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The impact of disability status on depression in the aged with the moderating effect of community support

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Abstract

Background China has entered an aging society, and the mental health of the aged has gradually attracted social attention. This study aimed to model the mediating effect of social activities on the relationship between incapacitation and depression in the aged and to explore the moderating effect of community support on the mediating role.

Methods This paper used the latest data from The Chinese Longitudinal Healthy Longevity Survey (CLHLS). A moderated mediation effect model was constructed with the degree of incapacity as the independent variable, depressive symptoms as the dependent variable, socialization as the mediator, and community support as the moderator.

Results Socialization was a partial mediating variable in the relationship between incapacitation and depression in the aged, and its mediating effect accounted for 13.29% of the total effect. The moderating effect of community support on the mediating role of socialization was significant (B = -0.006, SE = 0.003, 95% *CI*: -0.014 ~ -0.001), but it moderated only the second half of the model, which is the relationship between social activities and depression.

Conclusions (1) There was a significant positive correlation between disability and depression in the aged. (2) Socialization partially mediated the relationship between disability and depression in the aged. (3) Community support moderated only the relationship between social activities and depressive symptoms, whereas it did not affect the relationship between disability and social activities.

Keywords Depressive symptoms, Disability status, Socialization, Community support, Moderated mediation model

Background

With the advancement of medicine and the prolongation of human Lifespan, the problem of population aging is becoming more and more prominent. It has become a common challenge faced by all countries around the world. According to data from the World Health Organization, it is expected that by the middle of this century, there will be 2.1 billion elderly people aged 60 and over, including 426 million elderly people aged 80 and over [1]. China is a populous country and the size of the aged is among the largest in the world. According to data from (China) National Bureau of Statistics (NBS), by the end of 2022, 14.9% of our total population will be 65 years old, amounting to 209.78 million people [2]. This indicates that the country has entered a severely aging society. As the proportion of the aged in the population has continued to expand, the health problems of the aged have also become increasingly significant. Not only are the physical health and material satisfaction of the aged receiving attention from society, but this group's mental and psychological conditions are also gradually attracting society's attention.

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Depression, as an important indicator for assessing mental health, has attracted widespread social and academic attention. In recent years, the prevalence of depression in the aged has increased significantly. Studies have shown that in 2010–2019, the percentage of depression among the aged in China was 25.5%, and this percentage increased by about 3% compared with the previous decade [3]. Depression may cause cognitive impairment, decline in physical function, dementia, and even suicide, causing great physical and mental harm to the aged suffering from depression, as well as being detrimental to the positive development of society. Depression in the aged has become an important public health problem that needs to be addressed urgently.

The risk factors influencing geriatric depression primarily encompass physiological, psychological, and social dimensions. At the physiological level, studies have identified that elderly individuals with common age-related conditions such as Type 2 diabetes, Alzheimer's disease, and cerebrovascular diseases exhibit heightened vulnerability to depression [4]. Age-related physiological changes including diminished sleep quality and restricted mobility have been shown to increase depression risk [5, 6]. Specifically, AI Y T's research demonstrates that reduced instrumental activities of daily living (IADL) capacity significantly elevates depression susceptibility in older adults [7]. Psychosocially, the abrupt transition from occupational roles post-retirement and social isolation may induce anxiety, emptiness, and helplessness in elderly populations, which may progressively develop into depressive disorders [8]. Evidence suggests that the risk of depression in retired socially isolated people is higher than in non-isolated people [9]. Social engagement enhances self-identity and societal participation, effectively ameliorating negative emotional states. Joan's Spanish study on social networks' impact on loneliness and depression confirms that enhanced social interaction reduces depression likelihood in older adults [10]. Sun also confirmed the prominent role of socialization in alleviating depressive symptoms and maintaining mental health [11].

As a highly prevalent problem in the elderly population, disability has a significant impact on the living conditions and physical and mental health of the elderly. Due to the limited mobility of the disabled elderly, they may reduce the opportunities for socializing and show social isolation because of the inconvenience of going out and the concern about the opinions of others [12], which, coupled with the fact that they are alone to face the physical illnesses brought about by disability and the fear of aging and death, is more likely to induce the depressed mood of the elderly with disability. Participation in social activities can divert people's attention away from the disability itself, and it can also relieve their feelings of loneliness and emptiness, which is beneficial to the maintenance of the mental health of the elderly with disabilities.Simone also found that functional limitations affect mental health through participation in recreational social activities, which means that social activities play a mediating role in the relationship between functional limitations and mental health [13].

Post-retirement living environments primarily consist of familial and community settings. Adequate material and emotional support from these systems can mitigate the psychological impact of disability-related adverse events. Cohen and Wills' buffer effect model posits that social support reduces negative health consequences from stressful experiences [14]. As critical components of social support, intergenerational and community support demonstrate differential impacts: stable positive intergenerational relationships significantly lower depression risk [15], However, for empty nesters, there may not be stable, positive intergenerational relationships, and this is where the role of the community becomes very important. A cohort study confirms that enhanced community infrastructure investment effectively reduces depression incidence among low-income middle-aged and elderly populations [16]. Contemporary Chinese elderly care models emphasize cultural activities to address psychosocial needs [17], with Yang quantitatively validating the substantial positive impact of community-based psychological support services on mental health outcomes [18]. Compared to their healthy counterparts, elderly individuals with functional disabilities experience both reduced social accessibility and heightened challenges in social engagement. Community support can partially mitigate the disability-induced cascading effects, thereby lowering depression risk. This indicates that community support moderates the relationship between functional disability and depression in older adults.

