



## Original Article

## Multi-dimensional frailty and its risk factors among older residents in long-term care facilities in Shanghai, China

Huihui Wang<sup>a,1</sup>, Jing Wang<sup>a,b,1</sup>, Boqin Xie<sup>a</sup>, Bangzhong Liu<sup>c</sup>, Junqiao Wang<sup>a,\*</sup><sup>a</sup> School of Nursing, Fudan University, Shanghai, China<sup>b</sup> UNC Chapel Hill School of Nursing, Chapel Hill, NC, USA<sup>c</sup> Department of Rehabilitation, Zhongshan Hospital of Fudan University, Shanghai, China

## ARTICLE INFO

## Article history:

Received 31 March 2021

Received in revised form

31 May 2021

Accepted 1 June 2021

Available online 5 June 2021

## Keywords:

Aged

Activities of daily living

China

Cognition

Depression

Exercise

Frailty

Sleep

## ABSTRACT

**Objectives:** The integrated model of frailty shifted the physiologically-dominated view to an integrated and multidisciplinary view of frailty and adopted an integrated and holistic approach to the complex challenges facing frail older adults and their caregivers. There is an urgent need for researchers to identify multi-faceted frailty among older adults and to explore contributors to it. We assessed the level of frailty among older residents in long-term care (LTC) facilities in Shanghai, China and explored risk factors of multiple dimensions of frailty among older residents.

**Methods:** It is a cross-sectional descriptive study. We interviewed 218 older residents from nine LTC facilities. We used Tilburg Frailty Indicator to assess older residents' physiological, psychological, and social frailty. The Geriatric Depression Scale, Mini-Mental state examination, Athens Insomnia Scale, and Activity of Daily Living (ADL) Scale were used to assess their depressive symptoms, cognitive function, sleep quality and ADL abilities, respectively.

**Results:** Older residents have a moderate level of frailty in physiological, psychological and social domains. There is a high correlation among dimensions of frailty. Older residents' depressive symptoms have remained positively associated with their overall and each domain of frailty. Older residents' actual activity participation and exercise in LTC facilities are negatively associated with older residents' overall, physiological and social frailty.

**Conclusions:** Frailty is a multi-dimensional concept and is prevalent among older residents in LTC facilities. It is important to take an integrated view on frailty and carry out appropriate and comprehensive interventions to prevent adverse outcomes and provide holistic care for frail older residents in LTC facilities. There is an urgent need to improve the quality and expand the number of activities offered within LTC facilities that would engage older residents in a person-centered way, despite their age, ADL abilities, frailty and functional limitations.

© 2021 The authors. Published by Elsevier B.V. on behalf of the Chinese Nursing Association. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## What is known?

- Global aging is witnessing the increasing challenges of providing care for older adults in need, particularly frail older adults.

- The prevalence of frailty is much higher among older adults living in long-term care (LTC) facilities than in communities. Frailty is a significant predictor of mortality among older residents in LTC facilities.

## What is new?

- The narrow definition of frailty with exclusive emphasis on its biomedical indicators has neglected the multi-dimensional characters of frailty, which can jeopardize the focus on and care of the whole person.

\* Corresponding author.

E-mail addresses: [wanghh16@fudan.edu.cn](mailto:wanghh16@fudan.edu.cn) (H. Wang), [jingwangduke@fudan.edu.cn](mailto:jingwangduke@fudan.edu.cn) (J. Wang), [xieboqin\\_shelley@163.com](mailto:xieboqin_shelley@163.com) (B. Xie), [liu.bangzhong@zs-hospital.sh.cn](mailto:liu.bangzhong@zs-hospital.sh.cn) (B. Liu), [junqiwang@fudan.edu.cn](mailto:junqiwang@fudan.edu.cn), [junqiwang@fudan.edu.cn](mailto:junqiwang@fudan.edu.cn) (J. Wang).

<sup>1</sup> Both authors contributed equally to this work.

Peer review under responsibility of Chinese Nursing Association.

