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Research

The association of facility ownership with COVID-19 outbreaks in long-term care homes in British Columbia, Canada: a retrospective cohort study

Michelle B. Cox MSc, Margaret J. McGregor MD MHSc, Jeffrey Poss PhD, Charlene Harrington RN PhD

Abstract

Background: Long-term care (LTC) in Canada is delivered by a mix of government-, for-profit- and nonprofit-owned facilities that receive public funding to provide care, and were sites of major outbreaks during the early stages of the COVID-19 pandemic. We sought to assess whether facility ownership was associated with COVID-19 outbreaks among LTC facilities in British Columbia, Canada.

Methods: We conducted a retrospective observational study in which we linked LTC facility data, collected annually by the Office of the Seniors Advocate BC, with public health data on outbreaks. A facility outbreak was recorded when 1 or more residents tested positive for SARS-CoV-2 between Mar. 1, 2020, and Jan. 31, 2021. We used the Cox proportional hazards method to calculate the adjusted hazard ratio (HR) of the association between risk of COVID-19 outbreak and facility ownership, controlling for community incidence of COVID-19 and other facility characteristics.

Results: Overall, 94 outbreaks involved residents in 80 of 293 facilities. Compared with health authority–owned facilities, for-profit and nonprofit facilities had higher risks of COVID-19 outbreaks (adjusted HR 1.99, 95% confidence interval [CI] 1.12–3.52 and adjusted HR 1.84, 95% CI 1.00–3.36, respectively). The model adjusted for community incidence of infection (adjusted HR 1.12, 95% CI 1.07–1.17), total nursing hours per resident-day (adjusted HR 0.84, 95% CI 0.33–2.14), facility age (adjusted HR 1.01, 95% CI 1.00–1.02), number of facility beds (adjusted HR 1.20, 95% CI 1.12–1.30) and facilities with beds in shared rooms (adjusted HR 1.16, 95% CI 0.73–1.85).

Interpretation: Findings suggest that ownership of LTC facilities by health authorities in BC offered some protection against COVID-19 outbreaks. Further study is needed to unpack the underlying pathways behind this observed association.

Long-term care (LTC) facilities provide housing, support and nursing care to frail older adults who are no longer able to function independently. Given the nature of care provided, and the close contact between staff and residents, these facilities are at high risk for the spread of infections.[1] During the early months of the COVID-19 pandemic of 2020, LTC facilities proved to be sites of major outbreaks in British Columbia[2] and across Canada.[3,4] The impact of COVID-19 on LTC facilities and their residents highlighted the need to better understand the risk factors for COVID-19 outbreaks in this setting.

In BC, LTC facilities are publicly funded except for a small number of private-pay facilities in larger cities. Five regional health authorities in BC finance the province's LTC services. Of the LTC facilities in BC, about one-third are owned and operated by the health authorities (publicly owned). The remaining facilities are owned and operated by for-profit corporations or independent (nongovernment) nonprofit societies that contract with the health authorities to provide LTC. In addition to ownership differences between facilities, there is also variation in staffing levels and staff mix, human resource practices (e.g., subcontracting the workforce or services), facility characteristics (e.g., number of beds, number of rooms with shared beds, facility age) and resident case mix distribution.[5–8]

Past research has shown that differences among LTC facilities should be considered when assessing health outcomes.[9] Research from the United States found a number of facility characteristics to be predictive of COVID-19 outbreaks, including for-profit ownership, lower levels of total nursing staff (including licensed nursing and care aides) and

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Correspondence to: Margaret McGregor, mrgret@mail.ubc.ca

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of registered nurses and larger facility size.[10–12] One study, set in Ontario, Canada, reported that community incidence of COVID-19, facility size and older design standards — but not ownership — were associated with odds of an outbreak.[13] However, this study did show for-profit status was associated with the extent and number of resident deaths during outbreaks. Aside from this study, little Canadian research has been published on this topic. Our study aimed to assess whether facility ownership was associated with COVID-19 outbreaks in publicly funded LTC facilities, after controlling for staffing and other factors.

