BMJ Open

Relationship between frailty and long-term care needs in Chinese community-dwelling older adults: a cross-sectional study

Rui Chen,[1,2,3] Wen Bo Zhao,[4] Xiao Pei Zhang,[2,3] Hao Liang,[2,3] Na Na Song,[2,3] Zhu Yun Liu,[2,3] Hui Xiao,[2,5] Xue Ting Peng,[6] Yang Song,[1] Ruo Tong Liao,[1,2,3] Wang Hui Luo,[7] Lin Wei [ID] [2,5]

For numbered affiliations see end of article.

Correspondence to
Lin Wei;
weilin22@gzucm.edu.cn

ABSTRACT

Objectives Our study aimed to investigate the relationship between the severity of frailty and the long-term care (LTC) needs of older adults from Chinese communities.

Design A cross-sectional study.

Setting Three Chinese community health centres. All data were collected by trained researchers through face-to-face collection.

Participants We surveyed a total of 540 older residents who aged 60 or older from community in Guangzhou, China.

Measures The Chinese version of the Tilburg frailty indicator was used to assess the frailty status of participants. LTC needs was evaluated by Integrated Home Care Services Questionnaire. Using non-adjusted and multivariate adjusted logistic regression analysis to evaluate frailty and LTC needs, then smoothed plots, threshold effect analysis and P for trend were used to further investigate the relationship between them.

Results The prevalence of frailty was 45.2% among the 540 older adults enrolled (aged 70.4±8.3 years; 65.7% females). 27% had higher LTC needs, which increased to 65.1% for individuals with frailty. Logistic regression analysis showed that frailty was strongly associated with LTC needs (OR 3.06, 95% CI 2.06 to 4.55, p<0.01). In the multivariate model, after adjusting for demographic characteristics, economic situation, activities of daily living and comorbidities, frailty remained significantly associated with LTC needs (OR 2.32, 95% CI 1.39 to 3.88, p<0.01). The smoothed plots showed a nearly linear relationship between frailty and LTC needs. Threshold effect analysis showed that every point increase in frailty, the score of LTC needs increased 1.3 points. The IQR to regroup individuals with frailty. Compared with the first quartile (scores ≤2), the incidence of LTC needs increased with the frailty status (p value for trend <0.01).

Conclusion There is a linear relationship between frailty and LTC needs. With the increasing degree of frailty, the LTC needs of older adults dramatically increases.

INTRODUCTION

Frailty is becoming an increasing health concern with the ageing of the world's population.[1] It is not a disease but rather a

Strengths and limitations of this study

► This study is the first to evaluate the relationship between frailty and LTC needs at a multilevel in Chinese community.

► We adjusted in a stepwise manner for potential confounders to estimate the independent relationship between frailty and LTC needs.

► This study used a novel statistical method smoothing plots, threshold effect analysis and P for trends to find the relationship.

► This study was a cross-sectional study, the causal relationship between frailty and long-term care needs could not be demonstrated in this study.

► There is the possibility of selection bias in the data.

geriatric syndrome and has been defined as a state of vulnerability to adverse health factors.[2] Rohrmann's study reported that the prevalence of frailty ranges from 4% to 59%, which indicates that frailty is a common phenomenon among older adults.[3] Frailty is a complex age-related clinical symptom, due to chronic inflammation, a gradual decrease in physiological reserve and function across multiple organ systems leads to an imbalance of homeostatic control mechanisms.[4] Considering the physiological mechanisms of frailty, individuals with frailty are prone to adverse health outcomes involving falls, disabilities, hospitalisations, reduced quality of life or even death.[5] Thus, there are varying degrees of demands for medical and care resources among the older persons with frailty.[6]

Given the expanding frail older adults population and its major consequences on healthcare, studies on frailty have achieved increasing interest. Evidence suggests that sustainable long-term care (LTC) can promote health, reduce the harmful effects of chronic diseases, maintain functional autonomy

and respond to population ageing effectively.[7–9] LTC is described as a care activity that ensures the maximum possible independence, autonomy, participation and personal satisfaction of individuals who cannot fully take care of themselves.[10] In Japan, the main reasons for the requirement of LTC include cerebrovascular disease (17.2%), dementia (16.4%), age-related frailty (13.9%), falls and fractures (12.2%) and joint disease (11.0%).[11] It has been demonstrated that the unmet LTC needs were associated with negative outcomes such as falling, and the increasing use of primary, emergency, and acute healthcare services.[12 13] And most of the older adults with frail require some form of long-term care.[9 14] In addition, prefrail and frail older adults had a significantly higher risk of needing long-term care insurance (LTCI) services than robust older adults.[15] And it indicated that older persons with frail represent a dominant patient group for family practice, however, less attention has been given to the need for patients, and how frailty affects their needs.[16] Previous studies have shown that frailty may be associated with LTC needs,[14 15 17–19] but the specific relationship remains unclear. Thus, identifying and addressing the LTC needs of the frail is of great significance to reverse or delay the onset of frailty and improve the outcome of older adults.

