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Linguistic factors and COVID-19 outcomes among long-term care residents in Ontario, Canada

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Abstract

Background The COVID-19 pandemic disproportionately affected frail individuals, especially those living in long-term care (LTC) homes. This study examined the role of linguistic factors on COVID-19 related outcomes in LTC homes.

Methods We performed a population-based, retrospective cohort study of residents living in LTC homes in Ontario, Canada who were diagnosed with COVID-19 between March 31, 2020 and March 31, 2021. Resident language, obtained from LTC assessments, was used to classify residents into one of the three linguistic groups: Anglophone (English), Francophone (French), and allophone (other language). Language of the LTC home was determined using a person-time representation of the languages spoken by residents within each LTC home. We defined LTC facilities as *French homes* when Francophone residents contributed more than 25% of the person-days, and *allophone homes* when allophone residents contributed more than 50% of the person-days. Residents whose language corresponded to the language of the LTC home in which they were living were said to have received *language-concordant care*, while all other residents were said to have received *language-discordant care*. The outcomes of this study were ED visits, hospitalizations, and mortality within 90 days.

Results We included a total of 26,829 LTC residents (20,315 Anglophones, 1,032 Francophones, and 5,482 allophones) living in 572 LTC homes (502 English, 28 French, 42 allophone) who were diagnosed with COVID-19. LTC residents who lived in language-discordant homes were more likely to have ED visits (adjusted HR 1.12, 95% CI 1.01–1.25) and hospitalizations (adjusted HR 1.15, 95% CI 1.02–1.29) when compared to LTC residents who lived in language-concordant homes. Residents-facility language discordance was not associated with overall mortality (adjusted HR 1.00, 95% CI 0.91–1.10) or in hospital mortality (adjusted HR 1.04, 95% CI 0.88–1.23).

Conclusion Residents living in language-discordant LTC facilities experienced more ED visits and hospitalizations following diagnosis of COVID-19. The findings of this study highlight the importance of providing frail, vulnerable individuals with linguistically concordant care.

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Keywords COVID-19, Language barriers, Language concordance, Language discordance, Long-term care, Patient safety, Quality of care

Introduction

Coronavirus disease 2019 (COVID-19) has caused over 7,000,000 deaths worldwide [1]. Epidemiological data during the first year of the pandemic identified several individual-level risk factors for developing severe COVID-19 (including death), notably advanced age and chronic diseases (especially cancer, cardiovascular disease, chronic obstructive pulmonary disease, diabetes, hypertension, and obesity) [2, 3]. The combination of these risk factors, in addition to crowded living conditions and frequent contact with healthcare professionals, resulted in residents of long-term care (LTC) homes being disproportionately affected during the COVID-19 pandemic [4, 5]. This was especially evident during the first two waves of the pandemic (March–June 2020 and September 2020–January 2021) [4, 5], prior to the introduction of vaccines or treatments [6]. During this period, approximately 50% of COVID-19 deaths in the developing world were among residents of LTC homes [7]. Canadians living in LTC homes made up nearly 10% of COVID-19 cases and nearly two-thirds of COVID-19 deaths [5], despite the fact that there are only approximately 200,000 LTC beds across the country [8], which represents 0.5% of the population [9]. The situation was similar in the United States, where LTC residents represent only 1% of the population, yet accounted for one third of COVID-19 deaths [10].

Social determinants of health had a profound impact on COVID-19 infection rates, morbidity, and mortality [11]. Epidemiological studies consistently showed that ethnicity, immigration status, and socioeconomic status were independent risk factors for COVID-19 outcomes [11]. However, few studies explored the role of linguistic factors, despite a growing body of evidence that language barriers contribute to adverse health outcomes prior to the COVID-19 pandemic, especially amongst older, frail residents receiving home care or living in LTC homes [12–14]. For instance, four population-based studies found that Americans who primarily spoke a language other than English were significantly more likely to be diagnosed with COVID-19 (on the basis of a positive test result) [15–18]. Other studies showed that non-English speaking Americans diagnosed with COVID-19 were more likely to be admitted to hospital [19], and were also more likely to experience longer hospitalizations [20] requiring aggressive interventions such as intubation [21]. However, these studies generally excluded residents of LTC homes, and none of them examined language discordance, which occurs when patients receive care in a language other than their primary, or preferred, language.

The impact of language discordance in LTC homes during the COVID-19 pandemic warrants further investigation, as it represents a potentially modifiable risk factor which could be the target of interventions to avoid similar outcomes in the future (i.e., by asking individuals to specify their preferred language at the time of entry into LTC or hospital, and providing them with the option of living in a language-concordant LTC home and/or receiving hospital language-concordant services, whenever possible). Language discordance may represent an important barrier to appropriate advance care planning in older, frail individuals who are at risk of experiencing health decline resulting in hospitalization or death following diagnosis of COVID-19 [2, 3]. While studies have shown that Do-Not-Hospitalize (DNH) and Do-Not-Resuscitate (DNR) orders in LTC homes decrease unnecessary hospitalizations and life-sustaining treatments [22], the literature suggests that ethnic and linguistic minorities are less likely to have advance care plans [23].

The objectives of this study were to: (1) compare health outcomes of Ontarians living in LTC homes following diagnosis of COVID-19 (i.e., ED visits, hospitalizations, and death) stratified by linguistic group, and (2) determine whether resident-facility language concordance/discordance contributed to disparities observed across health outcomes.

Methods

Study design and population

We conducted a population-based, retrospective cohort study of all residents living in publicly funded LTC homes in Ontario, Canada, between January 15, 2019 and March 31, 2020 who were subsequently diagnosed with COVID-19 between March 31, 2020 and March 31, 2021. Residents were censored at 1 year after diagnosis of COVID-19 or at time of death, whichever occurred first. We excluded residents who: (1) were younger than 18 or older than 105 years at the index assessment, (2) were not Ontario residents during the 5 years preceding their index assessment, (3) were not eligible for the Ontario Health Insurance Plan (OHIP) on the date of the index assessment.

