

Association of pain and quality of life among nursing home residents with cognitive impairment, and the role of nursing home organizational context in this association: A cross-sectional study

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Abstract

(350/350 words) Background Pain is common among nursing home (NH) residents and is associated with adverse physical, psychological, and social outcomes that may diminish their quality of life (QoL). Yet evidence regarding the association between pain and QoL remains inconclusive. Existing evidence mainly examined demographic and clinical variables, while the role of residents' social determinants and NH organizational context in residents' QoL remains underexplored. We examined (i) whether resident pain (at least moderate intensity of any frequency in the last 7 days) was associated with lower QoL, when adjusted for NH organizational context, resident social determinants, and clinical characteristics, and (ii) compared whether these associations differ between sub-samples of residents with or without pain. Methods We conducted a cross-sectional analysis of 2,950 residents from 67 publicly funded NHs across five Canadian provinces. QoL was assessed using the DEMQOL-CH completed by staff proxies. NH context variables, including NH characteristics, staffing hours, person-centered care, and proportion of visible minority residents, were collected using a facility survey completed by NH administrators. Social determinants were collected using staff surveys. Clinical data were obtained from Resident Assessment Instrument–Minimum Data Set 2.0 records. Utilizing generalized linear mixed models with staff-level random intercepts, we examined (i) associations between pain and QoL, when adjusting for NH context, resident social determinants, and clinical characteristics and (ii) the association of NH and resident variables with QoL stratified by pain status. Results A total of 314 (10.6%) residents experienced at least moderate pain. Mean DEMQOL-CH score was 92.9 (95% CI: 92.37-93.51). Residents with pain had significantly lower QoL scores (by 2.9%) compared to those without pain. Responsive behaviors, depressive symptoms, and health instability were associated with lower QoL, while cognitive impairment was associated with better staff-rated QoL among the total sample and residents without pain. NH context variables were not associated with QoL among residents with or without pain. Conclusions Pain was independently associated with poorer QoL, highlighting the importance of incorporating inclusive pain definition for early pain identification and management. Larger longitudinal and qualitative studies focusing on residents with pain are needed. Interventions targeting clinical symptoms may help improve residents' QoL.

Background

Nursing homes (NHs) provide personal and health care for frail and vulnerable older adults,^{1–3} with maximizing residents' quality of life (QoL) recognized as a priority goal of NH care.^{4–8} QoL is defined as “an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns.”^{9(p. 551)} This paper focuses on health-related quality of life (HRQoL), hereafter referred to as QoL, which reflects the perceived impact of health condition, illness, or treatment (dementia in our study) on an individual's life.^{10–12} Despite growing emphasis on QoL alongside quality of care in Canada,^{8,13–15} QoL assessment in NHs remains limited, with predominant focus on indicators such as pressure ulcers, pain, falls, and depression.^{15,16} Although essential, these indicators do not fully capture residents' subjective experiences or key QoL dimensions, including their values, relationships, and sense of purpose.^{15,17} Consequently, the lack of comprehensive QoL data has impeded efforts to improve QoL in Canadian NHs.¹⁸

Pain is common among NH residents, with reported prevalence ranging from 22% to 85% of NH residents.¹⁹ It is described as an “unpleasant sensory and emotional experience associated with or resembling that of actual or potential tissue damage.”^{20 (p.2)} Residents with pain are more likely to experience physical and psychological health problems that may reduce QoL, including balance and gait problems,²¹ anxiety disorders, insomnia,^{22,23} depressive symptoms,²⁴ reduced physical activity,²¹ and social isolation.^{21,25} However, evidence on the association between pain and QoL, particularly among residents with cognitive impairment, remains inconsistent and inconclusive.^{26,27} Recent systematic reviews have reported an association between pain and lower QoL among older adults with dementia, including NH residents, but effect sizes were small and substantial heterogeneity suggests that other factors may influence these associations.²⁸ Our recent systematic review showed that NH residents can maintain good QoL despite pain.²⁹ Consistent with broader QoL research on NH residents in general,^{28,30–33} we found that studies primarily focused on demographic and clinical characteristics, while resident Social Determinants of Health (SDH) like socio-economic status, education, ethno-cultural background; and NH organizational context, like staffing, implementation of person-centered care, percentage of residents of visible minorities, are underexplored but seem to play a key role in supporting QoL among residents with pain. SDH include social and living conditions that shape the health and wellbeing beyond medical treatment.³⁴ NH organizational context is “the environment or setting in which residents receive care, or proposed changes are implemented”.^{35(p.150)}

Evidence suggests that residents residing in rural, smaller, non-profit NHs, and those with greater care aide and recreation staff support, more opportunities for meaningful activities and social connection, and fewer racialized residents have better QoL.^{30,31,33,36–43} Our team previously examined clinical, social, and NH-level factors associated with QoL in two cross-sectional studies involving 689 residents from nine NHs in Alberta,³⁹ and 2,950 residents from 67 NHs across Alberta, British Columbia, Manitoba, Ontario, and Nova Scotia.³⁰ In both studies, pain was defined as daily moderate or excruciating pain at least once in the last 7 days, and reported low pain prevalence (5.7%, $n = 39$ ³⁹; and 5.1%, $n = 151$ ³⁰). Although pain was associated with lower QoL in bivariate analyses in one study (median QoL score with pain = 91 vs without pain = 95, $p = 0.023$),³⁰ it was not associated with QoL in fully adjusted models in either study.^{30,39} Building on these studies, the present study further examined the association between pain and QoL using a more inclusive pain definition while accounting for NH Organizational context, resident SDHs, and clinical characteristics. Our objectives were:

1. To assess whether a more inclusive pain variable (at least moderate intensity of any frequency in the last 7 days) was associated with lower resident QoL, when adjusted for NH organizational context, resident SDHs, and clinical characteristics.
2. To compare whether these associations differ between sub-samples of residents with and without pain.

