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The impact of social interactions on the mental health of rural elderly cancer patient: evidence from China

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Abstract: Background: In recent years, the mental health problems of rural elderly cancer patients in China have become prominent. Social interaction has received increasing attention as an important means of alleviating depression. However, there are studies on the relationship between social interactions and mental health of rural elderly cancer patients that have not yet reached uniform conclusions. This study provides empirical research to inform strategies for reducing depression risk and improving mental health among rural elderly cancer patients in China. **Methods:** Descriptive statistics and empirical analyses were conducted using StataSE 15 based on data from the China Health and Retirement Longitudinal Study (CHARLS) 2020. Multiple linear regression and robust regression models were used to assess the impact of social interaction. **Results:** A total of 6574 rural elderly cancer patients were surveyed. The mean score on the CES-D depression scale was 10.754. Regression analysis showed that financial support from children, social participation, and social networks all significantly reduced the probability of psychological problems among rural elderly cancer patients ($p < 0.001$). In-home medical services is a “catalyst” for negative emotions and exacerbates mental health problems in rural elderly cancer patients ($p < 0.001$). **Conclusions:** To improve the mental health of rural elderly cancer patients and promote the implementation of the “Healthy China” strategy. There is a need to rationalize in-home medical services and to ensure that the positive effects of social support are maximized by increasing the financial support capacity of children, creating conditions for the social participation of rural elderly cancer patients and broadening rural social networks.

Keywords: mental health; rural elderly cancer patients; social support; social participation; social networks

1. Introduction

Cancer is recognized worldwide as an important public health problem and has become one of the major causes of death in the Chinese population [1] With the accelerated aging of the population and China’s status as a large agricultural country with a higher proportion of elderly residents in rural areas [2], the incidence of cancer will be higher [3]. Cancer patients are affected by the disease, their physical functioning, sleep, etc., and show negative emotions such as anxiety and depression [4]. Numerous studies have found that cancer patients may have psychological problems [5]. Psychological problems may be greater in rural elderly cancer patients [6], in part due to lack of necessary social support and unmet needs [7,8]. Psychological assessment of rural elderly cancer patients is increasingly playing an important role in clinical practice [9], providing a basis for understanding risk factors for mental illness and taking preventive and clinical measures.

The CES-D scale identifies individuals who may have depressive symptoms and is widely used in academia [10]. Originally designed to study depressive symptoms

in open groups, the CES-D scale plays an important role in assessing individuals' somatic symptoms, mood, and interpersonal relationships, and is widely used in the field of population studies [11]. The CES-D scale is freely available and still applicable across languages and countries, and is widely used in Spain, China, and other countries [12]. The questions of the CES-D scale can be fully demonstrated in the questionnaire and will not cause the respondents to be bored, ensuring the authenticity and validity of the interview [13]. The CES-D scale consists of ten sections of questions that greatly improve the efficiency of understanding the depressive symptoms of the respondents [14]. The Chinese Government attaches great importance to mental health and mental hygiene. The Outline of the Healthy China 2030 Plan proposes: "Strengthening interventions for common mental disorders such as depression and anxiety, as well as psychological and behavioral problems. Strengthen early detection and timely intervention of psychological problems in key populations." The CES-D scale has been widely used in rural surveys in China. Data from the 2023 Blue Book of China's Psychiatric Mental Health show that 19.05% of the nation's elderly are in a state of mild depression. 12.17% had moderate to high depression. Rural elderly cancer patients are at increased risk for mental health problems such as anxiety and depression due to declining physical functioning and multiple factors such as living alone, widowhood, and empty nesting [15]. Compared to urban older adults, rural older adults often lack mental health knowledge and are more likely to encounter systemic barriers to timely access to depression interventions and specialized care after cancer [16]. And rural elderly cancer patients feel more psychological distress [17]. Therefore, focusing on the mental health of rural elderly cancer patients to prevent and reduce the risk of depression has become an urgent public health issue.