Data sources

We used administrative databases at ICES (previously the Institute for Clinical Evaluative Sciences), an independent, nonprofit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and demographic data, without consent, for health system evaluation

and improvement. We obtained data on LTC residents through the Continuing Care Reporting System, which collects information on all LTC residents using the Resident Assessment Instrument Minimum Dataset (RAI-MDS), version 2.0 [24]. LTC residents complete this assessment annually, while abbreviated assessments may be performed more frequently (i.e., if there is a significant change in health status) [24]. The first assessment performed during the enrolment period (January 15, 2019 to March 31, 2020) was used to define the cohort and determine residents' baseline characteristics.

The Registered Persons Database (RPDB) provided residents' age, sex and postal code. The 2016 Statistics Canada Census was used to obtain neighbourhood income quintile and urban/rural status (by linkage of postal codes), while the Immigration, Refugees and Citizenship Canada (IRCC) Permanent Resident's Database was used to identify immigrants who became permanent residents after 1985. Chronic diseases were identified in administrative data using algorithms validated by ICES and applied in previous studies (see Appendix 1) [25–28]. The Charlson Comorbidity Index was derived from chronic diseases identified in administrative data (see Appendix 1) rather than self-reported data obtained from resident assessments. Residents with COVID-19 were identified through the COVID-19 Integrated Testing Data (C19INTGR), which captured all cases of COVID-19 by combining information from three different data sources: Ontario Laboratories Information System, distributed testing laboratories (within the COVID-19 Provincial Diagnostic Network), and the Public Health Ontario Case and Contact Management Solution (previously known as the integrated Public Health Information System) [29]. At the onset of the COVID-19 pandemic, the Ontario Ministry of Health directed LTC homes to screen residents for symptoms twice daily, and to administer COVID-19 tests to any residents who developed symptoms, and also to residents who were exposed to a person known to have COVID-19 [30]. Finally, the National Ambulatory Care Reporting System (NACRS) and the Discharge Abstract Database (DAD) provided data on ambulatory care visits and admissions to acute care treatment facilities, respectively. These datasets were linked using unique encoded identifiers and analyzed at ICES.

Exposure

We obtained resident language from the RAI-MDS. During these assessments, interviewers are instructed to determine the resident's primary language by listening, observing and, if necessary, asking the resident (or their family member or care provider) for clarification. In this study, we defined Anglophones and Francophones as residents whose primary language spoken was English or French, respectively, while we defined the remaining residents as allophones, which is a term used by the Government of Canada to refer to residents who identify with a linguistic group other than English or French [31].

Since we do not have information on the languages spoken by individual healthcare providers in LTC homes, we derived facility language by considering the frequency of individual linguistic groups represented within LTC homes. For the purposes of defining facility language, Allophones languages were combined to form groups of mutually understandable languages (i.e., closely related languages that may be understood without prior familiarity or special effort, such as Portuguese and Spanish) [32–34]. We calculated the person-time representation of each linguistic group (English, French, and allophone languages) by dividing the total person-days for each linguistic group in a given LTC facility (i.e., length of stay in days for each linguistic group in LTC facility) by the overall person-days for that same LTC facility (i.e., length of stay in days for all residents in LTC facility). We defined LTC facilities as *French homes* when Francophone residents contributed more than 25% of the person-days, and *allophone homes* when allophone residents contributed more than 50% of the person-days. We used a lower threshold to define French homes because prior analyses conducted by our group found that this threshold had better sensitivity (85%) and specificity (97%) for identifying homes that are designated by law to provide services in French [35]. The remaining LTC facilities were defined as *English homes*. This definition of facility language was chosen to be consistent with prior studies performed in LTC homes in Ontario, Canada [36, 37].

Resident-facility language concordance/discordance was defined as the concordance/discordance between resident language and facility language. Residents were said to have received language-concordant care if the language of the facility corresponded to their linguistic group, while all other residents were said to have received language-discordant care. A complete description of resident language, including list of mutually understandable languages, is presented in Appendix 2.

Outcomes

We identified ED visits, hospitalizations, and mortality within 90 days of index assessment. For residents admitted to hospital, we also obtained the following in-hospital outcomes from the DAD: length of stay in hospital (count variable), admission to Intensive Care Unit (ICU) (binary variable), length of stay (in days) in ICU (count variable).

Statistical analysis

We performed descriptive analyses to compare resident characteristics and outcomes across linguistic groups, and after stratifying by resident-facility language

concordance/discordance. Data were compared across linguistic groups using analysis of variance for continuous variables and chi-squared tests for categorical variables. The association between resident-facility language concordance/discordance and ED visits, hospitalizations, death (any location), death (in-hospital) was estimated using Cox regression to model the time to the first ED visit, hospitalization, and death, respectively. For each of these outcomes, we ran a single Cox regression model with multiple exposure variables: resident language (Anglophones, Francophones, allophones), facility language (English homes, French homes, allophone homes), and resident-facility language concordance/discordance. When considering the outcomes of ED visits and hospitalizations, we used a cause-specific hazard function to account for the competing risk of death. Adjusted analyses included the potential confounders of resident language, facility language, age at the time of COVID-19 diagnosis, sex, neighbourhood income quintile of the resident prior to entry into LTC, geographic region of the resident prior to entry into LTC, urban/rural residence of the resident prior to entry into LTC, immigration status, Charlson Comorbidity Index [38], activities of daily living (ADL) scale [39], cognitive performance scale, and changes in health, end-stage disease, signs and symptoms (CHESS) score, geographic region of the LTC home, and urban/rural residence of the LTC home, size of the LTC home (i.e., number of beds). We employed multilevel modeling with geographic region of the LTC home and urban/rural residence of the LTC home both included as fixed effects. We performed complete case analysis by excluding all observations with missing data for any of the variables included in the regression analysis ($n = 398$, 1.4%). Statistical tests were 2-tailed and the significance threshold was set at 0.05. Statistical analyses were performed using SAS version 9.4 (SAS Institute Inc).

