Research

Outcomes for people experiencing homelessness with COVID-19 presenting to emergency departments in Canada, compared with housed patients

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Abstract

Background: Whether people experiencing homelessness (PEH) have different COVID-19 outcomes than housed patients in Canada remains unclear. We sought to ascertain whether rates of in-hospital mortality, hospital admission, critical care admission, and mechanical ventilation differed between PEH and housed people with symptomatic SARS-CoV-2 infection.

Methods: We conducted a propensity score–matched cohort study to compare the outcomes of PEH and housed patients presenting to emergency departments for acute symptomatic COVID-19. We used data from the Canadian COVID-19 Emergency Department Rapid Response Network (CCEDRRN) registry. Covariates in our propensity score model included age, sex, comorbidities, substance use, vaccination status, previous do-not-resuscitate documentation, hospital type, province and calendar quarter of presentation to the emergency department, symptom duration, and severity of illness on presentation.

Results: We found no difference in mortality for PEH (3%) compared with a propensity score–matched cohort of housed patients (3%) (odds ratio [OR] 0.87, 95% confidence interval [CI] 0.43–1.74). We also found no difference in admission rates for PEH (44%) versus housed patients (45%). There was a reduced rate of critical care admission for PEH compared with housed patients (OR 0.66, 95% CI 0.44–1.00), and a trend toward decreased use of mechanical ventilation for PEH versus housed patients, which was not significant (OR 0.60, 95% CI 0.35–1.02).

Interpretation: We found no difference in mortality for PEH with COVID-19 compared with those who were housed. A signal for reduced critical care admission among PEH may reflect differential treatment unrelated to clinical characteristics that we matched for. Future research on resource allocation during pandemics could shed light on potential inequities for vulnerable populations and how best to address them.

Concerns have been raised about a disproportionate impact of COVID-19 on people experiencing homelessness (PEH).[1–3] Congregate living conditions frequently encountered by PEH were associated with increased transmission of SARS-CoV-2 and incidence of COVID-19;[4,5] however, it remained unclear whether PEH were more susceptible to severe illness than housed patients. Previous research on the topic has been contradictory and limited by sampling bias and unaddressed confounders.[6–11]

Studies using case fatality estimates to assess differences have been limited by the potential for programs to have divergent patterns of testing for SARS-CoV-2 among PEH versus housed patients, as well as differences in competing risks (e.g., death from overdose rather than COVID-19 illness).[6,7] Crude mortality has been estimated via administrative data that identified PEH based on health care visits and resource use, potentially selecting PEH with higher health care needs.[8–10] One large hospital-based study on PEH with COVID-19 was limited by confounding from age differences as well as differential admission rates for PEH versus housed patients.[11] To date, studies have not provided clarity on whether observed differences in mortality reflected differences in testing patterns, baseline characteristics, competing risks, or illness trajectory.

Our objective was to determine whether homelessness affects COVID-19 prognosis among patients presenting to the emergency department with symptoms of COVID-19. Our primary outcome of interest was in-hospital mortality, and secondary outcomes included hospital admission, critical care admission, and mechanical ventilation. We hypothesized that PEH would have higher rates of these outcomes than housed patients.

Methods

Data sources

The Canadian COVID-19 Emergency Department Rapid Response Network (CCEDRRN) is a Canada-wide network that has harmonized data collection on consecutive eligible patients with COVID-19 presenting to 50 emergency departments across 8 provinces from Mar. 1, 2020, onward (https://www.ccedrrn.com/).[12,13] Data were linked with British Columbia and Nova Scotia COVID-19 vaccination registries.[14]

Data collection by CCEDRRN included standardized recording of where patients resided. Patients were classified into 2 cohorts: PEH and housed patients. People experiencing homelessness were identified as arriving from no fixed address or shelter.[15–17] Housed patients were identified as arriving from home or single-room occupancy. We excluded patients who were identified as arriving from institutions (e.g., long-term care, prison, alternate level of care, rehabilitation institutions, retirement homes), as they have a different prevalence and risk from SARS-CoV-2 infection than the general population,[6,11] those visiting from out of town, and those with missing data on their residence. We excluded patients arriving from hotels, as we were unable to differentiate PEH with COVID-19 in hotels from people visiting from out of town. Detailed information on data collection for the housing variable can be found in Appendix 1, Supplemental Table 1, available at www.cmaj.ca/lookup/doi/10.1503/cmaj.241282/tab-related-content.