Social interaction is a fundamental part of social life. Social structures are constructed through interactive interactions between people [18]. Therefore, social interactions are the basis of emotional acquisition and help in personal identity building and social adaptation [19]. Rural elderly cancer patients have even lower cognitive function due to their disease and the environment in which they live. Their social interactions are influenced by geography, cultural traditions and family structure, and are characterized by certain peculiarities. The social networks of rural elderly cancer patients are small and dense [20], showing a pattern of interactions centered on traditional kinship and expanding sequentially to friendship and other circles. Previous studies have focused on the effects of social interactions on cognitive functioning [21] in rural elderly cancer patients, pointing out that positive social interactions and social connections enhance individual coping skills [22]. Negative social interactions are an important factor contributing to increased morbidity and mortality among rural elderly cancer patients [23]. The study also found that the community and social environments of rural elderly cancer patients were also key determinants of their overall health status [24]. This effect depends not only on the quality of social interactions, but is also closely related to the type of social interactions [25]. Social interactions are multidimensional and include social support, social participation, and social networks [26]. Social support is passive social interaction. Social participation as positive social interaction. Social networks are the basis for social interaction. Social support refers to the financial support, life help, and spiritual comfort that an individual receives from others [27]. At the theoretical level, social ecological systems theory, social activity theory, and social resource theory provide a foundation for social interactions to enhance the mental health of rural elderly cancer patients. Social ecological systems

theory emphasizes the impact of interactions between individuals and the environment in which they live. This theory suggests that social support from family and friends, among others, can meet the mental health needs of rural elderly cancer patients [28]. Sources of support for rural elderly cancer patients can generally be categorized into formal support provided by government and medical personnel and informal support provided by family, friends, or the community, among others [29]. Social support helps rural elderly cancer patients to better withstand the psychological stress of the disease [30], and reduces feelings of anxiety and depression and improves quality of life [31]. Rural elderly cancer patients who receive more social support will be more aware of their disease and have less fear of cancer, contributing to mental health recovery [32]. Female rural elderly cancer patients receive health care services in the community more frequently compared to men [33]. Social participation is a formal or informal socializing activity. In this activity, individuals are responsible for connecting and interacting with others in the social environment in order to realize their values [34]. Social activity theory states that rural elderly cancer patients' participation in social activities creates a sense of being valued, effectively alleviating the negative emotions associated with role deficits and having a more positive mindset to combat their illness. However, rural elderly cancer patients may also be neglected in the process of social participation and develop frustration and depression [35]. Gender factors can affect the health of rural elderly cancer patients differently and thus play different roles in the social participation of rural elderly cancer patients of different genders [36]. Social networks refer to the structure of social relationships maintained by an individual, including intimate relationships with family and friends and formal relationships with other individuals and groups [37]. Social resource theory states that social networks in the form of social resources provide a boost to rural elderly cancer patients in expanding their social networks and building emotional bridges with help providers by creating emotional connections, providing health and medical information, and material help [38].

In summary, the finding that social interactions are closely related to the mental health of rural elderly cancer patients is widely recognized, but there is still room for exploration. On the one hand, influenced by international research preferences, current research focuses on the mental health of urban elderly cancer patients. However, in the particular context of China's predominantly rural elderly population, the mental health problems faced by rural elderly cancer patients are even more serious. The effects of social interactions are group heterogeneous, and there is a need to explore in depth the effects of social interactions on the mental health of rural elderly cancer patients. On the other hand, most previous studies have used social support to refer to social interactions and have only discussed the impact of social support on mental health, while ignoring the role of social participation and social networks. To this end, this study aims to empirically analyze the impact of social support, social participation, and social networks on the mental health of rural elderly cancer patients in the context of population aging using the CHARLS 2020 microdata. To provide a reference basis for improving the psychological condition of rural elderly cancer patients and to further promote the effective implementation of the "Healthy China" strategy in rural areas.

