

The effects of life space on mental health among Chinese older adults - A conditioning process-based analysis

Xiaohan Mao^{1a}, Annuo Liu^{2b*}



1.School of Nursing, Anhui Medical University, Hefei 230032, Anhui,China;

The Third Affiliated Hospital of Anhui Medical University, Hefei 230061, Anhui,China;

2.School of Nursing, Anhui Medical University, Hefei 230032, Anhui,China;

The First Affiliated Hospital of Anhui Medical University, Hefei230022, Anhui,China;

aEmail:maoxiaohan2022@163.com

*bEmail: *Corresponding Author:w971002y@126.com*

Funding

This work was supported by the Natural Science Research Programme for Universities in Anhui Province (2023AH040085).

Abstracts

Objectives: The objective was to investigate the mechanisms through which physical functions mediates, and social relationships moderate, the association between life space and mental health among community-dwelling older adults in China.

Methods: We conducted a cross-sectional analysis using mediated analysis data from Life Spaces, involving 1,136 older people aged 60 and over in Hefei, Anhui Province, China. The study collected data through structured household interviews. The questionnaire assessed a number of domains including life space, cognitive functions, depressive symptoms, physical functions, social network and social support. Confounding factors such as frequency of movement are taken into account.

Results: The proportion of elderly individuals in the community experiencing restricted life space was 33.3%. The life space of older adults showed a positive correlation with cognitive functioning ($r = 0.207$, $P < 0.05$) and a negative correlation with depressive symptoms ($r = -0.122$, $P < 0.05$). Furthermore, physical functioning served as an indirect mediator of the relationship between life space and mental health, accounting for mediating effects of 34.62% and 20%, respectively. The indirect effects were moderated by the influence of social relationships.

Conclusions: In the association between life space and mental health among older Chinese adults, physical functioning and social relationships may serve as potential mediators and moderators. This suggests that community health workers or clinical staff should focus on the mobility of life spaces, the enhancement of physical functioning, and the moderation of social relationships when aiming to improve the mental health of older adults.

Keywords: Life space; Mental health; Social networking; Physical functions; Depression; Social relationship

Introduction

As the global population continues to age, the mental health of older adults has garnered increasing attention. Cognitive and emotional well-being are critical components of the psychological health profile in this demographic. Worldwide, it is estimated that over one-third of older adults experience depressive symptoms, while approximately 47 million individuals are newly diagnosed with cognitive impairments annually(Prince et al., 2016)(Baumgart et al., 2015). The onset of negative emotions, including depression and anxiety, in the context of Coronavirus Disease 2019(post-COVID-19) syndrome significantly impacts the mental well-being of older adults(Mazza et al., 2022). The research demonstrated that the cognitive functioning and psychosocial well-being, specifically the social networks and social support, of older adults were significantly influenced by their residential environment(Boyle et al., 2010; Stalvey et al., 1999; Webber et al., 2010).

Life space refers to the spatial extent of the various residential and social environments through which an individual navigates over a specified period, encompassing areas radiating outward from the core of one's daily residence (such as the bedroom)(Douma et al., 2021; Liddle et al., 2014). Cognitive aging theory posits that the complexity of the existing life space may mitigate cognitive decline in older adults(Crowe et al., 2008). Moreover, there may exist a deleterious feedback loop between diminished mobility within life spaces and depressive symptoms(Cohen-Mansfield et al., 2010a). Evidence indicates that markers of compromised physical function are also predictive of cognitive deterioration and dementia in the elderly population(Crowe et al., 2008). However, social relationships, including social support and social networks, can help people cope with negative life events and buffer the negative effects on older people's mental health that may result from limited life space(Wheatley & Buglass, 2019).

The relationship between life space and mental health has been investigated in various studies; however, findings remain inconsistent, suggesting the potential for moderating factors to influence this relationship. Research has shown that psychosocial factors (Social support vs Social network) and physical factors (Instrumental Activities of Daily Living(IADL) vs Basic Activities of Daily Living (ADL)) are related to life space and mental health(Johnson et al., 2020),(Pan et al., 2021). Besides, the interplay of psychosocial and physical factors as mediators or moderators in the relationship between life space and mental health remains unexplored.

Therefore, rather than analyzing the mechanisms underlying mental health in older adults solely from the perspective of life space, our study incorporated life space, physical function, and psychosocial factors. This approach aimed to elucidate the intrinsic mechanisms linking these three factors with mental health in older adults. Based on a multitheoretical framework, we introduced two variables—physical function at the individual level and psychosocial aspects at the group level—and developed a model associating life space, physical function, psychosocial relationships, and mental health. The following hypotheses were formulated: (1) The living environment of older adults has a significant positive effect on cognitive functioning; (2) The living environment of older adults has a significant negative effect on depression; (3) Basic daily living skills mediate the relationship between the living environment of older adults and cognitive functioning; (4) Instrumental daily living skills mediate the relationship between the living environment of older adults and depression; (5) Social networks moderate the relationship between the living environment of older adults and ADL; (6) Social support moderates the relationship between the living environment of older adults and IADL.

The research hypotheses are shown in Figure 1. By examining the mediating role of physical function and the moderating role of psychosocial factors, this study elucidates

how the life space of older adults influences their mental health. This approach provides a scientific basis for mitigating the decline in mental health status among the elderly.

