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Social frailty as a predictor of mortality among older adults in four Colombian departments: evidence from the SABE survey

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Abstract

Background Social frailty, defined as a decline in social resources and participation, has emerged as a critical yet underrecognized dimension of vulnerability in older adults. While its association with adverse outcomes is increasingly documented, evidence from low- and middle-income countries remains limited. This study aimed to examine the association between social frailty and mortality among community-dwelling older adults in Colombia.

Methods We conducted a nested cohort study using data from the Colombian Health, Well-being, and Aging Survey (SABE; fieldwork 2015, official report 2016). The analysis was restricted to adults aged ≥ 60 years residing in four Colombian departments (Antioquia, Caldas, Risaralda, and Quindío). A total of 3,213 participants with verified vital status were included. Social frailty was measured using a multidimensional index incorporating functionality, social participation, emotional isolation, and perceived healthcare support. Individuals in the highest quartile (≥ 75 th percentile) were classified as socially frail. Mortality follow-up was assessed through administrative linkage over 90 months. Cox proportional hazards models were used to estimate hazard ratios (HRs), adjusting for age and multimorbidity.

Results Using the percentile-based threshold, 25.2% of participants were classified as socially frail, and 22.2% died during follow-up. In multivariable analysis, social frailty was independently associated with higher mortality risk (HR = 1.18; 95% CI: 1.01–1.39; $p = 0.039$). Age, sex and multimorbidity were also significantly associated with mortality.

Conclusions Social frailty was independently associated with all-cause mortality among older adults in this Colombian regional cohort. These findings suggest that incorporating social vulnerability measures into geriatric assessment may improve risk stratification and help identify individuals who could benefit from supportive interventions.

Keywords Frailty, Social frailty, Social isolation, Aged, Survival

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Background

Aging in Colombia is a heterogeneous process shaped by a rapid demographic transition and significant structural challenges [1–3]. Data from the Colombian Health, Well-being, and Aging Survey (SABE) highlight a landscape of high vulnerability, characterized by limited pension coverage, low educational attainment, and restricted social participation [4]. Beyond a 15.2% prevalence of physical frailty, older Colombians face substantial social risks, including low emotional support (15%) and high levels of perceived social devaluation (66%) [4, 5]. These contextual factors create a unique environment of multidimensional frailty that necessitates a specific evaluation of how social resources, or the lack thereof, impact survival in middle-income settings.

Frailty is a state of increased vulnerability and reduced physiological reserve associated with adverse outcomes, including disability and mortality [6]. While traditional geriatric models focus primarily on physical phenotypes or deficit accumulation [7, 8], frailty is increasingly recognized as a multidimensional construct encompassing physical, cognitive, and social domains [9, 10]. Social frailty, specifically, reflects a decline or limitation in social resources, activities, and participation, serving as an indicator of an individual's inability to maintain expected social roles [11]. However, the operationalization of social frailty remains inconsistent across the literature, often measured through a heterogeneous range of factors such as living alone, limited social networks, loneliness, and low community participation. This lack of a gold standard measurement complicates the comparison of findings across different socioeconomic and cultural settings.

Evidence from high-income settings indicates that social frailty—with a global prevalence ranging from 10% to 25%, is a robust predictor of disability, poor quality of life, and a significant increase in all-cause mortality [12–18]. Recent systematic reviews and meta-analyses confirm that socially frail older adults exhibit up to a 31% higher mortality risk compared to robust peers [19]. However, most longitudinal data originate from Europe and East Asia, where health systems and community structures differ considerably from those in Latin America [13]. In middle-income countries like Colombia, rapid demographic aging occurs alongside marked socioeconomic inequalities and fragmented social protection systems. These structural factors likely exacerbate the consequences of social vulnerability, further limiting the capacity of older adults to cope with stressors.

Despite this evidence, there is a significant knowledge gap regarding the prognostic value of social frailty in Latin American populations. The lack of context-specific longitudinal evidence limits the development of effective, targeted geriatric risk stratification and public health

strategies in these regions. Therefore, this study aims to examine the association between social frailty and mortality among older adults in four Colombian departments, utilizing a multidimensional index grounded in social production theory and a 90-month follow-up. We hypothesize that social frailty is an independent predictor of survival, even after adjusting for clinical and functional covariates.

