



The Contextual Role of Social Isolation in Frailty-Associated Hospitalization Risk: Evidence from Chinese and European Older Populations



Hui Wang¹, Yan Qiang¹, Zeping Xu¹, Changhao Yin¹ and Yan Xing^{1*}

¹ Department of Intensive Care Unit, Jiangsu Cancer Hospital & Jiangsu Institute of Cancer Research & The Affiliated Cancer Hospital of Nanjing Medical University, Nanjing, 210000, China

*Correspondence to: Yan Xing, Department of Intensive Care Unit, Jiangsu Cancer Hospital & Jiangsu Institute of Cancer Research & The Affiliated Cancer Hospital of Nanjing Medical University, Nanjing, 210000 (yanxing202508@126.com)

ABSTRACT

Background: Global aging intensifies healthcare burdens. Frailty and social isolation independently link to acute hospitalization in older adults. Understanding their combined impact, especially across diverse socio-cultural contexts, is crucial for effective policy. This study investigated their independent and interactive effects on hospitalization risk in China and Europe.

Methods: Data from the China Health and Retirement Longitudinal Study (CHARLS, Wave 3, 2015-2016) and the Survey of Health, Ageing and Retirement in Europe (SHARE, Wave 8, 2019-2020) for adults aged over 60 were analyzed using adjusted Negative Binomial Regression models.

Results: Frailty significantly increased hospitalization risk in both cohorts (CHARLS: IRR=1.029, $p<0.001$; SHARE: IRR=1.016, $p<0.001$). Social isolation's main effect was non-significant. Critically, a significant interaction appeared only in SHARE (IRR=0.998, $p=0.012$), showing frailty's effect attenuated by increasing social isolation. No interaction was seen in CHARLS.

Conclusion: Frailty universally impacts hospitalization. Europe's unique interaction suggests potential healthcare access barriers or alternative care patterns for highly isolated frail older adults. Findings highlight the need for context-specific public health policies to improve accessibility and bolster community support for vulnerable older populations.

Keywords: Social Isolation, Frailty, Hospitalization

INTRODUCTION

The global aging population challenges healthcare systems with increased chronic conditions and acute hospitalizations, underscoring the need for preventive strategies [1-3]. Frailty, a diminished physiological reserve, is a strong predictor of adverse outcomes including acute hospitalization [4-7]. Separately, social isolation is a major public health concern linked to detrimental health outcomes, though its specific influence on healthcare utilization like acute hospitalization requires deeper exploration [8-11].

Despite existing literature, research on the joint and interactive effects of frailty and

social isolation on acute hospitalization risk, especially across diverse socio-cultural and healthcare contexts, remains limited. It is plausible that these factors interact complexly to modulate an individual's vulnerability. Comparing China and European countries, which represent distinct healthcare systems and cultural norms, offers invaluable insights into the generalizability and context-specificity of these associations for global health policy.

Therefore, this study aims to examine the independent and interactive effects of frailty and social isolation on acute hospitalization risk among older adults in China and Europe. Utilizing nationally representative data from CHARLS and SHARE, this research seeks to: 1) quantify the association between frailty and acute hospitalization risk; 2) assess the association between social isolation and acute hospitalization risk; and 3) investigate whether social isolation moderates the frailty-hospitalization link, comparing these relationships across Chinese and European contexts. This will provide crucial empirical evidence to inform targeted, culturally sensitive public health strategies for reducing acute hospitalization rates in an aging global population.

METHODS

This comparative study investigated the associations of frailty and social isolation with acute hospitalization risk in older adults using data from the China Health and Retirement Longitudinal Study (CHARLS, Wave 3, 2015-2016) and the Survey of Health, Ageing and Retirement in Europe (SHARE, Wave 8, 2019-2020). These globally recognized datasets provide comprehensive health, socio-economic, and demographic information for individuals aged 60 and above, ensuring cross-national comparability. Ethical approvals were obtained from Peking University (CHARLS) and the University of Mannheim (SHARE), with all participants providing informed consent.

The primary outcome was self-reported acute hospitalizations in the 12 months prior to the survey. Main independent variables included frailty, operationalized through a frailty index (FI) constructed based on the cumulative deficit model and scaled from 0 to 1, and social isolation. Social isolation was assessed via an unweighted composite score (0-4) derived from the sum of four binary indicators: unmarried status, living alone, infrequent contact with children, and non-participation in social activities. To examine the moderating effect, an interaction term between the frailty index and social isolation score was included.