Theoretical Framework

We used an integrated theoretical framework to understand how system, organization, and individual levels factors shape residents' QoL. (1) The SDH framework recognizes that living and social conditions, including gender, race, immigration status, and indigeneity, influence residents' health, QoL, and health inequities.³⁴ (2) The health equity framework,⁴⁴ extends this perspective by emphasizing how broader structural and systemic factors, including province, regions, and urban/rural location can either promote or hinder health equity. (3) The intersectionality lens recognizes that social identities, such as age, gender, race, and ethnicity, do not operate independently but interact in complex ways to create unique, context dependent experiences of discrimination and privilege,^{45–47} that shape QoL.^{48,49} (4) Finally, the revised version of Wilson & Cleary's model⁵⁰ by Zubtrisky et al.⁵¹ adapted for long-term support and services (LTSS) provides a conceptual pathway linking an individual's physiological, emotional, functional, general health perceptions, beliefs and behaviors, and environmental factors (e.g., service delivery system, structure) to QoL. Together, these complementary frameworks guided variable selection and interpretation of findings.

Methods

Study design and setting

This cross-sectional study was part of *Counting What Counts*, an explanatory sequential mixed-methods study⁵² that examined the association of residents' social determinants, clinical and NH characteristics with QoL. We collected data from 67 publicly funded NHs in Alberta, British Columbia, Manitoba, Nova Scotia and Ontario. Homes were randomly selected, stratified by health region, ownership model (for profit/not-for-profit status), and size (small: <80 beds, medium: 80–120 beds, large: >120 beds). Further details on NH and participant selection are reported elsewhere.³⁰

Participants

Residents were eligible if they: had resided in the NH for at least three months, had at least borderline cognitive impairment (Cognitive Performance Scale [CPS] score of ≥ 1),⁵³ and had a staff member available who knew the resident well enough to complete a proxy QoL assessment. Most staff proxies were care aides, and some were licensed practical nurses, occupational therapists, or recreational therapists. Staff were eligible if they had worked in the NH for at least three months before data collection (to ensure familiarity with the resident over a longer period of time) and had cared for the residents during at least four shifts (morning and evening shifts) in the week before the QoL assessment to ensure awareness of changes in resident's feelings/worries throughout the day.

We utilized G*Power 3.1⁵⁴ to determine a sample size of 803 for our complex mixed regression model (alpha = 0.05, power = 0.80, 28 covariates), which is sufficient to detect a moderate effect size of 0.14,⁵² in our eligible sample of 2950 residents. Supplementary file 1 provides calculation details.

Data collection

We collected data from January 2023 to April 2024. Our team generated random study IDs and shared them with each participating NH. Key contacts at each NH usually a director of care, care manager, or quality improvement specialist selected eligible residents and assigned IDs without disclosing resident details to us. We referred to residents only by ID during staff proxy interviews. The ethics board waived the need for informed consent from residents or their proxies (see declarations).

We collected NH data through facility surveys, interviewing key NH contacts via video calls.^{30,52} Eligible staff completed residents social determinants^{30,52} and QoL surveys^{55,56} via video interviews. NH staff routinely completed Resident Assessment Instrument-Minimum Data Set (RAI-MDS) 2.0 assessments,^{57,58} using vendor software, which was processed and stored in their database. Participating NHs shared resident IDs and details to data vendors, who selected relevant records, replaced identifiers with study IDs, and provided de-identified RAI-MDS data to the study team. We then linked facility surveys, resident social determinants, clinical and functional data, and QoL data using study IDs.

Outcomes and measures

Dependent variable

We utilized the DEMQOL-CH,^{55,56} completed by staff proxies, to collect QoL data. This 31-item measures residents' feelings (11 items), memory concerns (9 items), and worries about daily life (11 items), with each item rated on a 4-point Likert scale (4 = a lot, 3 = quite a bit, 2 = a little, 1 = not at all). Total scores range from 31 to 124, with higher scores indicating better QoL.

The DEMQOL-CH has demonstrated strong psychometric properties in both the UK⁵⁵ and Canada,⁵⁹ with high internal consistency (Cronbach's α = 0.90 in the UK⁵⁵ and Cronbach's α = 0.834 in Canada⁵⁹), acceptable test-retest reliability in the UK (ICC = 0.72)⁵⁵ and good inter-rater reliability in Canada (ICC = 0.735).⁵⁹ Construct validity was acceptable in Canada.⁵⁹ DEMQOL-CH scores showed good correlation with DEMQOL-Proxy and Dementia Care Mapping (r = 0.34–0.67).⁶⁰ Factor analysis identified four domains: functioning, positive emotion, negative emotion, and engagement.⁵⁵ Care staff and managers rated the tool as feasible and acceptable.⁵⁹

Independent variable

We collected pain data from RAI-MDS 2.0, measuring frequency (J2a: 0 = none, 1 = less than daily, 2 = daily) and intensity (J2b: 1 = mild, 2 = moderate, 3 = severe/excruciating). Following previous research,⁶¹ we defined pain as present if residents had at least moderate pain of any frequency in the week before assessment. These items demonstrated strong internal consistency (Cronbach's alpha > 0.80),⁶² interrater reliability (kappa = 0.73),⁶³ and test-retest reliability (0.84–0.87),⁶⁴ and were validated against the Visual Analogue Scale (VAS).⁶⁵ However, they may underestimate pain in residents unable to self-report, especially those with severe cognitive impairment.^{57,63}

Covariates

NH context data, including total care hours per resident day, proportion of care aide hours relative to total care hours per resident day, adoption of person-centered care model, and the proportion of visible minorities were collected through facility surveys completed by an NH key contact.^{30,52} Staffing variables were based on a validated measure.⁶⁶ Total care hours per resident day combined registered nurse (RN), licensed practical nurse (LPN), and care aide care hours. The proportion of care aide hours was calculated as total care aide hours per resident day divided by total care hours per resident day. Person-centered care adoption and the proportion of visible minority residents were derived from specific facility survey items.^{30,52}

Additional covariates included facility characteristics (province, size, ownership model, urban/rural location) obtained from facility surveys.^{30,52} QoL rater and social determinants, including resident demographics and socio-economic characteristics were collected via a staff-proxy-rated demographic survey.^{30,52} Clinical variables, including responsive behaviour, cognitive impairment, depressive symptoms, physical dependency, health instability, were obtained from the RAI-MDS 2.0. Variables were selected based on prior evidence of associations with residents' QoL (see Table 1 for details).^{28,30–32,37,38,41,43,67–73}

