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Facility-Level Variation of Resident Loneliness in Assisted Living and Associated Organizational Context Factors: A Repeated Cross-Sectional Study

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ABSTRACT

Background and Objectives: Loneliness is common among nursing home residents, and it is also thought to be a problem in assisted living (AL). However, we lack research on loneliness in AL. Our objectives were to assess changes in risk-adjusted prevalence of loneliness in AL, and facility-level variations in loneliness before and during the COVID-19 pandemic, and facility-level factors associated with AL resident loneliness during the pandemic.

Research Design and Methods: This population-based, repeated cross-sectional study used Resident Assessment Instrument—Home Care (RAI-HC) data (01/2017–12/2021) from Alberta, Canada. On a system-level, we estimated quarterly, risk-adjusted loneliness prevalence, and used segmented regressions to assess whether loneliness changed after the start of the pandemic. For risk adjustment, we used resident-covariates known to be associated with loneliness, but out the health system's or AL home's control (e.g., age or cognitive impairment) to enable fair comparisons over time. Linking AL home surveys, collected in COVID-19 waves 1 (March–June 2020) and 2 (October 2020–February 2021) to RAI-HC records, we used covariate-adjusted general estimating equations (GEE) to assess AL home factors (e.g., staffing shortages, social distancing measures) associated with resident-level loneliness during the pandemic.

Results: Quarterly samples included 2026–2721 residents. Loneliness [95% confidence interval] fluctuated between 13.6% [11.5%–15.7%], and 16.8% [14.4%–19.2%], with no statistically significant increase during the pandemic. Facility-level median [inter-quartile range] loneliness prevalence varied considerably before (14.9% [8.3%–21.1%) and during the pandemic (13.5% [6.9%–21.3%]). GEEs included 985 residents in 41 facilities (wave 1), and 1134 residents in 42 facilities (wave 2). Facility-factors associated with decreased odds of loneliness included: facilitating caregiver involvement (odds ratio = 0.531 [95% confidence interval: 0.286–0.986]), essential visitor policies (0.672 [0.454–0.994]), and video calls with volunteers or religious/spiritual leaders (0.603 [0.435–0.836]). Facilitating outdoor activities/visits (2.486 [1.561–3.961], and providing hallway-based activities (1.645 [1.183–2.288]) were associated with increased odds of loneliness.

Discussion and Implications: Loneliness did not change during COVID-19 in AL on a health system level, but varied considerably between facilities before and during the pandemic. Modifiable facility-level factors explained variations in loneliness within facilities, suggesting important targets for policies and improvement interventions.

1 | Introduction

Loneliness is a person's feeling that there is a mismatch between the desired and experienced amount and/or quality of social interactions [1]. A systematic review and meta-analysis reported a pooled loneliness prevalence of 29% among older adults in general [2]. Loneliness was even more prevalent among nursing home (NH) or assisted living (AL) residents (pooled prevalence of at least moderate loneliness: 61%) [3], but prevalence estimates were not reported separately for AL versus NH residents—a common practice that contributes to the knowledge gaps related to AL.

Loneliness erodes a person's quality of life and is associated with poor mental health, suicidal ideation, and premature death [4, 5]. Lonely older adults (vs. those who are not) are 26% more likely to die prematurely, which is comparable to the harmful effects of physical inactivity or substance abuse [4]. Loneliness is a particular problem in NHs. As Zhang et al. [6] report in their meta-synthesis of 13 qualitative studies, moving into an NH means leaving a home and community one is familiar with and entering a new, often not very homelike setting whose structural and organizational features create multiple barriers for social connections. Physical and cognitive impairments in combination with organizational rules (e.g., set times for activities and meals) make it difficult for NH residents to independently meet their need for social connections. Residents describe loneliness as an emotionally painful experience of feeling abandoned, unwelcome, and unappreciated [6].

Reported loneliness prevalence estimates vary widely (10%–56% in the general population [2], 9%–100% in NHs and AL [3]), largely due to variations in how loneliness is measured [7] (e.g., using a single item vs. an aggregate score of multiple items, or whether loneliness severity is considered). Measuring loneliness among older adults with cognitive impairment is challenging since their ability to self-report may be affected [8]. In Canada, 60% of residents in NHs and AL have dementia [9], highlighting the need for tools that are validated to assess loneliness among persons with dementia in these settings. Unfortunately, few such tools are available [8].

While numerous studies have investigated loneliness among NH residents [3, 6], far less such research is available in AL [10]. Like NHs, AL homes are institutional settings caring for older adults whose care needs cannot be safely met at home anymore [11]. However, they are designed to be more homelike than NHs, and to address less complex care needs [11]. Care is provided by care aides (personal support workers, nurse assistants) and licensed practical nurses, while registered nurses are often available on call only [11]. Because AL provides fewer services than NHs (including recreational and social activities) and lower staffing levels, loneliness is thought to be of even greater concern in AL [10].

In Canada, continuing care (including AL) is regulated by each province and territory, leading to substantial heterogeneity in AL oversight, organization, and delivery [12]. In Alberta, the Canadian province this study focused on, publicly-funded AL homes, then called Designated Supportive Living (DSL), and since 2024 called Continuing Care Homes Type B [13], are operated by the health system directly, or by contracted for-profit or not-for profit providers [14]. In 2020, Alberta had 11,853 DSL beds [14].

Extensive research has focused on older adults' characteristics associated with loneliness [15–17]. These include older age, female sex, lower levels of education, lower socio-economic status, functional impairment, cognitive impairment, and chronic conditions. Studies also demonstrate the critical role of caregivers [6, 15–19]. Studies have highlighted the higher risk of loneliness in NHs and AL, compared to the community [17], but we lack studies examining how loneliness varies between facilities, and facility-level factors associated with these differences. Such facility-level factors are often referred to as organizational context, defined as characteristics of the environment in which care is provided, including "the providers and users of health care, internal organizational arrangements, infrastructures and networks, responsiveness to change, and the broader healthcare system" [20] (p3466). One of the few studies on the association of organizational context factors with NH resident loneliness found that remote NH location, poor integration of the NH with the surrounding community, staffing shortages, and poor care staff communication with residents increase resident loneliness [18].

Finally, visitor restrictions are thought to have had severe impacts on loneliness in residential care settings, but few studies compared the prevalence of loneliness before and during the pandemic [21, 22]. Most focused on NHs, and very few examined facility-level variations of loneliness and organizational context factors associated with these variations. A Swedish study [23] reported an increase in loneliness in NHs during the pandemic. A Dutch study [24] did not find differences in loneliness among NH residents before versus during the pandemic, suggesting that facility-level structures and processes may have mitigated potentially negative effects of public health measures on residents. A qualitative study on NH residents' loneliness during the pandemic [19] suggested that contextual factors, such as COVID-19 outbreaks and spread in the facility, safety protocols, and visitor restrictions increased resident loneliness, and that social support, recreational activities, and a general atmosphere of positivity reduced resident loneliness.