Models controlled for a comprehensive set of covariates: age, gender, education, marital status, number of chronic diseases, self-rated health, limitations in activities of daily living (ADLs) and instrumental activities of daily living (IADLs), smoking status, alcohol consumption, and urban/rural residence. Due to the count nature and overdispersion of hospital stays, Negative Binomial Regression models were employed. The choice of the negative binomial model over a standard Poisson model was justified by a significant overdispersion test for both the CHARLS ($O = 60.504$, $p < 0.001$) and SHARE ($O = 388.301$, $p < 0.001$) datasets, which confirmed that the variance of the outcome was significantly greater than the mean. Independent models were fitted for the CHARLS and SHARE datasets, each including the frailty index, social isolation

score, and their interaction term (Frailty × Social isolation), alongside all aforementioned covariates, with Incidence Rate Ratios (IRRs) and their 95% Confidence Intervals (CIs) reported, noting that the IRR for the FI corresponds to a 0.1 unit increase in the index to enhance clinical interpretation. Where the interaction term was significant, marginal effects plots illustrated relationships. To account for the complex, multi-stage sampling designs of both CHARLS and SHARE, all analyses were performed using survey-specific sampling weights to produce nationally representative estimates. Standard errors were adjusted for clustering at the primary sampling unit (PSU) level using robust variance estimation to ensure accurate statistical inference. A sensitivity analysis was also conducted by fitting the models without survey weights, and the results confirmed that the direction and significance of the key associations reported were robust. All statistical analyses were conducted using STATA 18.0, with significance set at $p < 0.05$.

RESULTS

Sample Characteristics

The study analyzed 7,395 older adults from CHARLS and 41,553 from SHARE, The data screening process is shown in Figure 1. While both groups had comparable age distributions (mean age: CHARLS 67.77 years; SHARE 72.30 years, $p < 0.001$), significant demographic differences were observed. CHARLS had more males (51.48% vs. 43.87% in SHARE), a higher percentage with primary education or below (92.04% vs. 36.17%), and more married individuals (78.76% vs. 66.00%). Urban residency was lower in CHARLS (39.00%) compared to SHARE (66.43%) (Table 1).