Methods

Study design, participants and follow-up

This study is a prospective cohort analysis based on the 2015 wave of the Health, Well-being, and Aging survey (SABE Colombia), the largest population-based health survey of older adults in the region [4, 20]. Although the SABE survey was originally designed as a cross-sectional study to assess social determinants of health and active aging [21], we established a longitudinal design by linking baseline survey data with official administrative mortality records. This linkage with the Social Security Solidarity Fund (ADRES) allowed for a continuous follow-up from the initial interview in 2015 through December 31, 2022.

The analysis focuses on a regional subsample from four Colombian departments (Antioquia, Caldas, Risaralda, and Quindío). The selection of these departments was based on their status as the most demographically aged regions in Colombia according to the 2015–2021 DANE census data. Focusing on these departments provides a critical perspective on social frailty in contexts where the elderly population density is at its peak, thereby increasing the clinical and public health relevance of the findings for the region [2]. From an initial geographic pool of 3,898 eligible individuals, we excluded 392 proxy interviews. This exclusion was mandatory because the Social Frailty Index (SFI) incorporates subjective, perception-based variables (e.g., loneliness, self-rated health, and emotional support) that cannot be reliably reported by third parties. This resulted in a baseline analytic cohort of 3,506 participants.

Vital status was monitored over a 90-month period (mean 79 months) via the ADRES database. Successful administrative linkage was achieved for 3,213 individuals (91.6% of the baseline cohort), who constituted the final analytic sample. Individuals for whom vital status could not be verified (8.4%) were censored at the date of their last known contact.

This study was conducted in accordance with the principles of the Declaration of Helsinki. The original SABE Colombia survey protocol was reviewed and approved by the Ethics Committees of the University of Caldas and the University of Valle. All participants provided written informed consent prior to data collection. For the present study, authorization was obtained from the Ministry of Health and Social Protection of Colombia for the use

of the SABE survey database. The current analysis used de-identified secondary data, ensuring participant confidentiality in accordance with national data protection regulations.

Measures

Demographic, health-related, and social characteristics

To address the objectives of this study, variables were defined and operationalized across three major dimensions: demographic, health-related, and social. The demographic dimension included key characteristics for profiling the older adult population: age (calculated from the date of birth recorded on official identification), biological sex assigned at birth, and marital status (recoded from five categories into a dichotomous variable: with or without a partner). Socioeconomic status was assessed using Colombia's official classification system, which categorizes households into six strata: 1 (very low), 2 (low), 3 (lower-middle), 4 (middle), 5 (upper-middle), and 6 (high). Lower strata indicate higher levels of social and economic vulnerability. For the purposes of this study, the variable was recoded into a dichotomous indicator, with strata 1 and 2 grouped as "low socioeconomic status," representing the at-risk category.

Health and functional status were assessed through multimorbidity and disability indicators. Multimorbidity was defined as the presence of two or more self-reported chronic conditions, following conventional epidemiological thresholds. The 11 conditions evaluated included: hypertension, diabetes, cancer or malignant tumors (excluding minor skin cancers), chronic respiratory diseases (COPD, asthma, bronchitis, or emphysema), myocardial infarction or cardiac problems, stroke (cerebrovascular accident), joint diseases (arthritis or osteoarthritis), osteoporosis, dyslipidemia, mental or psychiatric illnesses, and skin ulcers.

Functional status was operationalized through two validated geriatric scales. Basic Activities of Daily Living (BADL) were measured via the Barthel Index (range 0–100), where any score < 100 was categorized as disability. Instrumental Activities of Daily Living (IADL) were assessed using the Lawton-Brody Scale, with disability defined as the reported inability to perform one or more instrumental tasks independently. These indicators ensure a comprehensive adjustment for the clinical and functional baseline of the participants in the survival models.

Social frailty index

Social frailty was not derived from a single item in the SABE survey but was conceptualized as a latent, multi-dimensional construct operationalized through a Social Frailty Index, previously developed and validated by García-Botina and Sierra-Hincapié [22]. Grounded in the

Social Production Function (SPF) theory, nine indicators were selected to represent domains of social, functional, and perceived support. These included: [1] poor self-rated health [2], dissatisfaction with healthcare services [3], dependence in basic activities of daily living (BADL) [4], dependence in instrumental activities of daily living (IADL) [5], non-participation in social or community groups [6], non-participation in volunteering activities [7], low affective/emotional support [8], reported feelings of loneliness, and [9] living alone. All variables were dichotomized, with higher scores indicating greater vulnerability.