Methods

Setting and study design

This retrospective observational study included all COVID-19 outbreaks in LTC facilities in BC during the first and second waves of the pandemic between Mar. 1, 2020, and Jan. 31, 2021. We included publicly funded LTC homes in the 5 health regions in BC, and excluded assisted living facilities (n = 132), and supportive housing (number not available), given differences in the care required by seniors living in these settings compared with those in LTC settings. We also excluded facilities with fewer than 5 beds (n = 3), new LTC facilities (n = 2), and private-pay facilities (estimate n = 30) since publicly available facility covariable data were not available.

Data sources

We obtained outcome data on COVID-19 outbreaks and community prevalence from publicly available data from the BC Centre for Disease Control, namely the Weekly COVID-19 Outbreak Reports for Long-Term Care, Assisted Living and Independent Living Facilities and the COVID-19 Dashboard Case Details database.[14] We identified COVID-19 cases according to the BC Centre for Disease Control's case definitions for community SARS-CoV-2 infections, and used the same diagnostic criteria among LTC residents. For this study, we deemed a resident of an LTC facility to have COVID-19 if they had a SARS-CoV-2 infection confirmed by polymerase chain reaction (PCR).[15] A PCR test was administered if a resident met the provincial criteria for testing, which initially stated that residents with a defined set of COVID-19 symptoms be tested, but were updated over time as public health developed a better understanding of the atypical nature of disease presentation among frail older adults.

We used the Office of the Seniors Advocate BC Long-Term Care Facilities Quick Facts Directory as the data source for our facility-level covariables.[8] It is a publicly available data source containing information from the Ministry of Health, the regional health authorities, the Canadian Institute for Health Information and the BC Centre for Disease Control, and is linked to facility-level data from the Office of the Seniors Advocate BC's Residential Care Survey. The data are sent to LTC operators each year for validation of their facility information. This report is released annually (at the end of December) and reflect data gathered over the fiscal period from Apr. 1, 2019, to Mar. 31, 2020. We chose to use data from this fiscal year because, in consultation with the Office of the Senior Advocate, it was determined that this year's data were most reflective of facility characteristics in the year before the start of the pandemic. We then linked the cross-sectional data to our outcome data from Mar. 1, 2020 (the beginning of the pandemic), to Jan. 31, 2021, when all LTC residents had received their first vaccination.

We computed the daily community incidence for each of BC's 5 health authorities using case data from the BC Centre for Disease Control for each day of the study period (Mar. 1, 2020, to Jan. 31, 2021) and population counts for each health authority from Statistics Canada.[14,16] At the beginning of the study, all residents and staff were unvaccinated. In BC, first doses of the SARS-CoV-2 vaccine were administered to LTC residents and staff beginning in December 2020, and second doses were provided mid-to-late January 2021. A decision was made to end the study on Jan. 31, 2021, since both the number of cases and the severity of SARS-CoV-2 infections decreased substantially after full vaccination of the LTC population (91% of all residents) around this time. We have included missing data for the descriptive variables to show the completeness of the LTC data. Since all positive laboratory results are reported to the BC Centre for Disease Control, we assumed these data to be complete and accurate.