2. Materials and methods

2.1. Data sources

The data used in this study comes from the China Health and Retirement

Longitudinal Study (CHARLS) 2020. CHARLS is a large-scale interdisciplinary survey project hosted by the National Development Research Institute of Peking University, which adopts a baseline sample tracking interview model. The sample covers 150 counties and 450 communities (villages) in 28 provinces (autonomous regions and municipalities directly under the central government), which is widely representative and authoritative. This study was approved by the Ethics Committee of Peking University (IRB approval number IRB00001052-11015). Written informed consent to participate in this study was provided by the participants or the participants' legal guardians/next of kin. The database contains individual and family information on Chinese rural elderly cancer patients, including data on mental health status as represented by depression level and social interactions such as social participation and social support, which provides data support for exploring the causal relationship between social interactions and mental health of rural elderly cancer patients. Due to the lack of medical resources and lower economic level in rural areas, the incidence of cancer in the rural elderly population is higher compared to that in urban areas. Therefore, rural elderly cancer patients aged ≥ 60 years in rural China were selected for this study. Excluding samples that refused to answer key questions about social support and social networks and those with missing responses, a final sample of 6574 valid samples was obtained.

2.2. Variable selection

2.2.1. Dependent variable

The dependent variable in this study was the mental health status of rural elderly cancer patients. The CES-D Depression Scale was used to measure depression in rural elderly cancer patients. The scale consists of 10 questions asking about the respondent's feelings and behaviors in the last week. Of these, eight questions were about the frequency of negative emotions during the week (worrying about small things, having trouble concentrating, feeling depressed, struggling to do anything, feeling scared, not sleeping well, feeling lonely, not being able to get on with life). 2 questions that reflect how often positive emotions occur (hopeful for the future, feeling good). Assigned a value of "little or nothing (less than 1 day)" based on the number of days of negativity in the last week and assigned a value of 0." Not too much (1 to 2 days)" is assigned a value of 1. "Sometimes or half the time (3 to 4 days)" is assigned a value of 2." Most of the time (5 to 7 days)" is assigned a value of 3. Questions reflecting positive emotions are assigned points in reverse. The depression scale score ranges from 0 to 30, with higher scores indicating higher levels of depression and poorer mental health.

2.2.2. Independent variable

The independent variable in this study was the social interaction status of rural elderly cancer patients, categorized as social support, social participation, and social networks.

1) There are two types of social support, informal and formal. Formal support was characterized by the questionnaire "Whether or not you have received in-home medical services in the past month", with a value of 1 if you have received it and 0 otherwise. Informal support was expressed in terms of financial support from children, which was selected from the questionnaire as "How much financial support did you receive from your children in the past year?". To facilitate comparative analysis, this study measures continuous variables by transforming them into ordinal variables with the following rules: The financial support received is less than 5000

RMB, taking the value of 1 and between RMB 5000 and RMB 10,000, bringing the value of 2 and between RMB 10,000 and 15,000, taking the value of 3. And so on, by rank.

2) Social participation. Social participation was measured by asking respondents in the CHARLS questionnaire whether they had engaged in eight social activities in the past month, including “visiting friends, socializing with friends,” “playing mahjong, chess, and cards,” and so on. This study coded having participated in at least one activity as 1 to be considered social participation and coded no social activity participation as 0. For rural elderly cancer patients with social participation, ask further questions about the frequency of their participation. For those who answered, “almost every day”, code 3. The answer “almost every week” was coded 2. The answer “infrequently” was coded 1. Finally, the summed score is calculated, taking values between 0 and 14.

3) Social networks. Social networks were represented by “people who are available for help”. The questionnaire asked respondents about the number of individuals or organisations that could provide long-term care now or in the future. Calculate the summed score, taking values between 0 and 9. Higher scores indicate more extensive social networks among rural elderly cancer patients.