Principal component analysis (PCA) was applied to these nine binary indicators to identify underlying dimensions of social frailty. Although PCA is traditionally applied to continuous variables, its use with dichotomous indicators has been described as an acceptable exploratory approach for dimension reduction and construct validation when supported by adequate inter-item correlation structure. The adequacy of the data for component extraction was supported by Bartlett's test of sphericity ($\chi^2 = 929$, $df = 36$, $p < 0.001$) and a Kaiser-Meyer-Olkin (KMO) measure of 0.503. Four principal components were retained, accounting for 54.2% of the total variance, and confirmed by parallel analysis. These components reflected the multidimensional nature of social frailty as follows: [1] functional dependence [2], reduced social participation [3], emotional and social isolation, and [4] negative health perception and dissatisfaction with the healthcare system.

A continuous weighted index was generated for each participant based on component loadings, and individuals scoring in the highest quartile (≥ 75 th percentile) were classified as socially frail. This percentile-based cutoff is commonly used in frailty epidemiology when no established gold standard exists. Sensitivity analyses using stricter thresholds (80th and 90th percentiles) yielded consistent associations with mortality (Supplementary Table S3). The full list of SABE items, coding procedures, and component structure is provided in Supplementary Tables S1 and S2 (factor loadings).

Mortality ascertainment

To establish the longitudinal component of this study, mortality was assessed through a deterministic record linkage between the SABE baseline and the Consolidated Database of the Administrator of the Resources of the General Social Security System in Health (ADRES). This administrative registry is considered the gold standard for mortality ascertainment in Colombia, as it tracks the vital status of all individuals enrolled in the national health insurance system for auditing and social security purposes.

The linkage utilized unique personal identification numbers (UID) as the primary matching key, ensuring a precise 1:1 correspondence between survey respondents and death records. The follow-up period commenced on February 1, 2015, and concluded on December 31, 2022, providing a maximum observation window of 90 months (mean 79.2 months). This duration was defined by the maximum available window of updated administrative records at the time of the study, ensuring sufficient longitudinal depth to capture the long-term impact of social frailty on survival.

Of the baseline sample, vital status was successfully verified for 3,213 individuals (91.6%). The remaining 293 individuals (8.4%) for whom status could not be verified primarily due to affiliation with 'special regimes' (e.g., military personnel or specific government entities) not captured by ADRES were handled as censored observations at the date of their last known contact. The high success rate of the linkage and the official nature of the registry ensure a robust and reliable estimation of mortality rates in this cohort.

Statistical analyses

All statistical analyses were conducted using Jamovi and Google Colab (Python). Categorical variables were described as absolute and relative frequencies, whereas continuous variables were summarized as means with standard deviations or medians with interquartile ranges, depending on their distribution.

To assess associations between individual variables and mortality, univariate binary logistic regression analyses were initially performed. Subsequently, a multivariate Cox proportional hazards regression model was employed to estimate the adjusted risk of mortality. The proportional hazards assumption was evaluated using both log-minus-log survival plots and Schoenfeld residual tests, with no significant departures from proportionality observed for the covariates included in the final model. Survival analysis was carried out using the Kaplan–Meier method, with survival time defined from the date of enrollment to the date of death; participants who were alive at end of the follow-up were censored at that date.

Covariates in the adjusted Cox model were selected a priori based on epidemiological knowledge of key confounders in the association between social frailty and mortality. Age was included as the strongest determinant of survival in older populations, and multimorbidity was incorporated as a central clinical driver of mortality risk closely linked to vulnerability. We intentionally prioritized a parsimonious adjustment strategy to avoid overfitting and to minimize adjustment for potential mediators or overlapping domains embedded within the social frailty construct itself.

Results are reported as absolute numbers, percentages, means, standard deviations, hazard ratios (HRs), and 95% confidence intervals (95% CIs). A two-tailed p -value < 0.05 was considered statistically significant.

Results

Sociodemographic and clinical characteristics of the study population

The median age of the 3,213 included participants was 68 years (interquartile range [IQR]: 63–74), and 61% were female. Overall, 52% reported living with a partner, and 70.3% belonged to the lowest socioeconomic strata (SES 1–2). Regarding health-related variables, 15.8% of participants exhibited dependency in BADL, 33.5% in IADL, and multimorbidity was present in 43.2%. A quarter of the study population (25.2%) were classified as socially frail using the ≥ 75 th percentile threshold. After 90 months of follow-up, 22.2% of participants ($n = 712$) had died.

