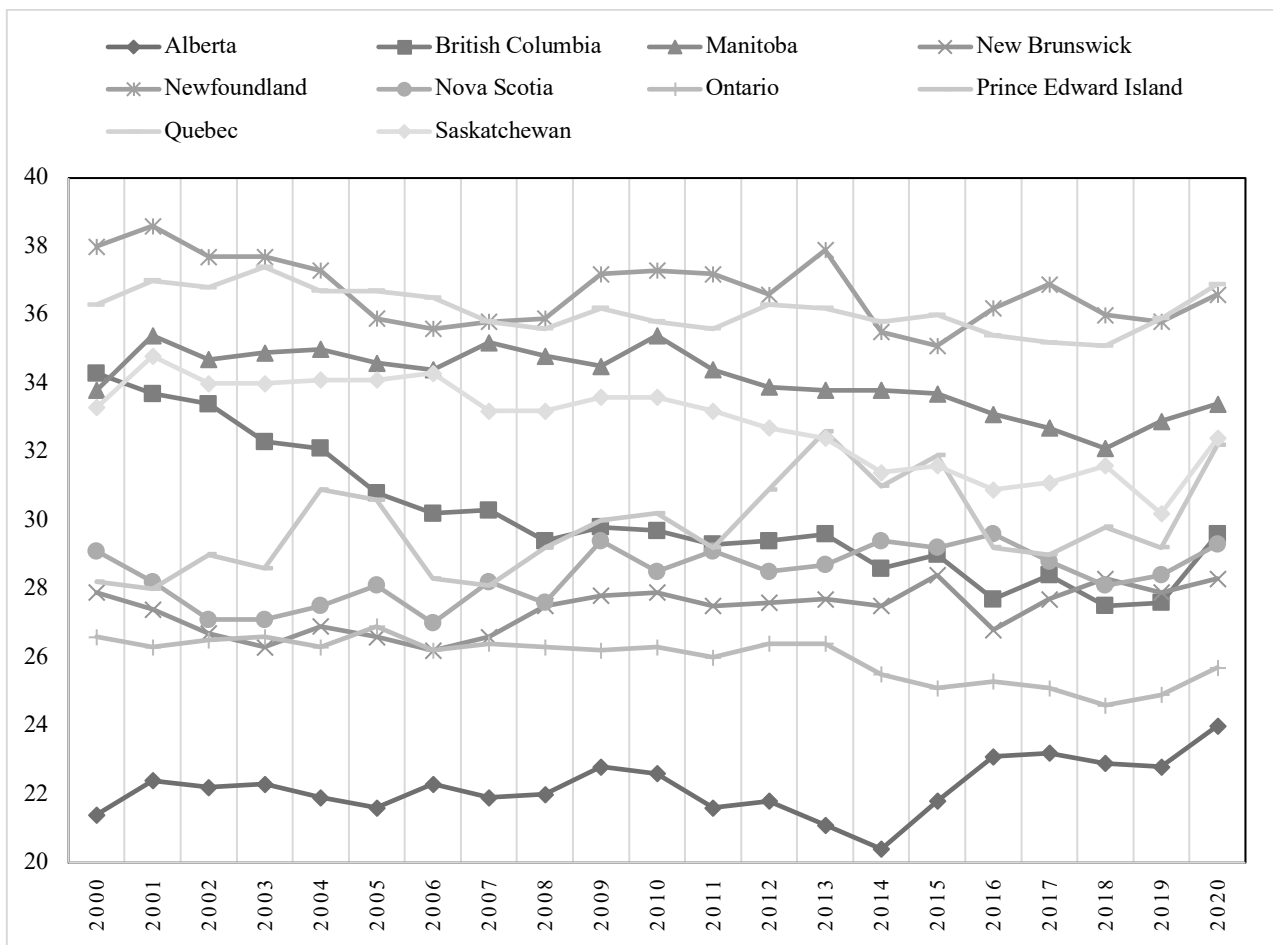
Figure 2: Unionization rates, Canadian provinces: 2000-2020