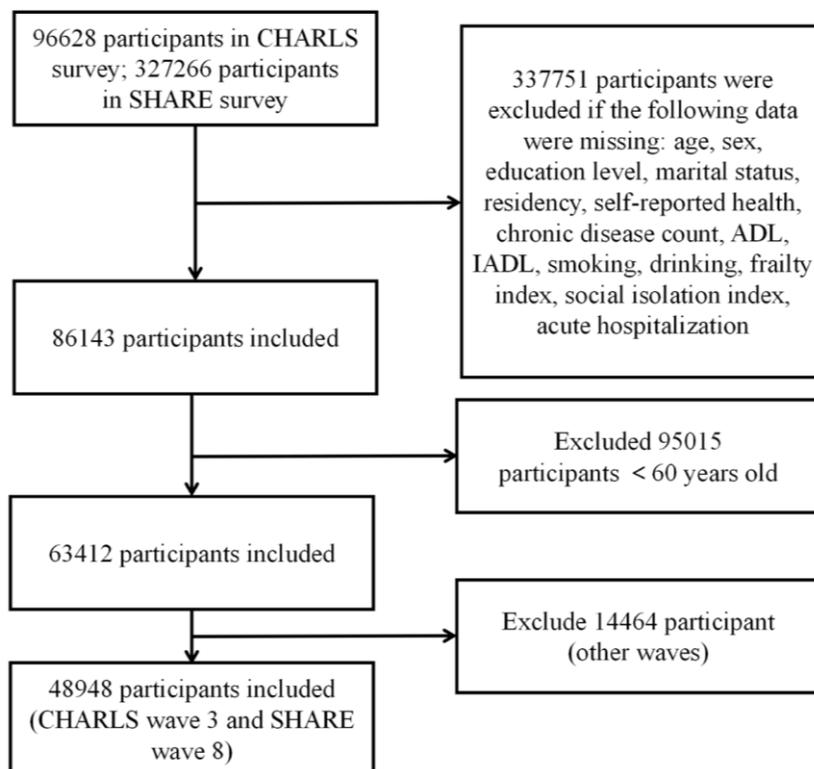


Figure 1: Flowchart of Study Participant Selection

Table 1: Descriptive Statistics of Study Participants in CHARLS and SHARE

Variable	CHARLS (N = 7395)	SHARE (N = 41553)	<i>p</i>
Demographics			
Age, mean (SD)	67.77(6.36)	72.30(8.13)	<0.001
Sex, n (%)			<0.001
Male	3807	18229	
Female	3588	23324	
Education Level, n (%)			<0.001
Primary school or below	6806	15030	
Middle or high school	459	16974	
College or above	130	9549	
Marital Status, n (%)			<0.001
Married	5824	27406	
Others	1571	14147	
Residency, n (%)			<0.001
Urban	2884	27603	
Rural	4511	13950	
Health Status & Function			
Self-Reported Health, n (%)			<0.001
Good/Very Good/Fair	5786	33267	
Very poor/Poor	1609	8286	
Chronic Disease Count, mean (SD)	1.85(1.41)	1.97(1.45)	<0.001
ADL Difficulty Count (0-5), mean (SD)	0.43(0.97)	0.28(0.87)	<0.001
IADL Difficulty Count (0-6), mean (SD)	0.70(1.28)	0.42(1.14)	<0.001
Smoking, n (%)			<0.001
Yes	3578	16882	
No	3817	24671	
Drinking, n (%)			<0.001
Yes	3546	21804	
No	3849	19749	
Key Exposures			
Frailty Index (%), mean (SD)	22.06(15.07)	20.51(14.87)	<0.001
Social Isolation Index, mean (SD)	0.88(0.80)	1.25(1.03)	<0.001
Outcome			
Acute Hospitalization (past year), mean (SD)	0.27(0.73)	0.33(1.11)	<0.001

ADL: Activities of Daily Living, IADL: Instrumental Activities of Daily Living
Negative Binomial Regression Analysis of Acute Hospitalization Risk
Negative Binomial Regression models were employed for both datasets due to observed overdispersion in hospitalization counts, confirming their appropriateness over Poisson regression (Table 2).

Table 2: Results of Negative Binomial Regression Models for Acute Hospitalization Risk among Older Adults in CHARLS and SHARE

Predictors	CHARLS	SHARE
-------------------	---------------	--------------

	p	IRR	95% CI	p	IRR	95% CI
Core Variables & Interaction						
FI, per 0.1 unit	<0.001	1.029	1.019~1.039	<0.001	1.016	1.012~1.020
Social Isolation Score, per unit	0.742	1.024	0.888~1.182	0.903	0.997	0.953~1.044
Frailty × Social isolation, per unit	0.099	0.996	0.992~1.001	0.012	0.998	0.997~1.000
Demographic Covariates						
Age, per year	<0.001	1.024	1.016~1.033	0.001	1.005	1.002~1.008
Gender, Male vs. Female	0.023	1.203	1.025~1.412	<0.001	1.279	1.222~1.339
Education Level, per unit higher education	0.717	0.972	0.832~1.135	<0.001	1.158	1.126~1.192
Marital Status, Married/Partnered vs. Others	0.978	0.998	0.851~1.169	<0.001	0.866	0.807~0.930
Residence, Rural vs. Urban	<0.001	0.788	0.706~0.880	<0.001	1.094	1.048~1.142
Health Status & Behavior Covariates						
Number of Chronic Diseases, per additional disease	<0.001	1.183	1.128~1.240	<0.001	1.174	1.151~1.197
Self-Reported Health, per unit healthier	<0.001	0.706	0.661~0.754	<0.001	0.661	0.642~0.681
ADL Difficulties, per additional difficulty	0.103	0.938	0.869~1.013	0.001	0.947	0.917~0.978
IADL Difficulties, per additional difficulty	0.970	0.999	0.945~1.056	0.004	1.039	1.012~1.067
Smoking Status, Smoker vs. Non-smoker	0.284	0.922	0.794~1.070	<0.001	1.114	1.066~1.165
Drinking Status, Drinker vs. Non-drinker	0.029	1.142	1.014~1.287	<0.001	0.839	0.802~0.878
Model Fit Statistics						
N, Observations	7395			41553		
McFadden R-squared	0.085			0.094		
Likelihood Ratio Test: χ^2 , p-value	817.224, 0.000			5829.878, 0.000		
Overdispersion Test: O value, p-value	60.504, 0.000			388.301, 0.000		