Outcome and explanatory variables

Our main outcome variable was a dichotomous variable for occurrence of a COVID-19 outbreak. An outbreak at a facility was declared when COVID-19 was diagnosed in 1 or more LTC facility residents by laboratory-confirmed SARS-CoV-2 infection.[15] The explanatory variables of interest included a categorical variable for facility ownership (for-profit, nonprofit or health authority); 2 continuous variables for staffing level (total nursing or care aide hours per resident-day and allied health hours per resident-day) and 3 dichotomous variables for subcontracted services (professional nursing, nonregulated services and food services). Subcontracted services refer to staff that are both hired and managed by a subcontracting agency to provide longitudinal services to a facility; a model for these services existed before the pandemic. We created a time-varying covariate for community-level incidence of COVID-19 by calculating a rolling 14-day average incidence per 1000 population for each day, by health authority of the facility. Since community incidence and health authority region are highly correlated, we chose to use the former as a surrogate measure of region to address any differences in ownership across the 5 health authorities. Other variables included mean facility age, mean facility size (i.e., bed numbers) and dichotomous variables for facilities with shared beds and facilities with a large number of shared beds (v. few shared beds or none). We defined facilities with a large number of shared beds as those with more than 20% of their beds in shared rooms. We used this cut-off because the mean proportion of beds in shared rooms across all facilities was 0.21. Facility distribution of resident mean age, proportion male, and mean case mix index were also analyzed.

Statistical analysis

We calculated descriptive statistics related to COVID-19 outbreaks in LTC facilities, including the number of residents

involved, length of outbreak and descriptive summary statistics on the total number of cases and deaths. We conducted bivariate analyses of facilities with and without a COVID-19 outbreak on ownership, community incidence, staffing, and facility and resident characteristics. Tests of comparison for the bivariate analyses included the Welch *t* test or Mann–Whitney *U* test for continuous variables and the χ^2 test for dichotomous or categorical variables.

We conducted Cox proportional hazards analyses to explore the association between ownership, community, staffing and facility characteristics, and time to COVID-19 outbreak. Facilities could have more than 1 outbreak, and contributed a new observation starting the day after an outbreak was over. We deemed facilities to be at risk of an outbreak throughout the duration of the study (Mar. 1, 2020, to Jan. 31, 2021) except when having a declared outbreak. In addition to ownership, we determined explanatory variables for the Cox proportional hazards analyses a priori from a review of the literature and in consultation with clinical experts in LTC. If variables were highly correlated, then we included only 1 variable of interest. The analysis used the time-varying variable for community incidence and included a robust sandwich estimator for the covariance matrix to account for correlation among observations between health authorities and repeated outbreaks at the same facility. We generated univariate models to explore the association of explanatory variables with time to outbreak. We then generated models that included the main ownership explanatory variable while adjusting for community incidence, staffing and facility characteristics. We reported unadjusted and adjusted hazard ratios (HRs) with 95% confidence intervals (CIs) for these analyses, and tested the proportional hazards assumptions.

We conducted sensitivity analyses to test the robustness of the final model results by re-running several different models. The alternate models excluded either outlier facilities or health authorities with fewer outbreaks, or used a more restrictive definition of an outbreak (i.e., outbreaks with only a single resident case were not included). We identified outlier facilities for the sensitivity analyses by visual inspection and by graphing boxplots. We identified health authorities with fewer outbreaks by visually inspecting the data.

We conducted statistical analyses using SAS software, version 9.4 (SAS Institute).

Ethics approval

The study was approved by the University of British Columbia Behavioural Research Ethics Board (H20-01378).

Results

From Mar. 1, 2020, to Jan. 31, 2021, 94 COVID-19 outbreaks involved facility residents in 80 of 293 facilities. Almost one-fifth of the outbreaks took place in wave 1 of the pandemic (Mar. 1 to July 31, 2020); most outbreaks were part of the second wave (Aug. 1, 2020, to Jan. 31, 2021). There were 2379 resident cases of COVID-19 and 749 resident deaths (Table 1).