Our study objectives were to assess (1) how the risk-adjusted prevalence of loneliness in AL changed over time before and after the start of the COVID-19 pandemic, (2) how loneliness varied between facilities, and (3) what facility-level organizational context conditions (e.g., staffing shortages or perceived

Summary

- Loneliness is common among older adults living in continuing care institutions, but unlike in the nursing home sector, we lack research on residents in assisted living (AL).
- This study addressed critical knowledge gaps related to (1) how loneliness changed in a population of AL residents in the Canadian province of Alberta between 2017 and 2021, (2) whether loneliness trends changed during, compared to before the pandemic, and (3) whether in a sample of residents in AL homes that had completed a facility survey facility-level factors were associated with AL resident loneliness during the pandemic.
- AL settings and policy makers can use this study's information on potentially modifiable AL organizational context factors that are associated with resident loneliness, to develop policies and interventions to reduce AL residents' loneliness. Those might include supporting caregiver involvement in resident care, increasing visits from essential visitors, and facilitating video calls with volunteers or religious/spiritual leaders.

preparedness for the pandemic), adjusted for caregiver, resident, and facility covariates, were associated with AL resident loneliness during the pandemic. Bronfenbrenner's Process-Person-Context-Time (PPCT) model [25], previously used to guide research on loneliness among older adults [15], guided our study (Figure 1). It proposes that a person's success in accomplishing developmental tasks (here: coping with loneliness) is influenced by a complex interplay among the person's individual characteristics, social context, and interactions with elements of the social context. The developmental task and the influencing factors depend on the historical time a person lives in, and they change over time.

2 | Materials and Methods

To address objectives 1 and 2, we used population-based Resident Assessment Instrument—Home Care (RAI-HC) data [26, 27] from AL (DSL) residents in Alberta, Canada. We conducted a retrospective, repeated cross-sectional time series analysis (January 1, 2017-December 31, 2021) of quarterly, risk adjusted, system-level loneliness prevalence. For objective 3, we used data from AL homes that submitted two facility surveys on the impact of COVID-19 in a prior study [28]. Surveys completed by a key contact in each home between October 26, 2020 and April 7, 2021 (focusing on wave 1 of the pandemic) and between July 10 and September 17, 2021 (focusing on wave 2) were linked to these homes' RAI-HC records.

2.1 | Objectives 1 and 2

2.1.1 | Setting and Sample

We included data from 23,799 residents in publicly funded AL (DSL) homes in Alberta. The RAI-HC, a validated, comprehensive clinical assessment [26, 27], is routinely collected by care staff for each resident at admission, annually, or in case of a significant status change [27]. We selected each resident's latest assessment in each quarter, applied inclusion and exclusion criteria, and created quarterly risk adjusted loneliness prevalence estimates.

2.1.2 | Risk Adjusted Loneliness Prevalence

We adapted methods used to generate publicly reported, risk adjusted NH quality indicators [29], similar to those we used in previous studies [9, 28]. Risk adjustment means adjustment for factors that are out of the control of a health system or facility, but that may increase a resident's risk for loneliness. Adjusting for these factors enables a fairer comparisons of loneliness over time and between facilities [30]. Risk adjustment included three steps.

1. Unadjusted loneliness prevalence. We excluded residents whose assessments were completed within 30 days of admission to ensure the outcome reflected care in AL (vs. in the previous setting). We counted all remaining AL residents experiencing loneliness in each quarter (numerator), using a dichotomous RAI-HC item ("Client says or indicates that he/she feels lonely") [26, 27]. The inter-rater reliability of RAI-HC social functioning items (including the loneliness item) was acceptable (0.7) [31]. In previous studies using the item, loneliness was associated as expected with lower socio-economic status, rural (vs. urban) location [32], and increased health services use [10], supporting construct validity. Our denominator were all AL residents in the respective quarter that met inclusion criteria.
2. Stratification. We stratified residents by cognitive impairment, using the Cognitive Performance Scale (CPS) [33] score: (1) no/mild impairment, CPS < 2, (2) moderate impairment, CPS of 2–4, (3) severe impairment, CPS > 4.
3. Regression-based adjustment. We ran a logistic regression in each stratum with loneliness as dependent variable, adjusted for variables known to be associated with loneliness [15, 16]: Resident age, hearing impairment, vision impairment, difficulty making self understood, difficulty to understand others, change in social activities and distressed about it, and caregiver availability/challenges. All of these RAI-HC variables have demonstrated acceptable reliability and validity [31]. Finally, we multiplied the regression-adjusted prevalence estimate in each stratum with a stratum weight (i.e., loneliness count in stratum/total loneliness count) and then summed the weighted stratum estimates to a total adjusted loneliness prevalence in each quarter.

2.1.3 | Sample Characteristics

RAI-HC variables were used to describe our sample, including age, sex, dementia, heart failure, chronic obstructive pulmonary disease, diabetes, end-stage disease, physical functioning (Activities of Daily Living Hierarchy [ADLh] scale [34]), Cognitive