FI: Frailty Index, ADL: Activities of Daily Living, IADL: Instrumental Activities of Daily Living, IRR: Incidence Rate Ratio, CI: Confidence Interval. Incidence Rate Ratios (IRRs) for continuous predictors are reported per unit of increase as follows: per 1-year for Age, per 1-disease for Number of chronic diseases, per 1-point for the Social Isolation Index, and per 0.1 unit for the Frailty Index.

Results from the CHARLS Model and the SHARE Model

In the Chinese context, frailty was a significant positive predictor of acute hospitalization risk (IRR = 1.029, 95% CI: 1.019~1.039, $p < 0.001$), indicating a 1.6% increase in hospitalization rate per unit increase in frailty index. Social isolation and the interaction term between frailty and social isolation were not statistically significant (IRR = 1.024, $p = 0.742$ for social isolation; IRR = 0.996, $p = 0.099$ for interaction), suggesting frailty's effect on hospitalization is consistent across social isolation levels in China. Significant covariates included older age, male gender, higher chronic diseases, and worse self-rated health increasing risk, while rural residence surprisingly decreased risk.

Similarly, frailty was a robust positive predictor of acute hospitalization risk in Europe (IRR = 1.016, 95% CI: 1.012~1.020, $p < 0.001$). Social isolation's main effect was not significant (IRR = 0.997, $p = 0.903$). However, the interaction term between frailty and social isolation was statistically significant (IRR = 0.998, 95% CI: 0.997~1.000, $p = 0.012$). This indicates a moderating effect where increased social isolation attenuated the positive association between frailty and acute hospitalization risk in Europe.

Among SHARE covariates, older age, male gender, higher education levels, more chronic diseases, and worse self-rated health increased hospitalization risk. Being married/partnered and current drinkers were associated with reduced risk. Contrary to CHARLS, rural residence increased risk (IRR=1.094, $p < 0.001$), and higher ADL limitations were associated with a decreased risk (IRR = 0.947, $p < 0.001$).

Interpretation of Interaction Effect in SHARE

The significant negative interaction in SHARE suggests that while frailty consistently increases hospitalization risk, this effect is less pronounced among highly socially isolated individuals. Marginal effects plots (Figure 2) visually confirmed that the steepest increase in hospitalization with frailty was for individuals with the lowest social isolation, flattening for those with higher social isolation. This counter-intuitive finding implies that highly isolated frail older adults in Europe might experience lower acute hospitalization rates, possibly due to barriers in healthcare access or reliance on alternative care modalities.

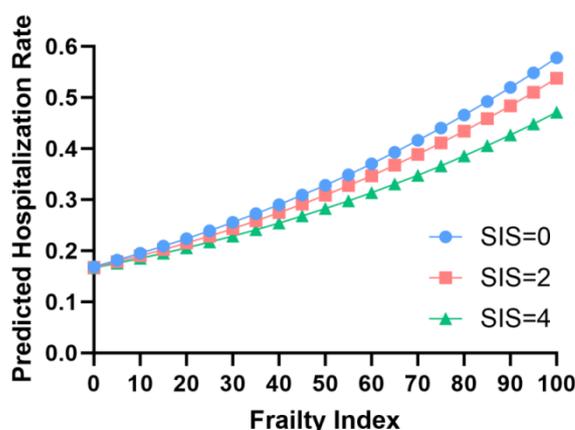


Figure 2: Predicted Hospitalization Rate by Frailty Index at Different Levels of Social Isolation in the SHARE Cohort

DISCUSSION

This comparative study leveraged large-scale CHARLS (China) and SHARE (Europe) datasets to explore the distinct impacts of frailty and social isolation on acute hospitalization risk among older adults within diverse socio-economic and healthcare contexts. Our robust findings offer crucial insights for global public health strategy.