Data collection

The study protocol was developed a priori and approved with a waiver of informed consent for patient enrolment, allowing us to capture a complete sample and mitigate selection bias. Patients were included in the database if they presented to participating emergency departments, were seen by an emergency physician, and were tested for SARS-CoV-2 infection. Data were primarily collected by retrospective chart review with some telephone follow-up variables; detailed registry methods have been described elsewhere.[12]

Patients

We included consecutive patients who presented to participating emergency departments with acute COVID-19 symptoms, based on World Health Organization (WHO) and National Institute for Health and Care Excellence definitions,[18,19] and who tested positive for SARS-CoV-2 infection. We included only acute symptomatic people, to mitigate bias from inclusion of patients presenting to the emergency department for reasons unrelated to COVID-19 illness (e.g., trauma) who incidentally had a positive screening SARS-CoV-2 test on admission.[20,21] Where a patient had multiple visits, we used the last emergency department visit for which they had acute symptomatic COVID-19, so as to not miss related mortality outcomes.

We considered a patient to have acute symptomatic COVID-19 if they met 1 of the following 3 criteria:

- a positive SARS-COV-2 test result within the 14 days before the emergency department visit date; or
- a positive SARS-COV-2 test result in hospital within 1 day of emergency department arrival; or
- emergency department or hospital discharge was "Confirmed COVID-19"

and if they met both of the following criteria:

- one or more symptoms in the emergency department, including cough, fever, chills, shortness of breath, nausea or vomiting, diarrhea, headache, myalgia, dysgeusia or anosmia, sputum production, chest pain, sore throat, runny nose, fatigue or malaise;[18] and
- symptom onset was within 4 weeks of presentation.[19]

Statistical analysis

We used propensity score matching to create the comparator cohort of housed patients with 1-to-1 matching to the PEH cohort.[22] We did not use 1-to-many matching, owing to limited numbers of patients in the housed cohort who were a good match for patients in the PEH cohort.[23] Covariates in our propensity score model included age, sex, comorbidities, smoking or vaping, alcohol misuse, illicit substance use, vaccination status, documented do-not-resuscitate order before arrival in the emergency department, teaching versus nonteaching hospital, province and calendar quarter of emergency department presentation (which we used to reflect different waves, as well as public health policies over time), symptom duration, and severity of illness on presentation to the emergency department (based on the WHO severity definition of oxygen saturation of < 90% on room air, a respiratory rate > 30 breaths/min, or signs of severe respiratory distress documented in the emergency department record).[18] A logistic regression model with these variables predicting PEH housing status provided the propensity scores (Appendix 1, Supplemental Table 3). We used nearest-neighbour matching without replacement with the standard caliper of 0.2 standard deviations from the logit of the propensity score.[24,25] We examined balance through plots and standardized mean differences (SMDs), with reiterations of propensity score modelling until balance with an SMD of less than 0.10 for each covariate was achieved.[24]

We classified missing data for oxygen saturation, respiratory rate, and duration of symptoms as unknown or missing. We classified vaccination status based on a combination of CCEDRRN data and linkage in British Columbia and Nova Scotia (Appendix 1, Supplemental Figure 1). We chose the missing indicator method for handling missing data.[26–28]

We used logistic regression to compare risk for in-hospital mortality across the propensity-matched cohorts, adjusting for the same covariates that were in the propensity score model to reduce residual bias.[29,30] We similarly analyzed secondary outcomes of hospital admission, critical care admission, and mechanical

ventilation. We calculated the area under the receiver operating characteristic curve to examine the discrimination ability of our main adjusted logistic regression models.[31] We provided estimates of odds ratios (ORs) with 95% confidence intervals (CIs) and considered a p value less than 0.05 as statistically significant.