Current research has focused on the effect of one factor on depression, and further study of the mediating and moderating variables is needed to provide insight into their action pathways.In this paper, we used the latest data from "The Chinese Longitudinal Healthy Longevity Survey (CLHLS)" database to explore the relationship between disability, different types of social activities and community support, and depression in the aged. We investigated the relationship between disability and depression in the aged through the mediated effects model with moderating effects, analyzing whether social activities are among the mediating variables and whether community support has a moderating effect on the mediating role. We hope to further explore the roles of social activities and community support in the relationship between incapacitation and

depression in the aged to provide a reference basis for the development of interventions for depression in the aged and to better promote strategic actions to cope with aging.

Therefore, we tried to test the following hypotheses in this study:

> Hypothesis 1: There is a significant positive correlation between the degree of disability and depression among older adults, and the higher the degree of disability the higher the risk of depression among older adults.
> Hypothesis 2: Active participation in socialization is effective in reducing the risk of depression among older adults.
> Hypothesis 3: Community support services provided by the community are effective in reducing the risk of depression among older adults.
> Hypothesis 4: Socialization is a mediating variable in the relationship between older adults' disability status and depression, i.e., older adults' disability affects the risk of depression by influencing participation in socialization.
> Hypothesis 5: Community support has a moderating effect on the mediating role of socialization in the relationship between incapacity and depression.

Methods

Sample

The data used in this study come from the data of one of the latest follow-up surveys of the CLHLS, which was collected from a cross-sectional survey of 15,874 elderly people aged 65 years and older during 2017–2018. The CLHLS is the world's largest survey program for a sample of elderly people aged 80 and above, and it is the earliest of China's social science surveys to be conducted. It is also one of the earliest and longest-running surveys in China's social science surveys. The CLHLS started with a baseline survey in 1998, and by 2018, the program covered 23 provinces, cities, and autonomous regions across the country, with surveys of seniors over 65 years old and their children over 35 years old. The data quality of the questionnaire has been evaluated and has been generally recognized by scholars, and the data ethics review number of the CLHLS is IRB00001052-13074 [19]. A total of 11,675 people met the inclusion criteria: 1) older adults aged 65 years and older and 2) completed the Depression Scale and the Assessment of Daily Activity Ability Scale (ADA) and 3) did not suffer from cataracts, cancer, Parkinson's disease, or dementia (Fig. 1).

Observation indicators

The dependent variable was depressive symptoms. The CESD-10 questionnaire was used in the CLHLS survey program to measure depressive symptoms in the aged. The Cronbach's α of this questionnaire in the Chinese population ranges from 0.78 to 0.81, which has been verified to have good reliability and validity. According to the research recommendations for the application of the CESD-10 in older Chinese adults [20], a score ≥ 12 on the CESD-10 was defined as depressive symptoms in this study.

The core independent variable was the degree of incapacity. In this study, we used the indicators of the ability to take care of oneself in daily life (ADLs), which include six indicators—eating, dressing, controlling urination and defecation, walking indoors, going to the toilet, and bathing—and used the Katz Index Scale to assess the mobility of the aged. We divided the questionnaire responses according to whether they needed help or not. In accordance with the methodology established by Yan et al., functional disability levels were categorized based on the number of Activities of Daily Living (ADL) items requiring assistance: intact function (0 items), mild disability (1–2 items), moderate disability (3–4 items), and severe disability (5–6 items) [21].

The mediating variable was social activities. Currently, there is no standardized operational definition for social activities in academic literature. The closely related concept of social participation has been defined by Li as activities requiring both sociality and interactivity. Building upon this conceptual framework, social participation is further classified into four domains: economic participation, political engagement, religious involvement, and leisure-time social participation [22]. In the study, social activities specifically refer to leisure-time social participation. Informed by existing classification methodologies and aligned with the survey items and activity characteristics in the Chinese Longitudinal Healthy Longevity Survey (CLHLS), we propose a four-category taxonomy of social activities: 1) Simple Social Interactions (e.g., visiting neighbors and interacting with friends); 2) Cognitive Engagement Activities (e.g., playing mahjong or cards); 3) Physical Exercise Activities (e.g., practicing tai chi or square dancing); and 4) Organized Group Activities (e.g., participating in community-organized events).And participation in the relevant activities was assigned a value of 1, otherwise 0. The sum of the scores of each activity was the overall score of the social activities.