Frailty consistently emerged as a powerful predictor of acute hospitalization across both populations, underscoring its universal public health significance [1-3, 4-7]. This reinforces that frailty is a fundamental indicator of heightened health vulnerability. Therefore, it must be integrated into routine public health surveillance and preventive care programs worldwide. Systematic frailty screening could facilitate the early identification of high-risk individuals. This would enable community-based interventions to delay progression and potentially reduce the burden on acute care services.

A particularly compelling and policy-relevant finding was the strikingly divergent interaction between frailty and social isolation. In Europe (SHARE), a statistically significant negative interaction was observed: as social isolation deepened, the amplifying effect of frailty on hospitalization risk surprisingly diminished. This counter-intuitive phenomenon suggests potential unmet healthcare needs among highly isolated, frail older Europeans. If these individuals are not being hospitalized despite high frailty, it may indicate systemic barriers to access. These barriers could include a lack of social support to navigate complex healthcare systems or insufficient community-based care alternatives that might otherwise prevent acute crises [18-20]. This points to a "hidden burden" of illness, where health deterioration may occur outside acute hospital settings. Public health policies must therefore focus on active outreach programs to identify and support socially isolated frail older adults. Such programs are essential for ensuring equitable access and strengthening social safety nets. Conversely, the absence of a significant interaction in China (CHARLS) suggests that frailty's elevated hospitalization risk is relatively consistent across varying social isolation levels. This may reflect fundamental differences in societal structures, where traditional family support systems in China might still play a more pervasive role in facilitating healthcare access, irrespective of broader social networks. The evolving nature of China's healthcare system, including universal health insurance expansion, might also contribute to a more uniform access landscape. However, further investigation into care access for frail, isolated individuals in China is warranted to ensure robust health equity.

Our analysis also revealed other significant cross-national distinctions in the determinants of hospitalization, highlighting the profound influence of socio-economic context. For instance, rural residence in China (CHARLS) was paradoxically associated with a significantly lower acute hospitalization risk (IRR=0.788, $p<0.001$). This counter-intuitive finding does not likely reflect better health, but rather may indicate significant systemic barriers to accessing hospital care for rural residents, or a greater reliance on local clinics and family-based care that is not captured as formal hospitalization.

In the European cohort (SHARE), rural residence was also significantly associated with an increased risk of hospitalization. This suggests that despite robust healthcare systems, disparities in access to primary and preventative care may still exist between rural and urban areas. Educational attainment also showed varied associations: not significant in CHARLS, but higher levels in Europe (SHARE) were significantly associated with increased hospitalization, possibly due to greater health literacy and proactive healthcare-seeking behaviors among more educated individuals.

A particularly striking divergence was observed regarding Activities of Daily Living (ADL) difficulties. In China (CHARLS), greater ADL difficulty was not significantly associated with hospitalization risk (IRR=0.938, $p=0.103$). However, in Europe (SHARE), greater ADL difficulty was paradoxically associated with reduced hospitalization. This suggests a crucial difference in care pathways. In Europe, highly ADL-impaired older adults may be disproportionately residing in long-term care facilities. In these settings, their acute needs are often managed institutionally, which diverts care from hospitals. This highlights the potential role of robust long-term care infrastructure in Europe, a model less prevalent or accessible in China. Furthermore, behavioral factors like smoking and drinking exhibited nuanced cross-national roles, emphasizing that public health interventions targeting lifestyle behaviors must be informed by local contexts.

These distinct patterns underscore that effective health policies for aging populations must be culturally sensitive, context-specific, and deeply informed by national epidemiological patterns and healthcare system characteristics. They highlight the necessity of developing tailored interventions that acknowledge the unique interplay of socio-economic factors, healthcare system design, and cultural norms in shaping health outcomes and healthcare utilization.

This study offers valuable insights but has several limitations. Its cross-sectional design precludes causal inference and necessitates longitudinal studies for validation. Additionally, reliance on self-reported hospitalization data may underestimate the full burden of acute care needs. Another limitation arises from the use of data from different time periods: CHARLS data were drawn from 2015–2016, while SHARE data came from 2019–2020, overlapping with the onset of the COVID-19 pandemic. This discrepancy may introduce period effects. The pandemic and related public health measures significantly altered healthcare access and utilization globally. For example, these circumstances could have suppressed hospitalizations for less severe conditions while increasing them for COVID-19. This, in turn, may have influenced the observed associations in the European cohort. Nevertheless, the fundamental relationship between frailty, social isolation, and increased vulnerability to health shocks remains a robust, well-documented phenomenon, and we believe the direction of the associations still reflects this core relationship. Finally, the ongoing need for standardized definitions across international studies remains crucial for rigorous comparative public health research.

