ORIGINAL RESEARCH

Frailty, Seasonal Sensitivity and Health-related Quality of Life in Older People Living in High Southern Latitudes: a Bayesian Analysis

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ABSTRACT

Background

In older people, a notable research gap exists regarding the intricate dynamics between frailty, seasonal sensitivity, and health-related quality of life (HRQoL). This study aimed to determine the association between frailty, seasonal sensitivity, and HRQoL in older people from high southern latitudes.

Methods

A cross-sectional observational study was conducted. Frailty, seasonal sensitivity, and HRQoL measurements were self-reported by participants through questionnaires. A total of 118 older people were recruited from a local community. The participants were selected through intentional non-probabilistic sampling.

Results

The adjusted models showed a trend where lower education was associated with a higher risk of frailty (BF = 0.218). For frailty and HRQoL, we observed a trend suggesting that HRQoL decreases with increasing severity of frailty (BF = 1.76). In addition, we observed a linear effect based on the severity of seasonal sensitivity, meaning that older people with higher perceived severity report a proportional decrease in HRQoL (BF = 6.66).

Conclusion

Sociodemographic factors, such as lower education levels, have increased the risk of frailty. At the same time, frailty and seasonal sensitivity perceived severity were associated with a lower HRQoL in older people.

Key words: older adults, frail elderly, aged, seasonal affective disorder, quality of life, Bayesian analysis

INTRODUCTION

The global demographic transition towards an aging population presents significant challenges in addressing the health and well-being of older people.[1,2] As older people face unique health vulnerabilities and complexities, understanding the factors influencing their overall health-related quality of life (HRQoL) becomes paramount.

Frailty is a geriatric syndrome that refers to a dynamic state of increased vulnerability and decreased physiological reserve, often observed in older people.[3] Frail people are at higher risk of adverse health outcomes, reduced functional capacity, and impaired quality of life.[3-8] This state of vulnerability, however, is not solely shaped by individual physiological factors; environmental influences play a significant role in the manifestation of frailty.[9] As we delve into the complex interplay between health and the environment, an emerging area of research has garnered increasing attention in recent years: seasonal sensitivity.[9]

Seasonal sensitivity, characterized by individual variations in response to seasonal changes, has a pronounced effect in high-latitude regions, impacting older people's physical and psychological well-being.[10,11] In the high-latitude areas, pronounced seasonal variations can impact older residents' physical and psychological well-being.[11–15] Furthermore, seasonality—the predictable changes in the environment and climate—could surpass the adaptability of frail people, leading to disability and vulnerability with a seasonal pattern.[9]

Hence, investigating the association between frailty and seasonal sensitivity in this population is critical for enhancing their health outcomes and HRQoL.

HRQoL is often one of the most important outcomes targeted by interventions and public policies. It is a multidimensional construct encompassing various aspects of an individual's physical health, psychological well-being, social interactions, and environmental factors.[16] As a comprehensive measure of an individual's life satisfaction and functioning, assessing HRQoL is fundamental, especially in older people.[17]

Despite the growing interest in the frailty, seasonal sensitivity, and HRQoL aspects, the evidence in this regard is limited, and these variables have been scarcely explored, especially in older people living in extreme environments. This research aims to determine the association between frailty, seasonal sensitivity, and HRQoL in older people from high southern latitudes. We hypothesize that frailty is related to seasonal changes and is associated with decreased health-related quality of life.

METHODS

Study Design

An observational cross-sectional and correlational study was conducted. The study was informed to all participants before data collection. Sociodemographic information, seasonal sensitivity, quality of life, and frailty data were obtained through self-report measures, while morphological measurements were obtained through bioimpedance and manual height rods.

Participants were informed about the objectives and assessments of this study, and they voluntarily signed the informed consent form. The assessments consisted of administering the criteria of the FRAIL scale for frailty, the SPAQ for seasonal sensitivity, and the WHOQoL-Old questionnaire for HRQoL. The questionnaires were administered privately by trained collaborators to address any questions or doubts, ensuring the acquisition of reliable responses.