However, provinces do have considerable discretion over many of the other rules that surround unionization. Approximately 90% of Canadian workers are covered by provincial (or territorial) law (Warner 2013). A complete account of provincial differences is beyond the scope of this paper, but a few key issues will demonstrate that provinces are largely responsible for the context in which unions operate. Provincial governments can institute back to work laws or enforce essential services agreements that take away or weaken unions' ability to strike. Provinces have discretion over whether employers can hire replacement workers during a strike (Duffy & Johnson 2009). They can, and have, legislated wage freezes for unionized public sector workers that effectively remove their right to collective bargaining. Provinces can also alter the rules that govern union certification (or decertification) votes. One example of this is 'card check,' in which unions can be certified by essentially collecting signatures or union cards from a certain percent of the workforce versus a 'secret ballot' as a voting mechanism. Research has found that the former is much more conducive to union formation than the latter, largely because the delay in union certification necessitated by the secret ballot permits employers time to organize a counter offensive (Campolieti et al. 2007, Riddell 2004, Slinn 2005, Warner 2013). Provinces also have discretion over the extent of employer anti-union actions. For example, in 2002, British Columbia expanded employers' 'right to communicate' with their workers during a unionization drive (Das et al. 2020). Finally, provincial governments fund and administer some form of a Labour Board, which facilitates collective bargaining, arbitrates workplace disputes, and enforces the rules in unionized workplaces. The manner in which this

is staffed and the extent to which it is funded has an impact on unions' ability to seek recourse when employers violate provincial labour law. The decentralized regulatory environment in Canada and the resulting differences in rules and unionization rates makes an interprovincial study useful.

Data and Model

Our empirical analysis includes data from the 10 Canadian provinces: Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, Prince Edward Island, Québec and Saskatchewan. The dataset covers the period from 2000 to 2020. We use three variables to represent health measures. These are: age standardized mortality rate per 100,000 population (MORTALITY), age standardized mortality rate from preventable causes per 100,000 population (PREVENT) and age standardized mortality rate from treatable causes per 100,000 population (TREAT).

　　While calculating these three variables, the difference in age structure was taken into account. Statistics Canada (2023) notes that 'In the calculation of the age-standardized rate, either one population is mathematically adjusted to have the same age structure as the other; or both populations are mathematically adjusted to have the same age structure as a third population, called the **standard population**. In this way, the two groups are given the same age distribution structure so that a more representative picture of the characteristic in question is provided.'

　　Preventable and treatable mortality are measures of the effectiveness of different kinds of health interventions, together termed avoidable mortality. Statistics Canada classifies preventable and treatable mortality using the International Statistical Classification of Diseases and Related Health Problems (Statistics Canada, 2022a). PREVENT is defined as the rate of premature deaths that could potentially have been prevented through public health and primary prevention efforts, which includes lifestyle changes and injury prevention. Examples include diseases that could have been prevented through the use of vaccines, and injuries such as suicides and drowning. TREAT includes premature deaths that could potentially have been avoided through health care interventions. TREAT includes deaths due to such things as 'misadventures to patients during surgical and medical care' and infections deemed treatable, such as sepsis. Some diseases, such as tuberculosis, are classified as both treatable and preventable. For a full list of how different health issues are classified as treatable or preventable see the Canadian Institute for Health Information (2022).