<https://doi.org/10.1016/j.ijnss.2021.06.003>2352-0132/© 2021 The authors. Published by Elsevier B.V. on behalf of the Chinese Nursing Association. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

- We assessed the level of multi-dimensional frailty and explored its risk factors among older residents in LTC facilities.
- The integral model of frailty shifts the physiologically-dominated view to an integrated and multidisciplinary view of frailty and from a bio-medically-directed approach to a more integrated and holistic approach to the complex challenges facing frail older adults and their caregivers.

## 1. Introduction

By the year of 2030, the number of older adults worldwide is projected to grow to 1.4 billion, and among them, the oldest old will increase to 434 million [1]. Global aging is witnessing the increasing challenges of providing care for older adults in need, particularly frail older adults. There is no internationally agreed definition of frailty in the current body of literature. Frail older adults have lower ability for independent living, may have impaired mental abilities, and often require assistance for daily activities [2]. Frailty has a negative impact on older adults' quality of life, increases health care expenditures, caregiving burden, and early or unnecessary institutionalization [3]. These are consequences of adverse health outcomes associated with frailty, including falls, cognitive impairment, disability, and mobility decline [4–6].

With the largest and fastest-growing older population globally and the development of a formal long-term care (LTC) facilities, more and more older adults in China choose to reside in LTC facilities after retirement [7]. Taking Shanghai as an example, the most aged and one of the biggest cities in China has 3.2 million older adults aged 65 years and over and among them, a total of 805,800 oldest old (older adults aged 80 years old and over), accounting for 21.8% and 5.5% of its population respectively. Among them, 140,000 older adults live in LTC facilities [8]. The prevalence of frailty is much higher among older adults living in LTC facilities than in communities [9,10]. Frailty is a significant predictor of mortality among older residents in LTC facilities [11]. Although researchers in the US and Western Europe have conducted studies on frailty across care settings, most of them interpreted frailty as a physiologically-dominated concept. Psychological and social domains of frailty among older adults are neglected. There is a lack of evidence to predict risks of multi-faceted frailty among older residents in LTC facilities. However, adverse health outcomes associated with frailty can be prevented or reversed if it is detected and intervened early through intervention [12,13]. There is an urgent need for researchers to identify multi-faceted frailty among older adults and to explore its risk factors; thus care providers can carry out timely and appropriate interventions to prevent adverse health outcomes and provide holistic care for frail older residents in LTC facilities. Therefore, in this study, we assessed the level of frailty among older residents in LTC facilities in Shanghai, China and explored risk factors of multiple dimensions of frailty among older residents.

Frailty has traditionally been a biomedically-dominated concept that is defined as a clinical syndrome or vulnerability in which three or more of the following criteria were present: “unintended weight loss (10 lbs [1 lbs = 0.45 kg] in past year), weakness (grip strength), slow walking speed, low physical activity, and exhaustion” (p. M148) [14]. The narrow definition of frailty with exclusive emphasis on its biomedical indicators has neglected the multi-dimensional characters of frailty, which can jeopardize the focus on and care of the whole person [15,16]. A growing number of scholars believe that frailty has multifaceted elements and should not be confined to the physiological dimension [17,18]. Gobbens et al. [19] believed that frailty was dynamic and introduced the model of frailty from a life course perspective. Tilburg Frailty

Indicator that measures frailty among older adults in physical, psychological, and social domains was developed based on Gobbens' model of frailty [19]. Psychological frailty considers brain changes beyond normal aging and results in decreased cognitive resilience in the presence of modest stressors, not necessarily inclusive of diseases. Social frailty focuses on the risk of disability by lower social engagement status among older adults [20]. Psychological and social frailty are also related to adverse health outcomes [21,22].