Ethics approval and consent to participate

ICES is a prescribed entity under Sect. 45 of Ontario's Personal Health Information Protection Act. Section 45 authorizes ICES to collect personal health information, without consent, for the purpose of analysis or compiling statistical information with respect to the management of, evaluation or monitoring of, the allocation of resources to or planning for all or part of the health system. Projects conducted under Sect. 45, by definition, do not require review by a Research Ethics Board. This project was conducted under Sect. 45, and approved by ICES' Privacy and Compliance Office.

Results

We identified a total of 26,829 LTC residents who were diagnosed with COVID-19 during one of the first two waves of the pandemic (March–June 2020 and September 2020–January 2021). Most LTC residents in the cohort were Anglophone (75.7%), while Francophones and allophones represented 3.8% and 20.4% of the cohort, respectively. The overwhelming majority of respondents (96.5%) were 60 years of age or older. A study flow diagram is presented in Appendix 3.

Individual-level characteristics

Baseline characteristics of the cohort are presented in Table 1. Compared to Anglophones, Francophones and allophones were older at the time of COVID-19 diagnosis. Both Francophones and allophones tended to have resided in lower-income neighbourhoods prior to entry into LTC. A greater proportion of Francophones had previously lived in rural areas (especially in eastern and northern Ontario), while most allophones had previously lived in urban areas. The proportion of recent immigrants was greater among allophones when compared to anglophones and francophones. The burden of multimorbidity was similar across linguistic groups (denoted by Charlson comorbidity index). Both Francophones and allophones tended to have more severe cognitive impairment when compared to Anglophones. Allophones were more likely to have functional limitations, while Francophones were more likely to have greater health declines, denoted by higher CHESS score.

Facility-level characteristics

The individuals in our cohort resided in 572 different LTC homes at the time of COVID-19 diagnosis (see Table 2). We identified 502 (87.8%) English homes, 28 (4.9%) French homes, and 42 (7.3%) allophone homes. French homes were over-represented in eastern Ontario and in rural areas, while allophone homes were found exclusively in urban areas. French homes tended to have fewer residents than both English homes and allophone homes.

Outcomes

We identified 4,546 ED visits and 3,001 hospitalizations during the 90-day follow up period. As shown in Table 3, the rates of both ED visits and hospitalizations were lowest for Francophones (71,321 and 32,471 per 100,000 person-years, respectively) and highest for allophones (115,791 and 86,713 per 100,000 person-years, respectively). Length of stay in hospital was similar across all three linguistic groups ($p = 0.84$). Of the 3,001 hospitalizations identified during the study period, 283 (9.4%) included an ICU admission. Francophones tended to have more ICU admissions and have longer stays in the ICU, but neither difference was statistically significant. The proportion of LTC residents who died within 90 days of COVID-19 diagnosis was higher for Francophones (18.3%) and allophones (18.5%) compared to

Table 1 Baseline characteristics of long-term care (LTC) residents in Ontario who were diagnosed with COVID-19 during the first two waves of the pandemic, stratified by resident language

Individual Characteristics	Anglophones (*N* = 20,315)	Francophones (*N* = 1,032)	Allophones (*N* = 5,482)	*P*-value
Sociodemographic characteristics				
Age – mean +/- s.d.	82.1 +/- 11.2	83.8 +/- 10.2	85.9 +/- 9.1	< 0.01
Sex – no. (%)				< 0.01
Female – no. (%)	13,024 (64.1%)	720 (69.8%)	3,710 (67.7%)	
Male – no. (%)	7,291 (35.9%)	312 (30.2%)	1,772 (32.3%)	
Neighbourhood income quintile prior to entry into LTC – no. (%)				< 0.01
1 (lowest)	5,835 (28.7%)	282 (27.3%)	1,792 (32.7%)	
2	4,847 (23.9%)	258 (25.0%)	1,189 (21.7%)	
3	3,524 (17.3%)	195 (18.9%)	1,048 (19.1%)	
4	3,213 (15.8%)	144 (14.0%)	728 (13.3%)	
5 (highest)	2,656 (13.1%)	124 (12.0%)	683 (12.5%)	
Missing	240 (1.2%)	29 (2.8%)	42 (0.8%)	
Geographic region prior to entry into LTC – no. (%)				< 0.01
Eastern	1,678 (8.3%)	644 (62.4%)	187 (3.4%)	
Northern	1,160 (5.7%)	269 (26.1%)	83 (1.5%)	
Other	17,450 (85.9%)	111 (10.8%)	5,209 (95.0%)	
Missing	27 (0.1%)	8 (0.8%)	3 (0.1%)	
Urban/Rural residence prior to entry into LTC – no. (%)				< 0.01
Urban	18,290 (90.0%)	748 (72.5%)	5,382 (98.2%)	
Rural	1,805 (8.9%)	255 (24.7%)	67 (1.2%)	
Missing	220 (1.1%)	29 (2.8%)	33 (0.6%)	
Recent Immigrant†				< 0.01
Yes	742 (3.7%)	18 (1.7%)	1,435 (26.2%)	
No	19,573 (96.3%)	1,014 (98.3%)	4,047 (73.8%)	
Functional Status & Health Characteristic				
Charlson Comorbidity Index – mean +/- s.d.	0.8 +/- 1.4	0.7 +/- 1.4	0.9 +/- 1.5	< 0.01
ADL scale – no. (%)				< 0.01
Independent	271 (1.3%)	30 (2.9%)	31 (0.6%)	
Supervision Required	758 (3.7%)	29 (2.8%)	172 (3.1%)	
Limited Impairment	1,392 (6.9%)	78 (7.6%)	329 (6.0%)	
Extensive Assistance Required	11,106 (54.7%)	553 (53.6%)	2,688 (49.0%)	
Dependent/Total dependence	6,788 (33.4%)	342 (33.1%)	2,261 (41.2%)	
Cognitive Performance Scale – no. (%)				< 0.01
Intact	1,636 (8.1%)	52 (5.0%)	279 (5.1%)	
Borderline intact	1,693 (8.3%)	60 (5.8%)	303 (5.5%)	
Mild impairment	2,904 (14.3%)	140 (13.6%)	772 (14.1%)	
Moderate or moderate-to-severe impairment	10,037 (49.4%)	530 (51.4%)	2,806 (51.2%)	
Severe or very severe impairment	4,045 (19.9%)	250 (24.2%)	1,321 (24.1%)	
CHESS Score – no. (%)				< 0.01
No Health Instability	8,977 (44.2%)	424 (41.1%)	2,550 (46.5%)	
Minimal Health Instability	7,360 (36.2%)	380 (36.8%)	1,967 (35.9%)	
Low Health Instability	2,884 (14.2%)	163 (15.8%)	692 (12.6%)	
Moderate Health to Very High Health Instability	1,094 (5.4%)	65 (6.3%)	272 (5.0%)	