Participants

One hundred eighteen participants were recruited from a local community in the Magallanes and Chilean Antarctic Region, Chile (located at high southern latitudes 48°36' to 56°30'). They were included in the analysis if they: (a) permanently resided in the Magallanes region, (b) were 60 years or older, and (c) were sufficiently autonomous to respond to self-reported questionnaires. However, participants were excluded if they: (a) had severe cognitive impairments or dementia that could hinder their ability to provide reliable self-reported data, (b) had significant communication barriers that prevented them from completing the self-report questionnaires effectively, or (c) were currently undergoing primary medical treatments or facing severe health conditions that could confound the study results.

Ethics

All participants gave their permission and signed informed consent before participation. The Ethics Committee of the University of Magallanes (N°008/SH/2022) approved this study following the regulations established by the Declaration of Helsinki on ethical principles in human beings.

Measures

Before the evaluations, the participants' sociodemographic data was collected, such as name, age, marital status, educational level, and chronic diseases.

Frailty

The Spanish version of the FRAIL scale was employed.[18] It encompasses fatigue, ambulation, resistance, illness, and weight loss criteria. One point is attributed to each domain and the scale scores from 0 to 5 points (0 = best to 5 = worst). Individuals are categorized as non-frail (0 points), pre-frail (1 or 2 points), or frail (3 or more points).[19] The questionnaire is an optimal screening test for clinicians to identify frail persons at risk of declining health and mortality.[20]

Seasonal Pattern

Spanish language adaptation of the Seasonal Pattern Assessment Questionnaire (SPAQ) in the adult versions.[21] The SPAQ measures seasonality classified as changes in mood and behavior through the seasons, treated as a cyclical pattern of depressive episodes with criteria of major depression that appear in the autumn–winter period and tend to present with atypical symptoms, such as hypersomnia, hyperphagia, and appetite for carbohydrates. The Spanish version of the SPAQ gives adequate reliability and internal consistency values for its use in epidemiological and clinical research.[21]

Health-related Quality of Life (HRQoL)

HRQoL was measured using the WHOQoL-Old instrument, validated in the Chilean older people. It assesses six dimensions (sensory abilities, autonomy, past, present, and future activities, social participation, death and dying, and intimacy) with 24 items on a 5-point Likert scale. The instrument has demonstrated good internal consistency in the Chilean population with a Cronbach's alpha of 0.83.[22]

Statistical Analysis

A total of 118 participants were included. In this data set, we aimed to explore the relationship between seasonal sensitivity, HRQoL, and frailty using a model-based inference approach under a Bayesian framework to describe the uncertainty associated with model parameters.

In this context, we developed three models to delve into different aspects. Firstly, we examined how the level of education impacts frailty scores. Secondly, we delved into the influence of fragility classification on HRQoL scores. Finally, we aimed to unify the preceding models by investigating the connection between perceived seasonal sensibility severity and HRQoL scores. To achieve this, we employed non-orthogonal polynomial contrasts up to the third order,

allowing us to explore potential linear, quadratic, and cubic trends associated with seasonal sensitivity.

As part of our strategy was to enhance model robustness and to mitigate the impact of outliers during the model fitting process, we opted for weakly informative priors for our model parameters. These priors are detailed in Equation 1, ensuring a balanced and practical approach.

$$\beta \sim \text{Normal}(0,10)$$
$$\sigma \sim \text{HalfCauchy}(0,15) \quad (1)$$

Following the Sequential Effect eXistence and sIgnificance Testing (SEXIT) framework,[23] we report the median of the posterior distribution along with its 95% credible interval (CI), the probability of direction (pd), the probability of significance, and the probability of being large. The thresholds used to determine significance (i.e., non-insignificant) and largeness were |0.05| and |0.30| of the standard deviation of the response variable, respectively.

Additionally, we present the Bayes factor (BF10), which indicates the degree to which the posterior distribution has shifted away from or towards the null value or values (relative to the prior distribution). This provides information on whether the null value has become more or less likely given the observed data. A Bayes factor greater than 1 can be interpreted as evidence against the null model, and a convention is that a Bayes factor greater than 3 can be considered "substantial" evidence against the null model (conversely, a Bayes factor less than 1/3 indicates substantial evidence in favor of the null model). All computations were performed using the R programming language for statistical computing on version 4.2.1 (R Foundation for Statistical Computing; https://www.r-project.org/foundation/).