The integral conceptual model of frailty takes the multi-dimensional nature of frailty into account and describes the pathway from life-course determinants to multi-dimensional frailty and adverse health outcomes [20,21]. It illustrates the operational definition of physical, psychological, and social frailty and its direct relationship with adverse health outcomes. The integral model of frailty shifts the physiologically-dominated view to an integrated and multidisciplinary view of frailty and from a bio-medically-directed approach to a more integrated and holistic approach to the complex challenges facing frail older adults and their caregivers. Gobbens also pointed out that further research should explore and understand multi-dimensional frailty among older residents in LTC facilities and its risk factors to identify frail older residents and prevent or reverse associated adverse health outcomes.

## 2. Methods

### 2.1. Study design and participants

Data collection was conducted from September to December 2018. Ethical approval of the study was obtained from the research ethical committee of the academic institutional review board (IRB) of Fudan University. Prior to structured interviews with older residents, we obtained consent from each of the participants after explaining the purpose of the study, risks and benefits, confidentiality, and options for withdrawal at any time of the study.

Convenience sampling was used to select older residents from 9 LTC facilities in Shanghai, China. Older residents were eligible for this survey if they were aged 60 years or over, could speak Mandarin or Shanghai dialect, and lived in the current facility for at least one month. Older residents were excluded if they had serious body shape abnormalities, limb loss or dysfunction, had advanced dementia and were unable to understand or communicate. A total of 218 older residents participated in the survey and completed the questionnaires through structured interviews. We included 12 independent/co-variables ( $12 \times 15 = 180$ ) in the regression analysis. We also anticipated 15%–20% of missing data. Therefore, the sample size of this study is appropriate.

### 2.2. Data collection

All the measures were pilot tested. The authors conducted face-to-face structured interviews with a total of 218 older residents after obtaining their informed consents. Residents were interviewed in places they preferred in the LTC facilities. Each interview took 45–125 min. All the surveys were digitally recorded with the older residents' permission so that investigators could double-check after filling out the questionnaires for them during the interviews.

### 2.3. Measures

We used Tilburg Frailty Indicator to assess older residents' overall, physiological, psychological, and social frailty. The Geriatric Depression Scale(GDS), Mini-Mental state examination (MMSE),

Athens Insomnia Scale (AIS), and Activity of Daily Living (ADL) Scale were used to assess their depressive symptoms, cognitive function, sleep quality, and ADL abilities, respectively. We also used self-designed questions to collect information of their social engagement/participation in activities within LTC facilities.

2.3.1. Frailty as the dependent variable

We adapted the Tilburg Frailty Indicator-Chinese version [21] based on the characteristics of the target population, current body of literature and expert consultation. The 4-point Likert scale was used to measure the level of frailty of older residents in LTC facilities. There are 25 items in the questionnaire, including physiological frailty (12 items), psychological frailty (7 items) and social frailty (6 items). The total score ranges from 25 to 100 points with a higher score indicating a higher degree of frailty. According to the pilot study with 15 older residents, the internal consistency coefficient Cronbach's  $\alpha$  of the overall questionnaire was 0.797, and the Cronbach's  $\alpha$  coefficient of each of the three dimensions ranges between 0.691 and 0.712. The Test-retest reliability coefficient of the total questionnaire was 0.921, and the Test-retest reliability coefficient of each dimension was between 0.785 and 0.914.

2.3.2. Independent variables

Depressive symptoms: Older residents' depressive symptoms were assessed using the Chinese version of the 15-item Geriatric Depression Scale (GDS-15) [23]. The GDS-15 has a total score ranging from 0 to 15.

Cognitive function: We used the MMSE to assess older residents' cognitive state. It included orientation, memory, calculation, and language proficiency test. The score ranges from 0 to 30, where a score of 17 or lower indicates severe cognitive impairment [24].

Quality of sleep: The AIS as a psychometric instrument was used to measure older residents' quality of sleep [25]. The 8-item AIS (AIS-8) consists of eight items. Each item can be rated 0–3. The AIS-8 has a total score ranging from 0 to 24, and the higher the score, the worse the sleep quality.