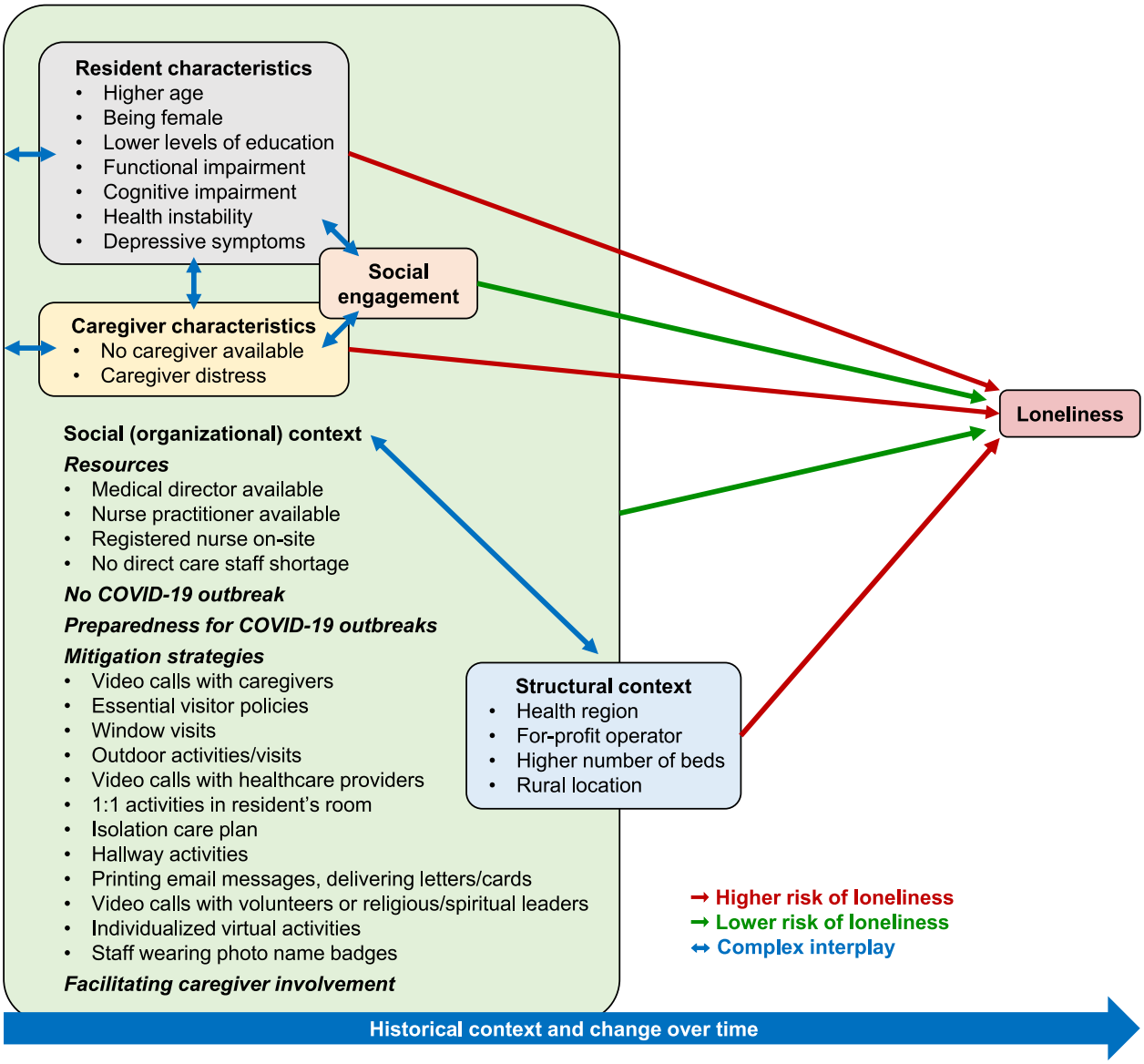

FIGURE 1 | Theoretical model of factors associated with resident loneliness in assisted living homes.

Performance Scale [CPS] [33], Depression Rating Scale [DRS] [35], Aggressive Behavior Scale [ABS] [36], and Frailty Index [37].

2.1.4 | Statistical Analyses

W used SAS 9.4 for all analyses. We described sample characteristics by quarter and assessed temporal changes of each characteristic, using Mann-Kendall tests for trends. We assessed minimum, maximum, median, and inter-quartile range of facility-level loneliness prevalence before and during the pandemic. We created a run chart of risk-adjusted quarterly loneliness prevalences and their 95% confidence intervals (CIs). An interrupted time series analysis (segmented regression), using 13 pre-pandemic quarters and 7 pandemic quarters, assessed whether the level (intercept) and/or trend (slope) of loneliness had changed after, compared to before the start of the pandemic.

2.2 | Objective 3

2.2.1 | Setting and Sample

As described in a previous study [28], a key contact in each of 44 AL homes submitted two surveys on the impact of pandemic waves 1 and two on the home, and related responses to the pandemic. We invited all 163 eligible AL homes in Alberta to participate, of which 64 (39%) submitted an initial survey, and 44 a second survey. We extracted RAI-HC records corresponding to the wave 1 and two periods for all residents in these homes, retaining each resident's latest record in each period, and excluding 2 homes with no RAI-HC records in either of the periods. Of the remaining homes, one had RAI-HC data only in wave 2.

2.2.2 | Dependent Variable

Our dependent variable was the dichotomous RAI-HC item (felt lonely) described above.

TABLE 1 | Facility survey variables considered for inclusion in the statistical models.

Construct	Survey question	Response options	Study variable	Hypotheses
Availability of a medical director	Was there a medical director affiliated with your home?	Yes/no	Survey question used	Availability of a medical director associated with lower odd of loneliness
Availability of a nurse practitioner	Was there a nurse practitioner affiliated (employed/contracted) with your home?	Yes/no	Survey question used	Availability of a nurse practitioner associated with lower odd of loneliness
Availability of a registered nurse	Did you have 24-h registered nurses on-site?	Yes/no	Survey question used	Availability of a registered nurse associated with lower odd of loneliness
Direct care staff shortage	Did your home experience challenges with ensuring care aide staffing levels?	5-Point Likert scale (1 = no staff shortage to 5 = not available at all)	Dichotomous (moderate or higher shortage of care aide or licensed practical nurse staffing vs. no or limited shortage of both)	Direct care staff shortage associated with higher odd of loneliness
	Did your home experience challenges with ensuring licensed practical nurse staffing levels?			
Preparedness for COVID-19 outbreaks	How well prepared was your home for a COVID-19 outbreak?	5-Point Likert scale (1 = very well prepared to 5 = not at all prepared)	Dichotomous (very well or well prepared vs. somewhat, poorly, or not at all prepared)	Better preparedness associated with lower odd of loneliness
COVID-19 outbreaks	Did your home experience a COVID-19 outbreak?	Yes/no	Survey question used	Outbreaks associated with higher odd of loneliness
Caregiver involvement	Do you believe your home created or facilitated opportunities for family/friend caregivers to be well informed and involved in the care and well-being of residents?	Yes/no	Survey question used	Caregiver involvement associated with lower odd of loneliness
Mitigation strategies	Did your home implement any of the following strategies to help to mitigate the impact of the COVID-19 pandemic?			
	Video calls with residents' caregivers	Each rated as yes/no	Survey questions used	Availability of each respective measure associated with lower odd of loneliness
	Designating caregivers as essential visitors			
	Facilitating window visits with caregivers			
	Facilitating outdoor activities/visits for residents			
	Facilitating video calls with healthcare providers			
	Delivery of one-on-one meaningful activities in the resident's room			
	Development of an isolation care plan			
	Hallway-based activities			

(Continues)

TABLE 1 | (Continued)

Construct	Survey question	Response options	Study variable	Hypotheses
	Printing of email messages or delivery of letters from family/friends			
	Video calling with volunteer friendly visitor programs and/or religious/ spiritual leaders			
	Individualized virtual activities (e.g. exercise programs, use of memory care tablet apps)			
	Staff wearing photo name badges			

2.2.3 | Independent Variables

Guided by our theoretical model (Figure 1) and previous research [15, 18, 19], we considered 19 facility characteristics from our facility survey for inclusion in our statistical models (Table 1).