Data analysis

We conducted all analyses using SAS 9.4®.⁷⁴ For categorical variables, we reported frequencies and percentages; for continuous variables, we reported means, standard deviations, medians, and interquartile ranges. Medians were used as cutoffs to categorize QoL scores and staffing as high or low. We utilized the Kruskal-Wallis test to compare NH, resident variables, DEMQOL-CH items by pain status.⁷⁵ We employed General Linear Model (GLM) regression⁷⁶ to examine unadjusted associations between each variable and log-transformed DEMQOL-CH scores. Natural log transformation enabled interpretation of regression coefficients as percentage changes in QoL per unit increase in the independent variable.⁷⁷ Utilizing Generalized linear mixed (GLM) models,⁷⁸ we conducted final regression analyses with staff level random intercepts to account for multiple proxy assessments of residents' QoL. We examined associations between: (i) pain and DEMQOL-CH scores when adjusted for NH, social determinants and clinical variables in the total sample; and (ii) NH context and DEMQOL-CH scores when adjusted for NH, residents' social determinants, and clinical variables separately among residents with and without pain. Because resident data were nested within staff proxies and NHs, we calculated intra-cluster correlation coefficients (ICCs) (measures of relatedness of clustered data⁷⁹) at both levels (0.0734 for NH level; 0.39 for staff). Since NH level clustering explained minimal variation in residents' assessments, we considered only a staff-level random intercept in the models. We re-ran the un-imputed final models to compare our findings with those from the imputed models as sensitivity analyses.

Model selection

To determine the best-fitting model, we used regression analyses (proc GLMselect)⁷⁶ with a backward stepwise approach.⁸⁰ Variable selection was guided by a conceptual framework rather than by data-driven approaches alone.^{81,82} Informed by our previous study³⁰ and theoretical framework,^{34,44–48,50,51} we selected all potential variables. We removed variables sequentially one by one according to the predefined conceptual order (social determinants, NH characteristics, clinical variables, and independent variables) until the empty model. At each stage, model fit was evaluated using AIC (Akaike Information Criterion).⁸² We selected the most parsimonious model (lowest AIC) while retaining the core theoretical blocks. We applied this process to the total sample, and separately to residents with and without pain. See Supplementary Tables S1 to S3 for details.

The models showed no collinearity issues (Variance Inflation Factor [VIF] < 5; condition indices < 100).⁸³ Variables with missing data included responsive behaviour (n = 31, 1.05%), cognitive impairment (n = 29, 0.98%), depressive symptoms (n = 2, 0.076%), physical dependency (n = 29, 0.98%) and health instability (n = 28, 0.94%). The Little MCAR test confirmed data were missing completely at random ($\chi^2 = 0.775$, DF = 3, p = 0.855).⁸⁴ We addressed missing data using multiple imputation by the fully conditional specification regression method with five imputed datasets^{85,86} to maximize statistical power.⁷⁶

Results

Sample description and bivariate analyses

Among 2,950 residents from 67 NHs, 314 (10.6%) had at least moderate pain of any frequency in the week before assessment. The mean DEMQOL-CH score was 92.9 (95% confidence interval [CI]: 92.37–93.51), with a median of 95 (interquartile range [IQR]: 83–105). Table 2 presents resident and NH characteristics by pain status. Residents with lower QoL were more likely to have a higher proportion of pain. Pain proportion was lower in NHs with person-centered care and higher proportions of visible minority residents, but higher in NHs with more care aide hours. Supplementary Table S4 shows DEMQOL-CH items distribution by pain status. Residents with pain had significantly lower mean scores on items, including worry, frustration, liveliness, mood, cleanliness, obtaining desired items, feeling useful, and physical health, reflecting poorer QoL than those without pain.

Model findings

Table 3 shows the association between residents' pain and QoL when adjusted for NH, residents' social determinants, and clinical variables in the total sample. Residents with pain had QoL scores 2.9% lower than those without pain. Responsive behaviour, depressive symptoms, and health instability were associated with lower QoL scores. Residents with moderate to severe cognitive impairment had significantly higher QoL scores. Residents in Ontario had higher QoL than those in British Columbia and Manitoba. Among residents with pain (Table 4), none of the variables were significantly associated with QoL, which could reflect limited power (small sample size) rather than true absence of associations.⁷⁵ For residents without pain (Table 4), findings were consistent with the total sample.

Supplementary Table S5 presents unadjusted regression analyses. Pain, a higher proportion of visible minorities, medium-or large-sized facilities, and residence in British Columbia or Manitoba were associated to lower QoL. Absence of a person-centered care model in the NH, absence of regular family/friend visitors, and not having a legal guardian were associated with better QoL. Majority of resident variables, including older age, responsive behaviours, depressive symptoms, and health instability were associated with lower QoL, while most social determinants were not associated with QoL.

Results of unimputed analyses (Supplementary Table S6) were consistent with imputed analyses, except residents with depressive symptoms had significantly lower QoL among those with pain.

Discussion

Guided by an integrated framework,^{34,44–48,50,51} we examined the association between pain, NH context, and resident QoL in this multi-province study. Pain (moderate pain occurring at least once in last week) was independently associated with lower QoL, even after adjusting for NH context, residents' SDHs, and clinical variables. Contrary to expectations, NH context and residents' SDHs were not associated with QoL in the overall or pain-stratified analyses. Clinical variables were associated with QoL in the expected direction in the overall sample and among residents without pain, while none were associated among residents with pain.

The association between pain and lower QoL is consistent with evidence suggesting that pain influences functional ability, emotional well-being, and social engagement.^{22,26,87–89} Unlike our previous studies,^{30,39} where pain was defined as severe or daily moderate pain in last week, according to the Canadian Institute of Health Information (CIHI) standards of publicly reported NH quality indicators,^{58,90} in the present study, we used a broader definition that captured at least moderate pain occurring at any frequency in the previous week. This inclusive definition captured more residents experiencing pain, increasing the pain sub-sample and potentially improving our ability to detect association of pain with QoL. Additionally, we accounted for staff-level random intercepts in contrast to our past studies,^{30,39} which accounted for only facility-level random intercepts. Because our QoL measurement largely reflects staff perspectives, this may have increased explanatory power and detected an association that was previously masked. Our findings support using more inclusive and sensitive pain definitions and measures to facilitate earlier identification of clinically meaningful pain and prompt management, potentially preventing adverse effects on residents' QoL.