Table 1 (part 1 of 2): Characteristics of COVID-19 outbreaks in long-term care facilities between Mar. 1, 2020, and Jan. 31, 2021, in British Columbia

Characteristic	No. (%) of total*
COVID-19 outbreaks	
Total outbreaks†	94
Wave 1‡	18 (19.1)
Wave 2‡	76 (80.9)
No. of residents involved in outbreak	
1	14 (14.9)
2–10	28 (29.8)
11–50	34 (36.2)
> 50	18 (19.1)
At least 1 resident death	75 (79.8)
Length of outbreak, d, mean ± SD	47.2 ± 18.6
Range	5.0–106.0
No. of outbreaks by health authority	
Vancouver Coastal Health	25 (26.6)
Fraser Health	55 (58.5)
Interior Health	9 (9.6)
Island Health	2 (2.1)
Northern Health	3 (3.2)
LTC facilities	
Total facilities	293
Facilities with outbreaks	80 (27.3)
No outbreaks	213 (72.7)
1 outbreak	66 (22.5)
2 outbreaks	14 (4.8)
Facilities by health authority	
Vancouver Coastal Health	54 (18.4)
Fraser Health	80 (27.3)
Interior Health	79 (27.0)
Island Health	58 (19.8)
Northern Health	22 (7.5)
COVID-19 cases among LTC residents‡	
Total resident cases	2379
Resident cases per outbreak facility, mean ± SD	29.7 ± 26.9
Total resident deaths	749
COVID-19 case mortality rate (resident deaths per resident COVID-19 cases)	749 (31.5)
Resident cases by health authority	
Vancouver Coastal Health	764 (32.1)
Fraser Health	1286 (54.1)
Interior Health	231 (9.7)
Island Health	8 (0.3)
Northern Health	90 (3.8)

Table 1 (part 2 of 2): Characteristics of COVID-19 outbreaks in long-term care facilities between Mar. 1, 2020, and Jan. 31, 2021, in British Columbia

Characteristic	No. (%) of total*
Community rates of COVID-19	
Health authority daily incidence, infections per 100 000 population¶	
Vancouver Coastal Health	4.14
Fraser Health	6.75
Interior Health	2.52
Island Health	0.76
Northern Health	4.20

Note: LTC = long-term care, SD = standard deviation.
*Unless indicated otherwise.
†An outbreak at a facility was declared when COVID-19 was diagnosed in 1 or more LTC residents by laboratory-confirmed SARS-CoV-2 infection.
‡Wave 1: Mar. 1, 2020, to July 31, 2020; wave 2: Aug. 1, 2020, to Jan. 31, 2021.
§A COVID-19 case refers to an LTC facility resident with laboratory-confirmed SARS-CoV-2 infection.
¶Average daily incidence (Mar. 1, 2020, to Jan. 31, 2021) calculated from laboratory-diagnosed or episode-linked case tallies by health authority in BC.

Long-term care facility characteristics

Among the 293 facilities included in this study, 35.8% were owned by for-profit organizations, 28.0% were nonprofit, and the remainder (36.2%) were owned and operated by a health authority. The mean total hours of nursing or care aide, and total allied health hours across all facilities was 2.98 and 0.32 hours per resident-day, respectively. About one-quarter of the facilities subcontracted professional nursing services and a similar proportion subcontracted nonregulated (care aide) services. The mean age of all facilities was 30.3 years and the mean number of beds per facility was about 100 beds. Almost two-thirds of facilities had some beds in shared occupancy rooms. The amount of missing data for all variables was minimal (Table 2).

Characteristics by outbreak status

In the bivariate analysis, among facilities with an outbreak, 46.3% were for-profit, 31.3% were nonprofit and 22.5% were health authority–owned and operated. Facilities with outbreaks had significantly lower mean total nursing or care aide hours than those without an outbreak (2.90 h v. 3.01 h, $p = 0.003$). Likewise, a significantly higher proportion of facilities with an outbreak subcontracted professional nursing ($p = 0.012$), nonregulated services ($p = 0.027$) and food services ($p = 0.027$) (Table 2).

Other characteristics that were significantly different between those with an outbreak versus those without an outbreak included higher median community incidence of COVID-19 ($p < 0.0001$), mean beds per facility ($p < 0.0001$) and facilities with beds in shared rooms ($p = 0.005$). There were no significant differences between the 2 groups for mean facility age or resident characteristics by outbreak status (Table 2).