The aim of this study was to classify the level of frailty and to explore the relationship between different severities of frailty and the resulting LTC needs. Our findings may provide empirical evidence for the development of intervention programmes for the frail older adults with their LTC needs.

METHODS
Study design setting and participants
A cross-sectional study was conducted among Guangzhou community-dwelling older adults. A stratified random sampling method was applied. Using a stratified random sampling method. The specific sampling steps are as follows: First, The Guangzhou's administrative regions were divided into three levels (high, moderate and low) based on its 2017 gross domestic product (GDP). Second, three districts (high: Yuexiu district; moderate: Haizhu district; low: Liwan district) were randomly selected from each level by lottery method. Finally, one street from each district was selected by convenience sampling. Participants were recruited through face to face with researchers at community health service centres. A total of 600 questionnaires were distributed and 597 were recovered. 57 questionnaires were removed from the analysis due to excessive missing data (data missing more than 25%). The inclusion criteria were: (1) aged 60 or older, (2) residing in the survey community for more than 5 years, (3) informed consent and (4) having suitable communicating and writing skills. The exclusion criteria were: (1) limited autonomy, such as physical limitations or mental incapacity.

Sample size
The sample size calculation formula [$n=(Z^2_{\alpha/2}pq)/^2$] for cross-sectional studies was used to calculate the minimum theoretical sample size for this study.[20] And the prevalence of frailty as 5.9% in Taipei community.[21] Details are as follows: (1) p=0.059, (2) q equals to (1 p)=0.941, (3) $Z_{\alpha/2}$= 1.96 and (4) represents an allowable error and equals to 0.02. Thus the sizes of our samples were 533, considering the invalid questionnaire, we increased the sample size by 10%, and the final theoretical sample size was 586. Ultimately, a total of 600 questionnaires were distributed.

Data collection
The study was carried out from July 2018 to January 2019. Data was collected face-to-face by undergraduate or graduate students. We explained the specific purpose, significance, and how to fill out the questionnaires of the investigation and obtain informed consent before the participants fill in the questionnaire. Meanwhile, names were not required on the questionnaires, and the strict confidentiality of participants' responses was assured.

Measurements
Demographic information
We used a self-designed questionnaire, including sex, age (60–69, 70–79,≥80), educational level (primary, junior, senior or higher), economic situation [monthly income (<3000 RMB, 3001-4500RMB, 4501-6000RMB, 6001-7500RMB,>7500 RMB), source of payment for medical expenses (free, medical or other)], and comorbidities (hypertension, osteoarthrosis, diabetes, stroke, cardiovascular disease).

Assessment of long-term care needs
The integrated home care services questionnaire was designed by our research group based on the Omaha system. It was validated to use with Chinese older adults and showed good reliability and validity in our previous research.[22] The total of Cronbach's α coefficient was 0.969. The questionnaire was used to evaluate LTC needs of the older adults who are living in the community. It consisted of 43 items in four dimensions: physiological fields (23 items), psychosocial fields (7 items), health-related behavioural fields (5 items), and environmental fields (8 items). For each item, participants were asked to indicate their level of LTC needs, with a 5-point Likert scale (1=not at all; 2=a little bit; 3=neutral; 4=quite a bit satisfied; and 5=very satisfied). The total scores ranged from 43 to 215, with higher scores indicating a higher level of LTC needs. In this study, we divided the LTC needs of each domain into two groups: 'no/low demand (including not at all/a little bit)' and 'moderate/high demand (including neutral/quite a bit satisfied/very satisfied)', specifically, the score of item ≥3 points and total score ≥129 points defined as higher LTC needs.[23 24]

Assessment of frailty
Gobbens et al,[25] developed the Tilburg frailty indicator (TFI) in 2010. It is a scale of self-report assessment that

includes three dimensions: physical frailty (8items), psychological frailty (four items), and social frailty (three items), to measure the frailty status among community-dwelling older people. Xi et al,[26] translated this scale into Chinese and applied the scale to older individuals with chronic diseases. The total score ranges from 0 to 15 points. 5 points and above are considered indicative of frailty, scores below five points are considered non-frail, while higher scores indicate a severe frailty state. The TFI is appropriate for the evaluation of frailty in the older adults Chinese population.