NH context variables, including staffing, person-centered care, and the proportion of visible minority residents, were not associated with QoL. However, a US based study⁶⁷ found that more RN and activity staff hours per resident day were associated with better QoL, which may reflect differences between the U.S. and Canadian healthcare systems.⁹¹ Past evidence that staff distress, burnout, and job dissatisfaction are associated with poorer resident QoL,^{39,92} suggests that relational aspects of care, including empathy, communication, and positive staff-resident interactions, may be more important in shaping residents' perceptions of QoL than staffing numbers alone.^{41,43} Future studies should examine relational and organizational factors, including communication quality, workplace culture, and staff well-being. Despite its importance,⁹³ the lack of association of person-centered care and QoL may reflect variation in its implementation across NHs and that managers' perceptions may not accurately reflect how well it was implemented. Meaningful integration requires supportive leadership, adequate staffing and resources, ongoing training, and organizational cultures that prioritize individualized care.⁹⁴ Future research should incorporate residents' perspectives on person-centered care and its influence on their QoL.

Our finding contrast with US studies,^{36,95} reporting lower QoL in homes with more racialized residents. This difference may be due to U.S two-tier funding system, where lower-tier, Medicaid dependent homes have fewer resources and lower quality ratings,⁹⁶ and racialized residents are more likely to reside in lower-tier homes, contributing to poorer QoL.^{36,95} Canada's public funding system⁷² may reduce such structural inequities, although implicit racism and inequitable care may still influence residents' well-being. Future qualitative research should explore whether racialized residents experience disparities in care and how these influence their QoL. Higher QoL among Ontario residents may suggest differences in provincial policies, funding models, and service delivery that influences residents' experiences. Consistent with previous research,^{28,30,39} responsive behaviour, depressive symptoms, and health instability remained associated with lower QoL, highlighting the importance of addressing physical and psychological needs alongside pain management.

The lack of association among residents in pain may reflect limited statistical power due to small sample size ($n = 314$),⁷⁵ rather than true absence of association. Alternatively, it may indicate that factors influencing QoL may differ between residents with and without pain, underscoring the complexity of maintaining QoL in the presence of pain. Nevertheless, our recent review among residents in pain,²⁹ found that clinical and functional impairments were consistently associated with lower QoL, whereas residents' positive outlook, staff and family/friend support, positive staff interactions, meaningful social engagement, and timely pain assessment and management helped maintain QoL. Future studies should investigate factors in larger samples and explore resident's experiences to identify factors most important to residents in pain to determine how QoL can be better supported.

Strengths and Limitations

To our knowledge, this is the first Canadian study to examine the association of NH context, social determinants, and clinical variables with QoL among residents with pain. Our multi-provincial study employed a robust analytical approach and a well-established theoretical framework. However, its cross-sectional design limits causal inference,⁷⁵ and staff proxy ratings may have introduced subjective bias. Care aides' diverse ethnocultural backgrounds could have influenced DEMQOL-CH item interpretation.⁹⁷ Nevertheless, the DEMQOL-CH allowed assessment among residents with moderate to severe cognitive impairment, who are often excluded from studies due to their inability to self-report. The small pain sub-sample may have reduced ability to detect associations. Additionally, our focus on structural NH context variables may have missed aspects of care quality or culture that could potentially influence residents' QoL.⁹⁸

Conclusion and Implications

Pain (at least moderate intensity of any frequency in the last 7 days) is an important and potentially modifiable predictor of QoL. Our finding supports the use of more inclusive and sensitive pain definitions to facilitate earlier identification of clinically meaningful pain and timely pain management, which may help prevent its adverse effects on residents' QoL. Clinical variables (depressive symptoms, responsive behaviours, health instability) were associated with lower QoL, stressing the need to address these symptoms, as part of routine efforts to optimize residents' QoL. The lack of association of NH organizational contexts examined in this study stresses the need to conduct larger longitudinal studies to examine how relational care, staff well-being, communication, organizational culture, and person-centered care influence QoL among residents with pain. Further studies should test interventions targeting responsive behaviors, emotional well-being, and social participation. Qualitative research is also needed to capture residents' perspectives on what matters most to them and to explore cultural or racial inequities not evident in quantitative data.

Declarations

Ethics approval and consent to participate

The research was conducted in accordance with the Declaration of Helsinki. We obtained ethical approvals from the University of Alberta Health Research Ethics Board (Pro00117476), York University Office of Research Ethics (2022 – 240), University of Victoria Human Research Ethics board (H22-00783), University of Manitoba Health Research Ethics Board (HS25536 (H2022:191)), Mount Saint Vincent University Research Ethics Board (2021 – 230), and St. Francis Xavier University Research Ethics Board (26675). For the involvement of participants, informed verbal consent was obtained from a key contact (director of care of NH administrator) for each participating home and from staff involved in interview. Resident consent was waived by the ethics boards because we did not access to residents' names and other residents' details at any time.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Author Contribution

MH, the study lead received the fundings. MH, GGC, JKS, SS conceptualized the study. SS conducted all data analyses under the supervision of MH, GGC, JKS and GJD. SS drafted an initial version of this manuscript. MH, GGC, JKS, SS, GJD assisted with interpretation of the results. All authors read, provided comments, and critically revised various iterations of this manuscript.

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Data Availability

We used residents' data governed by provincial confidentiality rules and institutional ethics requirement. Therefore, all data and analytic files are stored securely in the Health Research Data Repository environment on secure servers at the University of Alberta and cannot be shared publicly. Data were

accessible to only study investigators and research staff. Summary data and statistical code can be requested from the principal investigator, subject to the applicable approvals and data protection policies.

