



Employment and frailty among older adults: The mediating role of emotional support and the moderating role of physical activity

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Received: 18 January 2026; Accepted: 11 May 2026; Published: 30 October 2026

Abstract: Background: Frailty is a common geriatric condition. Employment, as an important social activity for older adults, may be closely related to their frailty status. However, the association between employment and frailty among older adults remains understudied. **Methods:** Data were derived from the 2018 China Health and Retirement Longitudinal Survey (CHARLS) dataset, involving 6161 older adults (age: $M = 69.378$, $SD = 6.875$; 49.619% female). PROCESS analysis was used to test the association between employment and frailty, as well as the mediating role of emotional support and the moderating role of physical activity. **Results:** First, employment was significantly associated with lower frailty levels among older adults. Second, emotional support mediated the association between employment and frailty. Third, physical activity moderated the relationship between emotional support and frailty, as higher physical activity strengthened their negative association. **Conclusion:** These findings align with activity theory, which posits that successful aging depends on maintaining a high level of activity engagement. These findings have notable practical implications for addressing frailty among older adults and promoting the progress of productive aging.

Keywords: Employment; frailty; emotional support; physical activity; older adults

Introduction

Against the backdrop of global population aging, older adults will face a range of health challenges, such as frailty. Frailty is a subclinical state between health and disease, reflecting compromised overall health among older adults (Clegg et al., 2013). When frailty reaches a certain point, it may increase the likelihood of harmful health outcomes among older adults, including falls, disability, cognitive decline, and even the loss of basic self-care abilities (Fried et al., 2001). Within the concept of productive aging, older adults are encouraged to remain in the labor force (Gonzales et al., 2015). Previous studies have found that the concept of productive aging represents one pathway to enhancing older adults' health, yet the association between employment engagement and frailty among older adults remains understudied (Su, 2025). Employment may influence health through pathways of family support and individual behaviors (Mauno et al., 2018; Van Domelen et al., 2011). Therefore, this study focuses on the mediating role of emotional support and the moderating role of physical activity, aiming to open the black box of the association between employment and frailty among older adults.

Employment and frailty

The theory of role accumulation posits that individuals can gain social support and resources by enacting multiple roles (Sieber, 1974). Employment allows older adults to retain or regain the “worker” role after retirement, and the resulting support and resources may help with frailty management. More specifically, employment may exert an impact on older adults' physical and mental health

by increasing income, enhancing cognitive functioning, and expanding their social-support networks (Fu & Li, 2024; Tang et al., 2013). Employment has been linked to a lower likelihood of major illness and mortality among older adults (Wang & Shi, 2014; Yin et al., 2022). The increased physical activity that accompanies employment may be conducive to improving older adults' health (Clemes et al., 2014; Hlebachuk et al., 2023; Tomonaga et al., 2024). Previous studies have mostly examined the association from a single dimension of health. Therefore, it is necessary to adopt an integrated-health perspective and delve into the association between employment and frailty among older adults.

The mediating role of emotional support

Emotional support, as defined in this study, refers to the emotional care provided by adult children to their elderly parents, mainly through reassurance, companionship, and attentive listening, which helps older adults gain spiritual strength and solace (Keyes, 2002; Ren et al., 2025). Social exchange theory posits that human social behavior can be viewed as an implicit exchange process in which actors pursue reciprocity and obtain rewards through interaction (Ahmad et al., 2023). Within the family, intergenerational interaction can be viewed as a resource-exchange process in which the party with more valuable resources usually holds greater power. Thus, enhancing personal value and available resources may help older adults obtain more emotional support from their children. The income earned from employment provides older adults with renewed resources for reciprocity, demonstrating their ability to



support themselves while also enabling them to contribute to household expenses and buy gifts for their grandchildren (Foweraker & Cutcher, 2020; Keefe & Fancey, 2002). Employment equips older adults with a wealth of social experiences, work anecdotes, and up-to-date knowledge, enhancing their attractiveness in the family's resource exchange, strengthening their children's willingness to communicate with them, and thereby potentially elevating the level of emotional support they receive (Caballero & Resnik, 1986; Wang & Ge, 2025).

As a key dimension of the family support network, emotional support may play a role in frailty reduction among older adults through multiple pathways. In terms of mental health, emotional support such as emotional sharing and daily chats across generations effectively alleviates older adults' negative emotions (Li et al., 2024; Zhou & Bai, 2022). In terms of cognitive function, intergenerational exchanges of life experiences and acquisition of new knowledge require older adults to mobilize their memory and analytical abilities, which may in turn show an association with lower levels of cognitive decline (Hu et al., 2024; Krzeczowska et al., 2021). In terms of health behaviors, emotional support can enhance older adults' sense of life value, and this positive mindset may show an association with lower frailty levels by promoting the adoption of healthy behaviors, including maintaining regular routines, engaging in physical exercise, and cooperating with medical treatment (Zhang et al., 2023). Therefore, this study suggests that emotional support is negatively associated with frailty among older adults. In summary, older adults' participation in employment may be associated with higher levels of emotional support from their children, which could in turn be linked to slower progression of frailty.