For the outcomes of in-hospital mortality, critical care admission, and mechanical ventilation, we conducted prespecified sensitivity analyses including only admitted patients. We also conducted post hoc sensitivity analyses without adjustment for covariates after propensity score matching and assessed outcomes in the full unmatched cohorts of PEH and housed patients for comparison of our cohort against the existing literature. We performed post hoc adjusted propensity score–matched analyses excluding patients with missing vaccination data, to assess the influence of missing data on the results. We also conducted a post hoc adjusted propensity score analysis without adjusting or matching for comorbidity, substance use, vaccination status, and pre–emergency department code status to assess the potential for overmatching.

Additionally, to mitigate the reduced power from 1-to-1 matching, we conducted post hoc inverse probability of treatment weighting analyses. We conducted analyses using overlap weights to reduce bias from extreme weights and performed logistic regression with adjustment by covariates and a robust variance estimator for each of our outcomes.[25,32–35]

Analyses were conducted in RStudio.[36]

Ethics approval

The study was approved by the research ethics boards of participating institutions (listed in Appendix 1, Supplemental Table 2) with a waiver of informed consent for patient enrolment.

Results

We identified 52 883 patients from the CCEDRRN database who met inclusion criteria, with 901 PEH and 51 982 housed patients (Figure 1). Baseline characteristics are shown in Table 1. Details of vaccination data linkage and missing data are shown in Appendix 1, Supplemental Table 4. Before propensity score matching, there were differences in baseline characteristics between the 2 groups. After propensity score matching, 874 PEH were matched with 874 housed patients, with SMDs less than 0.10 for all variables (Table 1).

Primary outcome

Among patients presenting to emergency departments with acute symptomatic COVID-19, we found no difference in in-hospital mortality between PEH and housed patients after logistic regression adjustment for all covariates (OR 0.87, 95% CI 0.43–1.74) (Table 2).

Secondary outcomes

In adjusted analyses, we found no difference in admission rates between PEH and housed patients (OR 0.97, 95% CI 0.77–1.21) (Table 2). However, PEH were less likely to be admitted to critical care than housed patients (OR 0.66, 95% CI 0.44–1.00). There was also a trend indicating a reduced likelihood of intubation for PEH compared with housed patients, although this was not statistically significant (OR 0.60, 95% CI 0.35–1.02).

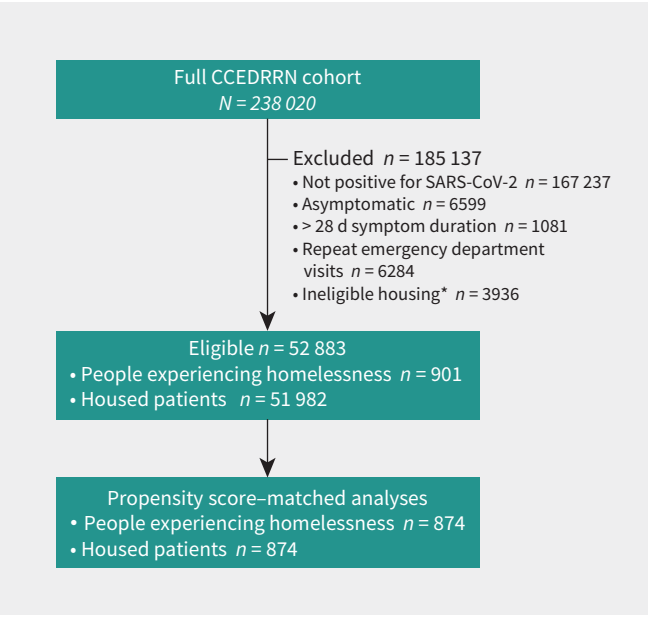

Figure 1: Enrolment diagram. Note: CCEDRRN = Canadian COVID-19 Emergency Department Rapid Response Network. *We included only patients arriving from no fixed address, shelter, home, or single-room occupancy. See Related Content tab for accessible version.