Assessment of activities of daily living

Barthel's activities of daily living (ADL) index (range 0 to 100) was developed by Dorother and Florence et al,[27] to evaluate functional ability in 1965. It comprises 10 items. Cronbach's α was 0.916, with lower scores indicating more severe ability to live dependently. The dependence level was ranked according to the physical condition: severe dependence ($\leq$40 points), medium dependence (41–60 points), minimum dependence (61–99 points), and independence (100 points).

Bias

The participants with mobility difficulties and mental incapacity were excluded, which may lead to potential selection bias. And we adjusted for multi-model confounding factors to address potential sources of bias.

Statistical analysis

This study was categorised into two groups based on the individual's LTC needs. Categorical variables were provided as numbers and percentages. All the categorical variables were analysed with the Chi-squared test. Univariate and multivariable logistic regression models were used to identify influencing factors of LTC needs. Several confounders were adjusted in the logistic models. Model one included frailty with no variables. Model two was adjusted for population characteristics. Model three was further adjusted for economic conditions. Model four was further adjusted for ADL. Model five adjusted comorbidities for all variables.Logistic regression determined the ORs and 95% confidence intervals (CIs). Next, the total frailty score was analysed as a continuous variable to construct smoothed plots of frailty and LTC needs. Threshold effect analysis used to found inflection point. Frailty scores were divided into quartiles as follows: quartile 1 (Q1) ($\leq$2 points), quartile 2 (Q2) (3–4 points), quartile 3 (Q3) (5–7 points), and quartile 4 (Q4) (>seven points). P-values for trends were used to estimate the trends of relationships between each level increase in frailty with LTC needs. All date were performed using Epi Data 3.1, and we use SPSS version 22.0 software for data analyses. Empower Stats using the statistical package R (3.4.3 version) for smoothed plots. This modle applies generalised additive model (GAM) to test the non-linear associations between outcome and exposure. P-values of <0.05 were considered statistically significant. 57 questionnaires were removed from the analysis because of missing more than 25%, then no missing value in this study.

Patient and public involvement

Patients and public were not involved in the study.

RESULTS

600 participants questionnaires were distributed, 597 of whom returned questionnaires for a response rate of 99.5%. A total of 540 participants were included for analysis excluding 57 participants because of missing survival data. And 34.1% were from Yuexiu district, 43.5% were form Haizhu district, 22.4% were from Liwan district. The age of the 540 participants ranged from 60 to 94 years, with a mean±SD age of 70.4±8.3and 65.7% of the participants were female. Overall, table 1 showed 9.6% of participants had a higher education level, while participants in the educational level of primary, junior, and senior represented 31.3%, 27.8%, and 31.3%, respectively. The prevalence of participants with independence, mild dependence, medium dependence, and severe dependence levels was 58.3%, 31.7%, 5%, and 5%, respectively. The participants had a mean score of 108.77±34.741 for LTC needs and the mean frailty score was 4.7±2.9 (median: 4 points; range: 0–15 points). The prevalence of participants with frailty was 45.2%. Their estimated LTC needs were classified into two levels: 27.0% of 540 participants had higher LTC needs and 65.1% of frail older adults had higher LTC needs. Table 1 reports the demographics and comorbidities of the participants. LTC needs showed dramatic differences in terms of age, education level, income, source of payment for expenses, and comorbidities including osteoarthrosis, stroke, cardiovascular disease, frailty level, and ADL (p<0.05).

The relationship between frailty and LTC needs was investigated using binary logistic regression analysis. Five multivariable models were estimated by adjusting for age, sex, education level, monthly income, source of payment of expenses, ADL, osteoarthrosis, stroke, and cardiovascular disease. The results showed that there was a significant relationship between frailty and LTC need and the ORs were 3.06, 3.1, 3.1, 2.5, and 2.3, respectively (table 2). We used the IQR to regroup the cases of frailty. Compared with Q1, the increase in the frailty score was closely related to the need for LTC (P-value for trend <0.01). After adjusting covariates, the P-values for trend were <0.01,<0.01,<0.01, and <0.02, respectively (table 3). This indicated a linear trend between frailty and LTC needs. The dose-response relationship between the state of frailty and LTC needs level is illustrated in figure 1. The smoothed plots showed that there was a nearly linear relationship between frailty and LTC needs. Threshold effect analysis showed every point increase in frailty, the score of LTC needs increased 1.3 points.