The moderating role of physical activity

Physical activity refers to any bodily movement produced by skeletal muscle contraction, mainly including household, transport, occupational, and leisure-time activities (Caspersen et al., 1985). Engaging in joint physical activity is more effective than mere verbal interaction in enhancing older adults' social connectedness and physical health, thereby helping them better perceive and translate emotional support into well-being (Krzeczowska et al., 2021; Lyndon & Moss, 2023). On the one hand, frequent participation in physical activity creates more opportunities for intergenerational communication, allowing children to directly observe the physical and psychological needs of older adults during shared exercise sessions (Park, 2014; Zhang & Hummert, 2001). This shift in emotional support from general care to targeted attention may play a role in alleviating frailty among older adults. On the other hand, frequent physical activity creates a synergistic effect between children's emotional support and the physiological benefits of exercise. Children's encouragement and affirmation, combined with the physical comfort brought about by physical activity, jointly strengthen older adults' sense of self-worth and confidence in resisting decline, thereby potentially amplifying the effect of emotional support on slowing frailty progression (Minghetti et al., 2021; Ren et al., 2025). Therefore, physical activity may

act as a vehicle for intergenerational interaction and moderate the indirect association between employment-derived emotional support and frailty.

Theoretical foundations

The theoretical framework of this study is grounded in activity theory. This theory holds that successful aging depends on maintaining a high level of activity engagement (Havighurst, 1961). A key mechanism underlying this relationship is role substitution. According to activity theory, as older adults face role losses with aging, they can substitute these former roles with new meaningful activities. This substitution process helps older adults maintain a positive sense of self, resist social pressures that limit their world, and achieve continued life satisfaction (Lemon et al., 1972). Previous research has shown that employment can help older adults maintain social activities (Danquah et al., 2024). Therefore, activity theory provides an appropriate theoretical lens for examining the relationship between employment and frailty among older adults.

Goals of the study

This study aimed to explore the association between employment and frailty and the role of emotional support and physical activity in that association. Based on Figure 1, we hypothesized that:

H1: *Employment is associated with lower frailty among older adults.*

H2: *Emotional support mediates the association between employment and frailty among older adults for greater activity engagement with less frailty.*

H3: *Physical activity moderates the mediated path between employment and frailty among older adults for less frailty.*

Methods

Data sources

We used the 2018 wave data from the China Health and Retirement Longitudinal Survey (CHARLS), led by Peking University. The data are available at <https://charls.pku.edu.cn/>. These data were collected using nationwide PPS (Probability Proportional to Size) sampling. This study focused on older adults aged 60 years and older. A total of 11511 research subjects participated. After excluding those under 60 years of age (4715) and those with substantial missing variables via listwise deletion (635), 6161 valid cases were retained for the empirical analysis of this study. For the remaining cases with a small number of missing values, single imputation was adopted for imputation; median imputation was adopted for continuous variables, including self-rated health, CES-D10 items, emotional support, and income; mode imputation was applied to binary (0/1) variables, including CHARLS-MMSE items and grandchild care. The top and bottom 1% of all continuous variables were winsorized to mitigate the influence of outliers.

Frailty

This study adopted the Frailty Index (FI), which provides a health deficit index as calculated by the number of existing health deficits divided by the total number of included

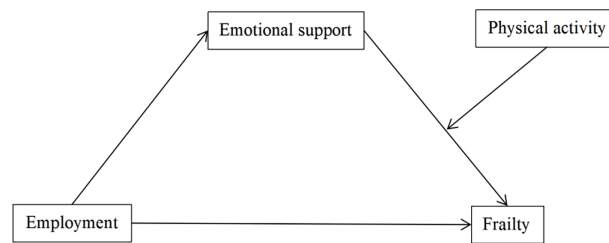


Figure 1. The theoretical model of the impact mechanism of employment on frailty among older adults

indicators, with a range from 0 to 1, where a higher value indicates a higher degree of frailty (Song et al., 2010). We constructed a Frailty Index (FI) among older adults by incorporating 45 health-related variables from the questionnaire, including disease conditions (hypertension, dyslipidemia, diabetes, pulmonary, hepatic, cardiac, cerebrovascular, renal, gastrointestinal, psychiatric, memory disorders, arthritis/rheumatism, and asthma) were coded as dichotomous variables (0 = No, 1 = Yes), physical symptoms (head, shoulders, arms, wrists, fingers, chest, stomach, back, waist, hips, legs, knees, ankles, toes, neck) were coded as dichotomous variables (0 = No, 1 = Yes), mental health (CES-D10 scale) was coded as a dichotomous variable based on the recommended cutoff value (0 = score < 10, 1 = score ≥ 10), accidental events (falls, fractures) were coded as dichotomous variables (0 = No, 1 = Yes), cognitive function (CHARLS-MMSE scale) was incorporated into the analysis as the ratio of the actual score to the maximum possible score (31), self-rated health was coded as a dichotomous variable (0 = Very good, Good and Fair, 1 = Poor and Very poor), life satisfaction was coded as a dichotomous variable (0 = Completely satisfied, very satisfied and somewhat satisfied, 1 = Not very satisfied and not at all satisfied), basic activities of daily living (dressing, bathing, eating, getting in and out of bed, toileting, controlling bowel and bladder) were coded as dichotomous variables (0 = able to complete independently, 1 = unable to complete independently), and instrumental activities of daily living (managing finances, taking medication, shopping, cooking, doing housework) were coded as dichotomous variables (0 = able to complete independently, 1 = unable to complete independently).

Employment

The employment measure primarily focused on non-agricultural work as follows: “In the past week, excluding agricultural work, did you work for at least one hour? This includes wage-earning employment, self-employed or private business activities, or unpaid help in a family business” and “Regarding the non-agricultural work just mentioned, even if you did not work (or worked less than one hour) last week, are you currently on temporary leave, sick leave, or other vacation, or engaged in on-the-job training?” Employment participation was defined as a binary variable: it was coded as 1 if the response to either question was “yes”; and 0 if the responses to both questions were “no”.