Baseline characteristics stratified by vital status are presented in Table 1. Participants who died during follow-up were older (median 74 vs. 67 years, $p < 0.001$) and had a higher prevalence of multimorbidity (49.4% vs. 41.4%, $p < 0.001$), BADL/IADL dependency (both $p < 0.001$), lower social participation ($p < 0.001$), and a higher prevalence of social frailty (31.3% vs. 23.5%, $p < 0.001$).

Survival distribution by social frailty status

Kaplan–Meier survival analysis revealed a clear divergence in survival probabilities between participants classified as socially frail and those not socially frail over the 90-month follow-up period. Survival probabilities remained consistently lower in the socially frail group throughout follow-up. The log-rank test confirmed that the difference between curves was statistically significant ($\chi^2 = 18.9$, $df = 1$, $p < 0.001$) (Fig. 1).

Independent association between social frailty and mortality

In the multivariable Cox model, social frailty remained independently associated with a higher risk of all-cause mortality (HR: 1.18; 95% CI: 1.01–1.39; $p = 0.039$), even after adjusting for age, sex, multimorbidity, and socioeconomic status. Male sex emerged as a potent predictor of mortality (HR: 1.43; 95% CI: 1.23–1.66; $p < 0.001$), while multimorbidity also retained a significant independent association (HR: 1.24; 95% CI: 1.07–1.44; $p = 0.004$). Each additional year of age was associated with an 8% increase in the risk of death (HR: 1.08; 95% CI: 1.07–1.09; $p < 0.001$). Interestingly, socioeconomic stratum did not reach statistical significance in the final model ($p = 0.188$), suggesting that the impact of social deficits captured by the index may transcend economic classification in this population. Collinearity diagnostics confirmed the

Table 1 Sociodemographic and clinical characteristics

Variable		Total N=3213	Alive n=2501 (77.8%)	Dead n=712 (22.2%)	p-value
Age, median (IQR)		68 (63–74)	67 (63–73)	74 (67–79)	<0.001
Sex, n (%)	Female	1960 (61)	1583 (63.3)	377 (52.9)	<0.001
	Male	1253 (39)	918 (36.7)	335 (47.1)	
Marital status, n (%)	With partner	1671 (52)	1334 (53.3)	337 (47.3)	0.005
	No partner	1542 (48)	1167 (46.7)	375 (52.7)	
Socioeconomic status, n (%)	SES 1–2	2256 (70.3)	1753 (70.1)	503 (70.6)	0.775
	SES 3+	957 (29.8)	748 (29.9)	209 (29.4)	
Living alone, n (%)		340 (10.6)	257 (10.3)	83 (11.7)	0.290
Low perceived emotional support, n (%)		843 (26.2)	640 (25.6)	203 (28.5)	0.118
Feelings of loneliness, n (%)		161 (5.0)	131 (5.2)	30 (4.2)	0.269
No participation in social groups, n (%)		1879 (58.5)	1417 (56.7)	462 (64.9)	<0.001
No volunteer participation, n (%)		2832 (88.1)	2183 (87.3)	649 (91.2)	0.005
Poor/fair self-perception of health, n (%)		276 (8.6)	220 (8.8)	56 (7.9)	0.434
Poor/fair perception of quality of health care, n (%)		838 (26.1)	654 (26.1)	184 (25.8)	0.869
B-ADL dependency, n (%)		508 (15.8)	362 (14.5)	146 (20.5)	<0.001
I-ADL dependency, n (%)		1075 (33.5)	793 (31.7)	282 (39.6)	<0.001
Multimorbidity, n (%)		1387 (43.2)	1035 (41.4)	352 (49.4)	<0.001
Social frailty, n (%)		811 (25.2)	588 (23.5)	223 (31.3)	<0.001

Values are presented as n (%) for categorical variables and as median (interquartile range) for age. Comparisons between survivors and non-survivors were performed using the χ^2 test for categorical variables and the Mann–Whitney U test for age due to its non-normal distribution. A two-tailed p-value < 0.05 was considered statistically significant

B-ADL Basic activity of daily living, I-ADL Instrumental activity of daily living

stability of the model, with Variance Inflation Factors (VIF) for all variables remaining below 1.5, including age (1.02), sex (1.28), and social frailty (1.34). Schoenfeld residual tests indicated no significant violations of the proportional hazards assumption. Schoenfeld residual tests indicated no significant violations of the proportional hazards assumption (social frailty $p=0.17$; age $p=0.30$; multimorbidity $p=0.60$) (Table 2).