RESULTS

Sample Characteristics

A total of 118 participants (male, n = 28 [23.7%]; female, n = 90 [76.3%]) were enrolled in the study. Sample characteristics and body composition parameters can be observed in Table 1.

Education Level and Risk of Frailty

The adjusted models show a trend suggesting that a lower education level is associated with a higher risk of frailty. When examining pairwise differences, older people with a middle

TABLE 1.
Overall descriptive statistics were grouped by maximum educational level reached

		Educational Level		
Characteristic	*Overall, N = 118*[a]	*Primary, N = 41*[a]	*Secondary, N = 56*[a]	*Higher, N = 21*[a]
Age (years old)	70.5 (5.9)	72.5 (6.0)	69.6 (5.8)	68.7 (5.2)
Frailty score	0.55 (0.76)	0.78 (0.88)	0.46 (0.69)	0.33 (0.58)
Frailty Classification				
Non-frail	68 (58%)	19 (46%)	34 (61%)	15 (71%)
Pre-frail	48 (41%)	20 (49%)	22 (39%)	6 (29%)
Frail	2 (1.7%)	2 (4.9%)	0 (0%)	0 (0%)
Self-Perceived Seasonality Severity				
Not a problem	87 (74%)	33 (80%)	39 (70%)	15 (71%)
Mild	9 (7.6%)	1 (2.4%)	4 (7.1%)	4 (19%)
Moderate	8 (6.8%)	2 (4.9%)	5 (8.9%)	1 (4.8%)
Important	7 (5.9%)	4 (9.8%)	3 (5.4%)	0 (0%)
Severe	6 (5.1%)	1 (2.4%)	4 (7.1%)	1 (4.8%)
Serious	1 (0.8%)	0 (0%)	1 (1.8%)	0 (0%)
Seasonal Sensitivity Index				
Typical	68 (67%)	22 (65%)	36 (73%)	10 (56%)
Winter blues	22 (22%)	8 (24%)	8 (16%)	6 (33%)
SAD	11 (11%)	4 (12%)	5 (10%)	2 (11%)
Unknown	17	7	7	3
HRQoL Overall Score	101 (14)	101 (15)	100 (14)	102 (13)
Marital Status				
Married	71 (60%)	22 (54%)	36 (64%)	13 (62%)
Divorced	7 (5.9%)	2 (4.9%)	0 (0%)	5 (24%)
In a relationship	1 (0.8%)	1 (2.4%)	0 (0%)	0 (0%)
Separated	6 (5.1%)	0 (0%)	5 (8.9%)	1 (4.8%)
Single	9 (7.6%)	5 (12%)	3 (5.4%)	1 (4.8%)
Widow	24 (20%)	11 (27%)	12 (21%)	1 (4.8%)

[a]Mean (SD); n (%)

education level have 0.32 points less (95% CI [-0.62, -0.02]) than those with only primary education (pd = 98%, Significant = 96%, Large effect = 72%, BF = 0.107). Furthermore, older people with higher education levels have 0.45 points less (95% CI [-0.84, -0.05]) than those with lower education levels (pd = 99%, Significant = 98%, Large effect = 86%, BF = 0.218) (see Figure 1).

Frailty and Overall HRQoL

For frailty and HRQoL, we observed a trend suggesting that HRQoL decreases with severity of frailty. When comparing with "Non-frail" older people, those classified as "Pre-Frail" had 5.83 points less (95% CI [-10.77, -0.86]) in terms of HRQoL (pd = 99%, Significant = 98%, Large effect = 73%, BF = 3.22). Meanwhile, participants classified as "Frail" had 9.31 points less (95% CI [-23.08, 4.64]) in HRQoL (pd = 91%, Significant = 88%, Large effect = 76%, BF = 1.76) (see Figure 2).