2.2.3. Control variable

The demand-control model explains the relationship between mental health, job demands, and autonomy. The combination of low decision-making freedom and high job demands can expose employees to greater mental and psychological stress [39]. Labor participation has been found to have a significant impact on the mental health of rural elderly cancer patients, and the impact of different types of labor on mental health is heterogeneous [40]. Therefore, in addition to commonly used control variables for demographic characteristics such as age, gender, marriage, and education level, the actual situation of rural elderly cancer patients in China after retirement should be considered. Labor participation variables such as participation in agricultural work/non-agricultural work/retirement were included as control variables. It should be noted that the marital status of being married includes the categories of being married and cohabiting with a partner, being married and not cohabiting with a partner for work reasons, and being separated. Divorced, widowed indicates not in a marriage. For educational attainment, elementary school graduation includes private school graduation. Graduation from secondary school covers graduation from secondary school (including secondary teacher training and vocational high school).

2.3. Method

The data were organized and descriptively analyzed in this study using StataSE 15. Multiple linear regression analysis is effective for studying the interaction between two or more variables [41]. Not only is it free from the limitations of traditional ANOVA, but the analysis is completed with ANOVA and many pairwise multiple comparisons, which allows for a better explanation of the relationships between variables [42]. Due to the fact that the dependent variable—mental health status in this study is a continuous variable and the sample data size is large. Therefore, multiple linear regression analysis was used as the main model to explore the association between social interactions and mental health among rural elderly cancer patients. And the following empirical model was established:

$$MH_i = \alpha + \beta_1 SS_i + \beta_2 SP_i + \beta_3 SN_i + \gamma Z_i + \varepsilon \quad (1)$$

In Equation (1), *MH* is the mental health status of rural elderly cancer patient,

and i is the sample of respondents. SS , SP , and SN stand for social support, social participation, and social networks, respectively. Z is the control variable, such as age and gender. α , β , γ are the coefficients, and ε is the random error perturbation term.

3. Results

3.1. Descriptive statistical analyzes

A total sample of 6574 rural elderly cancer patients was included in this study. The mean score on the CES-D depression scale was 10.754. Based on the basis of the assignment, it was judged that some degree of mental illness exists among rural elderly cancer patients. In terms of social support, only 21.57 % of rural elderly cancer patients have received in-home medical services. 61.62% of rural elderly cancer patients receive less than RMB 5000 per year on average in financial support from their children. Of these, 10.54% of the elderly respondents did not receive any financial support from their children. In terms of social participation, 56.16% of rural elderly cancer patients did not participate in any form of socialization. The percentage of rural elderly cancer patients with two or fewer social networks was 97.03%. In terms of gender, the proportion of rural elderly cancer patients is almost equal between men (48.72%) and women (51.28%). In terms of age, the respondents in this survey were concentrated between 60 and 120 years old. The mean age was 68.835 years, indicating that the majority of rural elderly cancer patients in the sample belonged to an older age group. The percentage of those whose marital status is married is 80.77%. The higher the level of education, the smaller the share of the group. The percentage below elementary school is 57.09%, while only 6.37% are above high school. In terms of work, 57.86% and 17.37% of the rural elderly cancer patients interviewed were still engaged in agricultural and non-agricultural work in the recent past, and only 2.62% had gone through retirement procedures. Specific descriptive statistics are shown in **Table 1**.

Table 1. Descriptive statistics.

Variable type	Variable	Definition	Mean	SD	Median	
Dependent variable	Level of mental health	CES-D Depression Scale Score, scores ranging from 0 to 30	10.754	6.900	10.000	
Independent variable	Social support	Formal support	Received in-home medical services, yes = 1, no = 0	0.216	0.411	0.000
		Informal support	Financial support from children, 0–5000 = 1, 5000–10,000 = 2, 10,000–15,000 = 3, 15,000–20,000 = 4, > 20,000 = 5	1.765	1.203	1.000
	Social participation	Frequency of social participation, ranging from 0 to 14	1.145	1.698	0.000	
	Social networks	Number of caregivers, ranging from 0 to 9	1.050	0.836	1.000	
Control variable	Gender	Female = 0, Male = 1	0.487	0.500	0.000	
	Age	Age	68.835	6.228	68.000	
	Marital status	Being married = 1, non-married = 0	0.808	0.394	1.000	
	Education level	Below elementary school = 1, Elementary school = 2, Middle school = 3, High school and above = 4	1.706	0.943	2.000	