Emotional support

This was measured by the frequency of emotional support provided by children to older adults (Jiang et al., 2024; Wang et al., 2025). The survey question was “When you and your children do not live together, how often do you see them?” (range 0–9). We summed the reported meeting frequencies across all children and divided by the number of children for each respondent.

Physical activity

Physical activity was measured into low, moderate and high intensity levels, and daily minutes and days per week for each level. Weekly time in any one level is truncated at 21 h (Lefferts et al., 2022). Metabolic equivalents were set at 3.3 for low, 4.0 for moderate and 8.0 for high intensity (Chen et al., 2025). Weekly physical activity energy expenditure was calculated using the following formula: MET for the level × daily activity duration × days of activity per week (Chen et al., 2025).

Covariates

Referring to previous studies (Daskalopoulou et al., 2018; Manzoli et al., 2007; Szinovacz et al., 1999; Yuan et al., 2025), Gender (0 = Female, 1 = Male), age (continuous variable, ranging from 60 to 108 years), marital status (Without spouse = 0, With spouse = 1), education level (0 = below junior high school, 1 = junior high school and above), household registration (0 = Agricultural household registration, 1 = Non-agricultural household registration), smoking (0 = No, 1 = Yes), drinking (0 = No, 1 = Yes), medical insurance (0 = No, 1 = Yes), grandchild caregiving (0 = No, 1 = Yes), ethnicity (0 = ethnic minorities, 1 = Han Chinese), Communist Party of China (CPC) membership (0 = Non-member, 1 = Member), income (continuous variable), financial support from children to older adults (continuous variable).

Data analysis

We use the Process plugin Bootstrap method to conduct a test of the effect (Preacher & Hayes, 2004), with the following specific settings: first, PROCESS Model 4 is set, X = Employment, M = Emotional support, Y = Frailty, with a sample size of 5000 and a 95% confidence interval. Second, PROCESS Model 14 is set, X = Employment, M = Emotional support, W = Physical activity, Y = Frailty, with a sample size of 5000 and a 95% confidence interval.

Common method bias test

To address potential common method bias (CMB), two complementary methods were used (Xin & Zhang, 2025).

First, the Harman single-factor test was conducted on all measurement items, and the first unrotated factor explained only 12.09% of the total variance, well below the 40% threshold. However, it should be noted that the Harman single-factor test has inherent limitations and can only serve as an initial screening tool for CMB. Second, a single-factor confirmatory factor analysis (CFA) was performed using all original measurement items to further verify the CMB issue. The results showed that the single-factor model did not fit the data well ($\chi^2(135) = 25,955.658$, $p < 0.001$, RMSEA = 0.173, CFI = 0.296, TLI = 0.202, SRMR = 0.125) (Hu & Bentler, 1999). The results showed that common method bias is not a serious concern in this study.

Results

Descriptive analysis

Table 1 presents the descriptive statistics. Older adults have an employment participation rate of 12.677%. Their mean Frailty Index (FI) is 0.190 (SD = 0.154), mean emotional support score is 4.723 (SD = 2.307), and mean physical activity energy expenditure is 4617.059 (SD = 4573.563). Most older adults are male, with spouse, have below-junior-high education, hold agricultural household registration, don't smoke or drink, are covered by medical insurance, don't engage in grandchild caregiving, are of Han ethnicity, and are not Communist Party members. The mean amount of financial support received is 5170.444 CNY (SD = 11,876.960). The mean income is 8824.766 CNY (SD = 19,489.840).

Frailty from employment

Model 1 in Table 2 presents the regression analysis results. Employment was significantly negatively associated with frailty ($\beta = -0.349$, $p < 0.001$), and Hypothesis H1 was supported.

The mediating role of emotional support

Model 2 and 3 in Table 2 present results of the mediating role. Employment was significantly positively associated with emotional support ($\beta = 0.122$, $p < 0.01$). Employment and emotional support were significantly negatively associated with frailty ($\beta = -0.343$, $p < 0.001$; $\beta = -0.047$, $p < 0.001$). The direct effect value of employment on frailty was -0.343 , with a confidence interval of $[-0.418, -0.269]$, which did not include 0, indicating that the direct effect was significant. The indirect effect value of employment on frailty was -0.006 , with a confidence interval of $[-0.011, -0.001]$, which did not include 0, indicating that the mediating role of emotional support was significant, and hypothesis H2 was established. Emotional support played a partial mediating role between employment and frailty.

The moderating role of physical activity

Model 4 in Table 2 presents results of the moderating role. After including physical activity as a moderator, the interaction between emotional support and physical activity significantly and negatively predicted frailty ($\beta = -0.028$, $p < 0.05$). Corresponding simple slope

analysis results were displayed in Tables 3 and 4. The conditional indirect effect of employment on frailty through emotional support was moderated by physical activity. At low levels of physical activity, the indirect effect was not significant (Effect = -0.003 , 95% bootstrap CI = $[-0.009, 0.002]$), whereas it was significant at medium (Effect = -0.006 , 95% bootstrap CI = $[-0.012, -0.002]$) and high levels (Effect = -0.010 , 95% bootstrap CI = $[-0.018, -0.003]$). The index of moderated mediation was significant (Index = -0.003 , 95% bootstrap CI = $[-0.008, -0.001]$), confirming that physical activity moderated the indirect effect of employment on frailty via emotional support. Pairwise contrasts further revealed that the indirect effect at the high level of physical activity was significantly stronger than that at the medium level (Contrast = -0.003 , 95% bootstrap CI = $[-0.008, -0.001]$) and the low level (Contrast = -0.007 , 95% bootstrap CI = $[-0.016, -0.001]$). Similarly, the indirect effect at the medium level was significantly stronger than that at the low level (Contrast = -0.004 , 95% bootstrap CI = $[-0.008, -0.001]$). These results indicated that with the increase in physical activity, the magnitude of the negative association between emotional support and frailty among older adults gradually increased.