　　Since we are estimating the impact of the strength of unions on health indicators, we include the rate of unionization (UNION) as one of the independent variables. UNION is defined as the ratio of unionized employees and total employees. Recently, Das and colleagues (2023) used this variable to measure the strength of unions. We also include a set of control variables that are unrelated to unionization rates but have potential impacts on mortality. The first is the ratio between the population with tertiary level of education and the total population (EDU), age 25 to 64 years old. Higher education can impact health outcomes in several ways. Educated individuals may be better able to undertake preventative measures. People with higher education are likely to have higher income, which may give them access to quality healthcare, nutrition and other resources that are important for better health care management. Other studies that include education as a determinant of health outcomes include Eisenberg-Guyot et al. (2020), Reynolds and Buffel (2020), and Wels (2020). The next variable is INDIGENOUS, which is defined as the total Indigenous population as a ratio of total population, age 15 to 64 years old. Canada's history as a settler colonial nation has resulted in longstanding socioeconomic disadvantage for its Indigenous population. As a result, a greater proportion of Indigenous people would likely be associated with higher mortality rates. Studies in the US have used race as a control variable because of its own history of race relations (Eisenberg-Guyot et al. 2020, Wels 2020). We also include the ratio between female population and the total population, age 15 to 64 years old (FEMALE). Women generally live longer than men, although that gap is moderated by marital status. Men are two times as likely to die from preventable causes than women, and 18% more likely to die from treatable causes

(Canadian Institute for Health Information 2024). A larger proportion of women in the total population would be expected to reduce mortality rates (Reynolds & Buffel 2020, Wels 2020). Finally, a political regimes variable (REGIME) is included in the short run equation. The goal is to explore whether political ideologies have any impact on health measures independent of the unionization rate (Reeves 2021). Das et al. (2020), for instance, examined the policy convergence theory and measured if health outcomes, among other socio-economic variables, are affected by different political ideologies in the provinces of Manitoba and British Columbia in Canada. We assign a value of 1 to years when a province was ruled by a party which is supportive of more neoliberal policies. Otherwise, we assign a value of 0. For example, the Progressive Conservative Party of Manitoba was the governing party in the province of Manitoba between 2016 and 2020, marking this period with a value of 1, whereas the New Democratic Party of Manitoba, which is generally known for greater, although still fairly minimal, support of social welfare programs, led the province from 2000 to 2015, attributing a value of 0 for this period.. Definitions and data sources of these variables are listed in Table 1.

Variable	Definition	Source
MORTALITY	Age standardized mortality rate per 100,000 population	Statistics Canada, Table: 13-10-0800-01
PREVENT	Age standardized mortality rate from preventable causes per 100,000 population	Statistics Canada, Table: 13-10-0744-01
TREAT	Age standardized mortality rate from treatable causes per 100,000 population	Statistics Canada, Table: 13-10-0744-01
UNION	Ratio between employees who are union members and total employees	Statistics Canada, Table 14-10-0129-01
EDU	Ratio between population with tertiary education and population with all levels of education, aged 25 to 64 years old	Statistics Canada, Table 37-10-0130-01
INDIGENOUS	Ratio between total Indigenous population and the total population, aged 15 to 64 years old	Indigenous Services Canada. Custom Tabulations, Indian Registry System
FEMALE	Ratio between female population and the total population, aged 15 to 64 years old	Statistics Canada, Table: 17-10-0005-01
REGIME	1 for neoliberal regime, 0 otherwise	Authors' calculation

Table 1: Variables, definitions and data sources

The dataset used in this study contains data points from 10 provinces over 21 years. In the dataset, on average, the age standardized mortality rate (per 100,000 population) between 2000 and 2020 is the highest in Newfoundland and Labrador (910.03) and lowest in British Columbia (694.31). The average age standardized mortality rate from preventable causes (per 100,000 population) is the highest in Saskatchewan (166.00) and lowest in Ontario (134.39). Newfoundland and Labrador and British Columbia have the highest (102.58) and lowest (66.30) average age standardized mortality rate from treatable causes, respectively. The average unionization rate from 2000 to 2020 varies between 22%

(Alberta) and 37% (Newfoundland and Labrador). Among other provinces, Québec has the second highest unionization rate of 36%. The average distributions of all variables from 2000 to 2020 are provided in Table 2.