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Tables

Table 1
Covariates, measurement and justification

#	Covariates	Measurement tool	Description/scoring	Justification for covariates
1.	Province	–	Information gathered during sampling from key contact person.	Services in Canada are governed by provincial and territorial legislation leading to variations in ownership, type of care, and cost coverage across Canada. ^{1,2} These factors could affect quality of care. ³ which in turn could affect QoL. ⁴ Besides, facility location is one of the stratification variables to sample NHs.
2.	Facility size	Facility survey ^{30,52}	Facility information, question asked to indicate number of beds in the NH.	Evidence suggests that residents living in larger NH had lower QoL scores. ^{4,5}
3.	Owner operator model	Facility survey ^{30,52}	Facility information, question asked to indicate owner-operator model for the NH.	Residents who lived in government, non-profit, private organizations had better QoL. ^{6–8} While residents living in for profit, ^{4,8} chain ownership facility ⁸ had lower QoL. Besides, facility size is one of the stratification variables to sample NHs.
4.	Urban/rural location	Facility survey ^{30,52}	Facility information, question asked to indicate whether NH is located in urban or rural area.	Residents who lived in rural, ^{6,7} location had better QoL than in urban locations.
5.	Staffing (Total care hours per resident day)	Facility survey ^{30,52}	Facility information, question asked: (i) number of registered nurses (RNs) on average scheduled daily in the facility; (ii) number of licensed practical nurses (LPN) scheduled daily in the facility; (iii) number of care aides on average scheduled daily in the facility. Total care hours per resident day were derived from the sum of registered nurse (RN), licensed practical nurse (LPN), and care aide care hours per resident day.	Higher number of RN and LPN hours per day were not associated with QoL, however, higher number of care aides and activity staff hours per day were associated with better residents' QoL. ³¹
6.	Staffing (Proportion of care aide hours relative to total care hours per resident day)	Facility survey ^{30,52}	The proportion of care aide hours relative to total care hours per resident day was calculated as total care aide hours per resident day divided by total care hours per resident day.	Higher number of RN and LPN hours per day were not associated with QoL, however, higher number of care aides and activity staff hours per day were associated with better residents' QoL. ³¹
7.	Proportion of visible minorities in the NH	Facility survey ^{30,52}	Facility information, question asked what proportion of residents living in the facility are members of a visible minority.	NHs with lower proportion of racialized residents were found to have better QoL. ³⁶
8.	Presence of person-centered care in the NH	Facility survey ^{30,52}	Facility information, question asked whether the facility implemented a person-centered model of care.	Person-centred care has been positively associated with better QoL. ⁴²
9.	QoL rater	Resident Social Determinants Survey ^{30,52}	Question asked to staff member proxy reporting on behalf of resident. Question asked to indicate primary role of staff member in the facility.	Residents' QoL scores may vary by proxy reported QoL raters. ⁹
10.	Age	RAI-MDS 2.0 ⁵⁸	A3, AA3a (1 item). Calculated as the difference between assessment reference data (A3) and birthdate (AA3a)	Age was found to have positive association, ¹⁰ negative association, ⁴ or no association ¹¹ with QoL of NH residents.
11.	Sex	Resident Social Determinants Survey ^{30,52}	Under the heading resident information, question asked: Resident's current gender which may be different from sex assigned at birth and may be different from legal documents.	Some studies reported that female had better QoL than male, ^{4,8,10} while others showed no association. ¹¹
12.	Sexual orientation	Resident Social Determinants Survey ^{30,52}	Under the heading resident information, question asked to indicate residents' sexual orientation.	Residents of sexual minorities often experience disparities in health care services ¹² which could potentially influence their NH experience and QoL.
13.	Marital status	RAI-MDS 2.0 ⁵⁸	A5 (1 item), indicates residents' marital status.	QoL was found better in married NH residents than single, divorced or widowed. ⁴ While some reported that residents who were never married, separated, divorced or had an unknown marital status had better QoL compared to married residents. ¹³
14.	Education	Resident Social Determinants Survey ^{30,52}	Under the heading resident information, question asked: highest certificate, diploma or degree that resident has completed.	Residents with secondary school or higher educational level had higher QoL scores than residents with lower education level. ¹⁴

#	Covariates	Measurement tool	Description/scoring	Justification for covariates
1.	Province	–	Information gathered during sampling from key contact person.	Services in Canada are governed by provincial and territorial legislation leading to variations in ownership, type of care, and cost coverage across Canada. ^{1,2} These factors could affect quality of care, ³ which in turn could affect QoL. ⁴ Besides, facility location is one of the stratification variables to sample NHs.
15.	Racial/Ethnicity	Resident Social Determinants Survey ^{30,52}	Under the heading ethnocultural background, question asked which one or more racial or cultural groups in the list resident belong to. Example: White, Chinese, South Asian, Latin American.	Black, indigenous, and other people of color reported lower QoL than white NH residents. ¹⁵
16.	English as additional language	Resident Social Determinants Survey ^{30,52}	Under the heading ethnocultural background, question asked, language that resident first learned at home in childhood and still understands.	Language barriers leads to communication challenges leading to social isolation and disengagement, ¹⁶ which could lower residents' QoL.
17.	Immigration status	Resident Social Determinants Survey ^{30,52}	Under the heading ethnocultural background, question asked, if resident ever been a landed immigrant in Canada.	Immigrant resident experienced higher hospitalization rate which would potentially influence their QoL. ¹⁷
18.	Practicing a religion	Resident Social Determinants Survey ^{30,52}	Under the heading resident information, question asked: indicate resident's specific denomination or religion even if the person is not currently a practicing member of that group. For example: Roman Catholic, Hindu, Muslim, Greek Orthodox.	Religious and spiritual coping practices was associated with better QoL among community dwelling older adults and nursing home residents. ¹⁸
19.	Have children	Resident Social Determinants Survey ^{30,52}	Under social support heading, question asked: if resident have children.	Having children is often linked to having social support, ¹⁹ which could potentially improve residents' QoL.
20.	Regular family/friend visitors	Resident Social Determinants Survey ^{30,52}	Under social support heading, question asked: if resident have family members of friends that visit regularly.	Residents experienced better QoL when they receive support and interaction from family/friends. ¹⁹
21.	Have legal guardian	Resident Social Determinants Survey ^{30,52}	Under social support heading, question asked: if resident have a legal guardian?	
22.	NH cost publicly covered	Resident Social Determinants Survey ^{30,52}	Under the heading resident information, question asked, if residents' NH cost is fully publicly covered.	Residents who had better financial security, ^{20,21} were found to have a better QoL.
23.	Responsive behavior	RAI-MDS 2.0 ⁵⁸	Aggressive behavior scale. ²² (4 items) • Verbally Abusive (E4b) • Physically Abusive (E4c) • Socially Inappropriate /disruptive behavior (E4d) • Resists care (E4e) Score ranges between 0–12, higher score indicates higher levels of aggressive behavior. ABS > 2: Severe aggressive behavior.	Responsive behaviour was associated with lower QoL among NH resident. ²³
24.	Cognitive impairment	RAI-MDS 2.0 ⁵⁸	Cognitive Performance Scale (CPS) ²⁴ (5 items) Comatose (B1); Short-term memory (B2a); Cognitive skills for daily decision-making (B4); Expressive communication (C4); Eating (G1hA). CPS > 3: At least moderate cognitive impairment.	Greater the cognitive function, greater is QoL. ¹⁰ Increasing cognitive impairment was found to decrease QoL among NH residents. ⁸
25.	Depressive symptoms	RAI-MDS 2.0 ⁵⁸	Depression Rating Scale (DRS). ²⁵ (7 items) DRS items	Depressive symptoms score are associated with lower QoL. ^{6,8,11,23}

