

Association Between Multidimensional Frailty and Activities of Daily Living Impairment in Rural Older Adults: Postprint

Authors: Zhao Yi, Yang Jingyuan, Yang Xing, Zhou Quanxiang, Jiang Yun, Huang Hui, Zhu Yujie, Yang Jingyuan

Date: 2023-09-01T00:00:00+00:00

Abstract

Background Previous studies have identified an association between physical frailty and Activities of Daily Living (ADL) impairment in older adults; however, the relationship between psychological frailty, social frailty, and ADL impairment remains unclear. **Objective** To investigate the association between multidimensional frailty and its individual dimensions with ADL impairment among rural older adults, thereby providing evidence for disability prevention in this population. **Methods** A cross-sectional study design was employed. From July to September 2021, older adults aged ≥ 60 years ($n=1,298$) from 30 administrative villages across 2 municipalities (prefectures) in Guizhou Province were selected using multistage cluster sampling. Data on demographic characteristics, chronic disease status, and sleep quality were collected via questionnaires. Multidimensional frailty was assessed using the Chinese version of the Tilburg Frailty Indicator (TFI), and ADL impairment was evaluated using the ADL scale. Binary logistic regression was conducted to analyze the effects of multidimensional frailty and its dimensions on ADL impairment, with calculation of the multivariate-adjusted population attributable risk percentage (PARc%). **Results** Among 1,298 older adults, 498 (38.37%) exhibited ADL impairment, 40 (3.08%) had Basic Activities of Daily Living (BADL) impairment, and 494 (38.06%) had Instrumental Activities of Daily Living (IADL) impairment; 382 (29.43%) had multidimensional frailty, 319 (24.58%) had physical frailty, 567 (43.68%) had psychological frailty, and 69 (5.32%) had social frailty. Binary logistic regression analysis revealed that after adjusting for confounders (sex, age, education level, marital status, sleep quality), multidimensional frailty, physical frailty, and psychological frailty significantly affected ADL, IADL, and BADL impairment ($P<0.05$). Further analysis of population attributable risk demonstrated that multidimensional frailty had the greatest attributable risk

for BADL impairment [PARc% (95%CI) = 24.6 (19.1, 27.1)], while psychological frailty showed relatively large attributable risks for ADL, BADL, and IADL impairment [PARc% (95%CI) = 18.4 (12.1, 24.5), 23.6 (3.2, 33.7), and 19.4 (12.4, 24.7), respectively]. Conclusion Multidimensional frailty, as well as its physical and psychological dimensions, significantly impacts ADL, BADL, and IADL impairment among rural older adults, with psychological frailty constituting a substantial contributor to disability. Enhanced screening and intervention for multidimensional frailty, particularly psychological frailty, may reduce disability risk in older adults.

Full Text

The Relationship between Multi-dimensional Frailty and Impairment of Activities of Daily Living in Rural Elderly

ZHAO Yi¹, YANG Jingyuan^{1*}, YANG Xing^{1,2}, ZHOU Quanxiang³, JIANG Yun¹, HUANG Hui¹, ZHU Yujie^{1}

¹School of Public Health/Key Laboratory of Environmental Pollution Monitoring and Disease Control, Ministry of Education/Guizhou Institute of Health Development, Guizhou Medical University, Guiyang 550025, China

²School of Medical and Health Management, Guizhou Medical University, Guiyang 550025, China

³Qiannan Medical College for Nationalities, Duyun 558000, China

Corresponding author: YANG Jingyuan, Professor; E-mail: yangjingyuan@gmc.edu.cn

Abstract

Background: Previous studies have confirmed a correlation between physical frailty and impairment of activities of daily living (ADL) in the elderly, but it remains unclear whether psychological and social frailty are similarly associated with ADL impairment. **Objective:** To investigate the relationship between multi-dimensional frailty and its individual dimensions with ADL impairment among rural elderly populations, providing evidence for disability prevention. **Methods:** A cross-sectional study was conducted from July to September 2021. Using multi-stage cluster sampling, we selected 1,298 elderly adults aged ≥ 60 years from 30 administrative villages across 2 municipalities in Guizhou Province. Data were collected via questionnaires covering demographic characteristics, chronic disease status, and sleep quality. Multi-dimensional frailty was assessed using the Chinese version of the Tilburg Frailty Indicator (TFI), while ADL impairment was evaluated with the ADL scale. Binary logistic regression was employed to analyze the effects of multi-dimensional frailty and its dimensions on ADL impairment, with multifactor-adjusted population attributable risk percentages (PARc%) calculated. **Results:** Among 1,298 participants, 498