Methods

study population

In July-August 2022, we conducted a health census of the elderly in Hefei City, Anhui Province, China. Firstly, Yaohai District was selected as a representative jurisdiction through a random number method from four jurisdictions within Hefei City. Subsequently, Yaohai District was stratified into urban and rural areas. Two streets or townships were randomly selected from each stratum using a simple random sampling method. Finally, within each selected street or township, two communities or villages were chosen as survey sites using the same sampling method. The respondents were individuals aged 60 years or older. The inclusion criteria were: (1) age ≥ 60 years; (2) ability to complete the questionnaire independently or with the assistance of the investigator; (3) voluntary participation and signed informed consent. The exclusion criteria were: (1) diagnosed serious cognitive or mental disorders; (2) significant impairments in language, vision, hearing, or other critical areas.

ethical considerations

This study received approval from the Biomedical Ethics Committee of Anhui Medical University (Approval No. 81220209).

measurement

Socio-demographic characteristics

The researcher developed his own questionnaire for general demographic information including age, gender, mode of residence, occupation, literacy, economic status, and past medical history based on reading the literature and taking into account the actual situation of the subjects.

life space

The Chinese Version of the Life Space Assessment for the Elderly (LSA-C) was utilized to evaluate the living environment of elderly individuals within the community. This assessment tool was adapted from the Life space Scale developed by Baker et al (Baker et al., 2003). The large-sample survey results, following the Chinese adaptation by Zhou et al., demonstrated a retest reliability of 0.89, indicating strong validity and suitability for evaluating outcomes (Ji et al., 2015). The scale comprises three indicators: activity scope, frequency, and independence. The life space activity scope encompasses five levels: 'at home', 'outside the home but within the apartment building', 'outside the apartment building but within the neighborhood', 'beyond the neighborhood on the street', and 'any street in the city', rated on a scale from 1 to 5.

The frequency of activities was classified as follows: less than once per week = 1, 1-3 times per week = 2, 4-6 times per week = 3, and daily = 4. Independence was

classified into three categories: 1 = assisted, 1.5 = equipment only, and 2 = fully independent without the use of equipment or assistance from others. The total score represents the sum of the scope of activities across various dimensions, where the score for each dimension is calculated as the product of three indicators. Scores range from 0 to 120, with scores below 60 indicating a restricted life space(New Frontiers in Resilient Aging, n.d.).The Cronbach's alpha coefficient for the scale was 0.786.

cognitive

Cognitive function was assessed using the Mini-Mental State Examination (MMSE)(Folstein et al., 1975). The MMSE test is 5-10 minutes long and includes 5 dimensions of orientation, memory, attention and calculation, recall, and verbal functioning, and is the most commonly used tool for assessing overall cognitive functioning (Jia et al., 2021). Each entry was assigned a score of 1, with a score range of 0-30, with higher scores indicating better cognitive functioning. The scale Cronbach's alpha. coefficient was 0.821.

depression

Geriatric Depression Scale (GDS-15) is a reliable tool to screen for depressive symptoms in older adults(Sheikh et al., 1991). There are a total of 15 entries, with higher scores indicating more severe depressive symptoms. Tang Dan et al. validated the GDS-15 by analysing data from the 2006 China Urban and Rural Elderly Population Tracking Survey, which showed good reliability and discriminant validity(Tang, 2013). The scale Cronbach's alpha. coefficient was 0.753.

Physical functions

Evaluate physical functioning using the Activities Of Daily Living Scale (ADL)(Lawton & Brody, 1969). The scale encompasses both ADL and IADL. A higher score on the scale indicates a more significant degree of functional impairment. The Cronbach's alpha coefficient was 0.900 for the total scale and 0.870 and 0.853 for the subscales.

Social network

The 6-item version of the Social network scale (Lubben Social Network Scale, LSNS-6) developed by Lubben et al. is a valid instrument for measuring social isolation (Jang et al., 2022). The scale consists of two dimensions, family network and friend network, each dimension has 3 entries, and for each entry the response 'none' = 0 points, '1 digit' = 1 point, '2 digits' = 2 points, '3-4 digits' = 3 points, '5-8 digits' = 4 points, '9 digits and above' = 5 points. The total score is 0-30, with higher scores indicating better availability of family or friends' networks(Chang et al., 2018). The scale Cronbach's alpha coefficient was 0.776.

Social support

The Social Support Rating Scale (SSRS) mainly reflects the degree of support that an individual can obtain in society, and is divided into three dimensions: subjective support, objective support and support utilisation(Xie et al., 2023). The higher the score the higher the level of support. The Cronbach's alpha coefficient for the scale was 0.682.

data analysis

Bivariate correlation test, independent samples t-test, and ANOVA were performed using IBM SPSS Statistic24.0 software. PROCESS prepared by Hayes was used for mediation effect analysis, Bootstrap test was selected for mediation effect, and simple slope analysis

test was selected for moderating effect, and the difference was considered statistically significant at $P \leq 0.05$.