#	Covariates	Measurement tool	Description/scoring	Justification for covariates
1.	Province	–	Information gathered during sampling from key contact person.	Services in Canada are governed by provincial and territorial legislation leading to variations in ownership, type of care, and cost coverage across Canada. ^{1,2} These factors could affect quality of care, ³ which in turn could affect QoL. ⁴ Besides, facility location is one of the stratification variables to sample NHs.
			• Negative Statements (E1a) • Persistent Anger (E1d) • Expression of Unrealistic Fears (E1f) • Repetitive Health Complaints (E1h) • Repetitive Anxious Complaints (E1i) • Sad, Pained, Worried Facial Expression (E1l) • Crying, Tearfulness (E1m) Score ranges between 0 and 14 Categorical: DRS score > 2: depression and ≤ 2: no depression	
26.	Physical dependency	RAI-MDS 2.0 ⁵⁸	Activities of Daily Living (ADL)-Hierarchy scale.²⁶ (4 items) The ADL-H scale is a seven-level (i.e., 0 to 6) measure of functional performance based on four items: • Personal Hygiene (G1jA) H2i • Toilet Use (G1iA) H2h • Locomotion (G1eA) H2c • Eating (G1hA) H2g Score ranges between 0 and 6. Higher scores indicate more physical dependency. 0: independent and 6: completely dependent. Categorical: Scores > 3 indicate resident needs maximal assistance with ADLs or is totally dependent.	Evidence suggests that physical dependency reduces QoL in NH residents. ^{4,6,8,11}
27.	Health instability	RAI-MDS 2.0 ⁵⁸	Changes in Health, End-Stage Disease, Signs, and Symptoms Scale score (CHESS).²⁷ (9 items) Decline in cognition (B6), Decline in ADL (G9), Dehydration (J1c), Edema (J1g), Shortness of breath (J11), Vomiting (J10), End-Stage Disease (J5c), Weight Loss (K3a), Leaving food Uneaten (K4c). Possible range: 0–5, higher scores indicate higher instability of resident's health. Scores of > 1 indicate presence of health instability.	Health stability was associated with lower QoL in NH residents. ²³

Table 2
Distribution of nursing home and resident variables by pain/no pain (N = 2950)

Variable	Total participants		With pain		Without pain		
	N	Column %	N	Row %	N	Row %	P
Total sample	2950	100%	314	10.6	2636	89.4	–
Dependent variable							
Quality of Life (QoL) (Raw scores)							
High QoL (> Median)	1439	48.8	111	7.7	1328	92.3	< .0001
Low QoL (≤ Median)	1511	51.2	203	13.4	1308	86.6	
Log transformed QoL scores							
High QoL (> Median)	1439	48.8	111	7.7	1328	92.3	< .0001
Low QoL (≤ Median)	1511	51.2	203	13.4	1308	86.6	
Nursing home variables							
Province							
Alberta	624	21.2	64	10.3	560	89.7	0.0814
British Columbia	745	25.3	66	8.9	679	91.1	
Manitoba	460	15.6	43	9.3	417	90.7	
Nova Scotia	171	5.8	29	17.0	142	83.0	
Ontario	950	32.2	112	11.8	838	88.2	
Owner operator model							
Not for profit (public or voluntary)	2040	69.2	206	10.1	1834	89.9	0.1500
Private for profit	910	30.8	108	11.9	802	88.1	
Facility size							
Small (< 80 beds)	754	25.6	99	13.1	655	86.9	0.0005
Medium (80–120 beds)	788	26.7	94	11.9	694	88.1	
Large (> 120 beds)	1408	47.7	121	8.6	1287	91.4	
Urban/Rural location							
Urban	2460	83.4	244	9.9	2216	90.1	0.0042
Rural	490	16.6	70	14.3	420	85.7	
Total care hours per resident day							
High total care hours (> Median)	1499	50.8	152	10.1	1347	89.9	0.3671
Low total care hours (≤ Median)	1451	49.2	162	11.2	1289	88.8	
Proportion of care aide hours per resident day							
High proportion of care aide hours (> Median)	1536	52.1	167	11.8	1247	88.2	0.0488
Low proportion of care aide hours (≤ Median)	1414	47.9	147	9.6	1389	90.4	
Presence of person-centered care model in the facility							
Yes	2016	68.3	191	9.5	1825	90.5	0.0025
No	934	31.7	123	13.2	811	86.8	
% of residents of visible minorities*							
< 25% (< 0.02)	516	17.5	63	12.2	453	87.8	0.0056
25–50% (> 0.02 to ≤ 0.05)	739	25.1	93	12.6	646	87.4	
50–75% (> 0.050 to ≤ 0.14)	957	32.4	96	10.0	861	90.0	
> 75% (> 0.14)	738	25.0	62	8.4	676	91.6	
QoL Raters							