DISCUSSION

In this cross-sectional study, 540 older adults were enrolled to examine the relationship between frailty status and

Table 1 Demographic and comorbidities of enrolled study subjects

Variable	Total	Level 1	Level 2	c^2	P-value
All	540	394 (73.0)	146 (27.0)		
Sex					
Male	185 (34.3)	128 (32.5)	57 (39.0)	2.032	0.154
Female	355 (65.7)	266 (67.5)	89 (61.0)		
Age Group					
60–69	269 (49.8)	212 (53.8)	57 (39.0)	16.096	<0.001**
70–79	174 (32.2)	126 (32.0)	48 (32.9)		
≥80	97 (18.0)	56 (14.2)	41 (28.1)		
Education					
Primary	169 (31.3)	130 (33.0)	39 (26.7)	10.507	0.015*
Junior	150 (27.8)	115 (29.2)	35 (24.0)		
Senior	169 (31.3)	120 (30.5)	49 (33.6)		
Higher	52 (9.6)	29 (7.4)	23 (15.8)		
Income					
<3000	137 (25.4)	113 (28.7)	24 (16.4)	22.089	<0.001**
3001–4500	280 (51.9)	208 (52.8)	72 (49.3)		
4501–6000	61 (11.3)	41 (10.4)	20 (13.7)		
6001–7500	18 (3.3)	10 (2.5)	8 (5.5)		
>7500	44 (8.1)	22 (5.6)	22 (15.1)		
Payment of Expenses					
Free	61 (11.3)	32 (8.1)	29 (19.9)	14.659	0.001**
Medical	459 (85.0)	347 (88.1)	112 (76.7)		
Other	20 (3.7)	15 (3.8)	5 (3.4)		
Frailty					
No	296 (54.8)	245 (62.2)	51 (34.9)	31.940	<0.001**
Yes	244 (45.2)	149 (37.8)	95 (65.1)		
Hypertension					
No	250 (46.3)	179 (45.4)	71 (48.6)	0.438	0.508
Yes	290 (53.7)	215 (54.6)	75 (51.4)		
Osteoarthrosis					
No	422 (78.1)	322 (81.7)	100 (68.5)	10.928	0.001**
Yes	118 (21.9)	72 (18.3)	46 (31.5)		
Diabetes					
No	403 (74.6)	297 (75.4)	106 (72.6)	0.434	0.510
Yes	137 (25.4)	97 (24.6)	40 (27.4)		
Stroke					
No	336 (62.2)	261 (66.2)	75 (51.4)	10.026	0.002**
Yes	204 (37.8)	133 (33.8)	71 (48.6)		
Cardiovascular disease					
Yes	452 (83.7)	339 (86.0)	113 (77.4)	5.834	0.016*
No	88 (16.3)	55 (14.0)	33 (22.6)		
Activities of daily living					
Severely dependence	27 (5.0)	8 (2.0)	19 (13.0)	42.746	<0.001**
Medium dependence	27 (5.0)	12 (3.0)	15 (10.3)		
Minimum dependence	171 (31.7)	125 (31.5)	46 (31.5)		
Independence	315 (58.3)	249 (63.2)	66 (45.2)		

Level 1: Long-term care scores<129;
Level 2: Long-term care scores≥129.
*indicates a dramatic difference (p<0.05); **indicates a dramatic difference (p<0.01).

Table 2 Association of frailty and long-term care needs in the study subjects (n=540)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
OR	3.063	3.111	3.105	2.501	2.328
95% CI	2.060 to 4.553	2.024 to 4.782	2.005 to 4.811	1.525 to 4.101	1.394 to 3.887
Wald	30.615	26.778	25.740	13.202	10.426
P-value	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**

Model 1: Frailty.
Model 2: Adjusted demographic characteristics (gender, education level and age).
Model 3: Adjusted model two and economic situation (monthly income and payment manner of expenses).
Model 4: Adjusted model three and Activities of daily living (ADL).
Model 5: Adjusted for model four and comorbidities (osteoarthrosis, stroke and cardiovascular).
*indicates a dramatic difference (p<0.05); **indicates a dramatic difference (p<0.01).

need for LTC. We found the LTC need increased significantly with the increasing severity of frailty. There is a linear relationship between LTC need and frailty status. Older adults with severe frailty showed a greater demand for LTC. Moreover, the risk of LTC needs increased 30% with each point increase in frailty.