Results

Common Method Bias (CMB) test

Harman's single-factor test was employed to assess common method bias in the collected data. The analysis identified 23 factors with eigenvalues greater than 1, with the first factor accounting for 14.7% of the variance, indicating that common method bias was not present (Podsakoff et al., 2003).

descriptive analysis

The findings revealed that a total of 1,136 older adults participated in the study, with 60% being female. Slightly more than half of the participants were below 70 years of age. Apart from living arrangements and sleep duration, life space was found to be statistically significant across all groups ($P < 0.05$). Cognitive function also demonstrated statistically significant differences across all groups ($P < 0.05$). Additionally, depression showed significant associations ($P < 0.05$) with sleep duration, social participation, place of residence, gender, and self-rated health. Detailed results are presented in Table 1.

correlation analysis

The results show that life space was positively correlated with cognition ($r = 0.207$, $p < 0.05$) and negatively correlated with depression ($r = -0.122$, $p < 0.05$) (see Table 2).

Analysis of conditional processes between life space and cognition

the mediating role of ADL

The mediation analysis revealed that the direct effect of life space on cognitive function was 65.38%, while the mediation effect of ADL accounted for 34.62%. The 95% confidence interval for the mediation effect was (0.004, 0.015), which does not include 0, and the p-value was less than 0.05. This indicates that the partial mediation effect of basic daily living skills on the relationship between life space and cognition in older adults is statistically significant. See Table 3 - Model 1.

the moderating role of the social network

Mediation analyses incorporating moderation revealed that the interaction term significantly predicted ADL ($\beta=0.001$, $p<0.001$), indicating a substantial moderating effect of the Social Network, as shown in Model 1. The moderation analysis demonstrated a statistically significant predictive slope for ADL with respect to Life space under conditions of low Social Network (simple slope = -0.015, $t = -8.973$, $p<0.05$), while no significant effect was observed under high Social Network conditions. This implies that the extent of the Social Network may influence the direction of the relationship between Life space and ADL.

The Johnson-Neyman (JN) technique further quantified the moderating effect of varying levels of Social Network on the relationship between Life space and ADL. The upper 95% confidence interval (upper curve) intersected the X-axis at Social Network values of 3.30 and 13.35, indicating that the moderating effect was significant (approximately 61% of the significant regions) when Social Network was either below 3.30 or above 13.35. This suggests that the moderating effect remains significant in about 61% of the significant areas. See Figure 3 (A).

Analysis of conditional processes between life space and depression

The mediating role of IADL

In the mediation effect analysis, after including mediator variables, life space ($\beta = -0.011$, $p < 0.05$) and IADL ($\beta = 0.109$, $p < 0.05$) remained significant predictors of depression. The mediation effect accounted for 20% of the total effect, with IADL partially mediating the relationship between life space and depression. See table model 2 for details.

moderating role of social support

The interaction term between life space and social support in older adults was significant ($\beta=0.002$, $P<0.001$). Moderated effects in Figure 2 revealed that at low levels of social support, life space had a significant negative predictive effect on IADL (simple slope = -0.044, $t = -11.615$, $p<0.001$). Conversely, at high levels of social support, the predictive effect of life space on IADL was less negative (simple slope = -0.025, $t = -5.67$, $p<0.001$). This suggests that the negative predictive effect of life space on IADL diminishes as social support increases, as illustrated in Model 2 of Table 3.

Figure 3(B) quantifies the moderating effect of social support on the relationship between life space and IADL. The upper limit of the 95% confidence interval (upper curve) intersects with the X-axis at a social support value of 7.127, suggesting that the moderating effect is significant when social support is below 7.127 (with approximately 61% of the region being significant). The negative influence of life space on IADL (in absolute terms) diminishes as social support increases. Specifically, the absolute value of the negative effect of life space on IADL decreases by 0.002 for each unit increase in social support.

Discussion

The objective of this study was to examine the intrinsic mechanisms underlying the mediating role of physical functioning and the moderating role of social relationships in the relationship between life space and mental health among community-dwelling older adults in China. The results indicated that life space mobility positively predicted cognitive health and negatively predicted emotional health. Physical functioning partially mediated this relationship, while social relationships moderated the effect of life space on mental health in older adults. These findings suggest that enhancing mental health in older adults requires attention to their life space mobility, physical functioning, and social relationships to mitigate adverse impacts on emotional well-being.

This study also identified variability in life space and cognitive scores based on residence patterns, marital status, and frequency of exercise. Specifically, older adults who are married, cohabit with family, and engage in regular physical activity demonstrate enhanced mobility in life space. This suggests that physical exercise contributes not only to the maintenance of physical functions but also to the activation of cognitive functions in older adults (Nuzum et al., 2020). In the present study, the cognitive status of the older age cohort exhibited a decremental trend with advancing age (Jung et al., 2023). This may be associated with diminished brain reserves and cerebral damage attributable to advanced age (Nolan & Blass, 1992). Compared to men, women exhibited lower scores in life space and cognitive function in this study, a finding that aligns with the results of prior research (Lee et al., 2023). This may be attributable to the higher participation rates of men in sports compared to women, coupled with the more restricted sense of autonomy experienced by female participants in outdoor activities (Polku et al., 2015), (Mielke et al., 2014). It has also been noted that older women with limited life space have a higher risk of all-cause mortality. Therefore, older women need more social attention.