ADL scale was used to assess older residents' daily living ability over the past month [26]. The scale consists of 13 items, including physical self-maintenance scale (6 items) and instrumental activities of daily living scale (8 items). The total score of ADL ranges from 14 to 56. A lower score indicates a higher level of daily activity. We also assessed their grip strength and short physical performance using Short Physical Performance Battery (SPPB).

Older residents' social engagement/participation in the LTC facilities were investigated using self-designed questions as follows: 1) In the past seven days, how often did you participate in the activities held by the LTC facility? 2) In the past seven days, how often did you exercise in the LTC facility?

Based on Gobbens' integrated model of frailty and the current body of literature, we included socio-demographic information (age, gender, marital status, financial status, and educational background), health-related information, such as the number of chronic illnesses as co-variables in the analyses.

2.4. Statistical analyses

We used descriptive frequency, percentage, and distribution to describe older residents' socio-demographic characteristics and other information. Single-factor analysis were performed using *t*-test, One-way ANOVA and Pearson Correlation. The significant factors of the single-factor analysis were included in multiple linear regression analyses of frailty and each dimension of frailty.

3. Results

3.1. Socio-demographic characteristics

The socio-demographic and other information of the older residents are presented in Table 1. Most of the 218 participants (91.3%) were 80 years old and over. More than 70% of the participants are female and 88% of them have no spouse (being single, widowed or divorced). As reported by the participants, most of them have enough income to cover their living costs without other forms of financial support. About half of the participants have 1 or 2 chronic illnesses. More than half of the participants have depressive symptoms. The majority of the participants have normal cognitive function. Overall, older residents have a relatively low level of activity within the LTC facilities ( $5.42 \pm 1.72$ ). Their grip strength was  $16.53 \pm 6.76$ , and score of SPPB was  $4.73 \pm 3.41$ .

3.2. Level of frailty

Older residents in this study has a moderate level of overall frailty ( $55.02 \pm 11.75$ ), physiological frailty ( $25.90 \pm 6.86$ ), psychological frailty ( $16.78 \pm 4.52$ ), and social frailty ( $12.33 \pm 3.20$ ).

3.3. Multiple linear regression analysis of frailty and each dimension of frailty

The significant factors of the single-factor analyses (Table 1) were included into multiple linear regression analysis of frailty and each dimension of frailty (Table 2). The results showed that depressive symptoms, grip strength, cognitive function, participation in activities in LTC facilities, number of chronic illnesses, and sleep quality are significantly associated with older residents' overall frailty ( $P < 0.001$ ). Older residents' physiological frailty is significantly influenced by their grip strength, depressive symptoms, number of chronic illnesses, activity participation, and sleep quality ( $P < 0.05$ ). Psychological frailty is significantly affected by their depressive symptoms, cognition and grip strength ( $P < 0.05$ ). Social frailty is significantly influenced by their depressive

**Table 1**  
Socio-demographic characteristics and other information ( $n = 218$ ).

Variables	$n$ (%) or Mean $\pm$ SD
Age group	
60–79	19 (8.7)
$\geq 80$	199 (91.3)
Gender	
Male	59 (27.1)
Female	159 (72.9)
Marital status	
Have a spouse	27 (12.4)
Have no spouse	191 (87.6)
Educational level	
Primary education or below	104 (47.7)
Medium education or above	114 (52.3)
Need other financial support	
Yes	41 (18.8)
No	177 (81.2)
Number of chronic illness	
0	15 (6.9)
1–2	104 (47.7)
3–4	72 (33.0)
$\geq 5$	27 (12.4)
Sleep quality	$5.01 \pm 4.13$
Depressive symptoms	$5.61 \pm 2.90$
Cognition	$23.98 \pm 4.67$
Activity	$5.42 \pm 1.72$
Grip strength (kg)	$16.53 \pm 6.76$
Activity of Daily Living	$24.45 \pm 8.94$