	AB	BC	MB	NB	NL	NS	ON	PEI	QC	SK
MORTAL- ITY (per 100,000)	742.80	694.31	817.36	798.46	910.03	826.94	718.09	804.20	735.41	800.65
PREVENT (per 100,000)	155.28	134.98	165.31	153.23	157.92	160.34	134.39	149.54	143.94	166.00
TREAT (per 100,000)	78.42	66.30	95.88	76.39	102.58	86.94	77.39	79.89	72.97	90.85
UNION (%)	22.20	30.13	34.12	27.40	36.70	28.42	25.98	29.81	36.15	32.84
EDU (%)	46.33	48.52	45.19	45.95	37.33	47.29	56.48	48.67	47.00	37.95
INDIGEN- OUS (%)	2.72	2.97	10.70	1.89	3.24	1.57	1.45	0.88	0.96	12.60
FEMALE (%)	48.73	50.03	49.44	49.89	50.31	50.50	50.09	50.56	49.44	49.08

Note: AB = Alberta; BC = British Columbia; MB = Manitoba; NB = New Brunswick; NL = Newfoundland and Labrador; NS = Nova Scotia; ON = Ontario; PEI = Prince Edward Island; QC = Québec; SK = Saskatchewan

Table 2: Distribution of variables across Provinces

The general form of the equations estimated in this study can be presented as follows:

$$\text{MORTALITY} = F(\text{UNION, EDU, INDIGENOUS, FEMALE, REGIME}) \quad (1)$$
$$\text{PREVENT} = F(\text{UNION, EDU, INDIGENOUS, FEMALE, REGIME}) \quad (2)$$
$$\text{TREAT} = F(\text{UNION, EDU, INDIGENOUS, FEMALE, REGIME}) \quad (3)$$

Except for REGIME, all other variables are transformed using their respective natural logarithm. REGIME, a dummy variable, takes the values of 0 and 1, and therefore, is not log-transformed. Logarithmic transformation has certain advantages. First, such transformation linearizes the relationship between variables. Second, it mitigates the potential impact of outliers by aligning their values closer to the mean. Third, logarithmic transformation allows us to explain the coefficients in percentage terms. After the transformation, we denote MORTALITY, PREVENT, TREAT, UNION, EDU, INDIGENOUS and FEMALE as LN(MORTALITY), LN(PREVENT), LN(TREAT), LN(UNION), LN(EDU), LN(INDIGENOUS) and LN(FEMALE), respectively. We provide a detailed discussion of the statistical analysis in Appendix 1.

Results

Table 3 presents regression results for the impact of unionization on the broad mortality measure[1,2]. The coefficient REGIME in the short run equation is not statistically significant. Therefore, we do not find evidence of any discernible impact of political regimes on the broad measure of mortality. The coefficient of LN(EDU) is negative and statistically significant at the 1% level. This suggests that, after controlling for the impacts of unionization rate, female population and Indigenous population on age-standardized mortality rate, people who pursue advanced education tend to have a lower mortality rate. The coefficient of LN(INDIGENOUS) is positive and statistically significant at the 5% level. Therefore, conditional on LN(UNION), LN(EDU) and LN(FEMALE), a rise in the Indigenous population relative to the total population is associated with an increase in mortality rate in Canada. We also find a negative association between mortality rate and a relative increase in the female population. This is evident from a negative (and statistically significant at the 1% level) coefficient of LN(FEMALE).

        LN(UNION) is negative and statistically significant at the 5% level when LN(MORTALITY) is the dependent variable. The absolute size of this coefficient is 0.56, suggesting that, on average, a 1% increase in the rate of unionization is associated with a 0.56% decline in mortality rate in Canada. This reflects the combined effects of collective bargaining—including wage gains, health benefits, and health and safety provisions, for example—and political action that puts downward pressure on the mortality of the entire population of the province.