This study investigated the impact of life space mobility on the mental health of older adults and explored its underlying psychological mechanisms. The findings indicated that life space mobility was a positive predictor of cognitive health and a negative predictor of emotional health. The physiological and psychological deterioration observed in elderly individual post-retirement, particularly when their life space is constrained and they do not engage in suitable social activities, can expedite physical and cognitive aging. This lack of engagement often results in disconnection from societal networks, potentially leading to psychological disorders(Cohen-Mansfield et al., 2010b),(Watanabe et al., 2022).

This study identified significant correlations between life space and both cognition and depression, with stronger associations observed for cognition. Mediation analyses suggest that physical functioning partially mediates the relationship between life space and mental health among older adults. A potential explanation is that constraints in life space negatively impact both physical activity and mental health in this demographic(Byles et al., 2015).

On the one hand, this study identified significant correlations between life space and both cognition and depression, with stronger associations observed for cognition. Mediation analyses suggest that physical functioning partially mediates the relationship between life space and mental health among older adults. A potential explanation is that constraints in life space negatively impact both physical activity and mental health in this demographic. Engagement in regular physical activity enhances cognitive function, offers protection against depressive disorders, and ameliorates clinical symptoms and negative affect in older adults(Sofi et al., 2011)(Maier et al., 2021; Schuch et al., 2018). Conversely, maintaining physical function through regular physical activity constitutes a crucial skill for mitigating adverse mood states and enhancing positive life attitudes,

which are essential for alleviating negative emotions. (Iwon et al., 2021). These findings also imply that physical function partially moderates the relationship between the two variables, indicating that additional mediating variables should be investigated in future analyses.

This study also explores the moderating role of social relationships. Social relationships have a significant impact on both physical and mental health (Santini et al., 2015). Social support and social networks offer older adults the opportunity to collaborate in achieving positive life goals, thereby enhancing their personal capacities and expanding their mobility within life spaces. (Miyashita et al., 2021). The possible explanation for the stronger moderating effect of low levels of social relationships is that older adults with high levels of social relationships have less impact of life space on physical functioning due to the buffering effect of social functioning, and physical functioning plays more of a role in solving one's own problems of living and dealing with family matters. The overall explanation is that when individuals have higher levels of Social support, i.e., higher satisfaction of social relationship needs, it promotes a positive state of health, and vice versa for negative depressive moods (Kandola et al., 2019). Several studies have suggested that the size of the social support network may attenuate the relationship between cognitive decline and pathological conditions through its impact on neuronal function. Individuals with more extensive social networks tend to exhibit better cognitive maintenance (Bennett et al., 2006).

This study has several limitations. First, due to its cross-sectional design, it cannot establish causality or account for the impact of confounding variables. Second, constructs such as life space and physical function were assessed through scales, and future research should aim to monitor the objective activity levels of older adults using innovative wearable devices. Finally, the study's sample limitations precluded a comparative

analysis based on urban versus rural attributes. Future research may explore the mechanisms linking life space mobility and mental health among older adults residing in different types of environments.

Conclusion

In the association between life space and mental health among older Chinese adults, physical functioning and social relationships may serve as potential mediators and moderators. This suggests that community health workers or clinical staff should focus on the mobility of life spaces, the enhancement of physical functioning, and the moderation of social relationships when aiming to improve the mental health of older adults.

Acknowledgement

The authors declare that they have no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding

This study was supported by the Natural Science Research Programme for Universities in Anhui Province (2023AH040085).

Reference

- Tang, Dan. (2013). Use of the short version of the Geriatric Depression Scale (GDS-15) among Chinese older adults. *Chinese Journal of Clinical Psychology* 21(3), 402–405.
- Baker, P. S., Bodner, E. V., & Allman, R. M. (2003). Measuring life-space mobility in community-dwelling older adults. *Journal of The American Geriatrics Society*, 51(11), 1610–1614.
- Baumgart, M., Snyder, H. M., Carrillo, M. C., Fazio, S., Kim, H., & Johns, H. (2015). Summary of the evidence on modifiable risk factors for cognitive decline and dementia: a population-based perspective. *Alzheimer's & Dementia: The Journal of the Alzheimer's Association*, 11(6), 718–726.
- Bennett, D. A., Schneider, J. A., Tang, Y., Arnold, S. E., & Wilson, R. S. (2006). The effect of social networks on the relation between alzheimer's disease pathology and level of cognitive function in old people: a longitudinal cohort study. *The Lancet. Neurology*, 5(5), 406–412.
- Boyle, P. A., Buchman, A. S., Barnes, L. L., James, B. D., & Bennett, D. A. (2010). Association between life space and risk of mortality in advanced age. *Journal of The American Geriatrics Society*, 58(10), 1925–1930.
- Byles, J. E., Leigh, L., Vo, K., Forder, P., & Curryer, C. (2015). Life space and mental health: a study of older community-dwelling persons in Australia. *Aging & Mental Health*, 19(2), 98–106.
- Chang, Q., Sha, F., Chan, C. H., & Yip, P. S. F. (2018). Validation of an abbreviated version of the lubben social network scale (“LSNS-6”) and its associations with suicidality among older adults in China. *PLoS One*, 13(8), e0201612.