Discussion

This study builds on previous findings on the role of social frailty by focusing on a population often under-represented in geriatric epidemiology, the older adults in Colombia, Latin America. Social frailty was operationalized using a percentile-based threshold, whereby individuals in the highest quartile of the index distribution (≥ 75 th percentile) were classified as socially frail. This approach was intended to identify the subgroup with the greatest burden of social vulnerability rather than to estimate population prevalence. Importantly, participants classified in this high-risk quartile showed a significantly increased risk of all-cause mortality over 90 months of follow-up, even after adjustment for age, sex, socioeconomic status and multimorbidity, supporting the prognostic relevance of the construct. These findings underscore the importance of considering social domains of vulnerability within comprehensive geriatric assessment, specifically in Colombia, and likely across Latin America. In this cohort, social frailty coexisted with multiple health-related vulnerabilities, as could be expected.

Our main contribution is not to re-demonstrate that social vulnerability is linked to mortality, but to extend this evidence to a Latin American context that remains underrepresented in geriatric epidemiology. Most studies on social frailty have been conducted in high-income or East Asian populations, while structural conditions in middle-income countries such as Colombia, characterized by pronounced inequality, limited social protection, and barriers to healthcare access, may modify both the distribution and consequences of social frailty. Our findings therefore provide important contextual validation of social frailty as a prognostic marker in aging populations outside traditionally studied settings.

Social frailty

Several studies and meta-analyses have explored the prevalence of social frailty among older adults across various settings and populations. In a recent meta-analysis of community-dwelling older adults, Li et al. (2024) reported a combined prevalence of social frailty and pre-frailty at 34.5%, with social frailty alone accounting for 21.1% of cases [13]. Similarly, Zhang et al. (2023) found an overall prevalence of 18.8% in community settings, with notable differences based on the assessment