Continuation Table:

Variable type	Variable	Definition	Mean	SD	Median
	Agricultural work	Yes = 1, No = 0	0.579	0.494	1.000
	Non-agricultural work	Yes = 1, No = 0	0.174	0.379	0.000
	Retirement	Yes = 1, No = 0	0.026	0.160	0.000

3.2. Multicollinearity test

In order to exclude the possible effects of multicollinearity on the results of the analysis and to ensure that the results of the empirical analysis are testable, the main variables were tested for multicollinearity. The results of the analysis are shown in **Table 2**. As can be seen from **Table 2**, VIF values are < 10. There is no problem of multicollinearity between the variables.

Table 2. Multiple covariance test.

Variable	VIF	1/VIF
Formal support	1.004	0.996
Informal support	1.019	0.982
Social participation	1.021	0.979
Social networks	1.031	0.970
Gender	1.199	0.834
Age	1.213	0.825
Marital status	1.160	0.862
Education level	1.201	0.832
Agricultural work	1.063	0.941
Non-agricultural work	1.111	0.900
Retirement	1.021	0.979

3.3. Baseline regression results

Stepwise regression was used to derive regression results for social interaction on the mental health of rural elderly cancer patients (**Table 3**). Model 1 considers only the effects of the core explanatory variables on the mental health of rural elderly cancer patients. Model 2 incorporates individual characteristic control variables. Model 3 adds a labor participation control variable to Model 2. The three core explanatory variables of social support, social participation, and social networks significantly influenced the mental health of rural elderly cancer patients, whether or not the effects of other variables were controlled for. From model 1 to model 3, the R^2 value is getting larger and larger, indicating that the model has more and more explanatory power.

Table 3. Baseline regression results.

Variable			Model 1		Model 2		Model 3	
			Estimate	P	Estimate	P	Estimate	P
Independent variable	Social support	In-home medical services	2.339 (11.515)	< 0.001***	2.239 (11.273)	< 0.001***	2.198 (11.108)	< 0.001***
		Financial support from children	-0.433 (-6.219)	< 0.001***	-0.372 (-5.435)	< 0.001***	-0.383 (-5.621)	< 0.001***
		Social participation	-0.162 (-3.288)	0.001***	-0.170 (-3.504)	< 0.001***	-0.166 (-3.441)	< 0.001***
		Social networks	-0.841 (-8.402)	< 0.001***	-0.683 (-6.897)	< 0.001***	-0.659 (-6.681)	< 0.001***
Control variable		Gender			-2.023 (-11.509)	< 0.001***	-1.844 (-10.360)	< 0.001***
		Age			-0.002 (-0.114)	0.909	-0.019 (-1.303)	0.193
		Marital status			-0.930 (-4.192)	< 0.001***	-0.949 (-4.273)	< 0.001***
		Education level			-0.648 (-6.869)	< 0.001***	-0.594 (-6.291)	< 0.001***
		Agricultural work					0.169 (0.995)	0.320
		Non-agricultural work					-1.192 (-5.275)	< 0.001***
		Retirement					-2.556 (-4.969)	< 0.001***
R^2			0.038		0.082		0.090	

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, inside the parentheses is the value of *t*.

Among social support, in-home medical services significantly and positively affect depression scores in rural elderly cancer patients ($B = 2.198$, $p < 0.001$). Rural elderly cancer patients who received in-home medical services were 2.198 times more likely to have psychological problems than those who did not. Most rural elderly cancer patients are more traditional in their thinking and accustomed to independent lifestyles and may feel anxiety and resistance to external interventions, especially in-home medical services, as they may feel an invasion of privacy or a loss of autonomy. When in-home medical services are provided too frequently, it may cause some rural elderly cancer patients to worry excessively about their illnesses, triggering excessive worries about their health status and thus increasing their psychological burden. Financial support from children is effective in reducing depression scores in rural elderly cancer patients ($B = -0.383$, $p < 0.001$). For every unit increase in financial support from children, there will be a corresponding decrease of 0.383 standardized units in the depression level of rural elderly cancer patients. Financial support from their children enables rural elderly cancer patients to feel more at ease and less anxious about their illness in later life. Especially for rural elderly cancer patients who do not have pensions