Note: *ADL* Activities of Daily Living, *CHESS* Changes in Health, End-Stage Disease, Signs, and Symptoms

† Residents who immigrated to Canada and were granted citizenship and/or permanent residency after 1985

Anglophones (16.5%). A greater proportion of allophones (8.7%) died in hospital when compared to Anglophones (4.6%) and Francophones (2.2%).

Of the 26,829 LTC residents with COVID-19 included in this study, 22,047 (82.2%) lived in language-concordant homes, while 4,782 (17.8%) lived in language-discordant homes. The overwhelming majority of Anglophones (94.2%) lived in English homes. About three quarters of Francophones (75.4%) lived in French homes, while slightly more than one third of allophones (38.9%) lived

Table 2 Facility level characteristics of long-term care (LTC) homes in Ontario, stratified by facility language

Facility Characteristics	English (*N*=502)	French (*N*=28)	Allophone (*N*=42)	*P*-value
Geographic region of LTC home – no. (%)				< 0.01
Eastern	37 (7.4%)	16 (57.1%)	1 (2.4%)	
Northern	30 (6.0%)	11 (39.3%)	1 (2.4%)	
Other	433 (86.3%)	1 (3.6%)	40 (95.2%)	
Missing	2 (0.4%)	0 (0.0%)	0 (0.0%)	
Urban/Rural residence of LTC home – no. (%)				< 0.01
Urban	409 (81.5%)	17 (60.7%)	42 (100.0%)	
Rural	91 (18.1%)	11 (39.3%)	0 (0.0%)	
Missing	2 (0.4%)	0 (0.0%)	0 (0.0%)	
Total number of – no. (%)				0.15
1 to 49	28 (5.6%)	2 (7.1%)	3 (7.1%)	
50 to 99	152 (30.3%)	12 (42.9%)	8 (19.0%)	
100 to 149	140 (27.9%)	7 (25.0%)	8 (19.0%)	
150+	182 (36.3%)	7 (25.0%)	23 (54.8%)	

Table 3 Outcomes for long-term care (LTC) residents in Ontario who were diagnosed with COVID-19 during the first two waves of the pandemic, stratified by resident language

Outcomes	Anglophones (*N*=20,315)	Francophones (*N*=1,032)	Allophones (*N*=5,482)	*P*-value†
Healthcare utilization				
ED visits – rate per 100,000 person-years	92,967	71,321	115,791	< 0.01
Hospitalizations – rate per 100,000 person-years	59,311	32,471	86,713	< 0.01
Admission to ICU – no. (%)	206 (10.8%)	9 (16.7%)	68 (9.0%)	0.13
Length of stay in ICU – mean (days) +/- s.d.	8.0 +/- 18.6	13.0 +/- 21.8	5.2 +/- 5.0	0.29
Length of stay in hospital – mean (days) +/- s.d.	14.6 +/- 21.2	14.4 +/- 17.0	14.1 +/- 19.2	0.84
Mortality – no. (%)				
Any setting – no. (%)	3,350 (16.5%)	189 (18.3%)	1,014 (18.5%)	< 0.01
In hospital – no. (%)	938 (4.6%)	23 (2.2%)	479 (8.7%)	< 0.01

†Outcomes were compared across linguistic groups using analysis of variance (ANOVA) for continuous variables and chi-squared tests for categorical variables

Table 4 Outcomes for long-term care (LTC) residents in Ontario who were diagnosed with COVID-19 during the first two waves of the pandemic, stratified by resident-facility language concordance/discordance

Outcomes	Total (*N*=26,829)		
	Language-concordant homes (*N*=22,047)	Language-discordant homes (*N*=4,782)	*P*-value†
Healthcare utilization			
ED visits – rate per 100,000 person-years	93,249	113,575	< 0.01
Hospitalizations – rate per 100,000 person-years	60,554	79,659	< 0.01
Admission to ICU – no. (%)	220 (10.4%)	63 (10.5%)	0.93
Length of stay in ICU – mean (days) +/- s.d.	7.9 +/- 18.1	5.8 +/- 9.2	0.37
Length of stay in hospital – mean (days) +/- s.d.	14.4 +/- 20.8	14.5 +/- 19.9	0.95
Mortality			
Any setting – no. (%)	3,681 (16.7%)	872 (18.2%)	0.01
In hospital – no. (%)	1,101 (5.0%)	339 (7.1%)	< 0.01

†Outcomes were compared across linguistic groups using analysis of variance (ANOVA) for continuous variables and chi-squared tests for categorical variables

in allophone homes. A breakdown of the cohort stratified by both resident language and facility language is found in Appendix 4.