2.2.4 | Covariates

Based on previous research, we adjusted our models for resident [15, 16], caregiver [6, 15, 16, 18, 19], and facility characteristics [18]. Resident covariates came from the RAI-HC and included age (85+ years vs. younger), sex, significant physical impairment (ADLh score ≥ 3), significant cognitive impairment (CPS score ≥ 3), significant depressive symptoms (DRS score ≥ 3), health instability (RAI-HC Changes in Health, End-Stage Disease, Signs, and Symptoms Scale [CHESS] [38] score ≥ 2), decline in social activities and feeling distressed about it, and time the resident had stayed in the home at the time of assessment. We also included the caregiver availability/distress. Facility structural characteristics included health zone (Calgary, Central, Edmonton, North, South), for-profit versus not-for-profit ownership, size (small: < 41 beds, medium: 41-80 beds, large: > 80 beds), and urban/vs rural location.

2.2.5 | Statistical Analyses

Descriptive analyses included frequencies and proportions of included variables by COVID-19 wave (1 or 2) overall and by loneliness status within each wave. To assess bivariate differences in variables between waves 1 and 2, we used general estimating equations with the respective characteristic as dependent variable, wave (1 vs. 2) as independent variable, and a random term to account for repeated measures within residents. Differences in variables between residents who did versus did not feel lonely were assessed, using Chi [2] tests.

We ran general estimating equations with loneliness as dependent variable (log link, binary distribution), accounting for repeated measures within residents and using a robust sandwich estimator to account for non-normality and clustering of residents within facilities. Time of assessment (wave 1 vs. 2) was included in all models. Following a blocked stepwise approach, we included all facility survey variables that differed by resident loneliness ($p \leq 0.25$) in our bivariate analyses. We deviated from the traditional p value cut-off of < 0.05 since this can lead to the exclusion of variables that turn out to be relevant in the multivariable regression model [39]. Variables were added one-by-one and removed if they caused collinearity issues or negatively affected model fit (increased −2 Res Log Pseudo-Likelihood and/or generalized Chi-square). Variables were considered to have collinearity issues if they had a variance inflation factor of > 5, or if a variable had a condition index of ≥ 10 and at the same time explained a variance proportion of > 0.5 of two or more of the other variables [40]. Excluded variables were then added one-by-one to the final model to minimize the risk of suppression effects [41]. None of the initially excluded variables became statistically significant when added back into the final multi-variable model, nor did their addition substantially change model effects. Resident, caregiver, and facility covariates were then added, using the same approach.

No resident data were missing. Facility preparedness, availability of a registered nurse, and family involvement were each missing in one facility survey (wave 1), affecting 40 (1.9%), 2 (0.1%), and 32 (1.5%) of all records, respectively. Information on COVID-19 outbreaks was missing in 3 facility surveys (wave 2), affecting 162 (7.6%) of all records. We used multiple imputations ($n = 5$, using the percentage of incomplete cases as the number of imputations) to manage missing data.

3 | Results

Our quarterly samples (objectives 1, 2) ranged between 2026 and 2721 residents (Table 2). The observed quarterly, risk adjusted prevalence [95% CI] of loneliness (Figure 2) fluctuated between 13.6% [11.5%; 15.7%] (2021, quarter 2), and 16.8% [14.4%; 19.2%] (2018, quarter 4). Neither the pre-pandemic nor the pandemic trend (slope) indicated a significant temporal change, and the two trends did not differ statistically significantly. We also found no statistically significant change in intercept at the start of the

TABLE 2 | Assisted living resident sample characteristics by quarter.

	2017				2018				2019				2020				2021				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	p[a]
N	*2399*	*2319*	*2026*	*2346*	*2540*	*2564*	*2179*	*2502*	*2503*	*2520*	*2360*	*2647*	*2608*	*2715*	*2285*	*2425*	*2721*	*2600*	*2248*	*2337*	
85+ years	53.1%	51.5%	55.3%	52.4%	52.6%	51.6%	53.0%	51.6%	51.0%	54.0%	53.2%	47.8%	51.3%	51.4%	52.3%	51.2%	51.3%	51.6%	51.2%	50.9%	**0.0373**
Female sex	67.2%	66.9%	67.9%	66.9%	66.5%	68.0%	67.3%	65.5%	67.0%	66.5%	68.3%	65.0%	66.6%	64.6%	67.4%	66.1%	68.6%	65.8%	66.0%	65.7%	0.2703
Post-secondary education	18.3%	18.1%	20.0%	18.1%	19.9%	19.0%	20.8%	19.3%	20.8%	19.9%	19.8%	21.6%	20.6%	20.4%	21.7%	21.3%	21.2%	19.8%	21.3%	22.8%	**0.0022**
Time lived in home																					
Up to 1 year	26.9%	27.6%	29.7%	26.9%	25.8%	27.8%	26.7%	25.3%	24.4%	25.4%	24.1%	23.0%	24.5%	25.2%	25.7%	19.8%	18.7%	21.1%	23.8%	25.2%	**0.0003**
1–2 years	26.1%	26.5%	24.9%	25.1%	25.3%	26.3%	28.0%	26.1%	24.5%	26.2%	26.0%	24.3%	25.9%	25.7%	25.0%	27.8%	29.1%	26.3%	25.4%	22.0%	0.7742
2–3 years	18.8%	18.4%	18.3%	16.8%	17.1%	16.5%	15.5%	16.3%	18.0%	16.1%	17.8%	18.3%	15.4%	15.9%	15.7%	16.3%	16.4%	17.4%	18.4%	18.1%	0.4229
> 3 years	28.2%	27.6%	27.2%	31.1%	31.9%	29.4%	29.8%	32.3%	33.1%	32.3%	32.2%	34.3%	34.2%	33.2%	33.6%	36.2%	35.8%	35.2%	32.5%	34.7%	**< 0.0001**
Caregiver status																					
Available, no distress	90.7%	89.1%	90.9%	90.6%	91.1%	90.2%	90.2%	90.6%	91.6%	90.7%	90.8%	91.0%	92.2%	92.0%	92.1%	93.4%	92.3%	92.7%	92.0%	93.0%	**< 0.0001**
Available, distress	5.9%	6.0%	5.3%	5.4%	5.2%	5.4%	6.6%	5.7%	5.1%	5.3%	5.2%	4.9%	4.3%	3.6%	4.3%	3.6%	3.8%	3.3%	4.3%	3.7%	**< 0.0001**
Not available	3.4%	4.9%	3.8%	4.0%	3.7%	4.4%	3.2%	3.6%	3.4%	4.0%	3.9%	4.1%	3.5%	4.4%	3.6%	2.9%	3.9%	4.0%	3.7%	3.3%	0.3913
Change in social activities																					
No decline	83.1%	84.9%	83.8%	84.8%	84.9%	85.8%	83.8%	85.5%	83.2%	84.6%	83.4%	84.7%	84.5%	76.0%	81.2%	82.0%	79.1%	82.5%	83.4%	84.7%	**0.0200**
Decline, no distress	14.4%	13.1%	13.9%	13.3%	12.7%	11.7%	13.6%	12.7%	14.3%	12.8%	14.2%	13.0%	13.2%	18.1%	15.4%	14.8%	17.0%	14.3%	13.6%	11.7%	0.5403
Decline, distress	2.5%	2.0%	2.4%	1.9%	2.4%	2.5%	2.6%	1.8%	2.4%	2.6%	2.3%	2.3%	2.3%	5.9%	3.4%	3.2%	3.9%	3.2%	3.0%	3.6%	**0.0373**
DRS[b] > 2	23.3%	20.9%	23.0%	22.4%	23.6%	22.5%	23.4%	21.3%	21.8%	21.1%	20.1%	21.0%	18.3%	17.8%	17.8%	16.1%	17.6%	16.1%	17.0%	16.2%	**0.0004**
Dementia	60.9%	61.3%	63.3%	60.9%	61.5%	60.5%	61.9%	62.6%	61.9%	63.1%	63.8%	63.1%	62.7%	63.5%	65.2%	64.2%	63.7%	63.5%	65.4%	62.5%	**0.0009**
CPS[c] > 3	17.7%	15.0%	17.2%	16.6%	17.0%	14.0%	15.9%	16.7%	16.1%	15.8%	15.8%	16.1%	15.1%	15.1%	15.3%	15.9%	15.5%	15.9%	16.1%	15.5%	0.1114
Responsive behaviors	28.2%	29.2%	27.0%	27.0%	27.1%	28.4%	26.7%	25.6%	27.9%	26.1%	29.2%	29.3%	26.6%	26.6%	27.7%	26.4%	26.5%	27.6%	26.6%	25.2%	**0.0373**
ADL-H[d] > 3	19.1%	17.6%	20.5%	18.2%	20.0%	18.0%	19.1%	19.0%	19.5%	18.8%	18.9%	18.4%	18.9%	19.1%	19.3%	19.2%	20.2%	19.2%	20.3%	20.8%	**0.0200**
CHESS[e] > 1	19.0%	17.6%	20.4%	17.6%	19.4%	17.4%	18.9%	18.7%	19.2%	18.1%	18.1%	17.3%	16.6%	16.0%	16.1%	16.7%	17.8%	15.9%	17.9%	18.8%	**0.0373**
Hearing impairment	22.4%	19.4%	22.3%	20.6%	21.5%	20.8%	22.3%	21.7%	22.7%	22.1%	21.7%	21.6%	21.4%	22.0%	23.5%	22.4%	22.6%	21.8%	22.0%	22.5%	0.1780