(38.37%) had ADL impairment, 40 (3.08%) had basic ADL (BADL) impairment, and 494 (38.06%) had instrumental ADL (IADL) impairment. Multi-dimensional frailty was present in 382 individuals (29.43%), physical frailty in 319 (24.58%), psychological frailty in 567 (43.68%), and social frailty in 69 (5.32%). After adjusting for confounders (sex, age, education, marital status, and sleep quality), binary logistic regression revealed that multi-dimensional frailty, physical frailty, and psychological frailty significantly affected ADL, IADL, and BADL impairment ($P < 0.05$). Population attributable risk analysis demonstrated that multi-dimensional frailty had the greatest impact on BADL impairment [PARc% (95%CI) = 24.6 (19.1, 27.1)], while psychological frailty showed relatively high attributable risk for ADL, BADL, and IADL impairment [PARc% (95%CI) = 18.4 (12.1, 24.5), 23.6 (3.2, 33.7), and 19.4 (12.4, 24.7), respectively]. **Conclusion:** Multi-dimensional frailty, particularly physical and psychological frailty, is associated with ADL, BADL, and IADL impairment among rural elderly, with psychological frailty contributing substantially to disability risk. Enhanced screening and targeted interventions for multi-dimensional frailty, especially psychological dimensions, may reduce disability risk in this population.

Keywords: Frailty; Multi-dimensional frailty; Activities of daily living; Aged; Rural health; Logistic model; Population attributable risk

Introduction

Disability in older adults refers to the inability to independently perform any activity related to daily living, including eating, dressing, toileting, bathing, making phone calls, or shopping—collectively termed activities of daily living (ADL) impairment [1]. China's aging population presents an increasingly serious challenge, with rural areas experiencing faster aging rates than urban centers [2]. Disability represents a prominent issue in this demographic transition [3], adversely affecting quality of life while imposing heavy caregiving burdens on families and society [4]. It is projected that by 2030, China will have 62.9 million disabled or semi-disabled elderly individuals [5].

Frailty is a reversible [6] and preventable [7] condition, and early identification with effective intervention can reverse or slow its progression and prevent adverse health outcomes. Based on the integral conceptual model, Gobbens et al. [8] proposed the concept of multi-dimensional frailty, encompassing physical, psychological, and social dimensions. While previous research has focused primarily on physical frailty and its association with ADL impairment [9], the relationship between psychological and social frailty and ADL impairment remains unclear. Relative to physical frailty, psychological and social frailty may be more amenable to non-pharmacological interventions, making exploration of their associations with ADL impairment crucial for health promotion. This study examines rural elderly in Guizhou Province to investigate the relationship

between multi-dimensional frailty and ADL impairment.

Methods

Study Design and Participants This cross-sectional study was conducted from July to September 2021 using data from the follow-up survey of the “Guizhou Han-Bouyei Thyroid Function and Cognitive Function Cohort Study” [National Natural Science Foundation of China (81860598)]. A multi-stage sampling method was employed: first, two municipalities were randomly selected from all prefecture-level cities in Guizhou Province; then one county/district was randomly selected from each municipality; subsequently, five townships were randomly chosen from each selected county/district, and three administrative villages from each township. All permanent residents in the selected villages were invited to participate (n=1,298).

Inclusion criteria: (1) local residence for more than six months; (2) age \geq 60 years; (3) signed informed consent and ability to complete examinations and questionnaires. **Exclusion criteria:** (1) severe mental illness; (2) severe visual/hearing impairment or aphasia preventing survey completion. The study was approved by the Guizhou Medical University Ethics Committee (Approval No. 2018-092).

Data Collection After obtaining informed consent, trained interviewers conducted face-to-face interviews and completed questionnaires on participants’ behalf. The questionnaire included: (1) basic demographics (sex, age, ethnicity, education, marital status, chronic disease status); (2) Chinese version of the Tilburg Frailty Indicator (TFI) [8]; (3) ADL scale [10]; and (4) Chinese version of the Pittsburgh Sleep Quality Index (PSQI) [11].

Multi-dimensional Frailty Assessment: The TFI scale, developed by Gobbens et al. [8] and translated into Chinese by Xi et al. [12], assesses three dimensions: (1) Physical frailty (8 items: self-rated health, weight loss, walking ability, balance, vision, hearing, grip strength, fatigue); (2) Psychological frailty (4 items: memory decline, depressive symptoms, anxiety, coping ability); and (3) Social frailty (3 items: living alone, lack of social relationships, reduced social support). Items are dichotomously scored, with total scores ranging from 0-15. Multi-dimensional frailty is defined as total score \geq 5; dimension-specific frailty is defined as physical score \geq 3, psychological score \geq 2, or social score \geq 2 [13]. In this study, the scale demonstrated a Cronbach’s α coefficient of 0.662 and KMO value of 0.713.