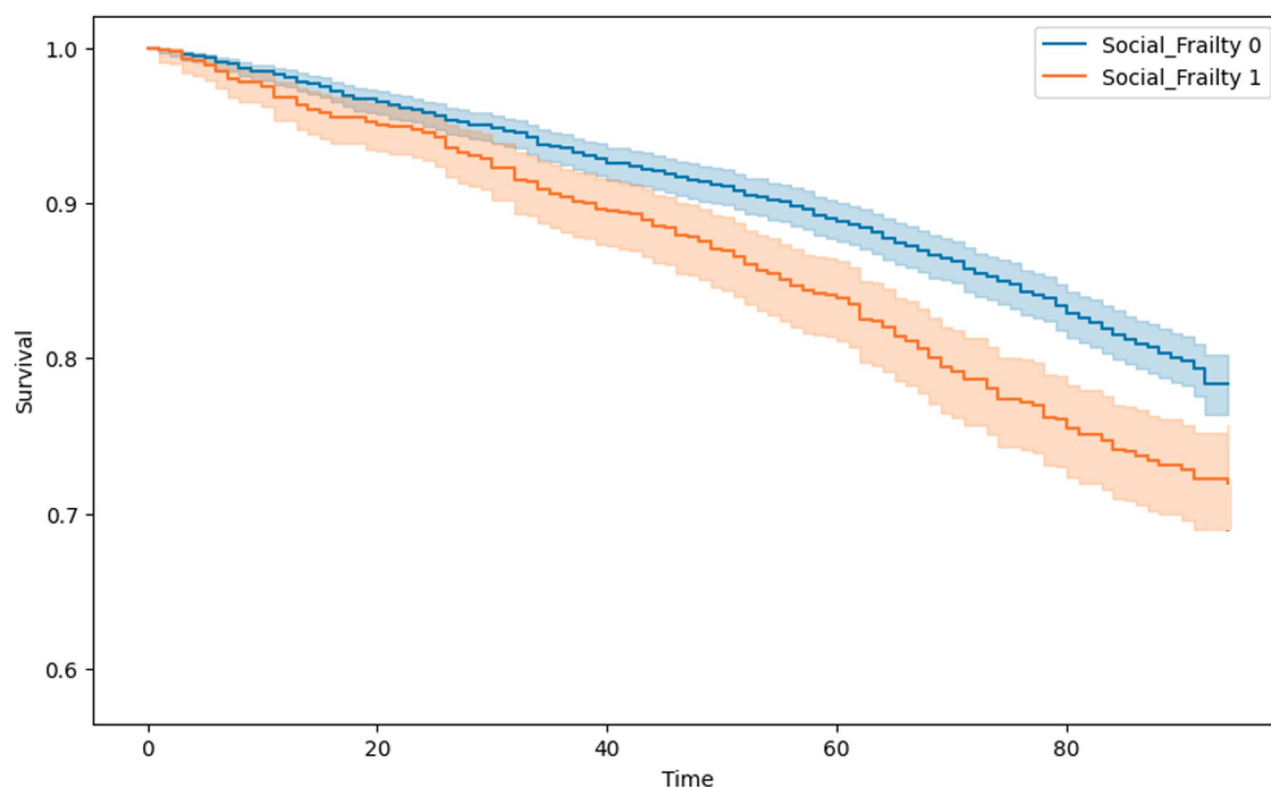


Fig. 1 Survival curves multivariate analysis. Kaplan–Meier survival curves stratified by social frailty status (0 = not socially frail; 1 = socially frail). Log-rank test $p < 0.001$. Follow-up time expressed in months

Table 2 Univariable and multivariable Cox proportional hazards regression for mortality

Variable		Univariable HR (95% CI)	p-value	Adjusted HR (95% CI)	p-value
Social frailty (ref: no)	811 (25.2)	1.42 (1.21–1.66)	< 0.001	1.18 (1.01–1.39)	0.039
Age (per year)	69.5 (7.3)	1.08 (1.07–1.09)	< 0.001	1.08 (1.07–1.09)	< 0.001
Sex (ref: male)	1253 (39)	1.46 (1.26–1.70)	< 0.001	1.43 (1.23–1.26)	< 0.001
Multimorbidity (ref: no)	1387 (43.2)	1.33 (1.15–1.54)	< 0.001	1.19 (1.03–1.38)	0.023
Socioeconomic status (ref: SES 1–2)	2256 (70.2)	1.03 (0.87–1.21)	0.744	1.12 (0.95–1.31)	0.188

HR Hazard ratio, CI Confidence interval

tool used; the prevalence was highest when using the Tilburg Frailty Indicator (32.3%), followed by the Makizako Social Frailty Index (27.7%) and the Social Frailty Screening Index (13.4%) [12].

Using the ≥ 75 th percentile threshold, 25.2% of participants were classified as socially frail, it is important to note that this figure reflects the operational cutoff used

in our sample and is not intended to be a national prevalence estimate. Which falls within the expected range reported in community-based studies and aligns closely with estimates obtained using the Makizako Index [15]. However, it differs from other studies [12], and this variation may be attributable to our context-specific methodology and the multidimensional approach used to construct the social frailty index. These variations likely reflect differences in cultural norms, family structures, and social support systems. In societies with strong intergenerational ties, the risk of social frailty may be reduced [23]. Conversely, in rapidly urbanizing settings such as those in parts of Latin America weakening family networks and social fragmentation may increase the frailty.

The index was constructed using principal component analysis, incorporating variables related to functional dependence, social interaction, emotional isolation, and perceived healthcare quality. This multidimensional approach may allow for a more sensitive detection of social frailty cases. Importantly, there is currently no validated social frailty index for Latin American populations, which limits accurate prevalence comparisons across regions [24].

Association of social frailty on survival outcomes

Our results align with previous literature emphasizing the health risks associated with social frailty. Shah et al. [25] emphasized the predictive value of social factors in estimating mortality risk among older adults. In their study of 8,250 participants from the Health and Retirement Study, the authors developed a parsimonious Social Frailty Index incorporating age, sex, and eight social characteristics. This model accurately stratified 4-year mortality risk and significantly improved the predictive capacity of commonly used comorbidity- and function-based models. Despite the well-established role of social attributes in shaping health outcomes, clinical and research-based risk models continue to rely predominantly on demographic and medical comorbidity variables. The study of social frailty indicators, as demonstrated both in Shah's work and in our study, may help to improve the precision of mortality risk assessments.

Our findings are also consistent with those reported in a recent systematic review published in *The Lancet* (2024) [26], which highlighted that both frailty, defined as a reduction in physiological reserve, and social vulnerability, understood as a lack of adequate social connections, support, or interaction, were independently associated with increased mortality, functional decline, and cognitive impairment. This review emphasized the multidimensional nature of social vulnerability and included studies assessing emotional support, social interaction and participation (e.g., volunteering, group involvement), and perceived loneliness dimensions that closely align with those included in the social frailty index developed and applied in our study. The convergence of evidence from high-income and middle-income countries reinforces the global relevance of integrating social dimensions into the assessment of aging-related risk and health outcomes.