(Continues)

TABLE 2 | (Continued)

	2017				2018				2019				2020				2021				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	p^a
Vision impairment	4.0%	4.7%	5.1%	5.1%	4.3%	5.4%	5.1%	4.0%	4.7%	5.3%	5.4%	5.3%	5.5%	5.0%	5.4%	4.0%	4.8%	4.7%	4.9%	5.2%	0.3913
Difficulties making self understood	15.7%	13.5%	15.2%	14.2%	14.7%	12.5%	14.5%	15.1%	15.3%	14.2%	13.8%	14.8%	13.9%	14.3%	13.8%	14.5%	14.1%	14.5%	14.9%	13.9%	0.7133
Difficulties understanding others	17.5%	15.9%	17.3%	16.6%	16.3%	15.5%	16.7%	16.9%	16.9%	16.7%	15.5%	17.3%	16.3%	16.2%	17.3%	16.5%	17.3%	17.0%	17.3%	17.4%	0.2703

[a] p values are based on Mann-Kendall tests for trends (**bold** = statistically significant change over time, $p < 0.05$).
[b] Depression Rating Scale.
[c] Cognitive Performance Scale.
[d] Activities of Daily Living—Hierarchy scale.
[e] Changes in Health, End-Stage Disease, Signs and Symptoms.

pandemic. Before the start of the pandemic, the median risk-adjusted facility-level loneliness prevalence was 14.9% with an inter-quartile range of 8.3%–21.1%, a minimum of 0.0%, and a maximum of 57.3%. Facility-level variation of loneliness during the pandemic was similar (median = 13.5%, inter-quartile range: 6.9%–21.3%, minimum = 0.0%, maximum = 80.0%).

Our facility sample for objective 3 included 41 homes in wave 1 and 42 homes in wave 2. Nearly one in every three (28.6%) had more than 80 beds, 31% operated under a for-profit model, and 14.3% were located in rural areas.

Table 3 presents characteristics of our resident sample (985 residents in wave 1, 1134 residents in wave 2). The unadjusted loneliness prevalence [95% CI] during the pandemic was 14.2% [12.0%; 16.4%] in wave 1%, and 14.4% [12.3%; 16.4%] in wave 2. In the corresponding pre-pandemic periods, loneliness prevalence was 12.3% [10.3%; 14.4%] (March 1–June 30, 2019), and 12.3% [11.1%; 14.8%] (October 1, 2019–February 29, 2020), respectively. These numbers did not differ statistically significantly from our population-based estimates.

Based on our final, fully adjusted general estimating equation model (Table 4), residents were more likely to report loneliness in wave 2 than in wave 1 and less likely to report loneliness in facilities that worked to involve caregivers in resident care, implemented essential visitor policies, and video calls with volunteers or religious/spiritual leaders. Loneliness prevalence was higher in facilities that facilitated outdoor visits/activities, and hallway-based activities. Availability of a registered nurse was not associated with loneliness, and neither were the other resource and staffing variables (many of which were excluded from the final model in previous stages). Resident covariates associated with lower loneliness prevalence were significant cognitive impairment and significant physical impairment. Depressive symptoms, health instability, decline in social activities that residents felt distressed about, and lack of a caregiver or having a distressed caregiver were associated with higher loneliness prevalence. Resident sex was not associated with loneliness. The pandemic loneliness prevalence was higher in facilities with a higher historic loneliness prevalence. Loneliness prevalence in the North Zone was lower than in the South Zone but did not differ from that in the South Zone in the other regions.