- Cohen-Mansfield, J., Shmotkin, D., & Hazan, H. (2010a). The effect of homebound status on older persons. *Journal of The American Geriatrics Society*, 58(12), 2358–2362.
- Cohen-Mansfield, J., Shmotkin, D., & Hazan, H. (2010b). The effect of homebound status on older persons. *Journal of The American Geriatrics Society*, 58(12), 2358–2362.
- Crowe, M., Andel, R., Wadley, V. G., Okonkwo, O. C., Sawyer, P., & Allman, R. M. (2008). Life-space and cognitive decline in a community-based sample of african american and caucasian older adults. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, 63(11), 1241–1245.
- Douma, L., Steverink, N., & Meijering, L. (2021). Geographical life-space and subjective wellbeing in later life. *Health & Place*, 70, 102608.
- Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). “mini-mental state”. A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, 12(3), 189–198.
- Iwon, K., Skibinska, J., Jasielska, D., & Kalwarczyk, S. (2021). Elevating subjective well-being through physical exercises: an intervention study. *Frontiers in Psychology*, 12, 702678.
- Jang, Y., Powers, D. A., Park, N. S., Chiriboga, D. A., Chi, I., & Lubben, J. (2022). Performance of an abbreviated lubben social network scale (LSNS-6) in three ethnic groups of older asian americans. *Gerontologist*, 62(2), e73–e81.
- Ji, M., Zhou, Y., Liao, J., & Feng, F. (2015). Pilot study on the chinese version of the life space assessment among community-dwelling elderly. *Archives of Gerontology and Geriatrics*, 61(2), 301–306.
- Jia, X., Wang, Z., Huang, F., Su, C., Du, W., Jiang, H., ... Zhang, B. (2021). A comparison of the mini-mental state examination (MMSE) with the montreal

- cognitive assessment (MoCA) for mild cognitive impairment screening in chinese middle-aged and older population: a cross-sectional study. *BMC Psychiatry*, 21, 485.
- Johnson, J., Rodriguez, M. A., & Al Snih, S. (2020). Life-space mobility in the elderly: current perspectives. *Clinical Interventions in Aging*, 15, 1665–1674.
- Jung, M., Kim, H., Loprinzi, P. D., Ryu, S., & Kang, M. (2023). Age-varying association between depression and cognitive function among a national sample of older U.S. immigrant adults: the potential moderating role of physical activity. *Aging & Mental Health*, 27(3), 653–662.
- Kandola, A., Ashdown-Franks, G., Hendrikse, J., Sabiston, C. M., & Stubbs, B. (2019). Physical activity and depression: towards understanding the antidepressant mechanisms of physical activity. *Neuroscience & Biobehavioral Reviews*, 107, 525–539.
- Lawton, M. P., & Brody, E. M. (1969). Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist*, 9(3), 179–186.
- Lee, B. H., Richard, J. E., de Leon, R. G., Yagi, S., & Galea, L. A. M. (2023). Sex differences in cognition across aging. *Current Topics in Behavioral Neurosciences*, 62, 235–284.
- Liddle, J., Ireland, D., McBride, S. J., Brauer, S. G., Hall, L. M., Ding, H., ... Chenery, H. J. (2014). Measuring the lifespan of people with parkinson's disease using smartphones: proof of principle. *JMIR mHealth and uHealth*, 2(1), e13.
- Maier, A., Riedel-Heller, S. G., Pabst, A., & Lupp, M. (2021). Risk factors and protective factors of depression in older people 65+. A systematic review. *PLoS One*, 16(5), e0251326.

- Mazza, M. G., Palladini, M., Poletti, S., & Benedetti, F. (2022). Post-COVID-19 depressive symptoms: epidemiology, pathophysiology, and pharmacological treatment. *CNS Drugs*, 36(7), 681–702.
- Mielke, M. M., Vemuri, P., & Rocca, W. A. (2014). Clinical epidemiology of alzheimer's disease: assessing sex and gender differences. *Clinical Epidemiology*, 6, 37–48.
- Miyashita, T., Tadaka, E., & Arimoto, A. (2021). Cross-sectional study of individual and environmental factors associated with life-space mobility among community-dwelling independent older people. *Environmental Health and Preventive Medicine*, 26(1), 9.
- New frontiers in resilient aging*. (n.d.).
- Nolan, K. A., & Blass, J. P. (1992). Preventing cognitive decline. *Clinics in Geriatric Medicine*, 8(1), 19–34.
- Nuzum, H., Stickel, A., Corona, M., Zeller, M., Melrose, R. J., & Wilkins, S. S. (2020). Potential benefits of physical activity in MCI and dementia. *Behavioural Neurology*, 2020, 7807856.
- Pan, H., Fokkema, T., Wang, R., Dury, S., & De Donder, L. (2021). “it's like a double-edged sword”: understanding confucianism's role in activity participation among first-generation older chinese migrants in the Netherlands and belgium. *Journal of Cross-Cultural Gerontology*, 36(3), 229–252.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879–903.
- Polku, H., Mikkola, T. M., Portegijs, E., Rantakokko, M., Kokko, K., Kauppinen, M., ... Viljanen, A. (2015). Life-space mobility and dimensions of depressive symptoms among community-dwelling older adults. *Aging & Mental Health*, 19(9), 781–789.