As shown in Table 4, LTC residents who lived in language-discordant homes tended to have more ED visits (113,575 per 100,000 person-years) and hospitalizations (79,659 per 100,000 person-years) compared to LTC residents who lived in language-concordant homes (93,249 and 60,554 per 100,000 person-years). Overall, there was no statistically significant difference for length of stay in hospital, ICU admission, or length of stay in ICU when comparing LTC residents in language-discordant homes

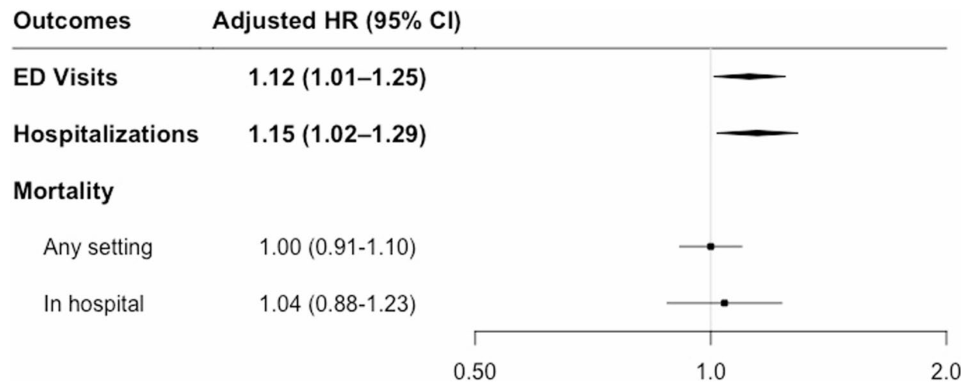

Fig. 1 Adjusted outcomes for long-term care (LTC) residents in Ontario who were diagnosed with COVID-19 during the first two waves of the pandemic, stratified by resident-facility language concordance/discordance

to LTC residents in language-concordant homes. The proportion of LTC residents who died within 90 days of COVID-19 diagnosis was higher amongst those living in language-discordant homes than those living in language-concordant homes (18.2% vs. 16.7%, $p = 0.01$). Similarly, LTC residents who lived in language-discordant homes tended to die in hospital more often than LTC residents who lived in language-concordant homes (7.1% vs. 5.0%, $p < 0.01$). Outcomes stratified by each linguistic group are presented in Appendix 5.

In the adjusted multivariable regression analyses (Fig. 1), we found that LTC residents who lived in language-discordant homes were more likely to visit the ED (HR 1.12, 95% CI 1.01–1.25) and be admitted to hospital (HR 1.15, 95% CI 1.02–1.29) when compared to LTC residents who lived in language-concordant homes. However, LTC residents who lived in language-discordant homes were not more likely to die during the follow-up period (HR 1.00, 95% CI 0.91–1.10 for death in any setting; HR 1.04, 95% CI 0.88–1.23 death in hospital). Complete regression models are presented in Appendix 6.

Language-concordant care is the reference group in all analyses. Values to the left of the line of null effect denote lower risk of ED visits, hospitalizations, or mortality during the 90-day follow-up period for residents living in language-discordant LTC homes; values to the right of the line of null effect denote high risk of ED visits, hospitalizations, and mortality during the 90-day follow-up period for residents living in language-discordant LTC homes. Effect sizes adjusted for resident language, facility language, age at the time of COVID-19 diagnosis, sex, neighbourhood income quintile of the resident prior to entry into LTC, geographic region of the resident prior to entry into LTC, urban/rural residence of the resident prior to entry into LTC, immigration status, Charlson Comorbidity Index, activities of daily living (ADL) scale, cognitive performance scale, and changes in health, end-stage disease, signs and symptoms (CHESS) score, geographic region of the LTC home, urban/rural residence of the LTC home, size of the LTC home (i.e., number of beds).

Discussion

In this study of LTC residents who were diagnosed with COVID-19 during the first two waves of the pandemic, we found that allophones had higher rates of ED visits, hospitalizations, and death within 90 days of COVID-19 diagnosis when compared to Francophones and allophones. Furthermore, those who lived in language-discordant homes were more likely to have ED visits and hospitalizations within 90 days of COVID-19 diagnosis, even after adjusting for resident language, facility language, and potentially confounding variables. We believe that this association was driven, at least in part, by cultural and/or linguistic factors acting as barriers to advance care planning. While advance care planning is not required by law in Ontario, the overwhelming majority of LTC facilities have standardized forms to document advance directives [40], including limits on escalation of care (i.e., DNH and DNR orders), which prevent unnecessary hospitalizations and life-sustaining treatments [22]. However, the literature suggests that ethnic minorities are less likely to have properly documented advance care plans when compared to the ethnic majority group [23]. One study of LTC residents in Ontario, Canada also found that residents' whose primary language was a language other than English or French were less likely to have DNH and/or DNR orders [41]. Therefore, it is possible that residents without advance care plans may have been offered interventions and treatments deemed appropriate and/or necessary by their physician (including transfers to acute care treatment facilities, which may have exceeded the level of care that residents or residents' families would have accepted if an advance care plan were properly documented). It is of note that, despite visiting the emergency room and being hospitalized at a greater rate, those that received language-discordant care in the home did not have improved mortality rates.

The majority of residents who lived in language-discordant homes were allophones, a group that was also more likely to have ED visits and hospitalizations in the multivariable regression analysis, i.e. even after controlling for potential confounders. Prior studies have found that allophones prefer community-based care rather than acute treatment; [42, 43] if these preferences were incorporated into the decision to transfer residents to acute care treatment facilities, one would have expected allophones (and, by extension, residents in language-discordant homes) to have had fewer ED visits and hospitalizations when compared to Anglophone and Francophone residents. Yet, our results indicate the opposite was in fact happening. This provides further support for our hypothesis that the advance care plans of allophones may not have appropriately represented their wishes regarding advance care planning. Finally, we propose that proximity to acute care treatment facilities may have also had an impact on ED visits and hospitalizations. Given that most allophones lived in either English or allophone homes, which are generally found in urban areas, transfers to acute care treatment facilities may have been considered less burdensome when compared to residents living in French homes, which tended to be more rural. However, the increased likelihood of ED visits and hospitalizations persisted in the multivariable regression analysis, after adjusting for geographic location and urban/rural status.