Robustness checks

As shown in Table 5, two robustness checks were conducted to assess the reliability of the core findings. First, in Model 1, the overall physical activity measure was replaced with moderate-intensity physical activity as the moderator, and the core results of the moderated mediation model remained consistent (Index = -0.003 , 95% bootstrap CI = $[-0.007, -0.001]$). Second, a sensitivity analysis was performed for Models 2, 3, 4, and 5 by adjusting the winsorization threshold to 2%. The results showed that the core findings of the mediation model were consistent in both direction and statistical significance (Index = -0.006 , 95% bootstrap CI = $[-0.011, -0.001]$). Meanwhile, the core results of the moderated mediation model also held consistent in terms of direction and statistical significance (Index = -0.003 , 95% bootstrap CI = $[-0.008, -0.001]$). Collectively, these two robustness checks indicated that the conclusions of this study were robust.

Discussion

Under the concept of productive aging, employment provides a new perspective for exploring the association between work participation and frailty among older adults. The results of this study indicate a negative association between employment and frailty among older adults, which aligns with activity theory as well as the theory of role accumulation (Mize & Kincaid, 2025). Employment is associated with lower frailty levels among older adults, possibly related to attainment of the "worker" role. On the one hand, the economic income generated by this role is positively associated with access to more abundant nutrition and higher-quality medical services among older adults, and these material resources are negatively associated with frailty (Hamasaki, 2025; Sinclair et al., 2025). On the other hand, the physical activity associated with

Table 1. Descriptive analysis

	Percent (%)	Mean (SD)	Min	Max
Main variables				
Frailty		0.190 (0.154)	0.002	0.903
Employment				
Participate	12.677			
Not participate	87.323			
Emotional support		4.723 (2.307)	0	9
Physical activity		4617.059 (4573.563)	0	19,278
Covariates				
Gender				
Female	49.619			
Male	50.381			
Age		69.378 (6.875)	60	108
Marital status				
Without spouse	30.953			
With spouse	69.047			
Education level				
Below junior high school	73.917			
Junior high school and above	26.083			
Household registration				
Agricultural household registration	75.816			
Non-agricultural household registration	24.184			
Smoking				
No	72.602			
Yes	27.398			
Drinking				
No	68.593			
Yes	31.407			
Grandchild caregiving				
No	64.503			
Yes	35.497			
Ethnicity				
Ethnic minorities	7.174			
Han Chinese	92.826			
Communist Party of China (CPC) membership				
Non-member	87.534			
Member	12.466			
Financial support from children to older adults		5170.444 (11,876.960)	0	380,300
Income		8824.766 (19,489.840)	0	600,600

this role may help older adults maintain muscle strength, balance, and cardiovascular health, which is linked to lower levels of frailty (Steele & Mummery, 2003; Huang et al., 2025). Moreover, previous studies have mostly focused on the impact of employment on a single health dimension among older adults, whereas this study systematically reveals a negative association between employment and frailty, thereby broadening the scope of existing research.

This study finds that emotional support mediates the association between employment and frailty among older adults. In other words, employment is positively associated with emotional support from their children, and this support is negatively associated with frailty. This pathway of action is not only consistent with the core proposition of activity theory that continuous activity participation maintains individual health, but also can be explained with the help of social exchange theory (Brown, 1975). Employment can shift older adults from mere resource recipients

to active resource creators and providers, fundamentally altering the pattern of intra-family resource exchange. By increasing older adults' resources such as income and social information, employment makes children's emotional support stem more from recognition of their parents' current value than from a sense of duty alone (Wang & Shi, 2024). Children's recognition of older adults' contributions may relate to higher-quality emotional support, possibly linked to better health outcomes in older adults (Ko et al., 2023; Silverstein et al., 2002). High-quality emotional support may correlate with lower frailty levels, with emotional value, sustained cognitive engagement, and healthy lifestyles as potential contributing factors (Li & Guo, 2022; Sun et al., 2022).

This study also finds that physical activity positively moderates the mediating effect of emotional support in the relationship between employment and frailty among older adults. In other words, the increase in emotional support