- Prince, M., Ali, G.-C., Guerchet, M., Prina, A. M., Albanese, E., & Wu, Y.-T. (2016). Recent global trends in the prevalence and incidence of dementia, and survival with dementia. *Alzheimer's Research & Therapy*, 8(1), 23.
- Santini, Z. I., Koyanagi, A., Tyrovolas, S., Mason, C., & Haro, J. M. (2015). The association between social relationships and depression: a systematic review. *Journal of Affective Disorders*, 175, 53–65.
- Schuch, F. B., Vancampfort, D., Firth, J., Rosenbaum, S., Ward, P. B., Silva, E. S., ... Stubbs, B. (2018). Physical activity and incident depression: a meta-analysis of prospective cohort studies. *American Journal of Psychiatry*, 175(7), 631–648.
- Sheikh, J. I., Yesavage, J. A., Brooks, J. O., Friedman, L., Gratzinger, P., Hill, R. D., ... Crook, T. (1991). Proposed factor structure of the geriatric depression scale. *International Psychogeriatrics*, 3(1), 23–28.
- Sofi, F., Valecchi, D., Bacci, D., Abbate, R., Gensini, G. F., Casini, A., & Macchi, C. (2011). Physical activity and risk of cognitive decline: a meta-analysis of prospective studies. *Journal of Internal Medicine*, 269(1), 107–117.
- Stalvey, B. T., Owsley, C., Sloane, M. E., & Ball, K. (1999). The life space questionnaire: a measure of the extent of mobility of older adults. *Journal of Applied Gerontology*, 18(4), 460–478.
- Watanabe, D., Yoshida, T., Yamada, Y., Watanabe, Y., Yamada, M., Fujita, H., ... Kimura, M. (2022). Dose-response relationship between life-space mobility and mortality in older japanese adults: a prospective cohort study. *Journal of The American Medical Directors Association*, 23(11), 1869.e7-1869.e18.
- Webber, S. C., Porter, M. M., & Menec, V. H. (2010). Mobility in older adults: a comprehensive framework. *Gerontologist*, 50(4), 443–450.

- Wheatley, D., & Buglass, S. L. (2019). Social network engagement and subjective well-being: a life-course perspective. *British Journal Of Sociology*, 70(5), 1971–1995.
- Xie, J., Wang, C., Huang, F., & Li, H. (2023). Psychometric assessment of the structural-functional social support scale (SFSSS) among chinese older adults. *Current Psychology*, 42(25), 22024–22035.

Variable	Sample	Life space	T/F	Cognition	T/F	Depression	T/F
	n	($\bar{x} \pm s$)		($\bar{x} \pm s$)		($\bar{x} \pm s$)	
Sex							
Male	449	69.45±24.54	2.984*	26.46±3.46	6.128*	3.65±2.10	-1.757
Female	687	65.20±22.77		25.10±3.97		3.97±2.91	
Age							
60-64	200	72.92±21.52	53.670	26.61±3.08	19.590	3.71±0.21	1.240
65-69	387	68.75±22.89	*	25.92±3.45	*	3.85±0.15	
70-74	288	66.45±23.41		25.72±3.97		3.71±0.18	
≥75	261	59.94±24.61		24.38±4.41		4.07±0.17	
Type of Residence							
Urban	968	66.82±23.40	-0.189	25.80±3.69	3.004*	3.80±3.01	-1.267
Rural	168	67.21±24.82		24.70±4.48		4.08±2.54	
Sleep Duration							
<7h	589	66.48±23.12	-0.584	24.92±3.85	-6.693*	4.34±2.94	5.991*
≥7h	547	67.30±24.0		26.41±3.67		3.31±2.86	
Social Participatio							
n							

Often	541	71.62±22.40	21.910	26.10±3.21	20.140	4.55±3.05	32.199
			*		*		*
Sometimes	212	63.46±21.01		26.25±3.77		3.03±2.79	
Never	383	62.07±25.21		24.64±4.45		3.29±2.64	
Exercise							
Daily	776	69.65±22.51	18.120	25.87±3.64	10.000	3.97±3.03	2.742
			*		*		
Sometimes	139	59.10±22.01		25.96±3.97		3.70±3.17	
Never	221	62.05±26.22		24.61±4.26		3.47±2.44	
Housing Situation							
alone	128	60.77±26.07	5.250*	24.61±4.29	5.433*	4.52±3.03	4.120*
spouse or children	1000	67.71±23.15		25.77±3.76		3.76±2.93	
Other	8	60.50±20.30		24.75±3.69		3.00±1.60	
Self-Rated Health							
satisfied	899	68.44±23.03	13.243	25.86±3.33	38.682	3.53±2.90	25.971
			*		*		*
neutral	200	62.68±22.86		25.60±4.53		4.91±2.80	
dissatisfied	37	51.57±31.50		20.38±6.65		5.62±2.76	

Notes: *为 $P<0.05$

Table 2. Correlation Analysis

	Life space	Cognitive	Depression	ADL	IADL	Social network	Social network
Life space	-						
Cognition	0.274**	-					
Depression	-0.161**	-0.128**	-				
ADL	-0.235**	-.403**	0.133**	-			
IADL	-0.337**	-0.516**	0.189**	0.771**	-		
Social Network	0.189**	0.148**	-0.316**	-	-	-	
				0.128**	0.157**		
Social support	0.085**	0.129**	0.018**	-	-	0.346**	-
				0.143**	0.116**		