Sensitivity analyses

Unadjusted analyses of the propensity score–matched cohorts showed no significant difference in in-hospital mortality or admission rates (Table 3). The difference in critical care admission did not reach statistical significance in unadjusted analyses of our matched cohorts (p = 0.1) (Table 3), whereas the decreased rate of mechanical ventilation use for PEH was significant (p = 0.04). By contrast, unmatched analyses of the full PEH and housed cohorts showed reduced mortality and increased admission rates in PEH, with no significant difference in critical care admission or mechanical ventilation (Table 3).

An adjusted propensity score analysis of a matched subset of only admitted patients (n = 386 in both PEH and housed groups) yielded similar results to the main analysis, with no statistically significant difference in in-hospital mortality (OR 0.59, 95% CI 0.27–1.28). We observed no significant difference in rates of critical care admission (OR 0.71, 95% CI 0.46–1.09), but the reduced rate of mechanical ventilation among PEH was significant (OR 0.52, 95% CI 0.29–0.94) (Appendix 1, Supplemental Table 5).

An adjusted propensity score–matched subset of patients without missing vaccination data showed no significant difference in in-hospital mortality (OR 0.93, 95% CI 0.37–2.33) or admission (OR 1.00, 95% CI 0.77–1.30). We observed that PEH had reduced odds of critical care admission (OR 0.57, 95% CI 0.36–0.89) and mechanical ventilation (OR 0.51, 95% CI 0.28–0.95) (Appendix 1, Supplemental Table 6).

An adjusted propensity score–matched analysis of patients without adjusting or matching for comorbidities, substance use,