**Table 2**  
Multiple regression of factors associated with frailty and each dimension of frailty ( $n = 218$ ).

Variables	Overall frailty		Physiological frailty		Psychological frailty		Social frailty	
	$\beta$	$t$	$\beta$	$t$	$\beta$	$t$	$\beta$	$t$
Depressive symptoms	0.57	13.62**	0.30	5.64**	0.61	13.01**	0.47	8.41**
Grip strength	-0.29	-6.79**	-0.44	-9.26**	-0.11	-2.27*	–	–
Cognition	-0.18	-4.43**	–	–	-0.30	-6.14**	–	–
Activity rate	-0.15	-3.72**	-0.16	-3.38*	–	–	-0.28	-5.13**
Number of chronic illnesses	0.12	2.94**	0.20	4.19**	–	–	–	–
Sleep quality	–	–	0.10	2.01*	–	–	–	–
Marital Status	–	–	–	–	–	–	0.11	2.18*

Note: For overall frailty,  $R^2 = 0.682$ , adjusted  $R^2 = 0.674$ . \* $P < 0.05$ ; \*\* $P < 0.001$ .

symptoms, activity participation and marital status ( $P < 0.05$ ).

Older residents' depressive symptoms have remained positively associated with their overall frailty and each domain of the frailty ( $P < 0.001$ ). The variable of depressive symptoms explains over 50% and 60% of the variance of the overall and psychological frailty respectively. Older residents' ADL ability becomes not significantly associated with their frailty in the regression model, but their actual activity participation in LTC facilities is negatively associated with older residents' overall ( $P < 0.001$ ), physiological ( $P < 0.05$ ), and social frailty ( $P < 0.001$ ). Their activity participation explains over 50% of the variance of older residents' social frailty. Those with chronic illnesses tended to have a higher level of overall and physiological frailty than those with no chronic illness ( $P < 0.001$ ).

#### 4. Discussion

Frailty can be seen as a proxy for the severity of the aging process of a person and is associated to, but different from illnesses and disability [12]. Unlike community-dwelling older adults with a wide age distribution, most of our participants are the oldest old (over 80 years old). Most older residents in the study live with one or more chronic illness(es). Having chronic illness or not is an important factor influencing their frailty and physiological frailty, independent of socio-demographic factors in the study. It is consistent with Gobbens' (2012) conceptual model that frailty is uniquely associated with adverse outcomes such as living with chronic illnesses without being dependent on life course determinants.

In line with previous findings [9,27], frailty is prevalent among older residents. They have a moderate level of frailty in physiological, psychological and social domains in the current study. There is a high correlation among dimensions of frailty, which reflects the multi-dimensional nature of frailty. Older residents' depressive symptoms have remained positively associated with their overall and each domain of frailty and explains more than half of the variance of the overall and psychological frailty. The result is consistent with previous studies [28,29] and reveals that psychological frailty is an important component of frailty and affects physical function and strength. Although a growing number of researchers acknowledge the need for a multi-dimensional definition of frailty, there is a lack of consistency in the definition of frailty and psychological and social frailty are still largely neglected. In line with the integral conceptual model of frailty [20], our findings highlight the need for health care professionals to have a better understanding of multidimensions of frailty and its associated factors. We need to shift our focus from physiologically-dominated to multi-dimensional elements/indicators of frailty and adopt an integrated view on older residents as whole persons. The integrated view can help us identify early signs of frailty among older residents and carry out comprehensive interventions to prevent or reverse

adverse outcomes associated with frailty.

It is interesting to see that older residents' ADL ability becomes not significantly associated with their frailty in the regression model, but their actual activity participation and exercise in LTC facilities is negatively associated with older residents' overall, physiological, and social frailty. Other studies also present that activity is a significant factor associated with frailty [30] and social frailty [2]. Not only can exercise and activity improve their muscle strength [31], participation in activities and exercise can increase the social interaction and engagement among older residents and help them establish social relations and obtain social support [32]. However, older residents from nine LTC facilities have a relatively low level of activity and exercise. In fact, there is limited rehabilitation service and other health care service and resources available to older residents in LTC facilities in China [33]. There is an urgent need for health care professionals and other specialist allies to improve the quality and expand activities offered within LTC facilities that would engage older residents in a person-centered way, despite their age, ADL abilities, frailty and functional limitations [34].