Notes: **为 $p<0.001$

Table 3. Conditional Process Analysis of Life space and Mental Health in Older Adults

	Path Analysis	R ²	β	SE	T	P
Model 1Mediation Effect	Life space - ADL	0.143	-0.001	0.001	-6.368	<0.001
	Life space - Cognition	0.281	0.026	0.004	5.869	<0.001
	Life space - Cognition	0.359	0.017	0.004	3.925	0.001
	ADL - Cognition		-1.023	0.088	-11.610	<0.001
Moderation	Life space - Cognition	0.3587	0.0167	0.004	3.925	0.001
Effect	ADL - Cognition		-1.023	0.088	-11.61	<0.001
	Life space - ADL	0.164	-0.003	0.002	-4.9647	<0.001
	Life space × Social Network-ADL		0.001	0.002	4.4921	<0.001
Model 2 Midiation Effect	Life space - IADL	0.286	-0.026	0.003	-8.789	<0.001
	Life space - Depression	0.217	-0.015	0.004	-4.115	<0.001
	Life space - Depression	0.224	-0.011	0.004	-3.213	0.001
	IADL - Depression		0.109	0.035	3.068	0.002
Moderation Effect	Life space - Depression	0.224	-0.12	0.004	-3.213	0.001
	IADL - Depression		0.109	0.035	3.068	0.002
	Life space - IADL	0.304	-0.023	0.003	-7.461	<0.001
	Life space × Social Support-IADL		0.002	0.001	4.664	<0.001