The moderator variable was community support. Currently, there is no clear definition of community support. Drawing on previous research, we define community support as the emotional, informational, and material assistance obtained from the community [23]. In this

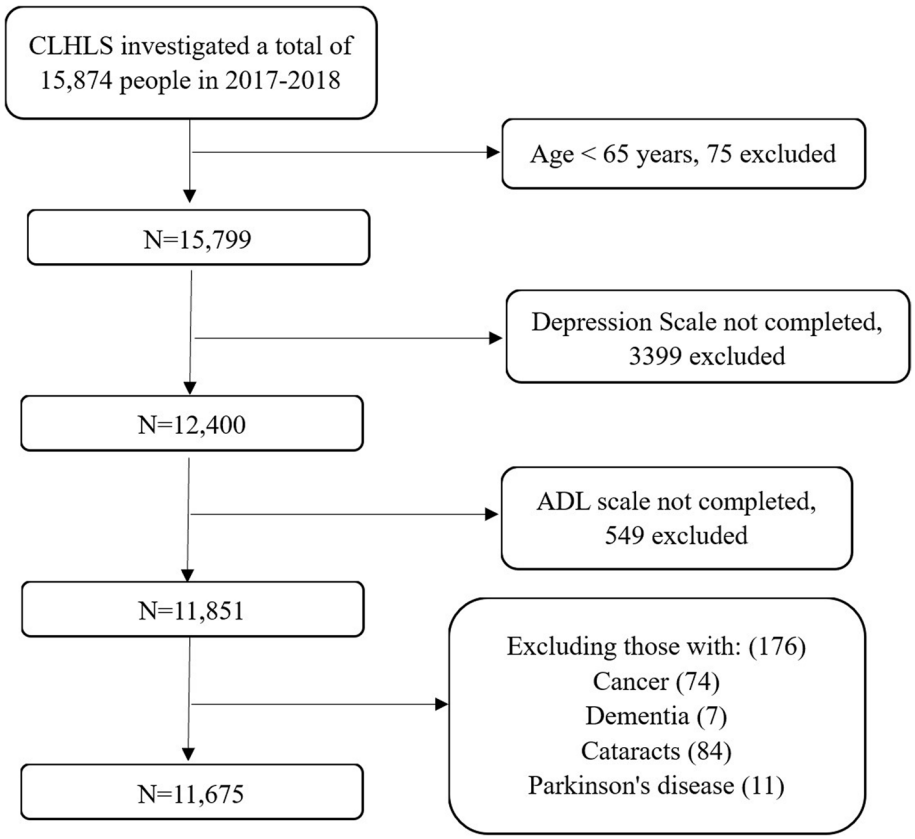

Fig. 1 Screening process

study, based on Yang classification of community support services and the survey question "What social services does your community provide for older adults?" [18], community support is categorized into four types: 1) psychosocial support services, including emotional counseling, companionship, organizing social/recreational activities, and mediating family/neighborhood disputes; 2) daily Living assistance, such as personal care and grocery shopping; 3) healthcare provision services, including mobile medical consultations, medication delivery, and health education; and 4) legal empowerment services, providing legal Aid and rights protection.The eight community services in the options were assigned values, with 0 indicating that the service was not provided in the elderly community and 1 indicating that the service was provided in the community.

Gender, age, account type, and residency status were also used as control variables in this study (Table 1).

Statistical analysis

In mediation analysis, commonly employed methods include the causal stepwise regression approach, Sobel test, and Bootstrap sampling technique. However, the causal stepwise regression method has been criticized for potentially overlooking mediators that exhibit substantive mediation effects despite non-significant total effects [24]. Similarly, the Sobel test requires the product term *ab* to follow a normal distribution, an assumption often violated in practice, thereby increasing the risk of Type I error [25]. In contrast, the Bootstrap method effectively addresses these Limitations and has gained widespread application across various mediation models. This approach involves repeated resampling with replacement from the study sample, calculating the average parameter estimates, and constructing 95% confidence intervals for the *ab* product term. The presence of mediation is established when the confidence interval excludes zero, whereas mediation is deemed non-significant if the interval includes zero [23].

SPSS 26.0 software was used to perform all the statistical analyses [26]. Age was normally distributed and expressed as $\bar{x} \pm s$, the remaining variables are count data and expressed as n (%). The correlation between each influential factor and depressive symptoms in the elderly individuals was analyzed using the chi-square test mediated effects. The moderated mediation model was tested using the PROCESS v4.1 macro developed by Hayes [27], with the Bootstrap method (5,000 resamples) employed

Table 1 Basic information about variables

Variables	Variable description
Dependent variable	
Depressive symptoms	No = 0, Yes = 1
Independent variable	
Incapacity	No disability = 0, Mildly disability = 1, Moderate disability = 2, Severe disability = 3
Control variables	
Gender	Male = 0, Female = 1
Age	65 ~ 74 = 1、75 ~ 84 = 2、85 ~ 94 = 3、95 years and over = 4
Account type	City/town = 0, Rural = 1
Residency status	Living with family = 1, Live alone = 2, Nursing institutions = 3
Mediating variable	
Social activities	Social activities include fitness and exercise, simple interaction, intellectual engagement, and organized group. No = 0, Yes = 1
Moderator variable	
Community supports	Community supports include daily care, health care, spiritual comfort, and legal aid services. No = 0, Yes = 1

to calculate the indirect effect and its 95% confidence interval. As illustrated in Fig. 2, the model specification positioned disablement as the independent variable (X), depression as the dependent variable (Y), socialization as the mediator (M), and community support as the moderator (W). All analyses adopted two-tailed tests with a significance level (α) of 0.05.