This study showed the overall prevalence of fraily in our study sample was 45.2%. However, the prevalence of frailty among older adults living in communities in the Asia-Pacific region is about 3.5%–27%.[28] It indicating that frailty has become a common problem for the older adults.[29] The major reasons for this inconsistency in the present study compared with a previous study might be the geographical variations and differences in measurement tools. And the rapidly ageing population and those with chronic diseases may result in a significantly increased demand for LTC.[30 31] 27% of the participants had higher LTC need, which was similar to that of previous study.[32] There are significant differences among LTC need in terms of age, education level, monthly income, medical and payment manner of expenses, which is consistent with previous studies.[33 34] Our study stressed the role of frailty, ADL dependence, comorbidities (osteoarthrosis, stroke, cardiovascular disease) on an older adult's LTC needs. In a population with high LTC needs, the proportion of frail is 65.1%, which is significantly higher than

non-frail individuals, suggesting that frail older individuals often have higher LTC needs.

In our study, a correlation between frailty and LTC need was demonstrated. Multi-model analysis indicated that the LTC demand of older adults in the frail status were 3.063-fold higher than for non-frail adults. The significant association between frailty and LTC need persisted even after adjustment of confounding factors, however, this association weakened after adding the ADL and comorbidities to the analyses. One possible explanation for the difference is as follow. The LTC need among older adults with chronic disease or disability is higher than frailty.[35] Compared with non-frail older persons, LTC needs increased by 2.328-fold in frail older individuals. We found that frailty, an important factor for LTC needs, was not always affected by other factors. Unlike the previous study, in our study further regrouping the frailty status into quartiles underlined the positive correlation between frailty and LTC needs. The risk of LTC need increased by 6.015- and 2.750-fold in the highest quarter group 4 (>7) and medium quarter group 3 (>4,≤7) than the lowest quarter group 1(≤2), respectively. After adjustment of confounders, the LTC needs added 4.375 fold in the highest quartile group (Q4) (>7), which was in contrast with the lowest quarter group 1 (Q1) (≤2). It indicated that there was a strong association between frailty severity

Table 3 Trend of frailty and long-term care needs in the study subjects (n=540)

Frailty state	Q1 (2(≤2))	Q2 (3(>2≤4)) Or (95% CI)	Q3 (6(>4≤7)) Or (95% CI)	Q4 (9(>7)) Or (95% CI)	*P-value* for trend
Case	152	144	134	110	
Model 1	1.0	1.642 (0.891 to 3.026)	2.750 (1.526 to 4.958)	6.015 (3.324 to 10.887)	<0.001**
P-values		0.112	0.001**	<0.001**	
Model 2	1.0	1.584 (0.850 to 2.95)	2.908 (1.578 to 5.358)	5.898 (3.131 to 11.110)	<0.001**
P-values		0.148	0.001**	<0.001**	
Model 3	1.0	1.542 (0.818 to 2.907)	2.738 (1.470 to 5.098)	6.141 (3.224 to 11.700)	<0.001**
P-values		0.181	0.001**	<0.001**	
Model 4	1.0	1.614 (0.848 to 3.073)	2.664 (1.373 to 5.169)	4.981 (2.353 to 10.548)	<0.001**
P-values		0.145	0.004**	<0.001**	
Model 5	1.0	1.436 (0.747 to 2.758)	2.374 (1.203 to 4.685)	4.375 (2.00 to 9.568)	<0.002**
P-values		0.277	0.013*	<0.001**	

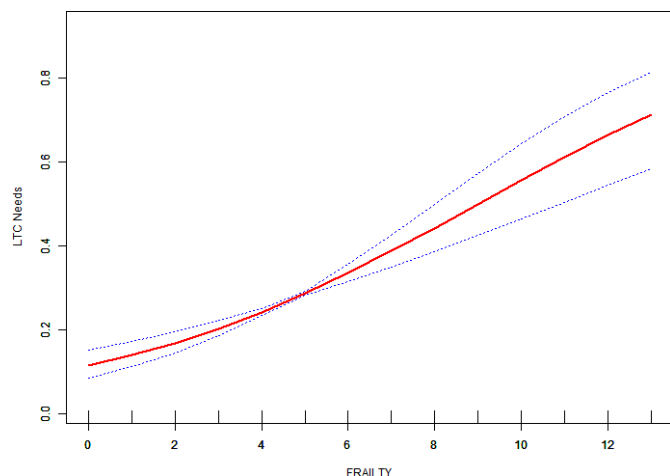*indicates a dramatic difference (p<0.05); **indicates a dramatic difference (p<0.01).