Table 2. Regression coefficients

	(1) Frailty	(2) Emotional support	(3) Frailty	(4) Frailty
Employment	−0.349*** (0.038)	0.122** (0.040)	−0.343*** (0.038)	−0.338*** (0.038)
Emotional support			−0.047*** (0.012)	−0.050*** (0.012)
Physical activity				−0.074*** (0.013)
Emotional support × physical activity				−0.028* (0.013)
Age	0.459 (0.242)	0.901*** (0.251)	0.501* (0.242)	0.528* (0.241)
Age ²	−0.424 (0.241)	−0.779** (0.250)	−0.460 (0.241)	−0.501* (0.240)
Gender	−0.341*** (0.031)	−0.159*** (0.032)	−0.348*** (0.031)	−0.344*** (0.031)
Household registration	−0.083* (0.033)	0.189*** (0.035)	−0.074* (0.033)	−0.098** (0.034)
Marital status	−0.046 (0.029)	0.094** (0.030)	−0.041 (0.029)	−0.035 (0.029)
Education level	−0.149*** (0.032)	0.018 (0.033)	−0.148*** (0.032)	−0.153*** (0.032)
Ethnicity	−0.229*** (0.047)	0.051 (0.049)	−0.226*** (0.047)	−0.232*** (0.047)
Communist Party of China (CPC) membership	0.007 (0.040)	0.038 (0.041)	0.009 (0.040)	0.009 (0.040)
Smoking	−0.031 (0.031)	−0.004 (0.032)	−0.031 (0.031)	−0.030 (0.031)
Drinking	−0.120*** (0.029)	−0.026 (0.030)	−0.122*** (0.029)	−0.111*** (0.029)
Grandchild caregiving	−0.038 (0.027)	0.025 (0.028)	−0.037 (0.027)	−0.034 (0.027)
Income	−0.056*** (0.014)	0.024 (0.014)	−0.055*** (0.014)	−0.053*** (0.014)
Financial support from children to older adults	−0.027* (0.012)	0.051*** (0.013)	−0.025* (0.012)	−0.024 (0.012)
_cons	0.577*** (0.051)	−0.102 (0.053)	0.573*** (0.051)	0.571*** (0.051)
N	6161	6161	6161	6161
R ²	0.101	0.033	0.103	0.108

Note. All continuous variables in the model are standardized before being entered into the regression equation.
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 3. Results of the moderation effect test

Physical activity	Effect	BootSE	BootLLCI	BootULCI
(M − 1SD)	−0.003	0.003	−0.009	0.002
(M)	−0.006	0.003	−0.012	−0.002
(M + 1SD)	−0.010	0.004	−0.018	−0.003

Note. All continuous variables in the model are standardized before being entered into the regression equation.

gained through participation in employment can be leveraged by high physical activity to enhance the association with lower frailty levels. Previous studies have focused on the impact of emotional support on health, whereas this study centers on its health conversion effectiveness (He et al., 2024). This study finds that high physical

activity may link emotional support to health outcomes, with employment-related emotional support possibly tied to lower frailty via more communication and greater self-worth. Conversely, without the vehicle of physical activity, children's emotional support is likely to remain limited to simple greetings and struggle to truly enter older adults'

Table 4. Pairwise contrasts of conditional indirect effects

Effect1	Effect2	Contrast	BootSE	BootLLCI	BootULCI
−0.006	−0.003	−0.003	0.002	−0.008	−0.001
−0.010	−0.003	−0.007	0.004	−0.016	−0.001
−0.010	−0.006	−0.004	0.002	−0.008	−0.001

Note. All continuous variables in the model are standardized before being entered into the regression equation.

Table 5. Robustness checks

	(1) Frailty	(2) Frailty	(3) Emotional support	(4) Frailty	(5) Frailty
Employment	−0.337*** (0.038)	−0.351*** (0.038)	0.122** (0.040)	−0.345*** (0.038)	−0.340*** (0.038)
Emotional support	−0.046*** (0.012)			−0.046*** (0.012)	−0.050*** (0.012)
Moderate-intensity physical activity	−0.037** (0.012)				
Emotional support × Moderate-intensity physical activity	−0.025* (0.012)				
Physical activity					−0.075*** (0.013)
Emotional support × physical activity					−0.028* (0.013)
Covariates	Yes	Yes	Yes	Yes	Yes
_cons	0.571*** (0.051)	0.574*** (0.051)	−0.100 (0.053)	0.569*** (0.051)	0.568*** (0.051)
N	6161	6161	6161	6161	6161
R ²	0.105	0.101	0.034	0.103	0.109

Note. All continuous variables in the model are standardized before being entered into the regression equation.

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

daily lives. Detached from concrete interaction, such support is prone to diluted effectiveness due to incomplete information exchange, which may be associated with a faster progression of frailty (Stein, 1991).

Theoretical and practical implications

This study has certain theoretical significance. First, this study enriches the literature on activity theory using the concept of Productive Aging to address older adults' health issues. Second, employment may allow older adults to retain or regain the "worker" role after retirement, with associated support and resources possibly linked to lower frailty levels. These findings align with the theory of role accumulation. Third, employment may enhance older adults' sense of value, and greater emotional support from their children is possibly associated with lower frailty levels. These findings align with activity theory. Moreover, this study offers a new theoretical basis for understanding frailty in older adults. It also enriches research on employment and frailty and provides a new perspective for future studies.

This study also has certain practical implications. On the one hand, employment may strengthen older adults' sense of worth, and higher-quality emotional support from their children could be linked to lower frailty levels. On the other hand, the increase in emotional support gained

through participation in employment can be leveraged by high physical activity to strengthen the association with lower frailty levels. These findings have practical implications for understanding frailty in older adults and promoting successful aging.

Limitations and future directions

This study has explored the association between employment and frailty among older adults to a certain extent, but there are still some limitations: first, due to the CHARLS 2018 data being cross-sectional data from 2018, the mechanisms of influence explored in this study are largely correlational rather than strictly causal. Second, although the Frailty Index (FI) was used to integrate the measurement of frailty, the items were restricted to those available in the existing questionnaire, leaving room for improved comprehensiveness. Third, based on the research objectives and literature review, this study selected emotional support and physical activity as both mediators and moderators. However, frailty may also be influenced by other factors that warrant further research.