or social security, financial help from their children provides security for medical care, food, daily expenses, etc., which reduces financial pressure and enables rural elderly cancer patients to have more positive expectations of life against cancer in their later years. At the same time, financial support from children usually means more maintenance of family relationships, such as visits home and communication on the phone. This kind of affectionate interaction helps to alleviate the loneliness of rural elderly cancer patients and enhances family emotional ties, thus promoting the mental health of rural elderly cancer patients. Social participation consistently had a significant negative effect on depression scores at the 1% confidence level ($B = -0.166, p < 0.001$). The higher the frequency of participation, the lower the depression scores of rural elderly cancer patients, effectively validating the ideas of social activity theory. Socializing with friends and neighbors and participating in community activities can help rural elderly cancer patients feel connected to the community, break the negative cycle of emotional isolation, and reduce feelings of anxiety and depression that may come from doing nothing. Activities such as playing chess and mahjong are both social and logical, and participation in such activities enhances emotional communication among rural elderly cancer patients while exercising their thinking skills and reducing the risk of cognitive decline. Social networks significantly inhibit depression levels in rural elderly cancer patients ($B = -0.659, p < 0.001$). The risk of depression among rural elderly cancer patients with n “available long-term caregivers” was 0.659 times higher than that with $n+1$ “long-term caregivers,” further validating the social resource theory. An expanded circle of relationships helps rural elderly cancer patients break free from loneliness and anxiety about their future lives. Through interaction and joint activities with friends and relatives, rural elderly cancer patients can obtain more health information and life guidance and enhance their resilience in the face of illness or difficult life situations, thus improving their quality of life and reducing the incidence of depression.

Regarding control variables, gender ($B = -1.844, p < 0.001$), marriage ($B = -0.949, p < 0.001$), and education ($B = -0.594, p < 0.001$) significantly and positively influenced mental health. The higher the likelihood of psychological problems among rural elderly cancer patients who are female, single, and less educated. Influenced by traditional concepts, women are more responsible for household chores and caring for their grandchildren than men, resulting in the squeezing of mental and personal space, which greatly deteriorates the mental health of female rural elderly cancer patients. Rural elderly cancer patients with spouses receive more spiritual comfort and life care and have relatively better mental health. Rural elderly cancer patients with higher levels of education are often able to better manage their physical illnesses by taking regular exercise and having regular medical checkups. Non-agricultural work ($B = -1.192, p < 0.001$) and retirement ($B = -2.556, p < 0.001$) were protective factors for the mental health of rural elderly cancer patients. By engaging in non-agricultural work such as handicrafts, retailing and services, rural elderly cancer patients can reduce excessive concern about cancer and avoid being caught up in anxiety and fear about their condition, while at the same time obtaining a stable economic income and enhancing their sense of security and self-worth. Retirement provides rural elderly cancer patients with more time off to spend with their families, relieves the physical effects of work and cancer, and enhances individual well-being. Age and participation in agriculture did not show significance ($p > 0.1$), and neither had an effect on the mental health of rural elderly cancer patients.

3.4. Robustness test

Robust regression can exclude the interference of outliers or data bias and assign appropriate weights to observations that deviate from the regression model, thus achieving better parameter estimation efficiency [43]. In order to ensure the robustness of the regression results, this study used robust regression analysis to test the results shown in **Table 3**. The specific results are shown in **Table 4**. In-home medical services have a “crowding out” effect on the mental health of rural elderly cancer patients, while financial support from children has the opposite effect. Social participation and social networks as protective factors for the mental health of rural elderly cancer patients. All of the above conclusions passed the test. This is consistent with the results of the benchmark regression, indicating that the model developed in this study has good robustness.