Figure.1 research hypothesis

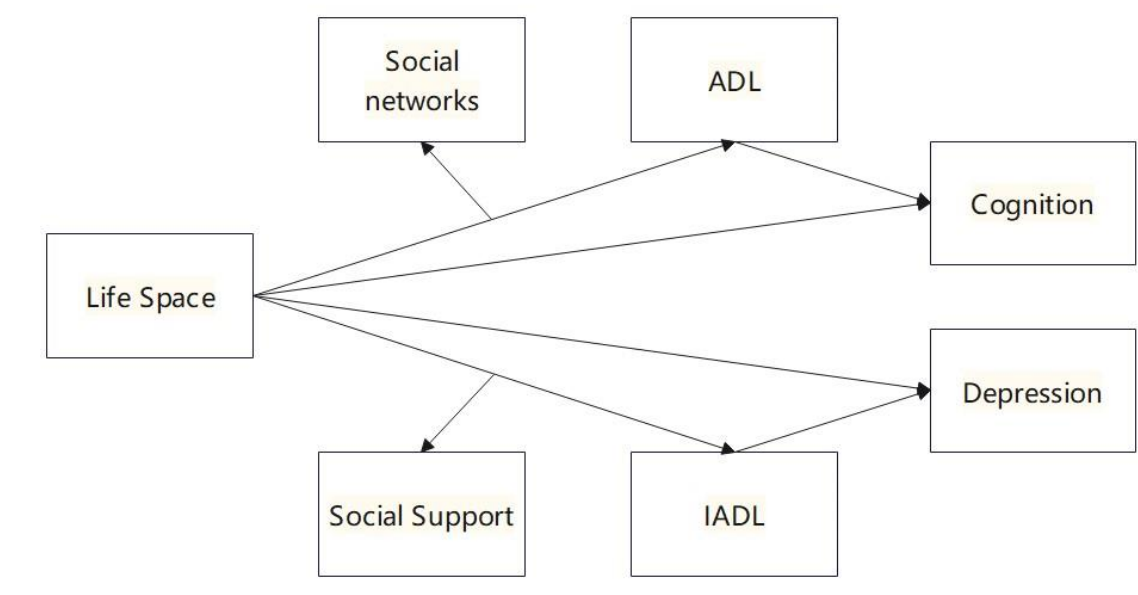


Figure.2 Moderating effect analysis of Social network and Social support

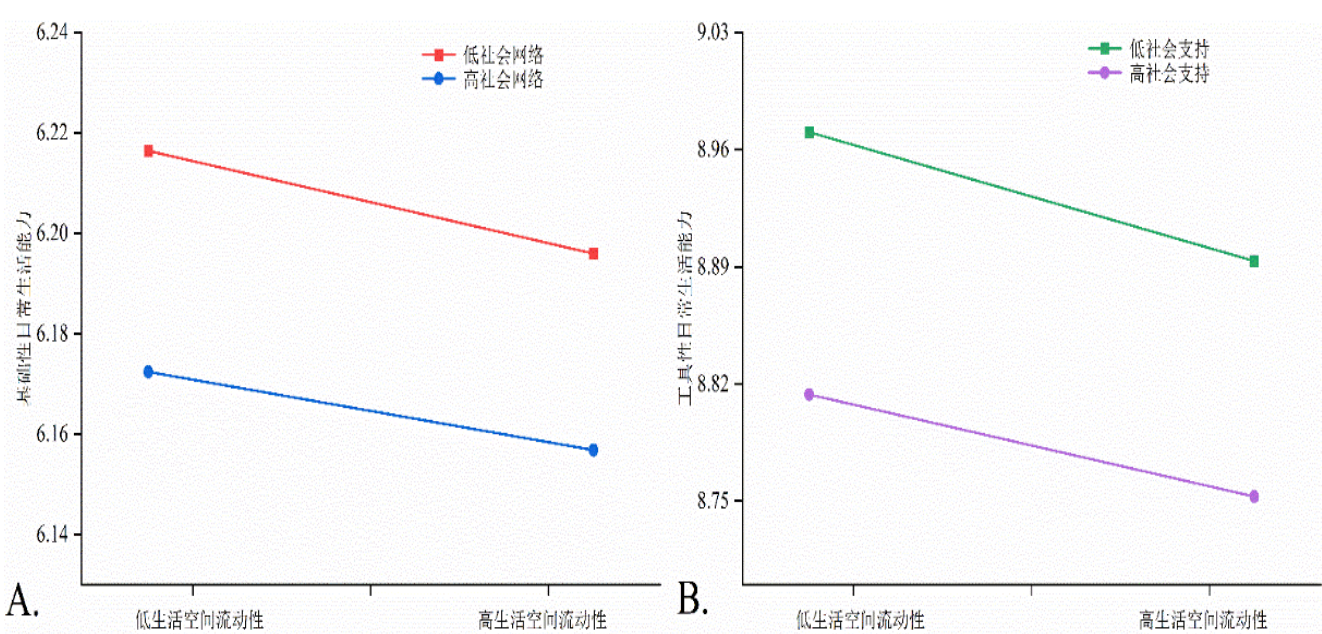
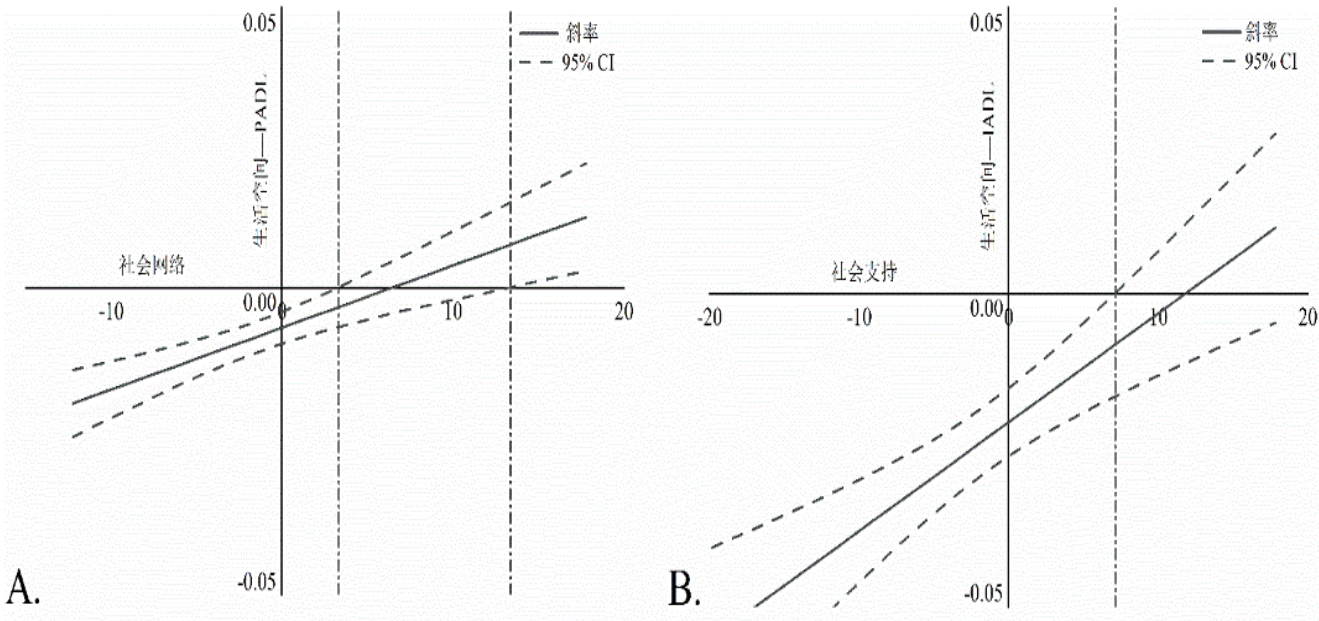


Figure.3 Johnson-Nyman diagram of social networks and social support



Supplemental material

Supplement 1. Abbreviations of variables or terms

Variables	Abride	application
Instrumental Activities of Daily Living	IADL	Assessing an individual's competence in complex daily life tasks.
Activities of Daily Living	ADL	Assessing an individual's functional capacity and independence.
Life Space Assessment for the Elderly	LSA-C	Assessing their quality of life and independence.
Mini-Mental State Examination	MMSE	Assessing for cognitive impairment and dementia.
Geriatric Depression Scale 15	GDS-15	Assessing depressive symptoms in older adults.
Social Support Rating Scale	SSRS	Assessing the level and type of social support an individual receives
Coronavirus Disease 2019	COVID-19	