Future research could integrate additional dimensions of frailty and systematically analyze its determinants. Moreover, a wider range of family support and individual

behaviors could be introduced as mediators and moderators and analyzed jointly with the present findings to provide a more complete understanding.

Conclusions

Employment is closely related to frailty among older adults. Emotional support mediates the association between employment and frailty among older adults. Physical activity positively moderates the mediating role of emotional support in the association between employment and frailty among older adults. These findings suggest that targeted interventions are needed to promote employment participation among older adults. Specifically, community workshops and online tutorials could be developed to enhance their job skills and confidence, thereby fostering an association between sustained employment and lower frailty levels among older adults.

Acknowledgement: Not applicable.

Funding Statement: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author Contributions: Jiahan Li contributed to developing the theoretical framework, data analysis, organization, and overall writing of the paper. Jie Yang and You Zhou contributed to the editing and organization of the paper. Lei Yuan was concerned with drafting the work and revising critically. All authors reviewed and approved the final version of the manuscript.

Availability of Data and Materials: China Health and Retirement Longitudinal Study (CHARLS) is a nationally representative longitudinal survey initiated by Peking University in 2011. If you want to obtain the data used in this paper, first visit website <https://charls.pku.edu.cn/>, register with your own email, and then apply to obtain the data.

Ethics Approval: Not Applicable.

Conflicts of Interest: The authors declare no conflicts of interest.

References

- Ahmad, R., Nawaz, M. R., Ishaq, M. I., Khan, M. M., & Ashraf, H. A. (2023). Social exchange theory: Systematic review and future directions. *Frontiers in Psychology*, 13, 1015921. <https://doi.org/10.3389/fpsyg.2022.1015921>
- Brown, A. H. (1975). A use of social exchange theory in family crisis intervention. *Journal of Marital and Family Therapy*, 1(3), 259–267. <https://doi.org/10.1111/j.1752-0606.1975.tb00093.x>
- Caballero, M., & Resnik, A. J. (1986). The attraction paradigm in dyadic exchange. *Psychology & Marketing*, 3(1), 17–34. <https://doi.org/10.1002/mar.4220030103>
- Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports*, 100(2), 126.
- Chen, C., Wu, H., Yang, L., Kan, K., Zhang, X., et al. (2025). Network analysis of chronic disease among middle-aged and older adults in China: A nationwide survey. *Frontiers in Public Health*, 13, 1551034. <https://doi.org/10.3389/fpubh.2025.1551034>
- Clegg, A., Young, J., Iliffe, S., Rikkert, M. O., & Rockwood, K. (2013). Frailty in elderly people. *The Lancet*, 381(9868), 752–762. [https://doi.org/10.1016/S0140-6736\(12\)62167-9](https://doi.org/10.1016/S0140-6736(12)62167-9)
- Clemes, S. A., O'connell, S. E., & Edwardson, C. L. (2014). Office workers' objectively measured sedentary behavior and physical activity during and outside working hours. *Journal of Occupational and Environmental Medicine*, 56(3), 298–303. <https://doi.org/10.1097/jom.0000000000000101>
- Danquah, E., Asiamah, N., Jnr, R. A. M., & Kouveliotis, K. (2024). Association of frailty with workplace social activity, physical activity, and well-being among older employees: A moderated mediation in two income-variant samples. *BMC Geriatrics*, 24(1), 574. <https://doi.org/10.1186/s12877-024-05178-9>
- Daskalopoulou, C., Stubbs, B., Kralj, C., Koukounari, A., Prince, M., et al. (2018). Associations of smoking and alcohol consumption with healthy ageing: A systematic review and meta-analysis of longitudinal studies. *BMJ Open*, 8(4), e019540. <https://doi.org/10.1136/bmjopen-2017-019540>
- Foweraker, B., & Cutcher, L. (2020). An ageless gift: Reciprocity and value creation by and for older workers. *Work, Employment and Society*, 34(4), 533–549.
- Fried, L. P., Tangen, C. M., Walston, J., Newman, A. B., Hirsch, C., et al. (2001). Frailty in older adults: Evidence for a phenotype. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, 56(3), M146–M157. <https://doi.org/10.1093/gerona/56.3.m146>
- Fu, Y., & Li, X. (2024). Work status among middle-aged and older individuals in China: The effects on physical and mental health. *Frontiers in Public Health*, 12, 1322398. <https://doi.org/10.3389/fpubh.2024.1322398>
- Gonzales, E., Matz-Costa, C., & Morrow-Howell, N. (2015). Increasing opportunities for the productive engagement of older adults: A response to population aging. *The Gerontologist*, 55(2), 252–261. <https://doi.org/10.1093/geront/gnu176>
- Hamasaki, H. (2025). The relationship between socioeconomic status and health behaviors in older adults: A narrative review. In: *Healthcare* (Vol. 13, No. 14, p. 1669). Multidisciplinary Digital Publishing Institute.
- Havighurst, R. J. (1961). Successful aging. *The gerontologist*, 1(1), 8–13. <https://doi.org/10.1093/geront/1.1.8>
- He, H., Wang, S., Huang, X., Li, Y., Jing, L., et al. (2024). Association between intergenerational contact and cognitive function in middle-aged and older Chinese adults: The mediating role of functional disability and depressive symptoms. *BMC Public Health*, 24(1), 3257. <https://doi.org/10.1186/s12889-024-20756-7>
- Hlebichuk, J. L., Gretebeck, R. J., Garnier-Villarreal, M., Piacentine, L. B., Singh, M., et al. (2023). Physical activity, inflammation, and physical function in older adults: Results from the health & retirement study. *Biological Research For Nursing*, 25(1), 24–32. <https://doi.org/10.1177/10998004221111217>
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Hu, S., Ge, J., Fang, M., & Yang, J. (2024). Role of intergenerational connections in cognitive aging: Evidence from a Chinese longitudinal study. *Frontiers in Public Health*, 12, 1396620. <https://doi.org/10.3389/fpubh.2024.1396620>