Results

Basic information about the survey respondents

A total of 11,675 people aged 65 years and above were included in this study, comprising 5,462 men (46.8%) and 6,213 women (53.2%). The mean age of the total sample was 83.75 years, the mean age of the aged with depressive symptoms was 85.39 years, and the mean age of the aged without depressive symptoms was 83.47 years. The rural population included in the study was 8299, representing 71.2% of the total population. The urban population was 3365 (28.8%). The proportion of the aged Living with family members was 79.9%, 16.8% of people chose to Live alone, and only 3.3% people chose to live in an institution. When the degree of incapacity was low, the aged were more inclined to choose to live alone, while when the degree of incapacity reached a moderate or severe level, a greater percentage of the aged would live in institutions.

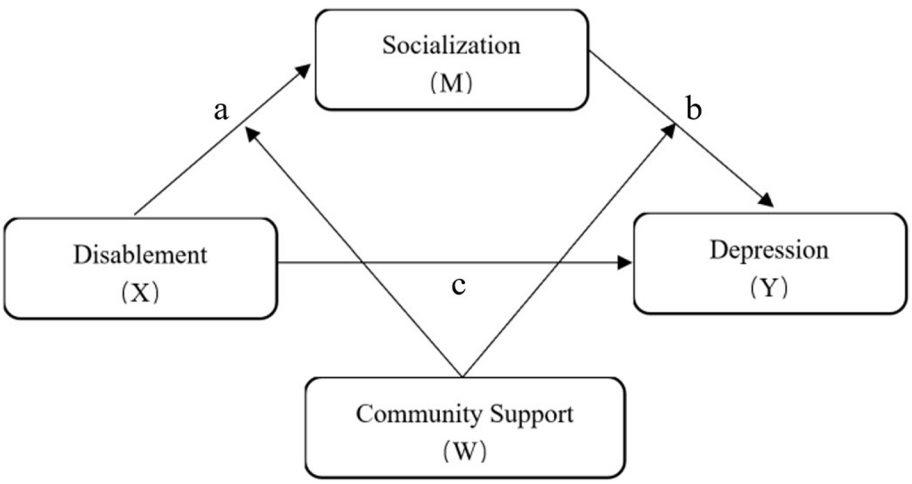

Fig. 2 Moderated mediating effect model. Note: Path coefficient *a* represents the effect of independent variable X on mediator M; path coefficient *b* indicates the effect of mediator M on dependent variable Y after controlling for the influence of X; and path coefficient *c* denotes the direct effect of X on Y after accounting for the mediating effect of M

Correlations between sociodemographic characteristics and depressive symptoms

There was an overall increasing trend in the percentage of the aged suffering from depression as their age increased ($\chi^2=48.333$, $P<0.001$). Gender was significantly associated with depression ($\chi^2=89.977$, $P<0.001$), females are more likely to suffer from depression than males. There was also a significant difference in depressive symptoms between different account types ($\chi^2=21.478$, $P<0.001$), the aged in rural areas are more likely to suffer from depression than those in urban areas.

There were also significant differences in depressive symptoms by residence situation ($\chi^2=67.033$, $P<0.001$), with the likelihood of depression being relatively greater among the aged living in institutions and living alone and relatively lower among those living with family members. In summary, depression among the aged was significantly associated with age, gender, type of household, and residence (Table 2).

Table 2 Relationships between sociodemographic characteristics and depressive symptoms

Variables	Typology	Depressive symptom		χ^2	P
		Yes	No		
Age	65 ~ 74	312(11.1%)	2487(88.9%)	48.333	< 0.001
	75 ~ 84	513((14.3%)	3062(85.7%)		
	85 ~ 94	517(17.0%)	2530(83.0%)		
	≥ 95	377(16.7%)	1877(83.3%)		
Gender	Male	623(11.4%)	4839(88.6%)	89.977	< 0.001
	Female	1096(17.6%)	5117(82.4%)		
Account	Urban	415(12.3%)	2950(87.7%)	21.478	< 0.001
	Rural	1302(15.7%)	6997(84.3%)		
Residency	Living with family	1229(13.3%)	7984(86.7%)	67.033	< 0.001
	Live alone	385(19.9%)	1549(80.1%)		
	Nursing institution	79(20.9%)	299(79.1%)		

Correlations between disability status and depressive symptoms

As the level of disability increased, the proportion of the aged with depressive symptoms increased significantly ($\chi^2=163.371$, $P<0.001$), indicating that depressive symptoms in the aged were significantly associated with disability status (Table 3), and hypothesis 1 was confirmed.