When examining the relationship between both scores, HRQoL and frailty, we observed a decrease of 4.82 points (95% CI [-8.08, -1.56]) (pd = 100%, Significant = 99%, Large effect = 63%, BF = 6.18).

Perceived Severity of Seasonal Sensitivity and HRQoL

Upon examining the effect of seasonality on HRQoL, we observed a linear effect based on the severity of seasonal sensitivity, suggesting that with higher perceived severity, there is a proportional decrease in HRQoL. Thus, for each movement from a lower severity category to a higher severity one, we observed a proportional decline of 12.36 points (95% CI [-23.49, -1.17]) in HRQoL (pd = 98%, Significant = 98%, Large effect = 92%, BF = 6.66) (see Figure 3).

DISCUSSION

This study aimed to determine the association between frailty, seasonal sensitivity, and HRQoL in older people high southern latitudes. Utilizing Bayesian statistics, we explored the uncertainties associated with these relationships and their implications for the well-being of older populations in regions with pronounced seasonal variations. Therefore, the hypotheses were confirmed. Our findings offer valuable insights by addressing a prior knowledge gap, as we, for the first time, delve into the interactions between frailty, seasonal sensitivity, and HRQoL in older people residing in the high southern latitudes. This research pioneers in an environment where the relationship between these factors is largely uncharted. Furthermore, our study employed a Bayesian statistical approach, introducing an innovative dimension to the analysis and comprehension of these relationships, thus contributing to the advancement of knowledge in this specific field.

The significant association between education level and frailty risk aligns with existing literature that highlights the impact of socioeconomic factors on health status in older people, especially in low-income countries.[24–26] Even more,