Variable	Total participants		With pain		Without pain		P
	N	Column %	N	Row %	N	Row %	
Care aides	2498	84.7	252	10.1	2246	89.9	0.0254
Licensed Practical Nurses	68	2.3	11	16.2	57	83.8	
Director of Care	8	0.3	2	25.0	6	75.0	
Others	376	12.7	49	13.0	327	87.0	
Resident social determinants of health variables							
Age							
< 65 years	119	4.0	23	19.3	96	80.7	0.0016
65–74 years	373	12.6	42	11.3	331	88.7	
75–84 years	868	29.4	103	11.9	765	88.1	
85–94 years	1144	38.8	110	9.6	1034	90.4	
95 years and above	426	14.4	34	8.0	392	92.0	
<i>Missing</i>	20	0.7	2	10.0	18	90.0	
Sex							
Women	2041	69.2	228	11.2	1813	88.8	0.1644
Men	909	30.8	86	9.5	823	90.5	
Sexual orientation							
Sexual minority	10	0.3	1	10.0	9	90.0	0.9473
Heterosexual or don't know	2940	99.7	313	10.6	2627	89.4	
Marital status							
Married	720	24.4	61	8.5	659	91.5	0.0005
Widowed	1293	43.8	126	9.7	1167	90.3	
Other marital status (single/never married, separated, divorced, unknown)	937	31.8	127	13.6	810	86.4	
Highest level of formal education							
Less than high school	712	24.1	79	11.1	633	88.9	0.6539
High school or higher	2238	75.9	235	10.5	2003	89.5	
Race/ethnicity							
Racialized or Indigenous	248	8.4	14	5.6	234	94.4	0.0077
White, not indigenous	2702	91.6	300	11.1	2402	88.9	
English as additional language							
Yes	405	13.7	30	7.4	375	92.6	0.0230
No or don't know	2545	86.3	284	11.2	2261	88.8	
Immigration status							
Immigrant	625	21.2	54	8.6	571	91.4	0.0673
Non-immigrant or unknown immigration status	2325	78.8	260	11.2	2065	88.8	
Practices a religion							
No	494	16.7	45	9.1	449	90.9	0.2255
Yes or don't know	2456	83.3	269	11.0	2187	89.0	
Have children							
No	516	17.5	55	10.7	461	89.3	0.9951
Yes or don't know	2432	82.4					
<i>Missing</i>	2	0.1	0	0.0	2	100.0	

Variable	Total participants		With pain		Without pain			
	N	Column %	N	Row %	N	Row %	P	
Regular family/friend visitors								
No	314	10.6	41	13.1	273	86.9	0.1425	
Yes or don't know	2636	89.4	273	10.4	2363	89.6		
Have legal guardian								
No	487	16.5	60	12.3	427	87.7	0.1894	
Yes or don't know	2463	83.5	254	10.3	2209	89.7		
LTC cost publicly covered								
No	2211	74.9	240	10.9	1971	89.1	0.5209	
Yes or don't know	739	25.1	74	10.0	665	90.0		
Resident clinical variables								
Responsive behaviours (ABS > 2) ¹								
Yes	506	17.2	55	10.9	451	89.1	0.8630	
No	2413	81.8	256	10.6	2157	89.4		
Missing	31	1.1	3	9.7	28	90.3		
Cognitive impairment (CPS > 3) ²								
Yes	945	32.0	74	7.8	871	92.2	0.0006	
No	1976	67.0	238	12.0	1738	88.0		
Missing	29	1.0	2	6.9	27	93.1		
Depressive symptoms (DRS > 2) ³								
Yes	739	25.1	120	16.2	619	83.8	< .0001	
No	2209	74.9	193	8.7	2016	91.3		
Missing	2	0.1	1	50.0	1	50.0		
Physical dependency (ADL-H > 3) ⁴								
Yes	1584	53.7	173	10.9	1411	89.1	0.6471	
No	1337	45.3	139	10.4	1198	89.6		
Missing	29	1.0	2	6.9	27	93.1		
Health instability (CHESS > 1) ⁵								
Yes	577	19.6	90	15.6	487	84.4	< .0001	
No	2345	79.5	220	9.4	2125	90.6		
Missing	28	0.9	4	14.3	24	85.7		

Notes

CI= Confidence intervals, p values are based on Kruskal-Wallis tests, *categorized by quartiles. Bold p values indicate significant at < 0.05.

¹Aggressive Behaviour Scale, ²Cognitive Performance Scale, ³Depression Rating Scale, ⁴Activities of Daily Living Hierarchy Score, ⁵Changes in Health, End-stage disease, and Symptoms and signs.

Table 3

Association between residents' pain and natural log transformed DEMQOL-CH scores when adjusted for nursing home, residents' social determinants and clinical variables.

Variable	Model 1: Total sample, with pain as independent variable (N = 2950)				
	Est.	S. E	LCL	UCL	p
Intercept	4.598	0.080	4.442	4.754	0.0000
Independent variable					
Pain (Moderate pain intensity at least once in last week)	-0.029	0.009	-0.047	-0.011	0.0014
Covariates					
Nursing home variables					
Province (ref: Ontario)					
Alberta	-0.013	0.018	-0.047	0.022	0.4712
British Columbia	-0.063	0.021	-0.103	-0.023	0.0022
Manitoba	-0.047	0.022	-0.090	-0.004	0.0304
Nova Scotia	-0.006	0.033	-0.071	0.059	0.8547
Private for-profit owner-operator model	-0.009	0.014	-0.037	0.020	0.5548
Facility size (ref: small < 80 beds)					
Medium (80–120 beds)	-0.020	0.020	-0.059	0.020	0.3320
Large (> 120 beds)	-0.031	0.021	-0.073	0.010	0.1418
Rural location	0.014	0.021	-0.028	0.055	0.5162
Total care hours per resident day	-0.007	0.011	-0.030	0.015	0.5272
Proportion of care aide hours per resident day	-0.007	0.110	-0.223	0.209	0.9484
No person-centered care model in the facility	0.009	0.016	-0.022	0.040	0.5659
% of residents of visible minorities	-0.006	0.046	-0.096	0.084	0.8927
QoL rater (ref: care aides)					
Licensed Practical Nurses	0.040	0.044	-0.047	0.126	0.3697
Director of Care	-0.221	0.126	-0.468	0.027	0.0809
Others	-0.029	0.020	-0.069	0.011	0.1531
Resident social determinants of health					
No family/friend visitors	-0.003	0.009	-0.021	0.014	0.7017
No legal guardian	0.003	0.010	-0.017	0.023	0.7751
LTC cost publicly not covered	0.010	0.011	-0.012	0.032	0.3738
Resident clinical variables					
Responsive behaviours (ABS > 2) ¹	-0.027	0.008	-0.043	-0.012	0.0005
Cognitive impairment (CPS > 3) ²	0.040	0.007	0.027	0.054	0.0000
Depressive symptoms (DRS > 2) ³	-0.075	0.007	-0.089	-0.061	0.0000
Physical dependency (ADL-H > 3) ⁴	0.002	0.006	-0.010	0.015	0.7051
Health instability (CHESS > 1) ⁵	-0.032	0.007	-0.046	-0.017	0.0000
Notes: Est=Estimate, SE= Standard error, LCL=Lower 95% confidence level, UCL=Upper 95% confidence level, Bolded: p < 0.05. 1Aggressive Behaviour Scale, 2Cognitive Performance Scale, 3Depression Rating Scale, 4Activities of Daily Living Hierarchy Score, 5Changes in Health, End-stage disease, and Symptoms and signs.					