CONCLUSION

Frailty universally predicts hospitalization. Social isolation's impact varies by context (Europe: access barriers; China: consistent management). Policies need integrated,

context-specific strategies for aging populations.

ETHICAL CONSIDERATIONS:

The National School of Development at Peking University provided the data sets in the CHARLS. The original CHARLS study was approved by the Institutional Review Board (IRB) of Peking University (approval number: IRB00001052-11015 for the household survey and IRB00001052-11014 for blood samples). The SHARE project was approved by the Ethics Committee of the University of Mannheim. The SHARE data collection procedures are subject to continuous ethics review by international research ethics principles such as the professional and ethical guidelines for the conduct of socio-economic research and the Declaration of Helsinki. All participants provided written informed consent.

DATA AVAILABILITY STATEMENTS:

The original survey data involved in this study were sourced from the CHARLS database (<https://charls.charlsdata.com/>) and SHARE database (<https://share-eric.eu/>; DOI:10.6103/SHARE.w8.900).

REFERENCES

1. Gianfredi V, Nucci D, Pennisi F, Maggi S, Veronese N, Soysal P: Aging, longevity, and healthy aging: the public health approach. *Aging Clin Exp Res* 2025, 37(1):125.
2. Watson KB, Wiltz JL, Nhim K, Kaufmann RB, Thomas CW, Greenlund KJ: Trends in Multiple Chronic Conditions Among US Adults, By Life Stage, Behavioral Risk Factor Surveillance System, 2013-2023. *Prev Chronic Dis* 2025, 22:E15.
3. Loyd C, Markland AD, Zhang Y, Fowler M, Harper S, Wright NC, Carter CS, Buford TW, Smith CH, Kennedy R et al: Prevalence of Hospital-Associated Disability in Older Adults: A Meta-analysis. *J Am Med Dir Assoc* 2020, 21(4):455-461 e455.
4. Yang ZC, Lin H, Jiang GH, Chu YH, Gao JH, Tong ZJ, Wang ZH: Frailty Is a Risk Factor for Falls in the Older Adults: A Systematic Review and Meta-Analysis. *J Nutr Health Aging* 2023, 27(6):487-595.
5. Boucher EL, Gan JM, Rothwell PM, Shepperd S, Pendlebury ST: Prevalence and outcomes of frailty in unplanned hospital admissions: a systematic review and meta-analysis of hospital-wide and general (internal) medicine cohorts. *EClinicalMedicine* 2023, 59:101947.
6. Fehlmann CA, Patel D, McCallum J, Perry JJ, Eagles D: Association between mortality and frailty in emergency general surgery: a systematic review and meta-analysis. *Eur J Trauma Emerg Surg* 2022, 48(1):141-151.
7. Knight T, Atkin C, Kamwa V, Cooksley T, Subbe C, Holland M, Sapey E, Lasserson D: The impact of frailty and geriatric syndromes on metrics of acute care performance: results of a national day of care survey. *EClinicalMedicine* 2023, 66:102278.
8. Brandt L, Liu S, Heim C, Heinz A: The effects of social isolation stress and discrimination on mental health. *Transl Psychiatry* 2022, 12(1):398.
9. Wang F, Gao Y, Han Z, Yu Y, Long Z, Jiang X, Wu Y, Pei B, Cao Y, Ye J et al: A systematic review and meta-analysis of 90 cohort studies of social isolation, loneliness