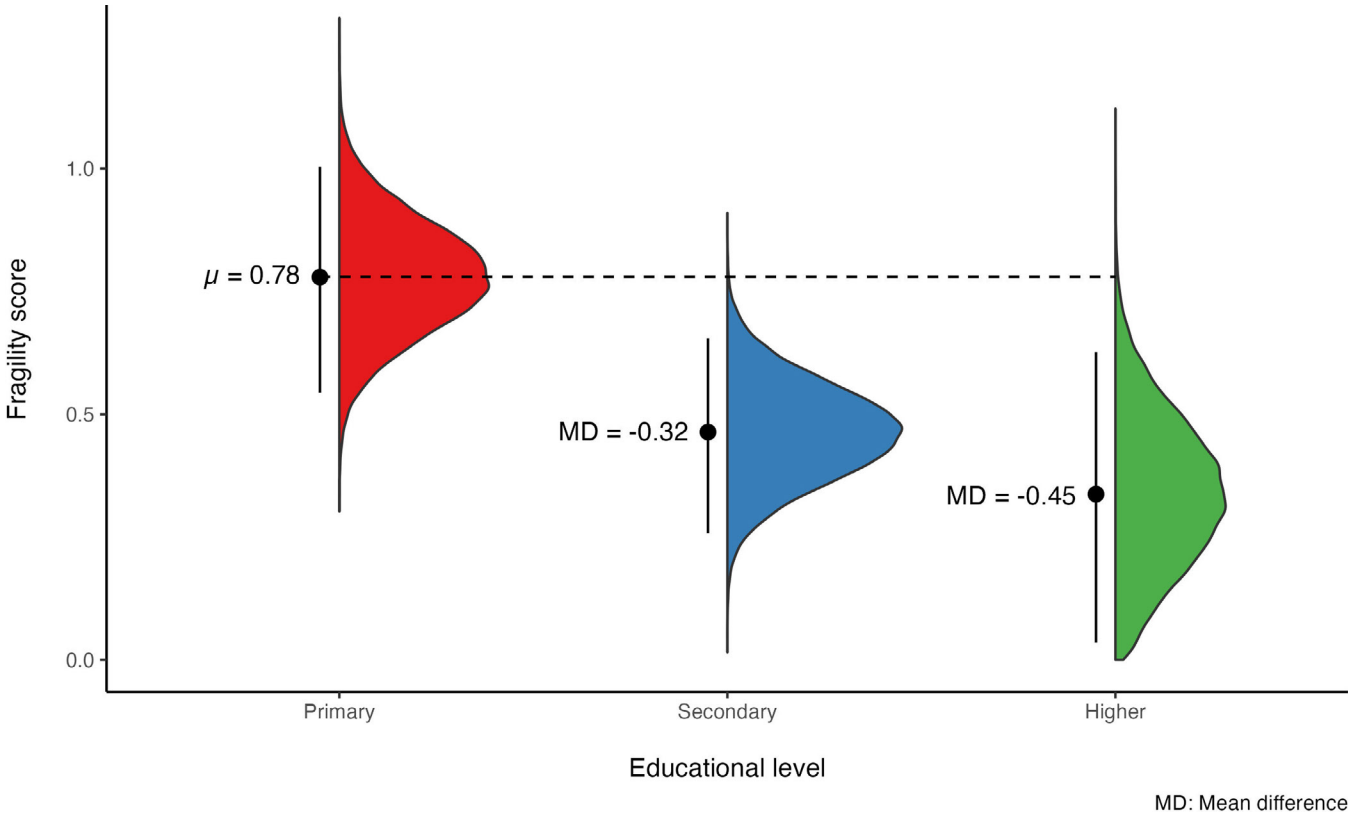

FIGURE 1. Posterior distributions of plausible true values (φ for frailty score at each educational level