Table 4

Association between nursing home, residents' social determinants and clinical variables and natural log transformed DEMQOL-CH scores among residents with and without pain.

Variable	Model 2: Among residents with pain (N = 314)					Model 3: Among residents without pain (N = 2636)				
	Est.	S. E	LCL	UCL	p	Est.	S. E	LCL	UCL	p
Intercept	4.582	0.166	4.257	4.907	< 0.0001	4.602	0.081	4.442	4.761	0.0000
Nursing home variables										
Province (ref: Ontario)										
Alberta	-0.006	0.036	-0.077	0.065	0.8691	-0.013	0.018	-0.048	0.023	0.4815
British Columbia	-0.035	0.042	-0.118	0.047	0.4005	-0.066	0.021	-0.107	-0.025	0.0015
Manitoba	-0.026	0.040	-0.105	0.052	0.5071	-0.048	0.022	-0.092	-0.005	0.0302
Nova Scotia	-0.018	0.060	-0.136	0.101	0.7679	-0.007	0.034	-0.074	0.060	0.8372
Private for-profit owner operator model (ref: Not for profit-public or voluntary)	0.003	0.028	-0.051	0.058	0.9041	-0.012	0.015	-0.041	0.017	0.4177
Facility size (ref: small < 80 beds)										
Medium (80–120 beds)	-0.001	0.036	-0.072	0.069	0.9732	-0.020	0.021	-0.061	0.021	0.3335
Large (> 120 beds)	-0.062	0.041	-0.142	0.019	0.1319	-0.028	0.022	-0.071	0.015	0.1989
Rural location	0.023	0.041	-0.056	0.103	0.5670	0.015	0.022	-0.027	0.057	0.4873
Total care hours per resident day	-0.030	0.022	-0.073	0.013	0.1744	-0.005	0.012	-0.028	0.018	0.6946
Proportion of care aide hours per resident day	0.035	0.228	-0.412	0.481	0.8790	-0.015	0.112	-0.235	0.205	0.8925
No person-centered care model in the facility	0.008	0.027	-0.045	0.062	0.7654	0.009	0.016	-0.023	0.041	0.5817
% of residents of visible minorities	-0.012	0.105	-0.218	0.194	0.9102	-0.014	0.047	-0.106	0.077	0.7601
QoL rater (ref: care aides)										
Licensed Practical Nurses	0.097	0.066	-0.032	0.225	0.1395	0.034	0.046	-0.056	0.125	0.4605
Director of Care	-0.161	0.151	-0.457	0.135	0.2860	-0.233	0.131	-0.490	0.023	0.0745
Others	-0.003	0.035	-0.072	0.066	0.9257	-0.035	0.021	-0.075	0.006	0.0965
Resident social determinants of health variables										
No family/friend visitors	-0.014	0.029	-0.070	0.042	0.6312	-0.005	0.010	-0.024	0.015	0.6291
No legal guardian	0.012	0.028	-0.042	0.067	0.6572	0.002	0.011	-0.020	0.025	0.8350
LTC cost publicly not covered	0.018	0.028	-0.037	0.072	0.5192	0.007	0.012	-0.017	0.030	0.5824
Resident clinical variables										
Responsive behaviours (ABS > 2) ¹	-0.053	0.027	-0.106	0.001	0.0530	-0.027	0.008	-0.043	-0.010	0.0016
Cognitive impairment (CPS > 3) ²	0.040	0.024	-0.006	0.087	0.0915	0.040	0.007	0.026	0.054	0.0000
Depressive symptoms (DRS > 2) ³	-0.040	0.021	-0.081	0.002	0.0594	-0.080	0.008	-0.095	-0.065	0.0000
Physical dependency (ADL-H > 3) ⁴	0.017	0.020	-0.022	0.057	0.3872	0.002	0.007	-0.011	0.015	0.8089
Health instability (CHESS > 1) ⁵	-0.032	0.021	-0.074	0.010	0.1308	-0.031	0.008	-0.046	-0.015	0.0001
Notes: Est=Estimate, SE= Standard error, LCL=Lower 95% confidence level, UCL=Upper 95% confidence level, Bolded: p < 0.05. 1Aggressive Behaviour Scale, 2Cognitive Performance Scale, 3Depression Rating Scale, 4Activities of Daily Living Hierarchy Score, 5Changes in Health, End-stage disease, and Symptoms and signs.										

Supplementary Files

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- [TableS1.ModelfitindicesFullsample.xlsx](#)
- [SupplementaryFile1.docx](#)

- [TableS6UnimputedRegressionAnalysisWorkingModel.xlsx](#)
- [TableS5.Unadjustedregressionanalysis.docx](#)
- [TableS2.Modelfitindicesamongreswpain.xlsx](#)
- [TableS3.Modelfitindicesamongreswithoutpain.xlsx](#)
- [TableS4.DistributionofDEMQOLCHitemsbypainnopain.docx](#)