Correlations between social activities and depressive symptoms

Regarding hypothesis 2, we found that depressive symptoms were significantly associated with all types of socialization.Engaging in "fitness and exercise" social activities significantly reduced the proportion of the aged suffering from depression, with the difference being statistically significant at the 0.05 level of significance ($\chi^2=9.103$, $P<0.05$). The aged who engaged in "simple interaction", "intellectual engagement", or "organized group" social activities had a significantly lower rate of depression, with the difference being statistically significant at the 0.001 level of significance ($\chi^2=57.061$, $P<0.001$; $\chi^2=47.673$, $P<0.001$; $\chi^2=37.457$, $P<0.001$). Overall, it appears that participation in social activities significantly reduces the likelihood of developing depression (Table 4).

Correlations between community support and depressive symptoms

The rates of depression were significantly lower among the aged who received "daily care services," "spiritual comfort services," and "legal aid services" than among those who did not receive these services, indicating that the provision of these three types of services in the community can significantly reduce the likelihood of depression among the aged ($\chi^2=19.782$, $P<0.001$; $\chi^2=6.573$, $P<0.05$; $\chi^2=6.154$, $P<0.05$), with some of the results of hypothesis 3 being confirmed. If the community provides "health care services" to the aged, it can also reduce the proportion of the aged suffering from depression to a certain extent, but the difference is not significant (Table 5).

Table 6 shows that the relationships between the degree of incapacity as the independent variable and social activities as the dependent variable are linear ($F=354.919$, $P<0.001$). There was a significant negative effect of

Table 3 Relationships between disability conditions and depression

Variables	Typology	Depressive symptom		χ^2	P
		Yes	No		
Disability status	No disability	1258(13.1%)	8326(86.9%)	163.371	< 0.001
	Mildly disability	223(17.8%)	1032(82.2%)		
	Moderate disability	169(26.4%)	470(73.6%)		
	Severe disability	69(35.0%)	128(65.0%)		

Table 4 Relationships between social activities and depressive symptoms

Variables	Typology	Depressive symptom		χ^2	*P*
		Yes	No		
Fitness and exercise	Yes	92(11.1%)	734(88.9%)	9.103	< 0.05
	No	1627(15.0%)	9222(85.0%)		
Simple interaction	Yes	931(12.8%)	6344(87.2%)	57.061	< 0.001
	No	788(17.9%)	3612(82.1%)		
Intellectually engaged	Yes	223(10.0%)	1996(90.0%)	47.673	< 0.001
	No	1496(15.8%)	7960((84.2%)		
Organizational group	Yes	173(9.9%)	1569(90.1%)	37.457	< 0.001
	No	1546(15.6%)	8387(84.4%)		

Table 5 Relationships between community support and depressive symptoms

Variables	Typology	Depressive symptom		χ^2	*P*
		Yes	No		
Daily care services	Yes	205(11.3%)	1606(88.7%)	19.782	< 0.001
	No	1514(15.3%)	8350(84.7%)		
Health care services	Yes	902(14.5%)	5317(85.5%)	0.512	> 0.1
	No	817(15.0%)	4639(85.0%)		
Spiritual comfort services	Yes	635(13.7%)	4004(86.3%)	6.573	< 0.05
	No	1084(15.4%)	5952((84.6%)		
Legal aid services	Yes	314(13.1%)	2079(86.9%)	6.154	< 0.05
	No	1405(15.1%)	7877(84.9%)		

Table 6 Linear regression of incapacity with socialization and depression

Variables	Social activities	Depressive symptom
Constant	3.554***	-3.194***
Control variable		
Age	-0.024***	-0.03
Gender	-0.065***	0.427***
Population	-0.238***	0.356***
Residence	0.055**	0.381***
Independent variable		
Degree of incapacity	-2.266***	0.359***
Intermediary variable		
Social activities		-0.205***
Model summary		
R	0.367	
R^2	0.135	
F	354.919***	

** $p < 0.01$, *** $p < 0.001$

disability status on social activities ($B = -2.266$, $P < 0.001$). In the study with the degree of incapacity as the independent variable, social activities as the mediating variable and depressive symptoms as the dependent variable, it was found that the degree of incapacity positively affected depressive symptoms in the aged ($B = 0.359$, $P < 0.001$) and that social activities negatively affected depressive symptoms in the aged ($B = -0.205$, $P < 0.001$).

Table 7 shows the estimates of the mediating effects. The results on hypothesis 4 indicated that the indirect effect of the degree to which disablement affects depressive symptoms through socialization was 0.055, representing 13.29% of the effect. Direct effect bootstrap 95% confidence interval was [0.033, 0.078], indicating that the mediating effect was considered to be statistically significant, and the mediating effect was considered to be significant.

The direct effect of the level of disablement on depressive symptoms was also significant when

Table 7 Analysis of the mediating effects of social activities on the relationship between disability and depression

Mold	*Effect*	*SE*	*z*	Bootstrap 95%CI	
Disability → Socialization → depressive symptoms				***LLCI***	***ULCI***
Direct effect	0.359	0.040	8.973***	0.280	0.437
Indirect effect	0.055	0.012		0.033	0.078
Percentage of indirect effects	13.29%(0.055/(0.359 + 0.055)				

*** $p < 0.001$

Table 8 Moderating effect test of different models

Categories	*B*	*SE*	Bootstrap 95%CI	
			LLCI	ULCI
Model 7	-0.001	0.005	-0.014	0.006
Model 8	-0.001	0.005	-0.014	0.006
Model 14	-0.006	0.003	-0.014	-0.001

controlling for mediator variables, with a bootstrap 95% CI [0.280, 0.437], suggesting that socialization was not the only mediator variable and that there are other mediator variables to be explored.