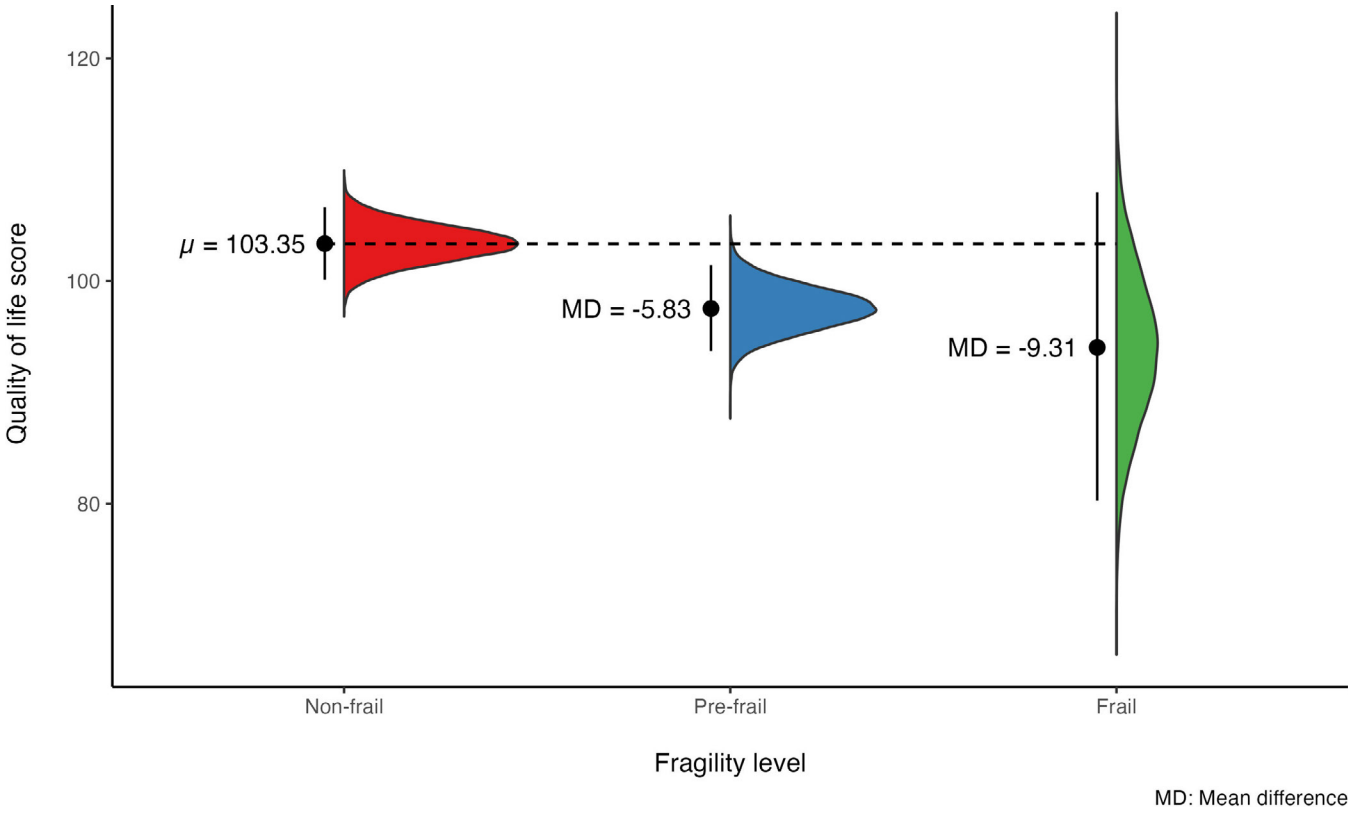

FIGURE 2. Posterior distributions of plausible φ for quality of life at each fragility classification