ADL Assessment: The ADL scale, comprising both Basic ADL (BADL) and Instrumental ADL (IADL) components, evaluates 14 items related to daily self-care and social activities [10]. Each item is scored 1-4: 1=“can do independently,” 2=“with some difficulty,” 3=“needs assistance,” and 4=“unable to do.” Total scores range from 14-56, with higher scores indicating greater impairment. An item score \geq 2 indicates impairment in that activity; BADL or IADL im-

impairment is defined as ≥ 1 impaired item within the respective domain, and ADL impairment is defined as impairment in either BADL or IADL [14].

Sleep Quality Assessment: The PSQI scale, translated and revised by Liu et al. [15], assesses sleep quality over the past month across seven domains (total score 0-21), with scores < 7 indicating good sleep quality and ≥ 7 indicating poor sleep quality [11].

Quality Control During preparation, the questionnaire was refined through pilot testing and expert review, with interviewers receiving standardized training. During implementation, interviewers strictly followed protocols. During data processing, unclear responses were verified with interviewers or participants. Data were double-entered using EpiData 3.1, with consistency checks performed to ensure accuracy.

Statistical Analysis Data were analyzed using SPSS 20.0. Continuous variables with normal distribution were expressed as mean \pm SD, and categorical variables as percentages. Chi-square tests compared ADL impairment prevalence across participant characteristics. Binary logistic regression analyzed the effects of frailty on ADL impairment. Population attributable risk percentages (PARc%) were calculated using Bruzzi's formula [16]: $PARc\% = 1 - \frac{\sum(P_j/R_j)}{R}$, where P_j represents the proportion of cases in stratum j and R_j represents the adjusted relative risk in stratum j . Statistical significance was set at $\alpha=0.05$ (two-tailed).

Results

Participant Characteristics Among 1,298 participants, 536 (41.29%) were male and 762 (58.71%) female, with ages ranging from 60-96 years (mean 72.7 \pm 6.3). Ethnic distribution included 680 (52.39%) Han and 618 (47.61%) non-Han individuals. Education levels: 969 (74.65%) illiterate/semi-illiterate, 207 (15.95%) primary school, and 122 (9.40%) junior high school or above. Marital status: 822 (63.33%) married, 476 (36.67%) unmarried/widowed/divorced. Chronic diseases were present in 756 (58.24%) participants. Sleep quality was good in 871 (67.10%) and poor in 427 (32.90%). Multi-dimensional frailty was present in 382 (29.43%), physical frailty in 319 (24.58%), psychological frailty in 567 (43.68%), and social frailty in 69 (5.32%). ADL impairment was observed in 498 (38.37%), BADL impairment in 40 (3.08%), and IADL impairment in 494 (38.06%).

ADL Impairment Prevalence by Participant Characteristics ADL impairment prevalence differed significantly by sex, age, education, marital status, and sleep quality ($P<0.05$). IADL impairment prevalence differed significantly by sex, age, ethnicity, education, marital status, and sleep quality ($P<0.05$). BADL impairment prevalence differed significantly by age, chronic disease status, and sleep quality ($P<0.05$). ADL and IADL impairment rates differed

significantly between those with and without multi-dimensional frailty, physical frailty, psychological frailty, and social frailty ($P < 0.05$). BADL impairment rates differed significantly between those with and without multi-dimensional frailty, physical frailty, and psychological frailty ($P < 0.05$), but not between those with and without social frailty ($P > 0.05$).

Binary Logistic Regression Analysis Using ADL, IADL, and BADL impairment as dependent variables (no=0, yes=1), and multi-dimensional frailty, physical frailty, psychological frailty, and social frailty as independent variables (no=0, yes=1), with sex (female=0, male=1), age (60-69=1, 70-79=2, 80+=3), education (illiterate/semi-illiterate=1, primary=2, junior high+=3), marital status (unmarried=0, married=1), and sleep quality (good=0, poor=1) as covariates, binary logistic regression models revealed that multi-dimensional frailty, physical frailty, and psychological frailty significantly affected ADL, IADL, and BADL impairment ($P < 0.05$). Social frailty showed no significant effect on any ADL domain ($P > 0.05$).