Table 4. Robust test.

Variable	Estimate	SE	<i>t</i>	<i>p</i>
In-home medical services	2.347	0.207	11.334	< 0.001***
Financial support from children	−0.405	0.071	−5.677	< 0.001***
Social participation	−0.162	0.051	−3.198	0.001***
Social Networks	−0.717	0.103	−6.946	< 0.001***
Gender	−1.948	0.186	−10.465	< 0.001***
Age	−0.014	0.015	−0.932	0.352
Marital status	−0.970	0.232	−4.177	< 0.001***
Education level	−0.578	0.099	−5.852	< 0.001***
Agricultural work	0.233	0.177	1.313	0.189
Non-agricultural work	−1.153	0.236	−4.878	< 0.001***
Retirement	−2.499	0.538	−4.644	< 0.001***
<i>R</i> ²	0.059			

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

3.5. Analysis of gender heterogeneity

Based on the analysis above, it can be found that the mental health of rural elderly cancer patients is affected to a different extent by different genders. Therefore, this study categorized rural elderly cancer patients into males and females to explore the effect of social interactions on their mental health status separately. The regression results are shown in **Table 5**. As can be seen from **Table 5**, social interactions have a greater impact on the mental health status of female rural elderly cancer patients than on men. It has been found that female rural elderly cancer patients are more vulnerable than men in terms of social resources [44]. That is, female rural elderly cancer patients have a greater need to interact with people and broaden their social networks, which is consistent with the findings of this paper.

Table 5. Analysis of gender heterogeneity.

Variable	Male		Female	
	Estimate	VIF	Estimate	VIF
In-home medical services	1.878*** (6.869)	1.005	2.481*** (8.705)	1.003
Financial support from children	−0.361*** (−3.964)	1.022	−0.406*** (−4.003)	1.019
Social participation	−0.134** (−2.009)	1.026	−0.190*** (−2.715)	1.020
Social networks	−0.632*** (−4.966)	1.033	−0.695*** (−4.549)	1.032
Age	−0.023 (−1.197)	1.208	−0.014 (−0.644)	1.229
Marital status	−1.054*** (−3.044)	1.103	−0.855*** (−2.885)	1.174
Education level	−0.475*** (−4.139)	1.097	−0.795*** (−4.989)	1.049
Agricultural work	0.113 (0.486)	1.068	0.213 (0.867)	1.058
Non-agricultural work	−1.500*** (−5.554)	1.108	−0.683* (−1.736)	1.048
Retirement	−2.750*** (−4.727)	1.024	−2.187** (−2.204)	1.015

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, inside the parentheses is the value of *t*.

4. Discussion

This study utilized data from the CHARLS 2020 to explore the impact of social interactions on the mental health of rural elderly cancer patients, and the following key conclusions were drawn. First, social interactions have a significant effect on the mental health of rural elderly cancer patients, but the variables do not act in the same direction. Among the social support variables, in-home medical services is a risk factor for the mental health of rural elderly cancer patients. This is consistent with the findings of scholars in China that in-home medical services can have a negative effect on the mental health of rural elderly cancer patients [45]. However, studies by foreign scholars have found that in-home medical services are beneficial to the mental health of rural elderly cancer patients [46]. Therefore, the negative effects of in-home medical services may be a phenomenon unique to Chinese rural society that requires attention and focus. Financial support from children is a protective factor and will alleviate psychological problems in rural elderly cancer patients [47]. Social participation and social networks were significantly and negatively associated with depression scores in rural elderly cancer patients. Relevant studies have indicated that active participation in social activities and expanding social networks can help rural elderly cancer patients improve their mental health problems [48], which is consistent with the findings of this paper. Second, on the control variables, rural elderly cancer patients who were female, single, and less educated were more likely to have psychological problems [49]. Participation in non-agricultural labor or retirement may mitigate depression risk in rural elderly cancer patients. The above conclusion still holds in the robustness test of the replacement model. Based on this, this study attempts to put forward the following recommendations to reduce the risk of depression among rural elderly cancer patients, improve their mental health, and promote the implementation of the “Healthy China” strategy.