- Huang, L., Liang, Z., & Chen, H. (2025). Association between physical activity and frailty transitions in middle-aged and older adults: A nationwide longitudinal study. *International Journal of Behavioral Nutrition and Physical Activity*, 22(1), 31. <https://doi.org/10.1186/s12966-025-01725-8>
- Jiang, Z., Liu, H., Deng, J., Ye, Y., & Li, D. (2024). Influence of intergenerational support on the mental health of older people in China. *PLoS One*, 19(4), e0299986. <https://doi.org/10.1371/journal.pone.0299986>
- Keefe, J. M., & Fancey, P. J. (2002). Work and eldercare: Reciprocity between older mothers and their employed daughters. *Canadian Journal on Aging/La Revue Canadienne Du Vieillessement*, 21(2), 229–241. <https://doi.org/10.1017/s0714980800001495>
- Keyes, C. L. (2002). The exchange of emotional support with age and its relationship with emotional well-being by age. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 57(6), P518–P525. <https://doi.org/10.1093/geronb/57.6.p518>
- Ko, K., Su-Russell, C., & Proulx, C. M. (2023). Filial support behaviours: Associations with filial piety, reciprocity and parent-child contact in China. *Families, Relationships and Societies*, 12(3), 411–430. <https://doi.org/10.1332/204674321X16605783687158>
- Krzeczkowska, A., Spalding, D. M., McGeown, W. J., Gow, A. J., Carlson, M. C., et al. (2021). A systematic review of the impacts of intergenerational engagement on older adults' cognitive, social, and health outcomes. *Ageing Research Reviews*, 71(5), 101400. <https://doi.org/10.1016/j.arr.2021.101400>
- Lefferts, E. C., Saavedra, J. M., Song, B. K., & Lee, D. C. (2022). Effect of the COVID-19 pandemic on physical activity and sedentary behavior in older adults. *Journal of Clinical Medicine*, 11(6), 1568. <https://doi.org/10.3390/jcm11061568>
- Lemon, B. W., Bengtson, V. L., & Peterson, J. A. (1972). An exploration of the activity theory of aging: Activity types and life satisfaction among in-movers to a retirement community. *Journal of Gerontology*, 27(4), 511–523. <https://doi.org/10.1093/geronj/27.4.511>
- Li, Y., & Guo, M. (2022). Filial piety matters: A study of intergenerational supports and parental health. *SSM-Population Health*, 18(3), 101096. <https://doi.org/10.1016/j.ssmph.2022.101096>
- Li, C., Li, X., Zhang, Y., & Lao, W. (2024). Interpersonal interactions, sense of loneliness and perceived depressive emotions among older adults: A cultural-psychological perspective from heterogeneous roles of different relationships. *SSM-Population Health*, 27(4), 101703. <https://doi.org/10.1016/j.ssmph.2024.101703>
- Lyndon, S., & Moss, H. (2023). Creating meaningful interactions for young children, older friends, and nursery school practitioners within an intergenerational project. *Early Childhood Education Journal*, 51(4), 755–764. <https://doi.org/10.1007/s10643-022-01330-5>
- Manzoli, L., Villari, P., Pirone, G. M., & Boccia, A. (2007). Marital status and mortality in the elderly: A systematic review and meta-analysis. *Social Science & Medicine*, 64(1), 77–94. <https://doi.org/10.1016/j.socscimed.2006.08.031>
- Mauno, S., Hirvonen, R., & Kiuru, N. (2018). Children's life satisfaction: The roles of mothers' work engagement and recovery from work. *Journal of Happiness Studies*, 19(5), 1373–1393. <https://doi.org/10.1007/s10902-017-9878-6>
- Minghetti, A., Donath, L., Zahner, L., Hanssen, H., & Faude, O. (2021). Beneficial effects of an intergenerational exercise intervention on health-related physical and psychosocial outcomes in Swiss preschool children and residential seniors: A clinical trial. *PeerJ*, 9(Suppl 2), e11292. <https://doi.org/10.7717/peerj.11292>
- Mize, T. D., & Kincaid, R. (2025). Role-accumulation and mental health across the life course. *American Sociological Review*, 90(2), 226–256.
- Park, A. L. (2014). The impacts of intergenerational programmes on the physical health of older adults. *Journal of Aging Science*, 2(3), 1–5. <https://doi.org/10.4172/2329-8847.1000129>
- Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, 36(4), 717–731. <https://doi.org/10.3758/bf03206553>
- Ren, K., Lan, J., Ge, L., & Zhou, L. (2025). The impact of intergenerational support on the mental health of older adults: A discussion of three dimensions of support. *Frontiers in Public Health*, 13, 1467463. <https://doi.org/10.3389/fpubh.2025.1467463>
- Siebert, S. D. (1974). Toward a theory of role accumulation. *American Sociological Review*, 39(4), 567–578.
- Silverstein, M., Conroy, S. J., Wang, H., Giarrusso, R., & Bengtson, V. L. (2002). Reciprocity in parent-child relations over the adult life course. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 57(1), S3–S13. <https://doi.org/10.1093/geronb/57.1.s3>
- Sinclair, D. R., Maharani, A., Kingston, A., O'Neill, T. W., & Matthews, F. E. (2025). Frailty-free life expectancy and its association with socio-economic characteristics: An analysis of the English Longitudinal Study of Ageing cohort study. *BMC Medicine*, 23(1), 276. <https://doi.org/10.1186/s12916-025-04112-z>
- Song, X., Mitnitski, A., & Rockwood, K. (2010). Prevalence and 10-year outcomes of frailty in older adults in relation to deficit accumulation. *Journal of The American Geriatrics Society*, 58(4), 681–687. <https://doi.org/10.1111/j.1532-5415.2010.02764.x>
- Steele, R., & Mummery, K. (2003). Occupational physical activity across occupational categories. *Journal of Science and Medicine in Sport*, 6(4), 398–407. [https://doi.org/10.1016/s1440-2440\(03\)80266-9](https://doi.org/10.1016/s1440-2440(03)80266-9)
- Stein, C. H. (1991). Peer support telephone dyads for elderly women: The wrong intervention or the wrong research? *American Journal of Community Psychology*, 19(1), 91–98. <https://doi.org/10.1007/BF00942256>
- Su, Z. (2025). Productive aging patterns and associations with health outcomes among Chinese urban older adults. *BMC Public Health*, 25(1), 2487. <https://doi.org/10.1186/s12889-025-23688-y>
- Sun, Q., Wang, Y., Lu, N., & Lyu, S. (2022). Intergenerational support and depressive symptoms among older adults in rural China: The moderating roles of age, living alone, and chronic diseases. *BMC Geriatrics*, 22(1), 83. <https://doi.org/10.1186/s12877-021-02738-1>
- Szinovacz, M. E., DeViney, S., & Atkinson, M. P. (1999). Effects of surrogate parenting on grandparents' well-being. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 54(6), S376–S388. <https://doi.org/10.1093/geronb/54B.6.S376>
- Tang, F., Choi, E., & Goode, R. (2013). Older Americans employment and retirement. *Ageing International*, 38(1), 82–94. <https://doi.org/10.1007/s12126-012-9162-3>
- Tomonaga, R., Watanabe, Y., Jiang, Y., Nakagawa, T., & Yamato, H. (2024). Comparison of physical activity and sedentary behavior between work in office and work from home: A