Table 1 (part 1 of 2): Patient characteristics

Variable	Unmatched		Matched		SMD†
	No. (%)* of PEH *n* = 901	No. (%)* of housed patients *n* = 51 982	No. (%)* of PEH *n* = 874	No. (%)* of housed patients *n* = 874	
Repeat emergency department visits	147 (16.3)	4949 (9.5)	141 (16.1)	120 (13.7)	–
Age, yr, mean ± SD	46 ± 14	50 ± 22	46 ± 14	47 ± 15	–
Age, yr, median (IQR)	45 (20)	51 (34)	46 (21)	46 (21)	–
Age, yr					
< 18	4 (0.4)	3274 (6.3)	3 (0.3)	1 (0.1)	0.034
18–29	118 (13.1)	6457 (12.4)	117 (13.4)	89 (10.2)	0.095
30–39	194 (21.5)	7432 (14.3)	186 (21.3)	197 (22.5)	−0.031
40–49	240 (26.6)	7752 (14.9)	227 (26.0)	221 (25.3)	0.016
50–59	186 (20.6)	8157 (15.7)	182 (20.8)	196 (22.4)	−0.040
60–69	107 (11.9)	7247 (13.9)	107 (12.2)	110 (12.6)	−0.011
≥ 70	52 (5.8)	11 663 (22.4)	52 (5.9)	60 (6.9)	−0.039
Male sex‡	655 (72.7)	25 950 (49.9)	629 (73.3)	641 (72.0)	0.031
Pre–emergency department code status					
Full code	888 (98.6)	50 616 (97.4)	861 (98.5)	863 (98.7)	−0.019
Other level of care	8 (0.9)	760 (1.5)	8 (0.9)	8 (0.9)	< 0.0001
Do not resuscitate	5 (0.6)	606 (1.2)	5 (0.6)	3 (0.3)	0.031
Vaccination status					
Vaccinated	186 (20.6)	15 378 (29.6)	183 (20.9)	200 (22.9)	−0.048
Unvaccinated	488 (54.2)	21 420 (41.2)	466 (53.3)	441 (50.5)	0.057
Unknown	227 (25.2)	15 184 (29.2)	225 (25.7)	233 (26.7)	−0.021
Days of symptoms					
0–3	359 (39.8)	21 232 (40.8)	351 (40.2)	359 (41.1)	−0.019
4–7	143 (15.9)	11 914 (22.9)	143 (16.4)	141 (16.1)	0.006
8–11	40 (4.4)	5030 (9.7)	40 (4.6)	36 (4.1)	0.022
12–15	40 (4.4)	2922 (5.6)	40 (4.6)	45 (5.1)	−0.028
16–19	7 (0.8)	335 (0.6)	7 (0.8)	5 (0.6)	0.026
20–23	8 (0.9)	595 (1.1)	8 (0.9)	6 (0.7)	0.024
24–28	7 (0.8)	153 (0.3)	7 (0.8)	6 (0.7)	0.013
Unknown	297 (33.0)	9801 (18.9)	278 (31.8)	276 (31.6)	0.005
Severe symptoms					
No	696 (77.2)	35 012 (67.4)	676 (77.3)	683 (78.1)	−0.019
Yes	195 (21.6)	16 398 (31.5)	189 (21.6)	189 (21.6)	< 0.0001
Unknown	10 (1.1)	572 (1.1)	9 (1.0)	< 5 (< 0.6)	0.076
Calendar quarter of presentation to emergency department					
January–March 2020	5 (0.6)	681 (1.3)	5 (0.6)	< 5 (< 0.6)	0.046
April–June 2020	19 (2.1)	1925 (3.7)	19 (2.2)	14 (1.6)	0.040
July–September 2020	18 (2.0)	1373 (2.6)	17 (1.9)	16 (1.8)	0.008
October–December 2020	237 (26.3)	7856 (15.1)	223 (25.5)	209 (23.9)	0.036
January–March 2021	147 (16.3)	5597 (10.8)	141 (16.1)	136 (15.6)	0.016
April–June 2021	83 (9.2)	8317 (16.0)	82 (9.4)	74 (8.5)	0.032
July–September 2021	69 (7.7)	2656 (5.1)	68 (7.8)	69 (7.9)	−0.004
October–December 2021	99 (11.0)	3155 (6.1)	97 (11.1)	95 (10.9)	0.007
January–March 2022	145 (16.1)	11 747 (22.6)	145 (16.6)	159 (18.2)	−0.044
April–June 2022	43 (4.8)	5870 (11.3)	42 (4.8)	53 (6.1)	−0.059
July–September 2022	36 (4.0)	2805 (5.4)	35 (4.0)	47 (5.4)	−0.070