We used convenience sampling to select participants from nine LTC facilities in Shanghai, China. The samples are not representative of older residents in China. However, Shanghai is the most aged and one of the biggest cities in China and its LTC services are in the lead of the whole country, thus using Shanghai's LTC facilities as our research settings can help us have a better idea of frailty and its associated factors in modern cities in China. We are unable to reach an internationally-consistent definition of frailty in the current study but our findings echoes what Gobbens et al. have explored and tested in their studies that psychological and social dimensions are important components of frailty and the integrated view of frailty can help us identify and understand frailty better and carry out comprehensive interventions amongst older residents in LTC facilities. Longitudinal studies in nursing home settings are needed to test the trend of multi-dimensional frailty among older residents and its predictors. There might be sampling bias because of the exclusion of older adults who had serious body shape abnormalities, limb loss and were unable to understand or communicate. The sample in this study may be biased because those with a higher level of frailty were excluded. We did not include those older residents because we need to assess their grip strengths and steps. The results might not be generalizable to older residents with severe physical and/or cognitive impairment.

#### 5. Conclusions and implications

Depressive symptoms are related to frailty and its each dimension. Frailty is a multi-dimensional concept and is prevalent among older residents in LTC facilities. It is important to take an integrated view on frailty and carry out appropriate and comprehensive

interventions to prevent adverse outcomes and provide holistic care for frail older residents in LTC facilities. Older residents' actual activity participation in LTC facilities is negatively associated with older residents' overall, physiological, and social frailty. There is an urgent need to improve the quality and expand the number of activities offered within LTC facilities that would engage older residents in a person-centered way, despite their age, ADL abilities, frailty and functional limitations.

### Funding

This work was supported by the Fudan University Nursing Research Foundation (Fund #FNF201706).

### Data availability statement

Authors declare the absence of shared data in the present study.

### CRediT authorship contribution statement

**Huihui Wang:** Conceptualization, Methodology, Data curation, Writing – original draft, Writing – review & editing. **Jing Wang:** Conceptualization, Methodology, Data curation, Writing – original draft, Writing – review & editing. **Boqin Xie:** Data curation, Writing – review & editing. **Bangzhong Liu:** Conceptualization, Investigation, Writing – review & editing. **Junqiao Wang:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Funding acquisition.

### Declaration of competing interest

The authors have declared no conflict of interest on behalf of all the authors, there is no financial or personal relationship that could cause a conflict of interest regarding this article.

### Acknowledgement

This work was supported by the Fudan University Nursing Research Foundation (Fund #FNF201706).

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijnss.2021.06.003>.