Figure 1 Smoothed plots of the relationship between frailty and long-term care (LTC). the red line represent the dose-response curve between the scores of frailty and LTC needs levels, the two blue lines refer to 95% confidence intervals.

and LTC need. A 6 year prospective study showed a significant association between physical frailty and increased risk of LTC needs. In the risk of LTC needs, being pre-frail and frail increased by 1.5- and 2-fold compared with robust patients at baseline respectively.[17] These estimates were lower than our study. A possible reason for this may include the different tools for assessing LTC needs and frailty status, and differences in the educational levels of the participants. We found the prevalence of frailty was 45.2% and in the Japan study, the prevalence of frailty was 9.46%. Furthermore, concerning the education level, participants with low education (high school degree or below) accounted for most of the participants in this study (83%), compared with a relatively smaller proportion of participants in the Japan study (48.3%). Previous studies revealed that educational level was one of factors influencing frailty and LTC needs.[36 37] Higher education levels were generally associated with more opportunities, higher incomes, and increased health awareness.[38] Meanwhile, the older adults with a lower level of education had less access to health treatments and rehabilitation information, which increases susceptibility for frailty and may affect LTC needs.[39] The smoothing plot analysis, revealed that LTC needs increased with frailty status and specifically, LTC needs increased 1.3 points with one-point increment in frailty score, which further described frailty and LTC needs as an almost linear relationship. Overall, we affirmed a significant correlation between frailty and LTC needs. And possible mechanisms underlying this association may include the following: first, the ageing population will lead to an unprecedented surge in the number of frail older adults with complex care needs.[6] Unfortunately, traditional family care is far from meeting the multi-level care needs of older adults in the current society.[40 41] Second, frailty increased the susceptibility to disease and it requires specific support and care.[42] Thirdly, frailty was considered to be the antecedent of disability, when the needs of frail older adults are unmet

this frequently leads to disability.[43] This is further corroborated from the association weakened after adding the ADL and comorbidities to the analyses.

Frailty is a dynamic, changing process. Early identification and management might reduce the risk of frailty and may even retard the progress of frailty. Understanding the relationship between frailty and LTC needs will allow to steps to manage frailty and improve the quality of life. Hence, there is an urgent need to address the frailty and LTC needs of older adults and to provide quality services for the transition between ageing and disability. There were some limitations to this study. First, the study was a cross-sectional study, thus, frailty and LTC needs may not have a causal relationship. Furthermore, there is potential selection bias in population in this study, because we only included the older adults mainly self-dependent or partially disabled with normal language comprehension. In general, this study revealed a correlation between frailty and LTC needs among older people in the community. It can be used as a pilot study for future research.

CONCLUSION

This study identified a linear relationship between LTC needs and frailty state. It suggested that frailty is closely related to LTC needs, especially in older adults with a severe frailty status. Therefore, the LTC needs of the frail older adults deserve more attention. Based on the results of our study, future research should identify the LTC needs of frail patients, formulate targeted intervention programmes, and contribute to achieve healthy ageing.

Author affiliations
[1]Second Clinical Medical College of Guangzhou University of Chinese Medicine, Guangzhou, Guangdong, China
[2]Guangdong Provincial Hospital of Traditional Chinese Medicine, Guangzhou, Guangdong, China
[3]Neurology, The Second Affiliated Hospital of Guangzhou University of Traditional Chinese Medicine, Guangzhou, Guangdong, China
[4]Nephrology, Third Affiliated Hospital of Sun Yat-Sen University, Guangzhou, Guangdong, China
[5]Nursing, The Second Affiliated Hospital of Guangzhou University of Traditional Chinese Medicine, Guangzhou, Guangdong, China
[6]Neurology, Foshan Hospital of TCM, Foshan, Guangdong, China
[7]Nursing, Hunan University of Chinese Medicine, Changsha, Hunan, China