Table 1 (part 2 of 2): Patient characteristics

Variable	Unmatched		Matched		SMD†
	No. (%)* of PEH *n* = 901	No. (%)* of housed patients *n* = 51 982	No. (%)* of PEH *n* = 874	No. (%)* of housed patients *n* = 874	
Province of emergency department presentation					
Alberta	298 (33.1)	13 190 (25.4)	287 (32.8)	255 (29.2)	0.078
Atlantic provinces§	10 (1.1)	1587 (3.1)	10 (1.1)	8 (0.9)	0.022
British Columbia	410 (45.5)	17 960 (34.6)	395 (45.2)	407 (46.6)	–0.028
Ontario	101 (11.2)	6675 (12.8)	100 (11.4)	112 (12.8)	–0.044
Quebec	40 (4.4)	10 344 (19.9)	40 (4.6)	38 (4.3)	0.011
Saskatchewan	42 (4.7)	2226 (4.3)	42 (4.8)	54 (6.2)	–0.065
Teaching site	837 (92.9)	43 754 (84.2)	810 (92.7)	821 (93.9)	0.049
Comorbidity					
Congestive heart failure	30 (3.3)	1793 (3.4)	29 (3.3)	37 (4.2)	0.051
Coronary artery disease	43 (4.8)	3288 (6.3)	42 (4.8)	44 (5.0)	0.011
Hypertension	153 (17.0)	13 567 (26.1)	149 (17.0)	145 (16.6)	0.012
Asthma	89 (9.9)	3927 (7.6)	87 (10.0)	70 (8.0)	0.065
Other chronic lung disease	71 (7.9)	2936 (5.6)	71 (8.1)	75 (8.6)	0.017
Chronic kidney disease	32 (3.6)	2438 (4.7)	32 (3.7)	40 (4.6)	0.050
Diabetes	95 (10.5)	7654 (14.7)	93 (10.6)	105 (12.0)	0.045
Mild liver disease	27 (3.0)	350 (0.7)	26 (3.0)	27 (3.1)	0.007
Moderate–severe liver disease	24 (2.7)	272 (0.5)	22 (2.5)	27 (3.1)	0.036
Neurological disorders	105 (11.7)	3764 (7.2)	99 (11.3)	99 (11.3)	< 0.0001
Immunocompromised	65 (7.2)	5572 (10.7)	62 (7.1)	67 (7.7)	0.022
History of cancer	19 (2.1)	1514 (2.9)	19 (2.2)	16 (1.8)	0.024
Atrial fibrillation	31 (3.4)	2346 (4.5)	29 (3.3)	38 (4.3)	0.057
Psychiatric disorder	294 (32.6)	5014 (9.6)	275 (31.5)	305 (34.9)	0.073
Dyslipidemia	50 (5.5)	7310 (14.1)	49 (5.6)	51 (5.8)	0.010
Hypothyroidism	33 (3.7)	3331 (6.4)	33 (3.8)	39 (4.5)	0.037
Other	509 (56.5)	19 487 (37.5)	484 (55.4)	511 (58.5)	0.062
Substance use					
Smoking or vaping	304 (33.7)	2035 (3.9)	282 (32.3)	302 (34.6)	0.048
Alcohol misuse	210 (23.3)	1224 (2.4)	197 (22.5)	233 (26.7)	0.097
Opioids	233 (25.9)	346 (0.7)	214 (24.5)	183 (20.9)	0.081
Stimulants	249 (27.6)	410 (0.8)	227 (26.0)	189 (21.6)	0.097
Cannabis	97 (10.8)	718 (1.4)	86 (9.8)	94 (10.8)	0.030

Note: IQR = interquartile range, PEH = people experiencing homelessness, SD = standard deviation, SMD = standardized mean difference.
*Unless otherwise specified.
†SMD applies to matched cohorts.
‡Female and nonbinary combined to suppress small cell sizes.
§New Brunswick and Nova Scotia combined to suppress small cell sizes.

vaccination status, or pre–emergency department code status showed no significant difference in mortality (OR 1.05, 95% CI 0.55–2.02), critical care admission (OR 0.80, 95% CI 0.54–1.19), or mechanical ventilation (OR 0.80, 95% CI 0.47–1.37) (Appendix 1, Supplemental Table 7). There was an increased odds of admission for PEH (OR 1.92, 95% CI 1.55–2.37).

An adjusted analysis using overlap weights (Table 4) found no significant difference in mortality (OR 0.70, 95% CI 0.42–1.17) or admission rates (OR 1.05, 95% CI 0.88–1.25). There was a lower rate of critical care admission (OR 0.71, 95% CI 0.52–0.98) and mechanical ventilation (OR 0.54, 95% CI 0.35–0.83) (Table 4).

Table 2: Outcomes and AUC-ROC for adjusted propensity score–matched analyses

Variable	OR (95% CI)	AUC-ROC
Primary outcome		
In-hospital mortality	0.87 (0.43–1.74)	0.89
Secondary outcomes		
Hospital admission	0.97 (0.77–1.21)	0.80
Critical care admission	0.66 (0.44–1.00)	0.83
Mechanical ventilation	0.60 (0.35–1.02)	0.85

Note: AUC-ROC = area under the receiver operating characteristic curve (also known as the concordance statistic), CI = confidence interval, OR = odds ratio.