Analysis of the moderating effects of community support

Model 7 in PROCESS v4.1 only moderates the first half, Model 8 moderates both the first and second half and Model 14 only moderates the second half. To analyze the moderating effect of community support on each path of the mediation model, community support was included in these three models as a mediating variable, and the results of the analysis are shown in Table 8. The results on hypothesis 5 indicated that community support did not modulate the first half of the mediation model; the 95% confidence interval of Model 14 was [-0.014, -0.001], indicating that community support moderates only the second half of the mediation model. In summary, community support influenced the mediating effect by moderating the relationship between social activities and depressive symptoms (Table 8).

Disability status influenced depressive symptoms through socialization. The average community support level group was represented by the mean (1.86), the low community support level group was represented by the mean minus one standard deviation (0.00), and the high community support level group was represented by the mean plus one standard deviation (4.04). The 95% CI for Bootstrap was [0.038,0.095] at high levels of community support, [0.033,0.076] at average levels of community support, and [0.020,0.063] at low levels of community support. We can see that the mediator was significant under conditions of different levels of community support; the 95% CI of the moderating variable was [-0.014, 0.001], indicating that the moderating mediator index was significant. The results of the above analyses suggest a moderating effect of community support on the role of disabling conditions in influencing depressive symptoms through social activities (Table 9).

Table 9 Moderation of the mediating effect of community support on socialization

Categories	*B*	*SE*	Bootstrap 95%CI	
			LLCI	ULCI
Low community support group	0.065	0.015	0.038	0.095
Average Community Support Level Group	0.053	0.011	0.033	0.076
High Community Support Group	0.039	0.011	0.020	0.063
moderator variable	-0.006	0.003	-0.014	-0.001

The moderating effect of different levels of community support on mediation was visualized using simple slope plots (Fig. 3). From the simple slope diagram, it can be seen that (1) the greater the level of community support provided to the aged is, the lower the depressive symptoms of the aged, based on the same socialization. (2) Depressive symptoms decrease as socialization increase, which is an inverse relationship, and the trend is the same at different levels of community support. (3) The linear slope of the high community support level is lower than that of the low community support level, which indicates that the effect of socialization on depressive symptoms is weaker in the high community support level condition than in the low community support level condition.

Discussion

Principal findings

The proportion of older people suffering from depression increased significantly with increasing levels of disability

There was a significant positive correlation between age and depression in the aged. With increasing age, the physical functions of the aged gradually deteriorated, their ability to work decreased, and they even became incapacitated. As the degree of incapacitation increased,