Associations with risk of outbreak

In the multivariable regression model, for-profit and nonprofit ownership were associated with a higher risk of COVID-19 outbreak, compared with health authority–owned facilities (adjusted HR 1.99, 95% CI 1.12–3.52) and adjusted HR 1.84, 95% CI 1.00–3.36, respectively). The model adjusted for regional incidence of COVID-19 (adjusted HR 1.12, 95% CI 1.07–1.17), total nursing or care aide hours per resident-day (adjusted HR 0.84, 95% CI 0.33–2.14), facility age (adjusted HR 1.01, 95% CI 1.00–1.02), higher number of beds in a facility (adjusted HR 1.20, 95% CI 1.12–1.30 per 25 beds) and facilities with shared rooms (adjusted HR 1.16, 95% CI 0.73–1.85) (Table 3). We did not observe any violations of the proportional hazards assumptions. For the sensitivity analyses with facility outliers removed, those with data restricted to health authorities with higher community incidence of COVID-19 and models using a more restrictive definition of outbreak (more than 1 resident case), the direction of the effect estimates did not differ from our final model. The magnitude of the for-profit effect estimate increased and the nonprofit effect decreased when we restricted our analysis to health authorities with a higher incidence of COVID-19, and effect estimates for both for-profit and nonprofit facilities were attenuated when a more restrictive definition of outbreak definition was used or facility outliers were removed (data not shown).

Interpretation

We set out to assess the association of LTC facility ownership with COVID-19 outbreaks while controlling for other potentially confounding factors. In the multivariable analysis, we included 293 LTC facilities and found that ownership by a health authority was protective of a COVID-19 outbreak compared with both for-profit and nonprofit facilities. We also found that community incidence and facility size were significantly associated with outbreak risk, but found no association with facility age in the univariate and multivariable models. There was a significant association between outbreak risk and presence of shared rooms in the univariate analysis that did not persist after adjustment for other covariates in the full model. Our study is part of the growing body of research assessing facility characteristics and risk of COVID-19 outbreak. More specifically, it adds to the US studies and scant Canadian research by showing that ownership status has a significant association with risk of COVID-19 even after adjusting for staffing, community and facility characteristics.[13,17]

The significant protective effect of LTC ownership by health authorities on outbreak occurrence differs from an Ontario study that found ownership was not associated with COVID-19 outbreak risk.[13] One explanation for this might be that, whereas public ownership in Ontario is through municipal governments, public ownership in BC is through an integrated system of health authorities that deliver acute and community health services to the population in their respective regions. This health system integration by health authority–owned and operated LTC facilities may afford a number of

Table 2: Characteristics of long-term care facilities in British Columbia by presence of a COVID-19 outbreak between Mar. 1, 2020, and Jan. 31, 2021