The first is to rationalize the arrangement of in-home medical services and to

enhance the ability of children to financially support rural elderly cancer patients. Strengthening the training of rural medical and nursing personnel to understand the condition and psychological state of each rural elderly cancer patient, and formulating individualized service plans to ensure the relevance and effectiveness of services. Provide psychologists in rural health-care teams to provide regular psychological assessment and counseling services for rural elderly cancer patients. At the same time, mutual support groups for cancer patients in rural communities have been established to enhance the psychological resilience of rural elderly cancer patients through activities such as exchanges among patients and the sharing of cancer-fighting experiences among those who have recovered from the disease. In terms of financial support from children, rural specialty industries, e-commerce to help farmers and rural tourism can be developed according to local conditions. The Government can also help rural youth improve their competitiveness in employment by providing job training based on market and individual needs. Increasing income while facilitating the ability of children to better provide financial support to rural elderly cancer patients reduces the financial anxiety of rural elderly cancer patients, thereby promoting mental health. Secondly, to create conditions for the social participation of rural elderly cancer patients. With the help of government subsidies, social donations and corporate donations, rural infrastructure has been further improved, and rural senior citizen activity rooms and village plazas have been improved in order to regularly organize handicrafts, cultural performances and other activities suitable for rural elderly cancer patients. Enriching the spiritual life of rural elderly cancer patients, thereby enhancing emotional regulation and maintaining mental health. Third, broadening the social networks of rural elderly cancer patients. On the one hand, it carries out villagers' mutual assistance activities and absorbs rural elderly cancer patients to participate in activities such as agricultural product picking, square dances and opera performances. For rural elderly cancer patients with limited mobility, they can participate in assisting and exercising appropriately. Enhancing social connectedness and collective identity among rural elderly cancer patients. On the other hand, digital technology is utilized to break down social geography. Regularly organizing digital technology training to teach rural elderly cancer patients to use smartphones, and establishing an exclusive WeChat group for rural elderly cancer patients. To facilitate rural elderly cancer patients to exchange their illnesses, treatment experiences and interesting life stories at any time, so as to enrich their daily life and broaden the scope of socialization, thereby improving the mental health of rural elderly cancer patients.

The contribution of this paper is, first, a more focused study. Limit the study to rural elderly cancer patients to suggest more targeted responses. Second, the research framework is novel. Exploring the impact of social support, social participation, and social networks on the mental health of rural elderly cancer patients provides an analytical framework for examining the role of social interactions on the mental health of rural elderly cancer patients. It is worth noting that this study also has some limitations. First, in terms of time, the data used in this study are mainly from existing databases. Considering the timing of data updates, the most recent data has not yet been obtained, but it does not affect the conclusions of this study, and further in-depth research will be done in the future. Secondly, in terms of research subjects, this study was conducted only on a special group of rural elderly cancer patients and did not consider other groups, which will be added in future studies. Third, limitations in data availability prevented a more detailed understanding of the mental health status

of rural elderly cancer patients. Although the CES-D scale has been confirmed as authoritative by numerous scholars in the academic community, it is still a subjective scale. Mental health needs to be measured in a more objective way in future research, and this is something we need to work on in future research.

5. Conclusion

This study utilized data from the CHARLS 2020 to explore the impact of social interactions on the mental health of rural elderly cancer patients. In which in-home medical services exacerbated depression in rural elderly cancer patients ($p < 0.001$). Financial support from children was effective in reducing depressive symptoms in rural elderly cancer patients ($p < 0.001$). Social participation reduces the risk of depression in rural elderly cancer patients ($p < 0.01$). Social networks inhibit psychological problems in rural elderly cancer patients ($p < 0.001$). There is a need to improve the mental health of rural elderly cancer patients and promote the implementation of the “Healthy China” strategy by rationalizing in-home medical services, creating conditions for social participation of rural elderly cancer patients, and broadening the social networks of rural elderly cancer patients.

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