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

ORCID iD
Lin Wei http://orcid.org/0000-0003-2129-1380

REFERENCES

1 He B, Ma Y, Wang C, *et al*. Prevalence and risk factors for frailty among community-dwelling older people in China: a systematic review and meta-analysis. *J Nutr Health Aging* 2019;23:442–50.
2 Khan MS, Segar MW, Usman MS, *et al*. Frailty, Guideline-Directed medical therapy, and outcomes in HFrEF: from the GUIDE-IT trial. *JACC Heart Fail* 2022;10:266–75.
3 Rohrmann S. Epidemiology of frailty in older people. *Adv Exp Med Biol* 2020;1216:21–7.
4 Hoogendijk EO, Afilalo J, Ensrud KE, *et al*. Frailty: implications for clinical practice and public health. *The Lancet* 2019;394:1365–75.
5 Morley JE, Vellas B, Abellan van Kan G, *et al*. Frailty consensus: a call to action. *J Am Med Dir Assoc* 2013;14:392–7.
6 Pot AM, Briggs AM, Beard JR. The sustainable development agenda needs to include long-term care. *J Am Med Dir Assoc* 2018;19:725–7.
7 Feng Z, Glinskaya E, Chen H, *et al*. Long-Term care system for older adults in China: policy landscape, challenges, and future prospects. *Lancet* 2020;396:1362–72.
8 Kim H, Kwon S. A decade of public long-term care insurance in South Korea: policy lessons for aging countries. *Health Policy* 2021;125:22–6.
9 Yeung W-JJ, Thang LL. Long-Term care for older adults in ASEAN plus three: the roles of family, community, and the state in addressing unmet eldercare needs. *J Aging Health* 2018;30:1499–515.
10 World Health Organization,, WHO. *Global strategy and action plan on ageing and health*. Geneva: WHO, 2016.
11 Someya Y, Tamura Y, Kaga H, *et al*. Skeletal muscle function and need for long-term care of urban elderly people in Japan (the Bunkyo health study): a prospective cohort study. *BMJ Open* 2019;9:e31584.
12 Tobis S, Wieczorowska-Tobis K, Talarska D, *et al*. Needs of older adults living in long-term care institutions: an observational study using Camberwell assessment of need for the elderly. *Clin Interv Aging* 2018;13:2389–95.
13 Meng D, Xu G, Davidson PM. Perceived unmet needs for community-based long-term care services among urban older adults: a cross sectional study. *Geriatr Nurs* 2021;42:740–7.
14 Makizako H, Shimada H, Tsutsumimoto K, *et al*. Physical frailty and future costs of long-term care in older adults: results from the NCGG-SGS. *Gerontology* 2021;67:695–704.
15 Yamada M, Arai H. Predictive value of frailty scores for healthy life expectancy in community-dwelling older Japanese adults. *J Am Med Dir Assoc* 2015;16:1002.e7–1002.e11.
16 Korenvain C, Famiyeh I-M, Dunn S, *et al*. Identifying frailty in primary care: a qualitative description of family physicians' gestalt impressions of their older adult patients. *BMC Fam Pract* 2018;19:61.
17 Chen S, Honda T, Narazaki K, *et al*. Physical frailty and risk of needing long-term care in community-dwelling older adults: a 6-year prospective study in Japan. *J Nutr Health Aging* 2019;23:856–61.
18 Satake S, Shimokata H, Senda K, *et al*. Validity of total Kihon checklist score for predicting the incidence of 3-year dependency and mortality in a community-dwelling older population. *J Am Med Dir Assoc* 2017;18:552.e1–552.e6.
19 Makizako H, Shimada H, Doi T, *et al*. Impact of physical frailty on disability in community-dwelling older adults: a prospective cohort study. *BMJ Open* 2015;5:e8462.
20 Gu C, Wang X, Zhang Z, *et al*. Pregnant women's clinical characteristics, intrapartum interventions, and duration of labour in urban China: a multi-center cross-sectional study. *BMC Pregnancy Childbirth* 2020;20:386.
21 Chang Y-W, Chen W-L, Lin F-G, *et al*. Frailty and its impact on health-related quality of life: a cross-sectional study on elder community-dwelling preventive health service users. *PLoS One* 2012;7:e38079.