Characteristic	No. (%) of facilities*			p value†
	All facilities n = 293	Facilities with outbreaks n = 80	Facilities with no outbreaks n = 213	
Total beds	29 095	9919	19 176	
Ownership characteristics‡				
For-profit	105 (35.8)	37 (46.3)	68 (31.9)	0.003
Nonprofit	82 (28.0)	25 (31.3)	57 (26.8)	0.029
Health authority	106 (36.2)	18 (22.5)	88 (41.3)	Ref.
Community characteristics				
Facility-weighted COVID-19 community incidence (infections per 100 000 population),§¶ median (IQR)	4.14 (2.52–6.75)	6.75 (4.14–6.75)	2.52 (0.76–4.14)	< 0.0001
Staffing characteristics				
Staffing hours**				
Total nursing or care aide hours, mean ± SD	2.98 ± 0.35	2.90 ± 0.20	3.01 ± 0.39	0.003
Total allied health hours, mean ± SD	0.32 ± 0.10	0.32 ± 0.07	0.32 ± 0.11	0.691
Missing	1	0	1	
Subcontracted services				
Professional nursing services	69 (23.6)	27 (33.8)	42 (19.7)	0.012
Nonregulated services (care aides)	69 (23.6)	26 (32.5)	43 (20.2)	0.027
Any food services	109 (37.8)	38 (48.1)	71 (34.0)	0.027
Missing	5	1	4	
Facility characteristics				
Age of facility, yr, mean ± SD	30.3 ± 16.3	31.3 ± 15.9	29.9 ± 16.4	0.494
Beds per facility, mean ± SD	99.3 ± 56.1	124.0 ± 56.9	90.0 ± 53.0	< 0.0001
Facilities with beds in shared rooms	174 (59.4)	58 (72.5)	116 (54.5)	0.005
Large proportion of beds in shared rooms†† (v. small or none)	88 (30.0)	30 (37.5)	58 (27.2)	0.088
Resident characteristics				
Facility-weighted age of population,§ yr, mean ± SD	83.8 ± 32.5	84.2 ± 26.6	83.6 ± 34.4	0.139
Missing	3	0	3	
Facility-weighted proportion of male residents,§ median (IQR)	0.35 (0.29–0.41)	0.35 (0.29–0.42)	0.35 (0.30–0.40)	0.613
Missing	3	0	3	
Facility-weighted case mix index,§ mean ± SD	0.58 ± 0.38	0.58 ± 0.35	0.58 ± 0.39	0.543
Missing	4	1	3	

Note: IQR = interquartile range, Ref. = reference category, SD = standard deviation.
*Unless indicated otherwise.
†Tests of comparison include the Welch *t*-test and Mann–Whitney *U* test for continuous variables, and the χ^2 test for categorical variables.
‡For-profit facilities include those owned and operated by for-profit corporations. Nonprofit facilities include those owned and operated by independent (nongovernment) nonprofit societies. Health authority facilities include those owned and operated by the provincial health authorities in British Columbia.
§Variable is weighted by size of facility.
¶Average daily incidence (Mar. 1, 2020, to Jan. 31, 2021) calculated from laboratory-diagnosed or episode-linked case tallies by health authority in BC.
**Nursing or care aide hours includes registered nurse hours, licensed practical nurse hours and care aide hours (average number of hours for entire facility, not how many hours each resident receives). Allied health includes physical, occupational, recreation, speech and language therapies, as well as social work services and dietitians.
††Large proportion of beds in shared rooms = greater than 20% of total beds are in shared rooms.

advantages.[18] For example, research from BC also suggests that health authority–owned facilities had greater access to support with infection prevention and control, and personal protective equipment, at least earlier on in the pandemic, both of which are key resources for outbreak prevention.[2] Health authority–owned facilities were also less likely to subcontract care staff and provided more sick benefits to their staff, compared with for-profit and nonprofit facilities.[2] Both of these

Table 3: Multivariable regression analysis of ownership and other characteristics associated with COVID-19 outbreaks in long-term care facilities in British Columbia, Mar. 1, 2020, to Jan. 31, 2021

Characteristic	Univariate models Unadjusted HR (95% CI)	Model 1 Adjusted HR (95% CI)	Model 2 Adjusted HR (95% CI)	Model 3 Adjusted HR (95% CI)
Ownership				
For-profit	2.17 (1.38–3.41)	1.90 (1.14–3.18)	1.72 (0.99–2.98)	1.99 (1.12–3.52)
Nonprofit	2.28 (1.39–3.73)	2.13 (1.21–3.75)	1.93 (1.06–3.50)	1.84 (1.00–3.36)
Health authority	Ref.	Ref.	Ref.	Ref.
Time-varying community incidence of COVID-19 (infections per 100 000 population)	1.14 (1.10–1.19)	1.13 (1.09–1.18)	1.13 (1.08–1.18)	1.12 (1.07–1.17)
Total nursing or care aide hours per resident-day	0.20 (0.07–0.59)		0.69 (0.26–1.83)	0.84 (0.33–2.14)
Facility age, yr	1.01 (1.00–1.02)			1.01 (1.00–1.02)
No. of beds per facility (per 25 beds)	1.20 (1.13–1.26)			1.20 (1.12–1.30)
Facilities with beds in shared rooms	1.56 (1.03–2.36)			1.16 (0.73–1.85)

Note: CI = confidence interval, HR = hazard ratio, Ref. = reference category.
*Model 1 adjusted for community incidence of COVID-19. Model 2 adjusted for incidence and staffing characteristics. Model 3 adjusted for incidence, and staffing and facility characteristics.

labour practices are possible causal pathways for the protective effect of health authority ownership observed in our study.