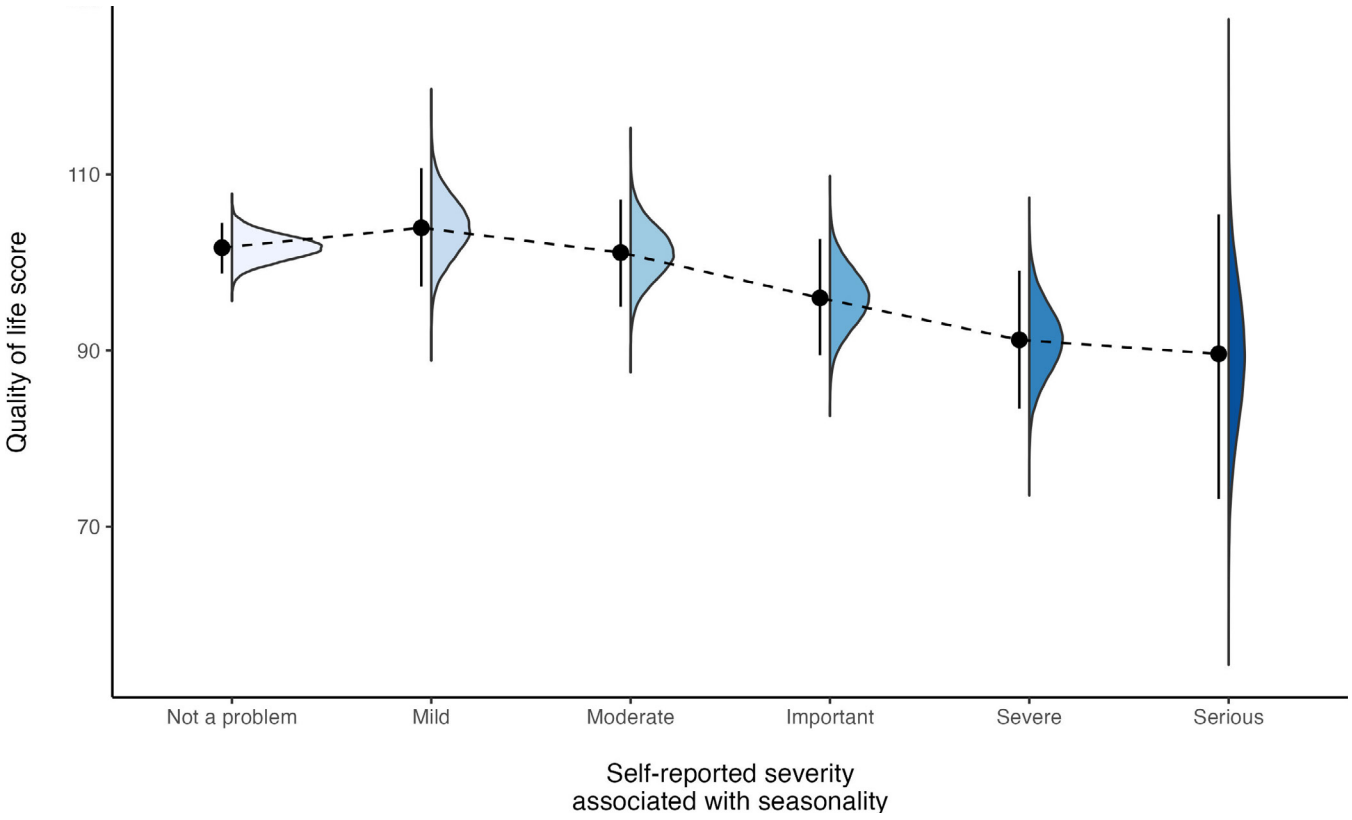

FIGURE 3. Posterior distributions of plausible φ for quality of life for each self-reported seasonality severity; parameter estimation is based on polynomial contrasts of the third order

a lower education level has been previously associated with lower physical performance[27] and higher odds of being frail.[28] These results emphasize the need to address educational disparities to enhance older adults' health and functional capacity in high-latitude regions.

The observed substantial negative association between frailty severity and HRQoL reinforces the importance of early detection and targeted interventions to mitigate the impact of frailty on HRQoL in older people. These findings resonate with existing literature on the adverse effects of frailty on various aspects of well-being.[29–31] Furthermore, the linear effect of seasonal sensitivity severity on HRQoL highlights the importance of addressing the impact of seasonal changes in health-care interventions and public health policies. A previous study conducted in extreme environments concluded that seasonal sensitivity affects psychological well-being in older people;[11] however, specific HRQoL assessing instruments were not employed. This observation contributes to the limited research on seasonal variations' and perceived severity effects on HRQoL in older people, particularly in high-latitude regions.

Even more, the Bayesian perspective employed in this study adds rigor to interpreting the observed associations by accounting for uncertainties and enhancing the reliability of our conclusions.[32-34] Using Bayesian statistics in the context of aging research and seasonal variations offers a novel approach, enriching the understanding of the complex relationship regarding frailty, seasonal sensibility, and HRQoL.

The implications of these findings are significant for health-care policy and interventions. Addressing educational disparities and providing targeted support to older adults with lower education levels can enhance resilience and reduce frailty risk.[26-28] Early detection and interventions for frailty can improve overall HRQoL in older populations.[30-31] Recognizing the impact of seasonal changes on HRQoL can inform targeted interventions to support older people in regions with extreme seasonal variations.[11] Also, this study provides valuable insights into the associations between frailty, seasonal sensitivity, and HRQoL in older people residing in high southern latitudes. By leveraging the Bayesian perspective, we contribute to evidence-based strategies for promoting healthy aging and enhancing the HRQoL of older people in regions with pronounced seasonal variations. Our study offers a new perspective on the implications of frailty and seasonal changes for the well-being of older adults, addressing important gaps in the existing literature.

While this study exhibits several strengths, it is essential to acknowledge and address certain limitations. Chief among these is the inherent constraint imposed by the cross-sectional design, which restricts our ability to establish a causal relationship among the variables under examination. To overcome this limitation, future research should prioritize longitudinal studies that can delve into the temporal dynamics and bidirectional associations among these variables. Furthermore, it is crucial to be mindful of potential biases and subjectivity introduced by relying on self-report measures to assess variables such as education level, frailty, and quality of life. To bolster the validity of our findings, we strongly advocate for incorporating objective measurements and utilizing comprehensive assessment tools in forthcoming research endeavors. By providing evidence in the context of high southern latitudes, our study offers a new perspective on the implications of frailty for older people residing in regions with pronounced seasonal variations.

CONCLUSION

This study reveals significant associations between frailty, seasonal sensitivity, and HRQoL in older people living in high southern latitudes. The Bayesian perspective offers a comprehensive understanding of the observed relationships, contributing to evidence-based strategies to enhance the well-being of older people residing in regions with pronounced seasonal variations. These findings have the potential to inform targeted interventions and policies, fostering improved health outcomes and HRQoL for this population.

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CONFLICT OF INTEREST DISCLOSURES

We have read and understood the *Canadian Geriatrics Journal*'s policy on conflicts of interest disclosure and declare there are none.

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