22 Peng X, Wei L, Zhang X. The development of services system of integrated home care for the elderly based on Omaha system. *Chin J Prac Nurs* 2019;35:1526–32.
23 Shi X, Zhang H, Sui J. Investigation of long-term care needs and its influencing factors among old people with chronic diseases in nursing homes in rural area of Liaoning. *Chin J Prac Nurs* 2016;32:2099–103.
24 Jie Y, Wang Y, Chen J, *et al*. Unmet supportive care needs and its relation to quality of life among adult acute leukaemia patients in China: a cross-sectional study. *Health Qual Life Outcomes* 2020;18.
25 Gobbens RJJ, van Assen MALM, Luijkx KG, *et al*. The Tilburg frailty indicator: psychometric properties. *J Am Med Dir Assoc* 2010;11:344–55.
26 Xi X, Guo G, Sun J. Reliability and validity of Chinese version of Tilburg frailty indicator. *Journal of Nuring* 2013;20:1–5.
27 Mahoney FI, Barthel DW. Functional evaluation: the BARTHEL index. *Md State Med J* 1965;14:61–5.
28 Dent E, Lien C, Lim WS, *et al*. The Asia-Pacific clinical practice guidelines for the management of frailty. *J Am Med Dir Assoc* 2017;18:564–75.
29 Nari F, Jang BN, Youn HM, *et al*. Frailty transitions and cognitive function among South Korean older adults. *Sci Rep* 2021;11:10658.
30 Lloyd-Sherlock P, Pot AM, Sasat S, *et al*. Volunteer provision of long-term care for older people in Thailand and Costa Rica. *Bull World Health Organ* 2017;95:774–8.
31 Zhang L, Zeng Y, Wang L, *et al*. Urban-Rural differences in long-term care service status and needs among home-based elderly people in China. *Int J Environ Res Public Health* 2020;17:1701–28. doi:10.3390/ijerph17051701
32 Verver D, Merten H, Robben P, *et al*. Care and support for older adults in the Netherlands living independently. *Health Soc Care Community* 2018;26:e404–14.
33 Wee S-L, Liu C, Goh S-N, *et al*. Determinants of use of community-based long-term care services. *J Am Geriatr Soc* 2014;62:1801–3. doi:10.1111/jgs.13003
34 Fu YY, Guo Y, Bai X, *et al*. Factors associated with older people's long-term care needs: a case study adopting the expanded version of the Anderson model in China. *BMC Geriatr* 2017;17:38. doi:10.1186/s12877-017-0436-1
35 Hu H, Si Y, Li B. Decomposing inequality in long-term care need among older adults with chronic diseases in China: a life course perspective. *Int J Environ Res Public Health* 2020;17:2559.
36 Wee S-L, Li Y, Sun Y, *et al*. Determinants of long-term care needs of community-dwelling older people in Singapore. *J Am Geriatr Soc* 2014;62:2453–4.
37 Gale CR, Westbury L, Cooper C. Social isolation and loneliness as risk factors for the progression of frailty: the English longitudinal study of ageing. *Age Ageing* 2018;47:392–7.
38 Liu N, Zeng L, Li Z, *et al*. Health-Related quality of life and long-term care needs among elderly individuals living alone: a cross-sectional study in rural areas of Shaanxi Province, China. *BMC Public Health* 2013;13:313.
39 Fernandes Bolina A, Rodrigues RAP, Tavares DMdosS, *et al*. Factors associated with the social, individual and programmatic vulnerability of older adults living at home. *Rev Esc Enferm USP* 2019;53:e3429.
40 Zhang L, Zeng Y, Wang L, *et al*. Urban-Rural differences in long-term care service status and needs among home-based elderly people in China. *Int J Environ Res Public Health* 2020;17:1701. doi:10.3390/ijerph17051701
41 Salinas-Rodríguez A, Manrique-Espinoza B, Heredia-Pi I, *et al*. Healthcare costs of frailty: implications for long-term care. *J Am Med Dir Assoc* 2019;20:102–3.
42 Vermeiren S, Vella-Azzopardi R, Beckwée D, *et al*. Frailty and the prediction of negative health outcomes: a meta-analysis. *J Am Med Dir Assoc* 2016;17:1163.e1–1163.e17.
43 Siriwardhana DD, Weerasinghe MC, Rait G, *et al*. Association between frailty and disability among rural community-dwelling older adults in Sri Lanka: a cross-sectional study. *BMJ Open* 2020;10:e34189.