Variable	Coefficient	Standard error
	Long run equation	
LN(UNION)	-0.560**	0.234
LN(EDU)	-0.683***	0.067
LN(INDIGENOUS)	0.113**	0.048
LN(FEMALE)	-8.461***	0.348
	Short run equation	
Error correction term	-0.095*	0.053
REGIME	-0.003	0.004
Adjusted sample	2002-2020	
Number of observations	190	
Selected model	Pooled mean group (PMG) (2,0,0,0,1)	

Note: ***, ** and * indicate statistical significance at the 1% level, 5% level and 10% level, respectively.

Table 3: Pooled mean group (PMG) results with dependent variable: ΔLN(MORTALITY)

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[1] Due to space constraints, we present the full long-run table and a concise version of the short run dynamics. Coefficients of other short run variables are available upon request.

[2] The model has short and long run equations. The short run equation provides important information on the error correction coefficient. If this coefficient is either positive or statistically insignificant, then the estimated model is unstable and using this model to estimate the association between unionization and health measures is inappropriate. However, a negative and statistically significant coefficient of the error correction term ensures stability of the model in the long run. In this case, the statistically significant error correction coefficient of -0.095 means that when the short run fluctuations cause a deviation from the long run equilibrium, 9.5% of such deviation is corrected in the first year.

We report results from estimating relationships between unionization rate and mortality rate from preventable causes in Table 4, and mortality rate from treatable causes in Table 5. In both cases, our findings echo the earlier results where broad mortality rate was treated as the dependent variable. Unionization rate is associated with reduction in both mortality rate from preventable causes and mortality rate from treatable causes. Specifically, a 1% increase in the rate of unionization is associated with a 0.47% decrease in mortality rate from preventable causes, and a 1% increase in the rate of unionization is associated with a 0.36% decrease in mortality rate from treatable causes. An increase in the proportion of people with tertiary education and the ratio of female to total population seem to have a negative impact on both mortality rate from preventable causes and mortality rate from treatable causes. The long run associations between the relative size of the Indigenous population and both mortality rate from preventable causes and mortality rate from treatable causes are found to be positive and statistically significant at least at the 5% level.

Variable	Coefficient	Standard error
	Long run equation	
LN(UNION)	-0.471***	0.105
LN(EDU)	-0.734***	0.037
LN(INDIGENOUS)	0.052***	0.014
LN(FEMALE)	-5.900***	0.165
	Short run equation	
Error correction term	-0.646***	0.231
REGIME	-0.005	0.013
Adjusted sample	2002-2020	
Number of observations	190	
Selected model	PMG (2,2,1,1,1)	

Note: *** indicates statistical significance at the 1% level.

Table 4: PMG results with dependent variable: ΔLN(PREVENT)

Variable	Coefficient	Standard error
	Long run equation	
LN(UNION)	-0.361**	0.140
LN(EDU)	-1.055***	0.078
LN(INDIGENOUS)	0.024**	0.012
LN(FEMALE)	-4.795***	0.270
	Short run equation	
Error correction term	-0.320*	0.162
REGIME	-0.000	0.014
Adjusted sample	2002-2020	
Number of observations	190	
Selected model	PMG (2,0,0,2,0)	

Note: ***, ** and * indicate statistical significance at the 1% level, 5% level and 10% level, respectively.

Table 5: PMG results with dependent variable: ΔLN(TREAT)

Conclusion

Our findings suggest that unionization rates in Canadian provinces are associated with improvements in total, preventable, and treatable mortality during the period of our study. Muller and Raphael (2023) noted that the impact of unions on health is an important, and understudied, topic of investigation in the Canadian context. We outlined four distinct, although complementary, pathways through which unions might influence population health outcomes based on two axes: the levers that unions can potentially pull to influence any policy environment (collective bargaining and political action) and the manner in which health can be influenced in a society (the SDOH and health care). Previous literature across and within other nations suggests that higher levels of unionization are frequently associated with better health outcomes, although these results are not unanimous and many test for self-reported health rather than objective health outcomes. Our findings support Reeves' (2021) results on mortality and unionization rates among high income countries.