Interpretation

In this large multicentre study assessing COVID-19 outcomes, we found no statistically significant differences for in-hospital mortality or hospital admission rates among PEH who presented to Canadian emergency departments with acute symptomatic COVID-19 compared with a propensity score–matched cohort of housed patients. In our adjusted propensity score–matched analyses, we found lower rates of critical care admission for the PEH group and a trend toward decreased rates of mechanical ventilation for PEH. Similarly, in our overlap weighted analysis, which had a larger effective sample size of 5080 patients, we again found no significant difference in mortality or admission, but we did find significantly lower rates of critical care admission and mechanical ventilation for PEH.

By contrast, a 2022 cross-sectional study found reduced in-hospital mortality and higher admission rates for PEH presenting to American hospitals than for the general population after adjusting for covariates — importantly, without propensity score matching.[11] We similarly found reduced in-hospital mortality and increased admission in our unmatched cohorts of PEH than in housed patients; however, after propensity score matching for baseline clinical characteristics, we did not find significant differences in either in-hospital mortality or admission. This suggests that apparent differences in mortality and admission between groups in Montgomery and colleagues' study[11] may reflect residual confounding from baseline characteristics across groups.

Similarly to their study, in our adjusted propensity score–matched analyses we found a trend toward reduced rates of mechanical ventilation in PEH.[11] We also found reduced rates of critical care admission. These differences were not apparent in our unmatched analyses but emerged after propensity score matching of the cohorts. Therefore, once we accounted for clinically relevant factors such as age, comorbidities, vaccination status, and severity of illness on presentation, there was a lower rate of critical care admission among PEH than housed patients. This raises the important question of whether scarce resources during the pandemic, such as ventilators and critical care spaces, were distributed differentially among PEH versus housed patients and withheld for PEH for reasons beyond clinical characteristics. Over time, evidence emerged that early mechanical ventilation did not improve patient outcomes,[37] so the differential treatment was not reflected in differential in-hospital mortality in our results. Another possible interpretation is that reduced rates of critical care admission among PEH may reflect less severe COVID-19, although this is not reflected in our mortality outcome.

In our study, we sought to answer the question of whether experiencing homelessness is a risk factor for worse prognosis from COVID-19 illness independent of important clinical variables including age, comorbidities, vaccination status, and substance use — i.e., whether clinicians should have a lower threshold for admission or other treatments for patients with COVID-19 based on housing status alone. In reality, homelessness is associated with not only differing

Table 3: Outcomes for unadjusted propensity score–matched analyses and the unmatched cohorts

Variable	No. (%) of people experiencing homelessness Matched *n* = 874 Unmatched *n* = 901	No. (%) of housed patients Matched *n* = 874 Unmatched *n* = 51 982	OR (95% CI)
Mortality			
Matched unadjusted	22 (2.5)	24 (2.7)	0.91 (0.51–1.64)
Unmatched	22 (2.4)	2248 (4.3)	0.55 (0.36–0.85)
Hospital admission			
Matched unadjusted	386 (44.2)	396 (45.3)	0.95 (0.79–1.15)
Unmatched	406 (45.1)	18 589 (35.8)	1.47 (1.29–1.68)
Critical care admission			
Matched unadjusted	55 (6.3)	73 (8.4)	0.74 (0.51–1.06)
Unmatched	58 (6.4)	3665 (7.1)	0.91 (0.69–1.19)
Intubation			
Matched unadjusted	28 (3.2)	45 (5.1)	0.61 (0.38–0.99)
Unmatched	29 (3.2)	2019 (3.9)	0.82 (0.57–1.19)

Note: CI = confidence interval, OR = odds ratio.