Further support for our findings comes from a systematic review and meta-analysis by Goto et al. [27], which examined the association between social frailty and all-cause mortality and disability. The pooled hazard ratio for mortality was 1.96, indicating a significant relationship, although high heterogeneity was reported across studies. These results are directionally consistent with our study, which also showed an independent association between social frailty and mortality over a 90-month follow-up. Although the effect size observed in our cohort is more modest than the pooled estimate reported by Goto et al., it falls within the range of individual studies included in the meta-analysis. For instance, Gobbens et al. [28]. (2021) reported an HR of 1.17, and Yamada et al. [29] (2018) reported an HR of 1.28. The higher overall hazard ratio in the Goto review may be partially explained by the inclusion of older adults in hospital settings or those with chronic heart failure—populations with a higher

baseline risk of adverse outcomes, which may amplify the observed associations. In contrast, our study focused on community-dwelling older adults, which may account for the lower magnitude of risk observed, while still confirming the clinical relevance of social frailty in predicting mortality.

Our results also align with a meta-analysis by Xin Li et al. [19], which synthesized findings from 15 studies on social frailty and its health consequences in older adults. Specifically, the pooled estimate from four studies evaluating mortality reported that social frailty significantly predicted higher risk of death. Although the hazard ratio reported in that analysis is greater than the one observed in our study, the wide confidence interval and substantial heterogeneity suggest that population characteristics and context play a critical role in moderating the effect size. Notably, our study focused on a community-dwelling population in a middle-income country, while several studies included in the meta-analysis were conducted in high-income settings with differing social protection systems and healthcare access. These findings reinforce the robustness of the association between social frailty and mortality, while also emphasizing the importance of locally contextualized research to inform policy and practice.

Underlying factors that may explain the elevated mortality associated with social frailty

Building on the theoretical framework proposed by Fried et al. [30], which conceptualizes physical frailty as a critical dysregulation of complex physiological systems, several pathophysiological hypotheses can be proposed to explain the increased mortality observed among socially frail older adults. First, social frailty may function as a negative systemic modulator, reducing an individual's physiological resilience to external stressors. Older adults with weakened social networks or living in social isolation may have limited access to essential resources, such as timely medical care or assistance during acute health events. This restricted access may be associated with faster age-related decline in homeostatic capacity, rendering these individuals more susceptible to chronic disease exacerbation, infections, or other acute decompensations.

Second, social frailty frequently coexists with multiple geriatric syndromes including cognitive impairment, multimorbidity, functional disability, and falls [31, 32] which may share overlapping pathophysiological pathways with physical frailty, such as chronic inflammation, mitochondrial dysfunction, and hypothalamic-pituitary-adrenal (HPA) axis dysregulation. In socially frail individuals, these vulnerabilities may be mutually reinforcing, particularly in the context of limited emotional support and behavioral disengagement. Poor lifestyle habits such

as inadequate nutrition, physical inactivity, and suboptimal treatment adherence are maybe more prevalent in socially isolated individuals with likely faster physiological decline. In this context, dysfunction in one system (e.g., musculoskeletal or immune) may contribute to a cascade of impairments in other systems, amplifying the risk of adverse outcomes, even in response to relatively minor stressors. This pattern is consistent with the critical transitions model, which describes tipping points in system stability.

Finally, social frailty may act as a form of chronic psychosocial stress, contributing to cumulative allostatic load over the life course. Prolonged social isolation has been associated with an increased prevalence of vascular and neurological diseases and premature mortality [33]. As such, social frailty may be more than a psychosocial construct; it may reflect a biologically embedded vulnerability that may contribute to transitions toward dependency, disability, and mortality. Recognizing social frailty as a clinical health determinant highlights the potential value of multidomain interventions, addressing both the physiological and social dimensions of aging, to help mitigate risk and support healthy aging. For example, community-based programs that promote social participation, strengthen support networks, and improve access to services could be considered within national aging strategies. In clinical practice, screening for social frailty, alongside physical and cognitive assessment, could be considered as part of routine geriatric evaluations, particularly in low-resource settings.

Beyond its clinical implications, social frailty also reflects broader structural and psychosocial factors. Our data illustrate the multifaceted nature of social disadvantage in older age and support the view that social frailty is not merely a subjective perception, but a measurable and impactful construct with relevant behavioral and biological correlates.