- and mortality. *Nat Hum Behav* 2023, 7(8):1307-1319.
10. Usama SM, Kothari YL, Karthikeyan A, Khan SA, Sarraf M, Nagaraja V: Social Isolation, Loneliness, and Cardiovascular Mortality: The Role of Health Care System Interventions. *Curr Cardiol Rep* 2024, 26(7):669-674.
 11. Mosen DM, Banegas MP, Tucker-Seeley RD, Keast E, Hu W, Ertz-Berger B, Brooks N: Social Isolation Associated with Future Health Care Utilization. *Popul Health Manag* 2021, 24(3):333-337.
 12. Politis M, Crawford L, Jani BD, Nicholl BI, Lewsey J, McAllister DA, Mair FS, Hanlon P: An observational analysis of frailty in combination with loneliness or social isolation and their association with socioeconomic deprivation, hospitalisation and mortality among UK Biobank participants. *Sci Rep* 2024, 14(1):7258.
 13. Zhao Y, Hu Y, Smith JP, Strauss J, Yang G: Cohort profile: the China Health and Retirement Longitudinal Study (CHARLS). *Int J Epidemiol* 2014, 43(1):61-68.
 14. Borsch-Supan A, Brandt M, Hunkler C, Kneip T, Korbmacher J, Malter F, Schaen B, Stuck S, Zuber S, Team SCC: Data Resource Profile: the Survey of Health, Ageing and Retirement in Europe (SHARE). *Int J Epidemiol* 2013, 42(4):992-1001.
 15. Theou O, Brothers TD, Mitnitski A, Rockwood K: Operationalization of frailty using eight commonly used scales and comparison of their ability to predict all-cause mortality. *J Am Geriatr Soc* 2013, 61(9):1537-1551.
 16. Hoogendijk EO, Afilalo J, Ensrud KE, Kowal P, Onder G, Fried LP: Frailty: implications for clinical practice and public health. *Lancet* 2019, 394(10206):1365-1375.
 17. Kocot E: Unmet Health Care Needs of the Older Population in European Countries Based on Indicators Available in the Eurostat Database. *Healthcare (Basel)* 2023, 11(19).
 18. Cabanero-Garcia E, Martinez-Lacoba R, Pardo-Garcia I, Amo-Saus E: Barriers to health, social and long-term care access among older adults: a systematic review of reviews. *Int J Equity Health* 2025, 24(1):72.
 19. Bertolazzi A, Quaglia V, Bongelli R: Barriers and facilitators to health technology adoption by older adults with chronic diseases: an integrative systematic review. *BMC Public Health* 2024, 24(1):506.
 20. Nguyen TNM, Whitehead L, Saunders R, Dermody G: Systematic review of perception of barriers and facilitators to chronic disease self-management among older adults: Implications for evidence-based practice. *Worldviews Evid Based Nurs* 2022, 19(3):191-200.
 21. Pan D, Wang H, Wu S, Wang J, Ning Y, Guo J, Wang C, Gu Y: Unveiling the Hidden Burden: Estimating All-Cause Mortality Risk in Older Individuals with Type 2 Diabetes. *J Diabetes Res* 2024, 2024:1741878.
 22. Howland J, Stone A: Public health nurses for case finding, assessment and referral of community-dwelling socially isolated and/or lonely older adults. *Front Public Health* 2023, 11:1114792.
 23. Nakagomi A, Tsuji T, Saito M, Ide K, Kondo K, Shiba K: Social isolation and subsequent health and well-being in older adults: A longitudinal outcome-wide analysis. *Soc Sci Med* 2023, 327:115937.

24. Jiang Z, Chen H, Lu T, Yin F, Ma Y: The Association Between Family Support and Changes in Self-Rated Health Among Chinese Older Adults: How Living Arrangements Moderate the Association? *J Am Med Dir Assoc* 2024, 25(5):810-816 e815.
25. Li XM: Spatiotemporal evolution and development path of healthcare services supply in China. *BMC Health Serv Res* 2024, 24(1):1258.
26. Shan L, Gan Y, Yan X, Wang S, Yin Y, Wu X: Uneven primary healthcare supply of rural doctors and medical equipment in remote China: community impact and the moderating effect of policy intervention. *Int J Equity Health* 2024, 23(1):97.
27. Zhang Z: Survey and analysis on the resource situation of primary health care institutions in rural China. *Front Public Health* 2024, 12:1394527.
28. Albert C, Davia MA: Education is a key determinant of health in Europe: a comparative analysis of 11 countries. *Health Promot Int* 2011, 26(2):163-170.
29. Moreno-Llamas A, De la Cruz-Sanchez E: Moderate Beer Consumption Is Associated with Good Physical and Mental Health Status and Increased Social Support. *Nutrients* 2023, 15(6).