Resident-facility language discordance was not a risk for mortality within 90 days of COVID-19 diagnosis. We propose several explanations for this finding, which did not support our hypothesis that residents in language-discordant homes would be more likely to die after COVID-19 diagnosis when compared to residents in language-concordant homes. Language barriers are thought to negatively impact the quality and safety of care by hindering the accuracy and timeliness of diagnoses, thereby delaying the implementation of appropriate management plans [44–46]. Since our study primarily took place during a period of time where neither vaccines nor treatments were available in Canada [6], delays in diagnosis and/or treatment attributed to language barriers were unlikely to result in differential outcomes. Of note, approximately three quarters of the residents in our study had at least moderate cognitive impairment (as denoted by the Cognitive Performance Scale), which may have contributed to communication barriers even in the absence of language barriers. This would attenuate any effect of language concordance/discordance, since a proportion of residents living in language-concordant homes would experience communication barriers, and thus face similar experiences as those living in language-discordant homes. Finally, our cohort included residents with advanced age, frailty, and multimorbidity, all of which are known to be risk factors for mortality after COVID-19 diagnosis [2, 3]. It is possible that the impact of language barriers on survival was negligible when compared to these risk factors.

Limitations

This study has several limitations. First, we obtained resident language from resident assessments. Previous analyses conducted by our group showed substantial agreement ($\kappa = 0.76$) between the language variable obtained from long-term care assessments and the language most often spoken at home in the Canadian Community Health Survey [47, 48]. However, interviewers can only record one language during resident assessments; therefore, we were not able to distinguish unilingual residents from multilingual residents. Such misclassification should be non-differential, thereby resulting in the effect size being biased towards the null. Second, the quality of the data collected during resident assessments could be impacted by language barriers, as interviewers (who are predominantly Anglophone) may not have been able to accurately elicit information from Francophone and allophone residents. Furthermore, some of the variables collected (such as ADL scale and cognitive performance scale) have not been validated among Francophone or allophone populations. Next, we defined facility language using a person-time representation of the languages spoken by residents in each LTC home. Thus, the interpretation of our analysis assumes that LTC facilities with a high proportion of residents who speak a given language are also staffed by healthcare providers who speak that same language. Unfortunately, we do not have information on the languages spoken by individual healthcare providers in LTC homes to confirm or refute this assumption. Additionally, we do not have individual-level data on race or ethnicity, which means that we could not assess for the independent associations of culture and language on the outcomes of interest. If we had adjusted for race or ethnicity, we believe that the association attributable to language would have been attenuated, at the expense of any association due to race or ethnicity. Finally, we did not adjust for advance directives. While this information is collected (by way of chart review) during resident assessments, prior studies of LTC residents in Ontario, Canada, have shown that DNH orders are infrequently used [41, 49], strongly associated with baseline health instability [41, 49], and often overturned [49]. It is also unclear if DNH and DNR orders that were documented during annual resident assessments would be accurate during the study period. In March 2020, the Ontario Ministry of Health directed LTC homes to review advanced directives for all residents; [30] changes made shortly after the onset of the COVID-19 pandemic may not have been captured immediately by annual resident assessments.

Conclusion

Ontarians living in LTC who were diagnosed with COVID-19 experienced more ED visits and hospitalizations when they resided in language-discordant facilities compared to those who resided in language-concordant facilities, even after controlling for potential confounders. The findings of this study highlight the importance of providing frail, vulnerable residents with linguistically concordant care to reduce unnecessary, burdensome transfers to acute care and minimize the risk of adverse or undesired health outcomes. At the time of application for LTC, individuals should be asked their preferred language and, whenever possible, be provided with the option of living in a language-concordant LTC home. For those who reside in language-discordant facilities, we recommend that trained interpreters be involved at frequent and regular intervals, especially when discussing sensitive topics, such as advance care planning.

Abbreviations

ADL	Activities of daily living
CHESS	Changes in health, end-stage disease, signs and symptoms
COVID-19	Coronavirus disease 2019
C19INTGR	COVID-19 Integrated Testing Data
DAD	Discharge Abstract Database
DNH	Do-Not-Hospitalize
DNR	Do-Not-Resuscitate
ED	Emergency Department
ICES	Institute for Clinical Evaluative Sciences
ICU	Intensive care unit
IRCC	Immigration, Refugees and Citizenship Canada
LTC	Long-term care
NACRS	National Ambulatory Care Reporting System
OHIP	Ontario Health Insurance Plan
RAI-MDS	Resident Assessment Instrument Minimum Dataset
RPDB	Registered Persons Database

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12877-025-06301-0.

Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Supplementary Material 4.

Supplementary Material 5.

Supplementary Material 6.

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Data sharing statement

The dataset from this study is held securely in coded form at ICES. While data sharing agreements prohibit ICES from making the data set publicly available, access may be granted to those who meet pre-specified criteria for confidential access, available at www.ices.on.ca/DAS. The full data set creation plan and underlying analytic code are available from the authors upon request, understanding that the computer programs may rely upon coding templates or macros that are unique to ICES and are therefore either inaccessible or may require modification.

Disclaimer

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Transparency statement

The lead author (MR) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Author contributions

The manuscript is co-authored by Michael Reaume, Ricardo Batista, Haris Imsirovic, Lise M Bjerre, Claire E Kendall, Louise Bouchard, Alain P Gauthier, Josette-Renée Landry, Marie-Hélène Chomienne, Mwali Muray, Amy Hsu, Denis Prud'homme, Doug G Manuel, and Peter Tanuseputro. Denis Prud'homme, Doug G Manuel, and Peter Tanuseputro conceived the original idea. All authors contributed to the design of the study. Haris Imsirovic performed statistical analyses. Michael Reaume and Ricardo Batista co-drafted the manuscript. All authors provided critical feedback and suggestions to help prepare the final manuscript. Michael Reaume had full access to all the data in the study and had final responsibility for the decision on content and publication submission. All of the authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work.