4 | Discussion and Implications

We found that loneliness has been persistent among AL residents in Alberta, Canada, between 2017 and 2021. Population-based adjusted loneliness did not change during, compared to before the pandemic, but in our survey-based sample was higher in wave 2 than in wave 1. Loneliness varied considerably between facilities before and during the pandemic. Modifiable facility-level organizational context factors, including efforts to involve caregivers in resident care, designating caregivers as essential visitors, and facilitating video calls with volunteers or religious/spiritual leaders were associated with lower loneliness prevalence. Facilitating outdoor visits and hallway-based activities were associated with higher loneliness prevalence. Various caregiver and resident factors were associated with loneliness, as

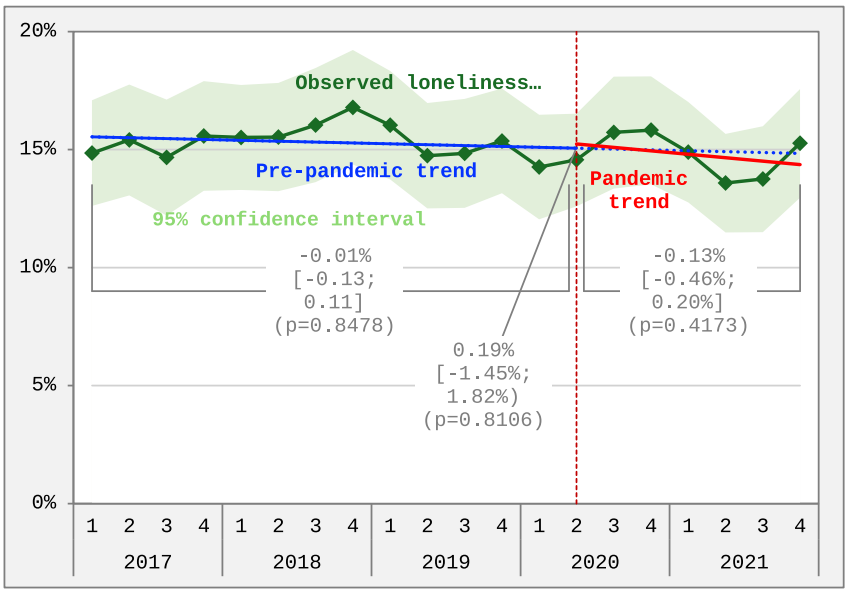

FIGURE 2 | Quarterly adjusted loneliness prevalence estimates, and pre-pandemic versus pandemic trends (segmented regression estimates).

hypothesized. However, unexpectedly, resident age and sex were not associated with loneliness, and physical and cognitive impairment were associated with lower, rather than higher loneliness prevalence. A facility's pre-pandemic loneliness prevalence was positively associated with loneliness during the pandemic.

Loneliness prevalence in our study match that reported by a study of AL residents in Alberta before the pandemic [10]. However, they are considerably lower than the pooled estimates identified in a systematic review and meta-analysis of international studies in NHs and AL (61%, 95% CI: 41%–80%) [3]. Studies included in that review were mostly from Europe (with some from Asia, Africa, Australia), did not report loneliness in AL separately (but rather focused on NHs only or mixed settings), and used tools other than the RAI-HC to assess loneliness. The RAI is known to under-detect outcomes among residents with dementia, which we think is the most likely reason explaining these differences [26, 42]. In our study, higher cognitive impairment was associated with lower loneliness prevalence, most likely because cognitively impaired residents have difficulties self-reporting loneliness, making it more challenging for staff to detect it. Higher physical impairment was also associated with lower loneliness prevalence. A possible explanation may be that staff spend more time with the physically impaired residents to address their higher care needs, or that these residents receive increased attention recreational group activities so they can participate. Future research needs to explore these phenomena in more detail, using tools that are validated to assess loneliness among persons with dementia [8].

We did not find an increase in population-based, adjusted loneliness during compared to before the pandemic. Previous studies reporting such an effect often were not population-based and lacked an adequate comparison of pandemic versus pre-pandemic loneliness estimates [22]. However, our survey-based, fully adjusted models suggest that residents were more likely in pandemic wave 2 than in wave 1 to report loneliness. Our population-based models compared the overall pre-pandemic period to the overall pandemic period, while our regression models compared different periods *within* the pandemic. By the time wave 2 started, isolation measures had been in effect for 7 months. It is possible that the prolonged isolation affected residents more severely and made it more difficult for them to cope than in the early stages of the pandemic. Surprisingly little research is available on how the duration of social isolation is associated with loneliness, but the few studies that are available suggest that longer exposure to social isolation may increase the risk and severity of loneliness [43]. However, like Angevaare et al. [24] we found that facility-level contextual factors may have mitigated negative effects of the pandemic on resident loneliness. Previous research found that continued caregiver involvement during the pandemic reduced caregivers' concerns for AL residents' mental health [44], and supported caregiver mental health [45]. Some facilities may have enabled caregivers to connect with residents more frequently and more meaningfully via phone or video calls, letters, or postal cards, reducing resident loneliness. While provincial policies allowed designation of caregivers as essential visitors, facilities operationalized those very differently, often banning visitors completely (especially in the early phases of the pandemic) [46]. A longitudinal US study of older adults in the community found that physical isolation did not negatively affect loneliness, partly because participants stayed digitally connected with their social networks [47].

Very little research is available on the role and effects of volunteers in NHs and AL [48], and on spiritual and religious needs of residents [49]. Pre-pandemic [48] and pandemic research studies [50] points to the potential of volunteers to mitigate resident loneliness. In a small-scale preliminary study in the US, facilitating residents' spiritual health was associated with improved quality of life [51]. While additional research is needed on the effects of volunteers and religious/spiritual care in NHs and AL, our study is one of the few larger-scale quantitative assessments of this issue in AL during the pandemic.

TABLE 3 | Resident characteristics and facility factors residents were exposed to by pandemic wave and by loneliness status x pandemic wave.