Population Attributable Risk Analysis Further analysis of population attributable risk showed multi-dimensional frailty had the greatest impact on BADL impairment [PARc% (95%CI) = 24.6 (19.1, 27.1)]. Psychological frailty demonstrated substantial attributable risk for ADL, BADL, and IADL impairment [PARc% (95%CI) = 18.4 (12.1, 24.5), 23.6 (3.2, 33.7), and 19.4 (12.4, 24.7), respectively].

Discussion

This study found a multi-dimensional frailty prevalence of 29.43% among rural elderly in Guizhou, lower than rates reported in other Chinese regions such as Harbin [17], possibly due to our rural sample's engagement in agricultural activities. Notably, psychological frailty prevalence (43.68%) exceeded physical (24.58%) and social frailty (5.32%), highlighting the need for attention to mental health in this population.

Consistent with previous research, physical frailty significantly affected ADL, BADL, and IADL impairment [18,19], with the strongest effect on BADL. While social frailty showed no significant association—possibly due to simpler social networks in rural settings limiting its health impact—psychological frailty significantly affected all ADL domains. This may be because psychological frailty components (subjective memory decline, depression, anxiety) are established ADL impairment risk factors [20-22], and psychologically frail elders exhibit reduced physical activity, a strong behavioral predictor of ADL impairment [23].

Population attributable risk analysis revealed that psychological frailty contributed more substantially to disability than physical frailty, underscoring its importance for prevention. This contrasts with some studies [24] that found no association between psychological frailty and ADL impairment, possibly because rural elderly may be more sensitive to psychological factors' health effects [25].

However, this cross-sectional design cannot establish temporal relationships or causality. Additionally, the sample was limited to rural Guizhou, potentially restricting generalizability. Future prospective cohort studies with broader geographic representation are needed.

In conclusion, multi-dimensional frailty, particularly physical and psychological dimensions, significantly impacts ADL impairment among rural elderly, with psychological frailty representing a major attributable risk factor. Given that multi-dimensional frailty is preventable and reversible, especially psychological frailty, rural healthcare providers should implement routine screening and targeted interventions to reduce disability risk.

Author Contributions: Zhao Yi conceptualized the study, collected and entered data, and drafted the manuscript. Yang Jingyuan provided critical revisions, supervised the research, and takes overall responsibility. Yang Xing and Zhou Quanxiang coordinated fieldwork. Jiang Yun, Huang Hui, and Zhu Yujie collected, organized, and entered data.

Conflict of Interest: None declared.

References: [1] Li ZZ, Tang Z. Epidemiological research progress on disability in the elderly[J]. Chinese Journal of Epidemiology, 2016, 37(7):1047-1050. DOI:10.3760/cma.j.issn.0254-6450.2016.07.028.

[2] Gill TM, Gahbauer EA, Allore HG, et al. Transitions between frailty states among community-living older persons[J]. Arch Intern Med, 2006, 166(4):418-423. DOI:10.1001/archinte.166.4.418.

[3] Wu XL, Liu J, Dong TY. Longitudinal study on self-care ability of Chinese elderly[J]. Aging Science Research, 2018, 6(1):28-45. DOI:10.3969/j.issn.2095-5898.2018.01.003.

[4] Chi WC, Chang KH, Escorpizo R, et al. Measuring disability and its predicting factors in a large database in Taiwan using the World Health Organization Disability Assessment Schedule 2.0[J]. Int J Environ Res Public Health, 2014, 11(12):12148-12161. DOI:10.3390/ijerph111212148.

[5] Min B, Pu YT, Wang Z, et al. Activities of daily living and influencing factors among elderly in Changchun nursing institutions[J]. Chinese Journal of Gerontology, 2022, 42(2):468-470. DOI:10.3969/j.issn.1005-9202.2022.02.054.

[6] Chen GH, Cai YF, Li F. Trend prediction and structural analysis of population aging in China: Based on non-parametric autoregressive model[J]. Northwest Population Journal, 2014, 35(4):81-87. DOI:10.15884/j.cnki.issn.1007-0672.2014.04.039.

[7] Bartley MM, Geda YE, Christianson TJ, et al. Frailty and mortality outcomes in cognitively normal older people: sex differences in a population-based study[J]. J Am Geriatr Soc, 2016, 64(1):132-137. DOI:10.1111/jgs.13821.

[8] Gobbens RJ, Luijckx KG, Wijnen-Sponselee MT, et al. Toward a conceptual definition of frail community dwelling older people[J]. Nurs Outlook, 2010, 58(2):76-86. DOI:10.1016/j.outlook.2009.09.005.