- self-controlled study. *Journal of Occupational and Environmental Medicine*, 66(4), 344–348. <https://doi.org/10.1097/JOM.0000000000003061>
- Van Domelen, D. R., Koster, A., Caserotti, P., Brychta, R. J., Chen, K. Y., et al. (2011). Employment and physical activity in the US. *American Journal of Preventive Medicine*, 41(2), 136–145. <https://doi.org/10.1016/j.amepre.2011.03.019>
- Wang, H., & Ge, Q. (2025). Empirical analysis of the impact of employment on the elderly mental health in China. *Psychology Research and Behavior Management*, 27(18), 1227–1240. <https://doi.org/10.2147/PRBM.S521892>
- Wang, Q., Jing, M., Tian, K., Xie, S., & Yang, X. (2025). The influences of intergenerational care on life satisfaction in older adults: Chain mediation by children's emotional support and depression. *Healthcare*, 13(10), 1235. <https://doi.org/10.3390/healthcare13111235>
- Wang, M., & Shi, J. (2014). Psychological research on retirement. *Annual Review of Psychology*, 65(1), 209–233. <https://doi.org/10.1146/annurev-psych-010213-115131>
- Wang, Y., & Shi, W. (2024). Effects of age stereotypes of older workers on job performance and intergenerational knowledge transfer intention and mediating mechanisms. *Behavioral Sciences*, 14(6), 503. <https://doi.org/10.3390/bs14060503>
- Xin, Z., & Zhang, J. (2025). Too little time to care for my loved ones: Time poverty for quality of care and the moderating role of community social capital among family caregivers. *Humanities and Social Sciences Communications*, 12(1), 1–11.
- Yin, R., Xin, Y., Bhura, M., Wang, Z., & Tang, K. (2022). Bridge employment and longevity: Evidence from a 10-year follow-up cohort study in 0.16 million Chinese. *The Journals of Gerontology: Series B*, 77(4), 750–758.
- Yuan, J., Xiang, J., & Liu, F. (2025). Intergenerational support and subjective well-being of older adults in China. *Journal of Applied Gerontology*, 44(6), 949–958. <https://doi.org/10.1177/07334648241292970>
- Zhang, Y. B., & Hummert, M. L. (2001). Harmonies and tensions in Chinese intergenerational communication: Younger and older adults' accounts. *Journal of Asian Pacific Communication*, 11(2), 203–230. <https://doi.org/10.1075/japc.11.2.06zha>
- Zhang, X., Xi, W., & Weiss, D. (2023). Intergenerational contact and the benefits for older adults. *Innovation in Aging*, 7(Suppl 1), 77. <https://doi.org/10.1093/geroni/igad104.0248>
- Zhou, J. J., & Bai, X. (2022). Influence of intergenerational relationships on depressive symptoms in ageing Chinese adults in Hong Kong: Mediating effects of sense of loneliness. *BMC Geriatrics*, 22(1), 587. <https://doi.org/10.1186/s12877-022-03269-z>