Strengths and limitations

This study has several notable strengths. First, it adopts a multidimensional perspective of social frailty by integrating components related to social participation, social and emotional vulnerability, and health and functional status. This comprehensive approach enables a more nuanced assessment of older adults' social conditions and their relationship with health outcomes. Moreover, the data-driven approach used to operationalize social frailty, not only optimizes the use of available information but also ensures that the construct is tailored to the local context, thereby enhancing its applicability and relevance. Second, the study contributes to filling an important gap in the literature by expanding knowledge on social frailty in Colombia and Latin America, regions sometimes underrepresented in global aging research. Third, the study

provides longitudinal evidence showing an independent association of death among socially frail individuals, which strengthens the clinical and public health relevance of the findings. Finally, the study opens avenues for future research, including analyses of other health consequences of social frailty, such as multimorbidity, disability, geriatric syndromes, and quality of life.

Several limitations should also be acknowledged. First, social frailty was assessed only once at baseline (fieldwork conducted in 2015) using SABE survey items, whereas it could evolve over time in response to changes in health status, social networks, or environmental circumstances. Therefore, our findings reflect the prognostic value of baseline social frailty but cannot capture transitions into or out of frailty during follow-up. Second, although this study is based on a population-derived cohort, the possibility of selection and survival bias cannot be excluded, as individuals with the highest levels of vulnerability may have been less likely to participate in the original survey or may have died before follow-up linkage was possible. Third, the SABE survey was not originally designed as a dedicated social frailty assessment resource, and some relevant dimensions may not be fully captured. In addition, our analysis was restricted to participants from four Colombian departments, and thus the results should not be interpreted as fully nationally representative but rather as applicable to similar regional aging populations within comparable sociocultural contexts. While we conducted sensitivity analyses using alternative thresholds to ensure the robustness of our survival models, external validation of this index in independent cohorts is still necessary to establish its clinical utility and generalizability. Last, although sex-specific patterns may exist, the present study was not designed to formally evaluate effect modification by sex, and further research is warranted.

Conclusions

Our findings contribute to a growing body of evidence indicating that social frailty is a significant and independent predictor of mortality among older adults, particularly in underrepresented Latin American settings, such as Colombia. Even after adjusting for traditional risk factors such as age, sex, socioeconomic status and multimorbidity, social frailty remained associated with a 18% higher risk of death over a 90-month follow-up period.

These results underscore the clinical relevance of social domains such as emotional support, community engagement, and perceived loneliness as important correlates of health outcomes in later life. In contexts such as Colombia, where structural inequalities and limited social protection persist, social frailty assessments may be considered as part of comprehensive geriatric evaluation to improve risk stratification and help identify vulnerable individuals who could benefit from supportive

interventions. Future studies with repeated measurements of social frailty and nationally representative follow-up are warranted to better understand trajectories over time and confirm these associations.

Abbreviations

ADL	Activities of Daily Living
CI	Confidence Interval
CFS	Clinical Frailty Scale
HR	Hazard Ratio
IADL	Instrumental Activities of Daily Living
IQR	Interquartile Range
MNA	Mini Nutritional Assessment
SD	Standard Deviation
SABE	Salud, Bienestar y Envejecimiento (Health, Well-being, and Aging study)

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12877-026-07731-0>.

Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Acknowledgements

N/A.

Authors' contributions

H.D.G.B.: Study conception and design, statistical analyses, drafting of the manuscript. C.L.C.: Contribution to study design, data interpretation, and critical revision of the manuscript. A.C.L.: Methodological guidance and support in interpretation of results. C.R.B.: Data analysis, interpretation, and manuscript revision. M.J.F.: Supervision of the study, data interpretation, and critical revision of the manuscript. All authors read and approved the final version of the manuscript.

Funding

The work was partially supported by the Instituto de Health Carlos III (CASS PI22CIII/00043; RICAPPS RD21CIII/0003/0002 and RD24CIII/0001/0002) and Madrid Community (ENCAGES-CM PHS-2024/PH-HUM-169).

Data availability

<https://hdl.handle.net/10946/9455>.

Declarations

Ethics approval and consent to participate

The study protocol was reviewed and approved by the Ethics Committee of Universidad CES, Medellín, Colombia. Additionally, authorization was granted by the Ministry of Health of Colombia for the use of anonymized microdata derived from the SABE survey. Since participants in the SABE survey had previously provided informed consent at the time of data collection, no individual informed consent was required for the present secondary analysis.

Consent for publication

Not applicable

Competing interests

The authors declare no competing interests.

Received: 26 September 2025 / Accepted: 24 May 2026

Published online: 11 June 2026

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