[9] Vermeulen J, Neyens JC, van Rossum E, et al. Predicting ADL disability in community-dwelling elderly people using physical frailty indicators: a

- systematic review[J]. *BMC Geriatr*, 2011, 11:33. DOI:10.1186/1471-2318-11-33.
- [10] Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living[J]. *Gerontologist*, 1969, 9(3):179-186.
- [11] Buysse DJ, Reynolds CF 3rd, Monk TH, et al. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research[J]. *Psychiatry Res*, 1989, 28(2):193-213. DOI:10.1016/0165-1781(89)90047-4.
- [12] Xi X, Guo GF, Sun J. Reliability and validity of the Chinese version of Tilburg Frailty Indicator[J]. *Journal of Nursing*, 2013, 20(16):1-5. DOI:10.16460/j.issn1008-9969.2013.16.006.
- [13] Van Campen C. Frail older persons in the Netherlands[M]. The Hague: The Netherlands Institute for Social Research, 2011.
- [14] Chen JF, Fang MW, Xiao CH, et al. Relationship between activities of daily living and depressive symptoms among Chinese elderly[J]. *Chinese General Practice*, 2020, 23(22):2852-2855, 2862. DOI:10.12114/j.issn.1007-9572.2019.00.693.
- [15] Liu XC, Tang MQ, Hu L, et al. Reliability and validity of the Pittsburgh Sleep Quality Index[J]. *Chinese Journal of Psychiatry*, 1996, 29(2):103-107. DOI:10.1007/BF02951625.
- [16] Bruzzi P, Green SB, Byar DP, et al. Estimating the population attributable risk for multiple risk factors using case-control data[J]. *Am J Epidemiol*, 1985, 122(5):904-914. DOI:10.1093/oxfordjournals.aje.a114174.
- [17] Li Y, Zhang LP, Luo Y. Prevalence and influencing factors of frailty among community-dwelling elderly in Harbin[J]. *Nursing Research*, 2018, 32(2):224-228. DOI:10.3969/j.issn.1009-6493.2018.02.016.
- [18] Venturini C, Moreira BS, Silva SLA D, et al. Physical frailty, activity limitation and mortality in older Brazilians: longitudinal findings from FIBRA-BH study (2009—2019)[J]. *Cien Saude Colet*, 2022, 27(10):4015-4023. DOI:10.1590/1413-812320222710.08492022.
- [19] Provencher V, Béland F, Demers L, et al. Are frailty components associated with disability in specific activities of daily living in community-dwelling older adults? A multicenter Canadian study[J]. *Arch Gerontol Geriatr*, 2017, 73:187-194. DOI:10.1016/j.archger.2017.07.027.
- [20] Xie J, Li Y, Zhang YJ, et al. Sleep duration and metabolic syndrome: an updated systematic review and meta-analysis[J]. *Sleep Med Rev*, 2021, 59:101451. DOI:10.1016/j.smrv.2021.101451.
- [21] Stogmann E, Moser D, Klug S, et al. Activities of daily living and depressive symptoms in patients with subjective cognitive decline, mild cognitive impairment, and Alzheimer's disease[J]. *J Alzheimers Dis*, 2016, 49(4):1043-1050. DOI:10.3233/JAD-150785.
- [22] Ormel J, Rijdsdijk FV, Sullivan M, et al. Temporal and reciprocal relationship between IADL/ADL disability and depressive symptoms in late life[J]. *J Gerontol B Psychol Sci Soc Sci*, 2002, 57(4):338-347. DOI:10.1093/geronb/57.4.p338.
- [23] LaCroix AZ, Guralnik JM, Berkman LF, et al. Maintaining mobility in late life. II. Smoking, alcohol consumption, physical activity, and body mass index[J]. *Am J Epidemiol*, 1993, 137(8):858-869. DOI:10.1093/oxfordjournals.aje.a116747.

- [24] Ament BHL, De Vugt ME, Verhey FRJ, et al. Are physically frail older persons more at risk of adverse outcomes if they also suffer from cognitive, social, and psychological frailty?[J]. Eur J Ageing, 2014, 11(3):213-219. DOI:10.1007/s10433-014-0308-x.
- [25] Jia HY, Wang JY. Analysis of mental health status of rural elderly[J]. Chinese Public Health, 2007, 23(6):763-764.

Received: July 25, 2023; Revised: August 17, 2023
(Edited by Wang Fengwei)

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv — Machine translation. Verify with original.