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Data availability

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Declarations

Ethics approval and consent to participate

ICES is a prescribed entity under Sect. 45 of Ontario's Personal Health Information Protection Act. Section 45 authorizes ICES to collect personal health information, without consent, for the purpose of analysis or compiling statistical information with respect to the management of, evaluation or

monitoring of, the allocation of resources to or planning for all or part of the health system. Projects conducted under Sect. 45, by definition, do not require review by a Research Ethics Board. This project was conducted under Sect. 45, and approved by ICES' Privacy and Compliance Office.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. World Health Organization. WHO Coronavirus (COVID-19) Dashboard. Available from: https://covid19.who.int/. Accessed 15 Jul 2023.
2. Booth A, Reed AB, Ponzo S, Yassaee A, Aral M, Plans D, et al. Population risk factors for severe disease and mortality in COVID-19: A global systematic review and meta-analysis. PLoS ONE. 2021;16:1–30.
3. Dessie ZG, Zewotir T. Mortality-related risk factors of COVID-19: a systematic review and meta-analysis of 42 studies and 423,117 patients. BMC Infect Dis. 2021;21:855.
4. Office of the Chief Science Advisory of Canada. Long-Term Care and COVID-19. Ottawa, Canada. 2020. Available from: https://science.gc.ca/site/science/sites/default/files/attachments/2022/Long-Term-Care-and-Covid19_2020.pdf.
5. Canadian Institute for Health Information. The Impact of COVID-19 on Long-Term Care in Canada: Focus on the First 6 Months. Ottawa, Canada. 2021. Available from: https://www.cihi.ca/sites/default/files/document/impact-covid-19-long-term-care-canada-first-6-months-report-en.pdf.
6. Public Health Agency of Canada. Federal, Provincial, Territorial Public Health Response Plan for Ongoing Management of COVID-19. Ottawa, Canada. 2022. Available from: https://www.canada.ca/content/dam/phac-aspc/documents/services/diseases/2019-novel-coronavirus-infection/federal-provincial-territorial-public-health-response-plan-ongoing-management-covid-19/fpt-response-plan-eng.pdf.
7. Lau-Ng R, Caruso LB, Perls TT. COVID-19 deaths in Long-Term care facilities: A critical piece of the pandemic puzzle. J Am Geriatr Soc. 2020;68:1895–8.
8. Canadian Institute for Health Information. How many long-term care beds are there in Canada? Available from: https://www.cihi.ca/en/how-many-long-term-care-beds-are-there-in-canada. Accessed 15 Jul 2023.
9. Statistics Canada. Census of Population. Available from: https://www12.statcan.gc.ca/census-recensement/index-eng.cfm. Accessed 15 Jul 2023.
10. The COVID Tracking Project, Long-Term-Care COVID, Tracker. Available from: https://covidtracking.com/nursing-homes-long-term-care-facilities. Accessed 15 Jul 2023.
11. Paremoer L, Nandi S, Serag H, Baum F. Covid-19 pandemic and the social determinants of health. BMJ. 2021;372:1–5.
12. Reaume M, Batista R, Talarico R, Rhodes E, Guerin E, Carson S, et al. The impact of hospital Language on the rate of in-hospital harm. A retrospective cohort study of home care recipients in ontario, Canada. BMC Health Serv Res. 2020;20:340.
13. Batista R, Prud'homme D, Rhodes E, Hsu A, Talarico R, Reaume M, et al. Quality and safety in Long-Term care in ontario: the impact of Language discordance. J Am Med Dir Assoc. 2021;22:2147–53.
14. Seale E, Reaume M, Batista R, Eddeen AB, Roberts R, Rhodes E, et al. Patient-physician Language concordance and quality and safety outcomes among frail home care recipients admitted to hospital in ontario, Canada. CMAJ. 2022;194:E899–908.
15. Cohen-Cline H, Li HF, Gill M, Rodriguez F, Hernandez-Boussard T, Wolberg H, et al. Major disparities in COVID-19 test positivity for patients with non-English preferred Language even after accounting for race and social factors in the united States in 2020. BMC Public Health. 2021;21:1–9.
16. Karmakar M, Lantz PM, Tipirneni R. Association of social and demographic factors with COVID-19 incidence and death rates in the US. JAMA Netw Open. 2021;4:1–12.
17. Otto WR, Grundmeier RW, Montoya-Williams D, Njoroge WFM, Wallis KE, Gerber JS, et al. Association between preferred Language and risk of severe acute respiratory syndrome coronavirus 2 infection in children in the united States. Am J Trop Med Hyg. 2021;105:1261–4.
18. Rozenfeld Y, Beam J, Maier H, Haggerson W, Boudreau K, Carlson J, et al. A model of disparities: risk factors associated with COVID-19 infection. Int J Equity Health. 2020;19:1–10.
19. Ingraham NE, Purcell LN, Karam BS, Dudley RA, Usher MG, Warlick CA, et al. Racial and ethnic disparities in hospital admissions from COVID-19: determining the impact of neighborhood deprivation and primary Language. J Gen Intern Med. 2021;36:3462–70.
20. Chua IS, Shi SM, Jia Z, Leiter R, Rodriguez JA, Sivashanker K, et al. Differences in End-of-Life care between COVID-19 inpatient decedents with english proficiency and limited english proficiency. J Palliat Med. 2022;25:1629–38.
21. Lopez S, Longcoy J, Avery E, Isgor Z, Jeevananthan A, Perez J, et al. The impact of Language on hospital outcomes for COVID-19 patients: A study of Non-English speaking Hispanic patients. J Racial Ethn Heal Disparities. 2024;11:1611–7.
22. Brinkman-Stoppelenburg A, Rietjens J, van der Heide A. The effects of advance care planning on end-of-life care: a systematic review. Palliat Med. 2014;28:1000–25.
23. Crooks J, Trotter S, Obe RB, Monaghan E, Clarke G. How does ethnicity affect presence of advance care planning in care records for individuals with advanced disease? A mixed-methods systematic review. BMC Palliat Care. 2023;22:43.
24. Kim H, Jung Y, Il, Sung M, Lee JY, Yoon JY, Yoon JL. Reliability of the interrai long term care facilities (LTCF) and interrai home care (HC). Geriatr Gerontol Int. 2015;15:220–8.
25. Muggah E, Graves E, Bennett C, Manuel DG. The impact of multiple chronic diseases on ambulatory care use; a population based study in ontario, Canada. BMC Health Serv Res. 2012;12:452.
26. Koné Pefoyo AJ, Bronskill SE, Gruneir A, Calzavara A, Thavorn K, Petrosyan Y, et al. The increasing burden and complexity of Multimorbidity. BMC Public Health. 2015;15:415.
27. Gruneir A, Bronskill SE, Maxwell CJ, Bai YQ, Kone AJ, Thavorn K, et al. The association between Multimorbidity and hospitalization is modified by individual demographics and physician continuity of care: a retrospective cohort study. BMC Health Serv Res. 2016;16:154.
28. Mondor L, Maxwell CJ, Bronskill SE, Gruneir A, Wodchis WP. The relative impact of chronic conditions and Multimorbidity on health-related quality of life in Ontario long-stay home care clients. Qual Life Res. 2016;25:2619–32.
29. Health Data Research Network Canada. COVID-19 Data Inventory. Available from: https://hdrn.ca/en/dash/covid/. Accessed 6 Mar 2025.
30. Chief Medical Officer of Health. COVID-19 Directive #3 for Long-Term Care Homes under the Long-Term Care Homes Act. 2007 Issued under Sect. 77.7 of the Health Protection and Promotion Act (HPPA), R.S.O. 1990, c. H.7. Toronto: Government of Ontario; 2020. Available from: https://www.oha.com/Bulletins/CMOHDirective3-Long-TermCareHomes-HPPA03302020Shared.pdf.
31. Lepage J-F. Interpreting and presenting census language data. Ottawa: Statistics Canada; 2020. Available from: https://www150.statcan.gc.ca/n1/pub/89-657-x/89-657-x2020003-eng.pdf.
32. Golubović J, Gooskens C. Mutual intelligibility between West and South Slavic languages. Russ Linguist. 2015;39:351–73.