Unlike 1 US research study that found a protective effect of both nonprofit and government-owned facilities on outbreak risk, we did not see the protective effect of ownership extend to nonprofit ownership.[17] Previous BC research has shown a similarly protective effect of health authority ownership of facilities compared with both for-profit and nonprofit ownership for other measures of quality, including higher staffing levels,[5] greater access to other direct care resources,[19,20] lower use of the emergency department[19,20] and lower hospital admission rates.[21] These findings are consistent with the protective effect of health authority ownership on outbreak risk seen in the current study.

Literature from the US similarly supports some but not all of the other findings explored in this study. A number of US studies report higher staffing levels associated with lower odds of facility infection.[10,11] We found that higher numbers of nursing or care aide hours per resident-day were protective in the univariate model, although this effect lost significance in the adjusted model. We found no association between facility age or shared room accommodation with outbreak risk in the multivariable analysis, which differs from Ontario research in this regard.[13] However, our research supports the literature that the cumulative incidence of COVID-19[13,22] and facility size are significantly associated with risk of an outbreak.[4,11–13]

Future research to build on the current findings should deploy more qualitative methods to better understand the underlying pathways that may have contributed to the protective effect of public ownership. Interviews with front-line staff, residents and facility directors of care could explore factors, including consistency of personal protective equipment practices, the proportion of facility funding allocated to staffing, timely implementation of single-site orders, infection control and prevention policies, team cohesion and other measures of facility leadership such as staff trust and the length of employment of directors of care as potential contributors to outbreak risk. Understanding the association of these factors with both outbreak risk and with facility ownership will help inform meso- and macro-level LTC policy and better prepare facilities for future similar events. Further research from BC and other provinces is also needed to evaluate the association of facility ownership and other characteristics with outbreak severity and mortality.

Limitations

Since BC had relatively few outbreaks during the first wave of the pandemic, this may have limited the overall power of the study to detect statistically significant differences in the regression models. The generalizability of the results is restricted to LTC facilities since we excluded all other types of care facilities, such as assisted living. This study was also limited by the cross-sectional and predetermined facility data. With these data, we were not able to account for other changes that occurred at facilities over the study period as a direct result of the pandemic, such as changes in staffing levels, or consider additional measures outside of those available from the data. In addition, the community incidence rates were for entire health authorities instead of more localized geographies that may better explain each facility's risk. We also acknowledge that hazard ratios of multivariable models express an average effect across the range of covariate values, and that interactions not explored here could show other findings specific to certain measure combinations. Despite these limitations, our study adds to the limited Canadian research on this topic in a context that is arguably very different from Ontario when it comes to LTC facility ownership.

Conclusion

The study findings suggest that ownership of LTC facilities by health authorities in BC was protective of COVID-19 outbreaks, compared with for-profit and nonprofit ownership. Further research is needed to unpack the underlying pathways behind the observed association to inform policy for mitigating the negative impact of future outbreaks on this vulnerable population.

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Affiliations: Department of Family Practice (Cox, McGregor), Faculty of Medicine, University of British Columbia; Centre for Clinical Epidemiology and Evaluation (McGregor), Vancouver Coastal Health Research Institute, Vancouver, BC; School of Public Health Sciences (Poss), University of Waterloo, Waterloo, Ont.; Department of Social and Behavioral Sciences (Harrington), University of California — San Francisco, San Francisco, Calif.

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