				Wave 1[e]			Wave 2[f]		
	Wave 1	Wave 2	p[g]	Lonely	Not lonely	p[h]	Lonely	Not lonely	p[h]
Total	985	1134	—	140	845	—	163	971	—
85+ years	459 (46.6%)	540 (47.6%)	0.6390	68 (48.6%)	391 (46.3%)	0.6135	74 (45.4%)	466 (48.0%)	0.5396
Female sex	605 (61.4%)	735 (64.8%)	0.1061	87 (62.1%)	518 (61.3%)	0.8498	122 (74.8%)	613 (63.1%)	**0.0038**
Post-secondary education	187 (19.0%)	232 (20.5%)	0.3956	34 (24.3%)	153 (18.1%)	0.0842	39 (23.9%)	193 (19.9%)	0.2356
Time lived in home									
Up to 1 year	365 (37.1%)	329 (29.0%)	0.1863	69 (49.3%)	296 (35.0%)	**0.0076**	56 (34.4%)	273 (28.1%)	0.2302
1–2 years	186 (18.9%)	270 (23.8%)		24 (17.1%)	162 (19.2%)		37 (22.7%)	233 (24.0%)	
2–3 years	125 (12.7%)	156 (13.8%)		17 (12.1%)	108 (12.8%)		25 (15.3%)	131 (13.5%)	
> 3 years	209 (31.4%)	379 (33.4%)		30 (21.4%)	279 (33.0%)		45 (27.6%)	334 (34.4%)	
No caregiver available or caregiver distressed	70 (7.1%)	81 (7.1%)	0.9739	15 (10.7%)	55 (6.5%)	0.0729	18 (11.0%)	63 (6.5%)	**0.0367**
Decline in social activities and distressed about it	40 (4.1%)	30 (2.7%)	0.0677	20 (14.3%)	20 (2.4%)	**< 0.0001**	20 (12.3%)	10 (1.0%)	**< 0.0001**
Significant physical impairment[a]	150 (15.2%)	194 (17.1%)	0.2420	18 (12.9%)	132 (15.6%)	0.3992	22 (13.5%)	172 (17.7%)	0.1859
Significant cognitive impairment[b]	151 (15.3%)	188 (16.6%)	0.4342	14 (10.0%)	137 (16.2%)	0.0588	11 (6.7%)	177 (18.2%)	**0.0003**
Dementia	648 (65.8%)	736 (64.9%)	0.6699	81 (57.9%)	567 (67.1%)	**0.0327**	89 (54.6%)	647 (66.6%)	**0.0029**
Significant depressive symptoms[c]	154 (15.6%)	197 (17.4%)	0.2832	36 (25.7%)	118 (14.0%)	**0.0004**	57 (35.0%)	140 (14.4%)	**< 0.0001**
Health instability[d]	121 (12.3%)	178 (15.7%)	**0.0244**	30 (21.4%)	91 (10.8%)	**0.0004**	37 (22.7%)	141 (14.5%)	**0.0079**
Medical director available	637 (64.7%)	762 (67.2%)	0.3298	83 (59.3%)	554 (65.6%)	0.1501	94 (57.7%)	668 (68.8%)	**0.0051**
Nurse practitioner available	355 (36.0%)	709 (62.5%)	**0.0177**	45 (32.1%)	310 (36.7%)	0.2997	86 (52.8%)	623 (64.2%)	**0.0054**
Registered nurse available	23 (2.3%)	68 (6.0%)	0.4045	1 (0.7%)	24 (2.8%)	0.0619	8 (4.9%)	60 (6.2%)	0.6496
Direct care staff shortage	273 (27.7%)	401 (35.4%)	**0.0002**	47 (33.6%)	226 (26.8%)	0.0947	54 (33.1%)	347 (35.7%)	0.5194
COVID-19 outbreak in facility	152 (15.4%)	647 (57.1%)	**0.0025**	23 (16.4%)	129 (15.3%)	0.7244	88 (54.0%)	559 (57.6%)	0.2765
Facility felt well prepared	396 (40.2%)	935 (82.5%)	**0.0007**	65 (46.4%)	331 (39.2%)	**0.0288**	140 (85.9%)	795 (81.9%)	0.2124
Social distancing measures implemented									
Residents dining in shifts	175 (17.8%)	666 (58.7%)	**0.0026**	29 (20.7%)	146 (17.3%)	0.3245	88 (54.0%)	578 (59.5%)	0.1838

(Continues)

TABLE 3 | (Continued)

				Wave 1[e]			Wave 2[f]		
	Wave 1	Wave 2	p[g]	Lonely	Not lonely	p[h]	Lonely	Not lonely	p[h]
Residents dining in their rooms	542 (55.0%)	571 (50.4%)	0.7064	74 (52.9%)	468 (55.4%)	0.5777	63 (38.7%)	508 (52.3%)	**0.0012**
Cancellation of group activities	888 (90.2%)	953 (84.0%)	0.4534	127 (90.7%)	761 (90.1%)	0.8096	122 (74.8%)	831 (85.6%)	**0.0005**
Residents asked to remain in their rooms	207 (21.0%)	539 (47.5%)	0.0768	25 (17.9%)	182 (21.5%)	0.3221	52 (31.9%)	487 (50.2%)	**< 0.0001**
Mitigation strategies implemented									
Video calling with caregivers	976 (99.1%)	489 (43.1%)	**0.0003**	137 (97.9%)	839 (99.3%)	0.0989	78 (47.9%)	411 (42.3%)	0.1875
Essential visitors	861 (87.4%)	781 (68.9%)	0.1322	114 (81.4%)	747 (88.4%)	**0.0212**	125 (76.7%)	656 (67.6%)	**0.0199**
Facilitating window visits	700 (71.1%)	337 (29.7%)	**0.0009**	116 (82.9%)	584 (69.1%)	**0.0009**	55 (33.7%)	282 (29.0%)	0.2244
Facilitating outdoor activities/visits	922 (93.6%)	583 (51.4%)	**0.0014**	137 (97.9%)	785 (92.9%)	**0.0264**	103 (63.2%)	480 (49.4%)	**0.0011**
Video calling with healthcare providers	573 (58.2%)	283 (25.0%)	**0.0193**	92 (65.7%)	481 (56.9%)	**0.0508**	46 (28.2%)	237 (24.4%)	0.2979
1:1 meaningful activities in the resident's room	854 (86.7%)	561 (49.5%)	**0.0111**	118 (84.3%)	736 (87.1%)	0.3636	93 (57.1%)	468 (48.2%)	0.0364
Development of an isolation care plan	389 (39.5%)	168 (14.8%)	**0.0218**	70 (50.0%)	319 (37.8%)	**0.0060**	35 (21.5%)	133 (13.7%)	**0.0097**
Hallway-based activities	442 (44.9%)	323 (28.5%)	0.1717	74 (52.9%)	368 (43.6%)	**0.0403**	54 (33.1%)	269 (27.7%)	0.1556
Printing of email messages or delivery of letters	683 (69.3%)	451 (39.8%)	**0.0121**	97 (69.3%)	586 (69.3%)	0.9880	66 (40.5%)	385 (39.6%)	0.8391
Video calling with volunteers or religious/spiritual leaders	486 (49.3%)	391 (34.5%)	0.0765	77 (55.0%)	409 (48.4%)	0.1481	51 (31.3%)	340 (35.0%)	0.3542
Individualized virtual activities	757 (76.9%)	291 (25.7%)	**0.0006**	110 (78.6%)	647 (76.6%)	0.6027	52 (31.9%)	239 (24.6%)	**0.0487**
Photo Name Badges for staff	282 (28.6%)	133 (11.7%)	0.0673	49 (35.0%)	233 (27.6%)	0.0718	25 (15.3%)	108 (11.1%)	0.1217
Facility facilitated caregiver involvement	902 (91.6%)	1068 (94.2%)	0.2362	125 (89.3%)	777 (92.0%)	0.2927	156 (95.7%)	912 (93.9%)	0.6425

[a]Activities of daily living Hierarchy scale score > 3.
[b]Cognitive Performance Scale score > 3.
[c]Depressive Rating Scale score of > 2.
[d]Changes in Health, End-Stage Disease, Signs and Symptoms (CHESS) scale score > 1.
[e]Pandemic wave 1: March 01, 2020 to June 30, 2020.
[f]Pandemic wave 2: October 01, 2020 to February 28, 2021.
[g]p values are based on z tests, generated using general estimating equation models with the respective resident characteristic as dependent variable, wave (1 vs. 2) as independent variable, and random intercept to account for repeated measures within facilities.
[h]p values are based on Chi^2 tests, **bold** = $p < 0.05$.