### References

- [1] Bloom DE, Mitgang E, Osher B. Demography of Global Aging. IZA Discussion Papers 2016;10164:1–20. <http://ftp.iza.org/dp10164.pdf>.
- [2] Bunt S, Steverink N, Olthof J, van der Schans CP, Hobbelen JSM. Social frailty in older adults: a scoping review. *Eur J Ageing* 2017;14(3):323–34. <https://doi.org/10.1007/s10433-017-0414-7>.
- [3] Lahousse L, Maes B, Ziere G, Loth DW, Verlinden VJ, Zillikens MC, et al. Adverse outcomes of frailty in the elderly: the Rotterdam Study. *Eur J Epidemiol* 2014;29(6):419–27. <https://doi.org/10.1007/s10654-014-9924-1>.
- [4] Yamada M, Arai H. Social frailty predicts incident disability and mortality among community-dwelling Japanese older adults. *J Am Med Dir Assoc* 2018;19(12):1099–103. <https://doi.org/10.1016/j.jamda.2018.09.013>.
- [5] Kojima G. Frailty as a predictor of nursing home placement among community-dwelling older adults: a systematic review and meta-analysis. *J Geriatr Phys Ther* 2018;41(1):42–8. <https://doi.org/10.1519/jpt.000000000000097>.
- [6] Fougère B, Kelaiditi E, Hoogendijk EO, Demougeot L, Duboué M, Vellas B, et al. Frailty index and quality of life in nursing home residents: results from INCUR study. *J Gerontol A Biol Sci Med Sci* 2016;71(3):420–4. <https://doi.org/10.1093/gerona/glv098>.
- [7] Peng R, Wu B. Changes of health status and institutionalization among older adults in China. *J Aging Health* 2015;27(7):1223–46. <https://doi.org/10.1177/0898264315577779>.
- [8] Shanghai Civil Affairs Bureau. Older population and aging development information of Shanghai [in Chinese]. <http://www.shanghaiyangleo.com/Detail/detail/id/18730>. [Accessed 2 January 2021].
- [9] Kojima G. Prevalence of frailty in nursing homes: a systematic review and meta-analysis. *J Am Med Dir Assoc* 2015;16(11):940–5. <https://doi.org/10.1016/j.jamda.2015.06.025>.
- [10] Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: a systematic review. *J Am Geriatr Soc* 2012;60(8):1487–92. <https://doi.org/10.1111/j.1532-5415.2012.04054.x>.
- [11] Matusik P, Tomaszewski K, Chmielowska K, Nowak J, Nowak W, Parnicka A, et al. Severe frailty and cognitive impairment are related to higher mortality in 12-month follow-up of nursing home residents. *Arch Gerontol Geriatr* 2012;55(1):22–4. <https://doi.org/10.1016/j.archger.2011.06.034>.
- [12] Kojima G, Liljas AEM, Iliffe S. Frailty syndrome: implications and challenges for health care policy. *Risk Manag Healthc Pol* 2019;12:23–30. <https://doi.org/10.2147/rmhp.s168750>.
- [13] Gobbens RJ, van Assen MA. The prediction of quality of life by physical-psychological and social components of frailty in community-dwelling older people. *Qual Life Res* 2014;23(8):2289–300. <https://doi.org/10.1007/s11366-014-0672-1>.
- [14] Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001;56(3):M146–56. <https://doi.org/10.1093/gerona/56.3.m146>.
- [15] Gobbens RJ, Luijckx KG, Wijnen-Sponselee MT, Schols JMGA. In search of an integral conceptual definition of frailty: opinions of experts. *J Am Med Dir Assoc* 2010;11(5):338–43. <https://doi.org/10.1016/j.jamda.2009.09.015>.
- [16] Levers MJ, Estabrooks CA, Ross Kerr JC. Factors contributing to frailty: literature review. *J Adv Nurs* 2006;56(3):282–91. <https://doi.org/10.1111/j.1365-2648.2006.04021.x>.
- [17] Freer K, Wallington SL. Social frailty: the importance of social and environmental factors in predicting frailty in older adults. *Br J Community Nurs* 2019;24(10):486–92. <https://doi.org/10.12968/bjcn.2019.24.10.486>.
- [18] Morley JE, Vellas B, van Kan GA, Anker SD, Bauer JM, Bernabei R, et al. Frailty consensus: a call to action. *J Am Med Dir Assoc* 2013;14(6):392–7. <https://doi.org/10.1016/j.jamda.2013.03.022>.