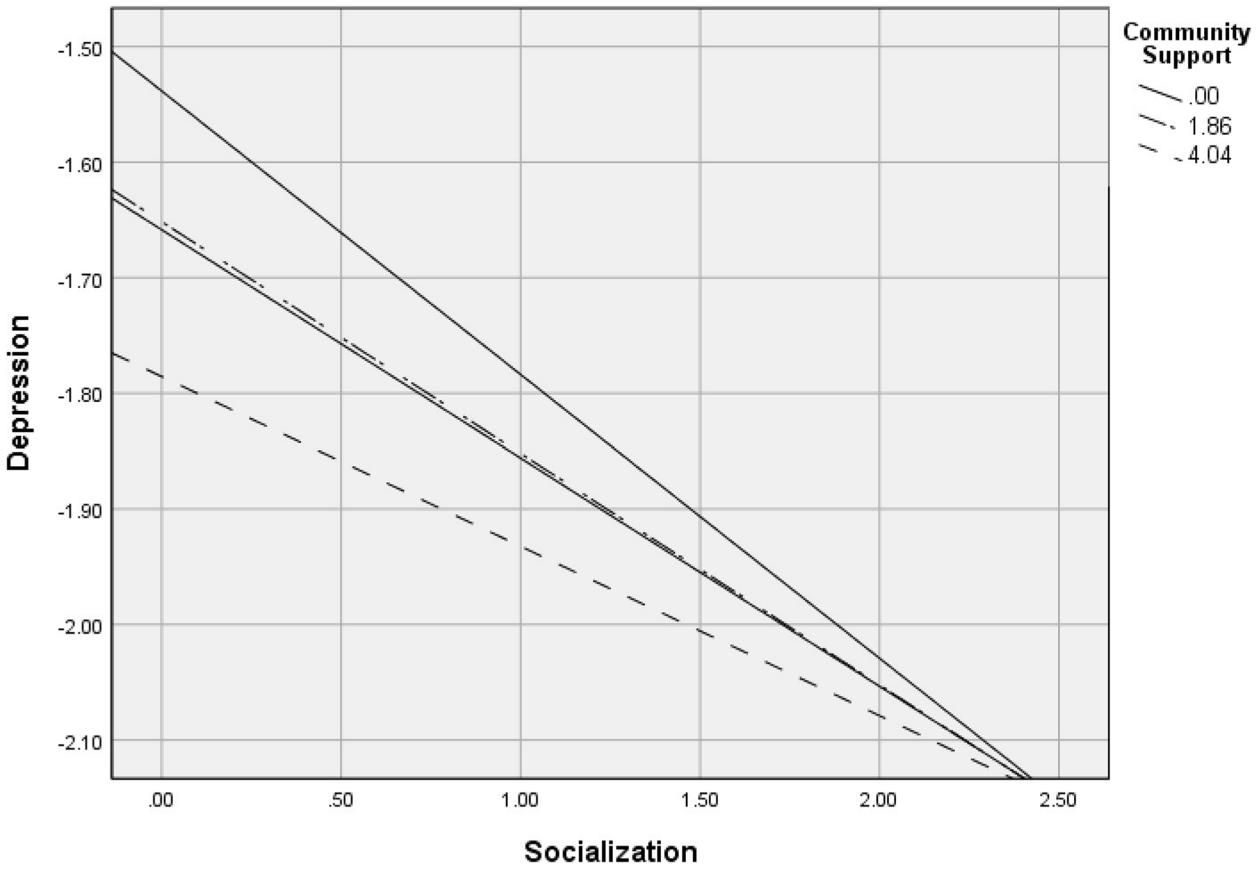

Fig. 3 A simple slope diagram of the moderating effect

the proportion of older adults suffering from depression showed a significant rise, which is consistent with findings from previous studies [28].This may be because physical pain and functional limitations aggravated the psychological burden, which made it easy for individuals to develop depression.

Social activities partially mediated the relationship between disability and depression

The present study revealed that the degree of disability had a significant positive effect on depressive symptoms, while social activities demonstrated a significant negative effect, which is consistent with the findings of Zheng [5]. Furthermore, socialization was identified as a partial mediator in the relationship between disability status and depressive symptoms among older adults, accounting for 13.29% of the total effect. Our results align with the findings documented in Milaneschi's seminal research [29]. Previous research has also identified partial mediating effects of interactions with friends and family, social support, and marital quality in the relationship between disability and mental health outcomes [30, 31]. It is also possible that incapacitation affects depressive symptoms through other mediating variables, suggesting that we need to further explore other mediators between incapacitation and depression to facilitate a deeper and clearer understanding of the mechanisms underlying the relationship between the degree of incapacitation and depressive symptoms.

Both social activities and community support were beneficial for reducing the likelihood of developing depression

Through participation in social activities, older adults can assume diverse social roles, which enhances their self-identity and social engagement while mitigating negative emotional states. This study found that all forms of social activities significantly reduce the likelihood of depression among older adults, a finding consistent with Li's research [22]. Numerous domestic and international studies have demonstrated the substantial impact of community and family support on the psychological well-being of older adults [32, 33], Specifically, Chen revealed that basic community care services, such as daily living assistance, exert a more pronounced positive effect on mental health compared to psychosocial services (e.g., emotional counseling and neighborhood dispute mediation) [34].

Our findings further indicate that, with the exception of healthcare services, spiritual comfort services, daily care services, and legal aid services all significantly reduce the risk of depression among older adults.

Community support moderated the mediating effect of socialization on the relationship between disablement and depression

Community support and intergenerational support are critical components of the broader social support system. Zheng found that the mediating effect of leisure activities between disability and depression was more pronounced when intergenerational support was limited [5]. Building upon this finding, the current study focuses on the moderating role of community support. Consistent with Zheng's results, our analysis reveals that community support moderates the mediating effect of social activities by influencing the relationship between social activities and depressive symptoms. Specifically, the mediating effect of leisure activities is significantly stronger among older adults with lower levels of community support compared to those with higher levels of community support. This suggests that increased participation in social activities may be particularly effective in reducing depressive symptoms among older adults who have limited access to community-based services.

Recommendations

Developing an integrated home-based elderly care model to consolidate care resources

The provision of elderly care services for individuals with disabilities primarily focuses on daily living assistance, healthcare, and psychosocial support. However, the diverse range of service providers often leads to coordination challenges and poor inter-organizational collaboration [35]. To address these issues, we propose establishing specialized community-based elderly care service centers that integrate multiple service providers. Under this model, community health centers would be responsible for maintaining health records, conducting regular medical check-ups, and providing basic care services for disabled older adults. Professional nursing staff from elderly care institutions would offer on-site care services, while social organizations (e.g., elderly assistance associations and volunteer teams) would provide psychosocial support and material assistance. These centers would serve as a crucial link between the community and national/social resources, bridging information gaps among different stakeholders and enhancing the alignment between service provision and the actual care needs of older adults.