33. Gooskens C, van Heuven VJ, Golubović J, Schüppert A, Swarte F, Voigt S. Mutual intelligibility between closely related languages in Europe. Int J Multiling. 2018;15:169–93.
34. Rowe B, Levine D. A concise introduction to linguistics. 5th ed. New York, USA: Routledge; 2018.
35. Office of the French Language Services Commissioner of Ontario. Study on Designation: Revitalizing the Provision of French Language Services. Toronto, Canada. 2018. Available from: https://csfontario.ca/wp-content/uploads/2018/03/OFLSC-275398-Special-Report_2018_03_06_EN-FINAL.pdf.
36. Batista R, Prud'homme D, Hsu AT, Guérin E, Bouchard L, Rhodes E, et al. The health impact of living in a nursing home with a predominantly different spoken Language. J Am Med Dir Assoc. 2019;20:1649–51.
37. Reaume M, Peixoto C, Pugliese M, Tanuseputro P, Batista R, Kendall CE, et al. The impact of patient-facility Language discordance on potentially inappropriate prescribing of antipsychotics in long-term care home in ontario, canada: a retrospective population health cohort study. BMC Geriatr. 2024;24:889.
38. Charlson M, Pompei P, Ales K, MacKenzie C. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis. 1987;40:373–83.
39. Morris JN, Pries B, Morris S. Scaling ADLs within the MDS. J Gerontol Biol Sci Med Sci. 1999;54:546–53.
40. Turcotte L, Scott M, Petrcich W, Tanuseputro P, Kobewka D. Quality of advance care planning in Long-Term care and transfers to hospital at the end of life. J Am Med Dir Assoc. 2024;25:105259.
41. Tanuseputro P, Hsu A, Chalifoux M, Talarico R, Kobewka D, Scott M, et al. Do-Not-Resuscitate and do-Not-Hospitalize orders in nursing homes: who gets them and do they make a difference?? J Am Med Dir Assoc. 2019;20:1169–74.
42. Crawley LM. Clarity in a changing landscape. J Palliat Med. 2005;8:58–69.
43. Bassett R, Bourbonnais V, McDowell I. Living long and keeping well: elderly Canadians account for success in aging. Can J Aging. 2007;26:113–26.
44. Bowen S. The Impact of Language Barriers on Patient Safety and Quality of Care. Ottawa: Société Santé en français; 2015. Available from: https://www.santefrancais.ca/wp-content/uploads/2018/11/SSF-Bowen-S.-Language-Barriers-Study-1.pdf.
45. de Moissac D, Bowen S. Impact of Language barriers on quality of care and patient safety for official Language minority francophones in Canada. J Patient Exp. 2019;6:24–32.
46. Al Shamsi H, Almutairi AG, Al Mashrafi S, Al Kalbani T. Implications of Language barriers for healthcare: A systematic review. Oman Med J. 2020;35:1–7.
47. Batista R, Hsu AT, Bouchard L, Reaume M, Rhodes E, Sucha E, et al. Ascertaining the Francophone population in ontario: validating the Language variable in health data. BMC Med Res Methodol. 2024;24:98.
48. Reaume M, Batista R, Prud'homme D, Tanuseputro P. Qualité et sécurité des services de Santé offerts En situation linguistique Minoritaire En ontario: investigations des Données administratives de Santé. Minor Linguist société / Linguist Minor Soc. 2024;22:1–19.
49. Adekpedjou R, Heckman GA, Hébert PC, Costa AP, Hirdes J. Outcomes of advance care directives after admission to a long-term care home: DNR the DNH? BMC Geriatr. 2022;22:22.

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