Unexpectedly, we found that outdoor visits and hallway-based activities were associated with increased loneliness. A possible explanation is that these activities may not always have met the needs of residents [52]. For example, while less dependent residents could participate, staff ability to assist more dependent residents may have been limited, leading to feelings of being left out. Residents with dementia were sometimes confused by these activities, and generally, residents viewed such activities as insufficient replacements of personal contacts, all of which may have exacerbated feelings of loneliness.

Our findings that sex was not associated with loneliness warrants further research. The majority of studies on factors associated with loneliness [15, 16] focused on older adults in general, rather than those in NHs or AL. Chamberlain et al. [10] only reported descriptive statistics and found no meaningful

TABLE 4 | Results of general estimating equation models, assessing facility-level factors associated with resident loneliness, adjusted for resident and facility covariates.

	Est[g]	SE[h]	*p*	OR[i]	CI[j]	
Wave 2 (ref.: Wave 1)[a]	0.347	0.169	**0.0400**	**1.415**	**1.016**	**1.972**
Availability of a registered nurse	−0.649	0.418	0.1204	0.523	0.231	1.185
Facilitated caregiver involvement	−0.633	0.316	**0.0451**	**0.531**	**0.286**	**0.986**
Essential visitors	−0.398	0.200	**0.0466**	**0.672**	**0.454**	**0.994**
Facilitated outdoor activities/visits	0.911	0.238	**0.0001**	**2.486**	**1.561**	**3.961**
Hallway-based activities	0.498	0.168	**0.0031**	**1.645**	**1.183**	**2.288**
Video calling with volunteers or religious/spiritual leaders	−0.506	0.167	**0.0024**	**0.603**	**0.435**	**0.836**
Female	0.222	0.147	0.1318	1.248	0.935	1.666
Significant cognitive impairment[b]	−0.938	0.255	**0.0002**	**0.392**	**0.238**	**0.645**
Significant physical impairment[c]	−0.460	0.224	**0.0403**	**0.631**	**0.407**	**0.980**
Significant depressive symptoms[d]	0.985	0.169	**< 0.0001**	**2.679**	**1.924**	**3.731**
Health instability[e]	0.606	0.203	**0.0028**	**1.833**	**1.232**	**2.726**
Decline in social activities and distressed about it	2.073	0.276	**< 0.0001**	**7.949**	**4.631**	**13.641**
No caregiver available or caregiver distressed	0.586	0.224	**0.0090**	**1.796**	**1.157**	**2.787**
Historic loneliness rate	0.031	0.009	**0.0009**	**1.032**	**1.013**	**1.051**
Region (ref.: South)[f]						
Calgary	0.016	0.258	0.9498	1.016	0.614	1.683
Central	0.404	0.263	0.1252	1.498	0.894	2.510
Edmonton	−0.323	0.250	0.1958	0.724	0.444	1.181
North	−0.860	0.397	**0.0303**	**0.423**	**0.194**	**0.921**

[a]Pandemic wave 1: March 01, 2020 to June 30, 2020, pandemic wave 2: October 01, 2020 to February 28, 2021.
[b]Cognitive Performance Scale score > 3.
[c]Activities of daily living Hierarchy scale score > 3.
[d]Depression Rating Scale score > 2.
[e]Changes in Health, End-Stage Disease, Signs and Symptoms (CHESS) scale score > 1.
[f]Central Zone not represented in this interaction term since this zone does not include any rural areas.
[g]Estimate (log-odds).
[h]Standard Error.
[i]Odds Ratio.
[j]Ninety-five percent Confidence Interval.

associations between loneliness and sex. It seems that context conditions in institutional settings affect males' and females' feelings of loneliness similarly.

Study limitations included the repeated cross-sectional design, preventing any causal conclusions. RAI-HC assessments in AL are collected annually, limiting the number of assessments available in any given time period and precluding assessments of change within residents. The loneliness measure used in this study is a single-item measure. While research demonstrates that such measures can be as reliable and valid as multi-item measures [53–56], they are more limited in capturing the complex, multi-faceted nature of phenomena such as loneliness. Like items in the RAI-HC in general, this loneliness item may under-detect issues among people with dementia [26, 42], suggesting that the problem is even larger in reality. Social determinants of health, such as socio-economic status, ethnocultural background, social networks, etc., are important risk factors for loneliness among older adults, but the data available to us did not include these. We excluded facilities from our objective 2 analyses that did not submit two facility surveys, introducing the risk of selection bias.

5 | Conclusion

While system-level analyses of loneliness in AL may suggest no concerning trajectories, loneliness varied considerably between facilities, and increased in later, compared to earlier phases of the pandemic. Facility-level factors explain variations in loneliness beyond resident and caregiver characteristics. Such facility-level factors are highly modifiable by health system and organizational interventions, providing important targets for policies and improvement activities. For example, supporting caregiver involvement in resident care, increasing visits from essential visitors, and facilitating video calls with volunteers or religious/spiritual leaders can be implemented relatively easily and significantly reduce resident loneliness.

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Ethics Statement

Ethics approvals were received from the University of Alberta Health Research Ethics Board (Pro00101048, Pro00116520), University of Calgary Conjoint Health Research Ethics Board (REB20-1544, pSite-22-0001), University of Waterloo Human Research Ethics Committee (# 42494), and York University Office of Research Ethics (e2022-239). Operational approvals from participating health regions and facilities were obtained as needed.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The dataset used in this study is held securely in coded form at the Alberta SPOR SUPPORT Unit. While legal data sharing agreements between the Alberta SPOR SUPPORT Unit and data providers (e.g., healthcare organizations and government) prohibit the Alberta SPOR SUPPORT Unit from making the dataset publicly available, access may be granted to those who meet pre-specified criteria for access, available at: https://absporu.ca/. (email: absporu@albertainnovates.ca).

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