Canadian provincial governments have considerable discretion over the labour market rules surrounding unionization. The results in this paper suggest that a policy environment that increases union membership, through making it easier to form unions and strengthening unions once they are formed, could have important health benefits.

This study focused on the overall relationship between unionization rates and three measures of mortality. An important avenue for future research might be to distinguish between the different pathways we have identified to determine which are the most important in terms of improvements in health outcomes.

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Appendix I

Since our dataset spans over 21 years (i.e., from 2000 to 2020), it is important to identify the order of integration of the variables, i.e., if the variables follow a unit root process. If we find that the variables are stationary (i.e., they do not follow a unit root process), then a least square technique is an appropriate technique. However, if the variables are non-stationary, then it is imperative to use a cointegration technique. We use two different unit root tests, which are discussed in Appendix 1. We present the results from these tests in Table A1 in the same appendix. At least one of the two tests suggests that all variables are non-stationary at levels and stationary at first differences. Therefore, we use the pooled mean group (PMG) technique that allows us to examine the long run cointegrating relationship between the rate of unionization and health measures. This method is proposed by Pesaran, Shin and Smith (1999). Das et al. (2024; 2023) used this approach to study socioeconomic impacts of unionization and provided a thorough discussion of the model.

Unit root tests are conducted to examine if a variable is non-stationary or stationary. A stationary variable does not follow the unit root process. If the variables are stationary, then a simple least square technique of regression can be used to analyze the relationship between them. However, in the case of non-stationary variables we need to use a method that can accommodate these variables and allows us to examine the long run cointegrating relationships among these variables. We employ two different unit root tests- the Fisher type Phillips-Perron test (Maddala & Wu, 1999) and the IPS test (Im et al., 2003). The null hypothesis of these tests is that the series contains a unit root.

Variable	IPS W statistic	Probability	Fisher χ^2 statistic	Probability
LN(MORTALITY)	-0.573	0.283	29.496	0.078
ΔLN(MORTALITY)	-5.622	0.000	389.157	0.000
LN(PREVENT)	0.080	0.532	23.834	0.250
ΔLN(PREVENT)	-6.841	0.000	417.962	0.000
LN(TREAT)	1.773	0.962	17.111	0.646
ΔLN(TREAT)	-9.691	0.000	521.549	0.000
LN(UNION)	-0.816	0.207	26.980	0.136
ΔLN(UNION)	-6.238	0.000	160.751	0.000
LN(EDU)	3.172	0.999	23.816	0.251
ΔLN(EDU)	-8.357	0.000	414.837	0.000
LN(INDIGENOUS)	2.600	0.995	14.252	0.818
ΔLN(INDIGENOUS)	-3.215	0.001	38.067	0.009
LN(FEMALE)	-1.621	0.053	12.737	0.884
ΔLN(FEMALE)	-1.585	0.057	28.861	0.091

Note: The null hypothesis of both tests is that the series follows a unit root process.

Table A1: Unit root tests

We report the results from the Fisher type and IPS unit root tests in Table A1. The null hypothesis that LNPREVENT, LNTREAT, LNUNION, LNEDU and LNINDIGENOUS contain a unit root is not rejected by either test. For LNMORTALITY and LNFEMALE, at least one of the two tests do not reject the null hypothesis. However, the same null hypothesis is rejected at conventional statistically significance level when we consider the first difference of the variables. Therefore, results from both tests suggest that LNPREVENT, LNTREAT, LNUNION, LNEDU and LNINDIGENOUS are non-stationary at levels but stationary at their respective first differences. For LNMORTALITY and LNFEMALE, the same conclusion is made by at least one of the two tests employed to examine the order of integration of the variables. Therefore, the standard least square

technique cannot be used to examine the dynamic relationship between unionization rate and health indicators. Instead, we call for an econometric technique that can estimate long run cointegrating relationships.

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