- [19] Gobbens RJ, van Assen MA, Luijckx KG, Wijnen-Sponselee MT, Schols JM. The Tilburg frailty indicator: psychometric properties. *J Am Med Dir Assoc* 2010;11(5):344–55. <https://doi.org/10.1016/j.jamda.2009.11.003>.
- [20] Gobbens RJ, van Assen MA, Luijckx KG, Schols JM. The predictive validity of the Tilburg Frailty Indicator: disability, health care utilization, and quality of life in a population at risk. *Gerontol* 2012;52(5):619–31. <https://doi.org/10.1093/geront/gnr135>.
- [21] Gobbens RJ, van Assen MA, Luijckx KG, Schols JM. Testing an integral conceptual model of frailty. *J Adv Nurs* 2012;68(9):2047–60. <https://doi.org/10.1111/j.1365-2648.2011.05896.x>.
- [22] Ma L, Sun F, Tang Z. Social frailty is associated with physical functioning, cognition, and depression, and predicts mortality. *J Nutr Health Aging* 2018;22(8):989–95. <https://doi.org/10.1007/s12603-018-1054-0>.
- [23] Cheng ST, Chan AC. A brief version of the geriatric depression scale for the Chinese. *Psychol Assess* 2004;16(2):182–6. <https://doi.org/10.1037/1040-3590.16.2.182>.
- [24] Shyu YI, Yip PK. Factor structure and explanatory variables of the Mini-Mental State Examination (MMSE) for elderly persons in Taiwan. *J Formos Med Assoc* 2001;100(10):676–83.
- [25] Sun JL, Sung MS, Huang MY, Cheng GC, Lin CC. Effectiveness of acupressure for residents of long-term care facilities with insomnia: a randomized controlled trial. *Int J Nurs Stud* 2010;47(7):798–805. <https://doi.org/10.1016/j.ijnurstu.2009.12.003>.
- [26] Tong AYC, Man DWK. The validation of the Hong Kong Chinese version of the Lawton instrumental activities of daily living scale for institutionalized elderly persons. *OTJR Occup Participation Health* 2002;22(4):132–42. <https://doi.org/10.1177/1539449202200402>.
- [27] González-Vaca J, de la Rica-Escuín M, Silva-Iglesias M, Arjonilla-García MD, Varela-Pérez R, Oliver-Carbonell JL, et al. Frailty in Institutionalized older adults from Albacete. The FINAL Study: rationale, design, methodology, prevalence and attributes. *Maturitas* 2014;77(1):78–84. <https://doi.org/10.1016/j.maturitas.2013.10.005>.
- [28] Lau BH, Kwan JS, Cheung KS, Martin P. Depression moderates the frailty-subjective health link among Chinese near centenarians and centenarians. *Am J Geriatr Psychiatr* 2016;24(9):753–61. <https://doi.org/10.1016/j.jagp.2016.05.014>.
- [29] Soysal P, Veronese N, Thompson T, Kahl KG, Fernandes BS, Prina AM, et al. Relationship between depression and frailty in older adults: a systematic review and meta-analysis. *Ageing Res Rev* 2017;36:78–87. <https://doi.org/10.1016/j.arr.2017.03.005>.
- [30] Woo J, Zheng Z, Leung J, Chan P. Prevalence of frailty and contributory factors in three Chinese populations with different socioeconomic and healthcare characteristics. *BMC Geriatr* 2015;15:163. <https://doi.org/10.1186/s12877-015-0160-7>.
- [31] Rosique-Esteban N, Babio N, Díaz-López A, Romaguera D, Alfredo Martínez J, Sanchez VM, et al. Leisure-time physical activity at moderate and high intensity is associated with parameters of body composition, muscle strength

- and sarcopenia in aged adults with obesity and metabolic syndrome from the PREDIMED-Plus study. *Clin Nutr* 2019;38(3):1324–31. <https://doi.org/10.1016/j.clnu.2018.05.023>.
- [32] Dulac MC, Aubertin-Leheudre M. Exercise:an important key to prevent physical and cognitive frailty. *J Frailty Aging* 2016;5(1):3–5. <https://doi.org/10.14283/jfa.2015.72>.
- [33] Wang J, Wang J, Cao Y, Jia S, Wu B. Older residents' perspectives of long-term care facilities in China. *J Gerontol Nurs* 2016;42(8):34–43. <https://doi.org/10.3928/00989134-20160615-05>.
- [34] Wang J, Wang J, Cao Y, Jia S, Wu B. Perceived empowerment, social support, and quality of life among Chinese older residents in long-term care facilities. *J Aging Health* 2018;30(10):1595–619. <https://doi.org/10.1177/0898264318795724>.