Demand-oriented provision of differentiated and personalized elderly care services

China has been actively promoting a home-based elderly care model supported by community services [36]. For older adults with disabilities, care needs and acceptable community services vary significantly depending on their level of impairment, necessitating differentiated care approaches tailored to individual circumstances. For independent older adults without disabilities, who typically have minimal medical and daily care needs, communities should prioritize organizing social and recreational activities. These may include physical exercise programs such as square dancing and Baduanjin (a traditional Chinese exercise), group travel activities, and various community events.For older adults with mild disabilities, who generally maintain self-care capacity but require some healthcare support, communities can provide cognitive engagement activities like chess and mahjong, which serve to stimulate mental faculties and regulate emotional well-being.For older adults with moderate to severe disabilities, whose mobility is significantly limited, communities should establish specialized care teams to deliver essential daily living assistance and healthcare services. Environmental modifications, such as installing anti-slip mats, handrails, and emergency call systems, should be implemented in their living spaces. Importantly, these individuals' social interaction needs must not be overlooked, with communities offering simple social engagement activities like conversation groups.

Developing intelligent social support platforms to address multidimensional needs of older adults

Leveraging advanced technologies such as artificial intelligence and big data analytics, we propose establishing smart elderly care platforms that integrate daily life assistance, social interaction, and psychosocial support functions. For older adults with disabilities, the platform would feature one-touch emergency call and AI-powered virtual care assistants, equipped with voice command recognition (e.g., "request meal delivery" or "contact doctor"), medication reminders, and real-time health monitoring capabilities. These features would be seamlessly connected with community health centers to enable early warning systems for abnormal health indicators.Drawing inspiration from Japan's PARO therapeutic robot model, the platform could incorporate emotionally intelligent AI systems that utilize natural language processing to simulate conversational companionship, thereby alleviating loneliness among isolated older adults. Furthermore, the platform would include interest-based social modules, employing matching algorithms to connect users with shared hobbies (e.g., calligraphy, painting, or traditional

opera communities). The platform would support voice and video interactions to reduce technological barriers for older users.

Establishing a policy safeguard mechanism combining legislative norms and dynamic supervision

In order to ensure the smooth implementation of community-based elderly care services, it is recommended that institutional innovation be promoted through a combination of legal amendments and dynamic supervision. Specifically, special provisions should be added to the *Law of the People's Republic of China on the Protection of the Rights and Interests of the Elderly* to clarify the responsible entities for community elderly care services and define their rights and obligations. An annual performance evaluation system should be established, focusing on key indicators such as the integration of elderly care resources, participation rates in senior activities, and the rate of home adaptation for disabled elderly. A tiered supervision mechanism should be implemented, providing fiscal incentives to high-performing communities while imposing corrective measures and accountability penalties on underperforming ones. Additionally, legislation should mandate communities to establish a "whitelist" disclosure system for elderly care service providers, dynamically publicizing institutional qualifications, service pricing standards, and complaint channels. This transparency mechanism will drive service quality improvement, fostering a collaborative governance model involving government oversight, social supervision, and market self-regulation.

There are still some limitations in this study. First, social activities and community support lack standardized definitions and unified assessment criteria. Although this study adopted scoring methods based on existing literature, the use of non-standardized measurement scales may restrict the comparability and replicability of the findings. Furthermore, the unvalidated assessment framework may fail to capture the multidimensional characteristics of social support and engagement activities, potentially compromising construct validity. Future research should focus on developing and validating standardized assessment instruments with established reliability and validity. Another limitation pertains to the model's explanatory power, as indicated by a relatively low coefficient of determination ($R^2 = 0.135$), which reflects limited explanatory capacity. This result may be attributed to external variables not incorporated in the current model—factors that could significantly influence the studied relationships but were excluded due to either theoretical scope constraints or data accessibility issues. Additionally, the potential presence of unobserved confounding variables that may influence outcome variables, mediating variables, and independent variables could introduce bias into the results.

Conclusion

This study revealed that increased levels of incapacitation increase the likelihood of depression in the aged. Active participation in social activities by the aged was effective in reducing depression levels. Community support can reduce depression levels by moderating the relationship between social activities and depression. Social activities was a partial mediating variable between incapacitation and depression, suggesting that there are other mediating variables to be explored. This study primarily explored the role of individual-level social activities, while the potential mediating effects of family support density and community resource accessibility in the relationship between disability and depression remain to be investigated. Beyond social factors, future research should examine the roles of physiological factors (e.g., cytokine levels) and psychological factors (e.g., self-perception) in the disability-depression nexus. Such investigations would contribute to a more comprehensive understanding of the mechanisms through which disability influences depression, providing theoretical insights for addressing depressive symptoms among older adults with disabilities. These efforts would not only advance interventions to improve mental health outcomes in this population but also further promote the development of active aging initiatives.

Abbreviation

CLHLS The Chinese Longitudinal Healthy Longevity Survey

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Authors' contributions

Yongqi Wu and Liying Zhao jointly confirmed the topic selection and study design; Yongqi Wu wrote the first draft of the paper and the statistical analysis of the data; Liying Zhao was responsible for the quality control of the article and the overall responsibility of the article; Yongqi Wu, Xiaowei Man, Yan Jiang, and Lu Zhang were responsible for collecting and organizing the data.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical standards of the Declaration of Helsinki. The data analyzed were obtained from the CLHLS database, which received ethical approval from the Ethics Committee of Peking University (Approval No. IRB00001052-13074). All participants in the original CLHLS surveys provided written informed consent, and the use

of de-identified data for secondary analysis was approved by the ethics committee.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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