Table 4: Outcomes for adjusted overlap weighted analyses*

Variable	OR (95% CI)
Primary outcome	
In-hospital mortality	0.70 (0.42–1.17)
Secondary outcomes	
Hospital admission	1.05 (0.88–1.25)
Critical care admission	0.71 (0.52–0.98)
Intubation	0.54 (0.35–0.83)

Note: CI = confidence interval, OR = odds ratio.
*The effective sample sizes after inverse probability of treatment weighting with overlap weights are *n* = 4259 for housed patients and *n* = 821 for people experiencing homelessness.

clinical characteristics, but also different sociodemographic factors such as race and income, which we have not adjusted for, as despite these factors' association with health outcomes, clinicians would not typically take them into consideration when deciding treatment course.[38,39] Although we carefully selected our covariates based on our research question, we also offer a sensitivity analysis for readers who may consider that matching for clinical variables associated with homelessness might constitute overmatching; these analyses also did not suggest a significant difference in mortality for PEH with COVID-19. Given the lower rates of vaccination and higher rates of substance use among PEH, the finding of increased admissions in the sensitivity analysis is perhaps unsurprising and may reflect that clinicians perceive PEH to be at higher risk for deterioration than housed patients, owing to increased substance use, lower vaccination rates, and different comorbidities. Overall, our study results do not support a different clinical threshold for treatment or admission based on homelessness as a risk factor for mortality. However, the finding of reduced critical care admission for PEH despite matching for clinical characteristics raises the question of whether this may reflect unconscious biases for treatment allocation in the face of scarce resources in a pandemic and suggests the need for future research in this area. Our results also do not capture differing transmission rates among PEH and housed patients in the community and should not be interpreted as indicating an equal burden of COVID-19 among PEH versus the housed population.

Limitations

Limitations of our study include those inherent to retrospectively collected data. Data were limited by what was documented in the medical record. Missing outcomes (e.g., death occurring outside of CCEDRRN sites) remain a limitation for discharged patients. To mitigate the potential impact of missing outcomes in those discharged, we conducted sensitivity analyses including only admitted patients, which resulted in findings similar to our primary analyses. Additionally, SARS-CoV-2 testing protocols varied across regions, over time, and between PEH and housed patients, which may have resulted in milder cases seen in the emergency department or selection bias across groups based on testing criteria (e.g., asymptomatic screening in shelters). We mitigated this by excluding patients with asymptomatic SARS-CoV-2 infection, and matching for severity of presentation, duration of illness, emergency department visit date, and province. Similarly, differential vaccination policies may have resulted in different virulence, which we mitigated by matching for vaccination status. However, we were limited by the variables within the data collection form. Residual confounding would most likely reflect characteristics beyond the criteria that commonly inform clinical decision-making, by which we have matched cohorts, and associations between PEH and our outcomes would remain meaningful and clinically relevant. Another limitation was the lack of common support (overlap between groups) that limited our ability to perform 1-to-many matching, which reflects how different the PEH population is from the general population. We attempted to mitigate this by including patients with single-room occupancy in our sample, who may share more characteristics with PEH, and in overlap weights analysis. Additionally, we used the missing indicator approach for missing baseline covariate data, which can introduce bias, but was chosen as we considered data to be not missing at random.[27] In studying outcomes for PEH, it is also important to acknowledge that we cannot fully capture the population experiencing housing insecurity. In our analyses, patients reporting no fixed address or shelter represented PEH, an approach that has also been used in previous studies,[15–17] but could result in some misclassification. Finally, CCEDRRN spans 50 emergency departments across 8 provinces, making results generalizable to PEH presenting to most emergency departments nationwide. However, its focus on urban teaching sites may limit applicability to rural or community hospitals, although PEH are more prevalent in urban areas.[40]

Conclusion

Our results did not show a signal for increased in-hospital mortality for PEH with COVID-19 presenting to the emergency department, but we found a signal for reduced critical care admissions among PEH, which raises the question of whether there may have been differential treatment for reasons unrelated to matched clinical characteristics. Future research could explore inequities in health care resource allocation, especially in times of scarcity, as well as interventions targeting transmission among PEH.

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