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Analysis of the correlation between social capital and frailty among the elderly in Zhejiang Province, China

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Abstract: *This study aims to investigate the current status and correlation between social capital and frailty among the elderly in Zhejiang Province, with the goal of providing a theoretical basis for delaying the onset of frailty. A questionnaire survey was conducted in 10 communities and 10 rural areas in Zhejiang Province from June to August 2023.Stratified sampling was used to select 853 elderly participants, who completed general information questionnaires, social capital assessments, and vulnerability scales. Pearson correlation analysis and binary linear regression were employed to explore the relationship between social capital and vulnerability. The average frailty score was 4.48 ± 2.42, with 352 (41.3%) of the elderly classified as frail. The average social capital score was 19.28 ± 2.30; 459 elderly individuals (53.8%) fell into the high social capital category, which showed a negative correlation with vulnerability scores (r=-0.428). Further analysis revealed that age, place of residence, alcohol consumption, living alone, self-rated health, and social capital all influenced vulnerability levels. Therefore, it is evident that social capital plays a significant role in shaping elderly frailty development; interventions targeting social capital may effectively delay this process.*

Keywords: *social capital; frailty; correlation*

1. Introduction

According to data released by the National Office for Aging, in 2020, the proportion of the elderly population aged 60 and above in China was 19.8%[1], and approximately 10% of the elderly aged 65 and above experienced frailty[2]. Frailty significantly impacts life expectancy[3]. It is commonly defined as a clinical syndrome characterized by diminished physiological reserve, increased vulnerability to internal and external stressors, and heightened susceptibility to adverse health events in the elderly, leading to poorer medical outcomes[4]. There is currently no unified definition of frailty diagnosis domestically or internationally. Fried and colleagues have identified frailty as a predictor of adverse outcomes in the elderly, such as falls, hospitalization, disability, and mortality, and have developed the frailty phenotype scale for its assessment[5]. Given the prevalence of frailty among the elderly, numerous scholars are researching frailty from both physiological and psychological perspectives, with many focusing on interventions through exercise and nutrition[6,7]. Some scholars argue that managing frailty based solely on individual health status information is insufficient and that it is necessary to explore frailty from the perspective of social capital[8]. Social capital centers on social relationships, with key elements including social networks, civic participation, norms of reciprocity, and generalized trust[9]. Broadly defined, social capital encompasses collective assets in the form of shared norms, values, beliefs, trust, networks, social relationships, and institutions that facilitate cooperation and collective action for mutual benefit. Previous studies have shown that social factors such as social isolation and interactions with friends and family also influence frailty[10]. These studies have primarily focused on the individual level, with relatively few exploring the relationship between frailty and broader social factors (social capital). Therefore, in the context of rapidly increasing global life expectancy and aging populations, it is necessary to study the relationship between social capital and frailty in the elderly to provide scientific evidence for subsequent interventions aimed at delaying frailty.

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2. Materials and Methods

2.1 Study Subjects

From June 23, 2023, to August 23, 2023, a stratified random sampling method was employed to select residents from ten urban communities and ten rural areas within Zhejiang Province, based on geographic location and economic status. The inclusion criteria were: (1) age ≥60 years; (2) no self-reported vision or hearing impairments; (3) normal reading and comprehension abilities, enabling participation in the questionnaire survey and physical assessment; and (4) voluntary participants who signed an informed consent form. The exclusion criteria were: (1) inability to walk independently (including elderly individuals who use walking aids); (2) presence of mild cognitive impairment or dementia; and (3) current or past severe physical diseases (such as severe organic diseases of the heart, brain, or lungs, or severe comorbidities) or severe mental disorders affecting cognitive function.

2.2 Research Instruments

2.2.1 General Survey Data Form

A self-designed form by the researchers that includes general information such as gender, age, educational level, marital status, place of residence, living conditions, smoking status, drinking status, physical exercise habits, diet, and self-rated health.

2.2.2 Social Capital Scale

The Social Capital Scale developed by Chinese scholar Yang Tingzhong[11] was used, which includes three dimensions: values (4 items), social networks (3 items), and social participation (5 items), totaling 12 items. The overall score ranges from 12 to 24 points, with higher scores indicating richer social capital among the elderly. A score above 19 is considered high social capital. The Cronbach's α coefficient for this questionnaire is 0.678. Lin Na applied this scale to explore the relationship between social capital and mental health in the elderly[12].

2.2.3 Tilburg Frailty Indicator

The Chinese version of the Tilburg Frailty Indicator, translated by Xi Xing[13], was used. It consists of three dimensions: physical frailty (8 items), social frailty (3 items), and psychological frailty (4 items), totaling 15 items. The overall score ranges from 0 to 15 points, with a score of 5 or above indicating the presence of frailty. Higher scores suggest a more severe degree of frailty in the elderly. The Cronbach's α coefficient for this scale is 0.71.

2.3 Data Collection Method

A questionnaire survey method was used to investigate the elderly residents in selected communities and rural areas of Zhejiang Province. All surveyors received standardized training and used a uniform script to explain the purpose, methods, and content of the survey. If any respondents were unable to fill out the questionnaire themselves, the surveyors assisted by filling in the relevant information based on the respondents' descriptions. A total of 890 questionnaires were distributed, and 853 valid questionnaires were returned, with an effective response rate of 95.8%. This study was approved by the Ethics Committee of the School of Nursing, Hangzhou Normal University, approval number: 2023045.

2.4 Statistical Methods

The collected data were analyzed using SPSS 26.0 software. Quantitative data conforming to a normal distribution were described using mean ± standard deviation, while qualitative data were described using frequency and percentage. Comparisons between groups were conducted using t-tests and χ^2 tests, and Pearson correlation was used to assess relationships. Logistic regression analysis was employed to identify influencing factors. A P-value of <0.05 was considered statistically significant.

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3. Results

3.1 General Sociodemographic Data

Among the 853 elderly individuals surveyed, the average age was 69.65 ± 6.19 years. The gender distribution was 405 males (47.5%) and 448 females (52.5%). In terms of residence, 412 participants (48.3%) lived in rural areas, while 441 participants (51.7%) lived in urban areas. There were 107 elderly individuals (12.5%) living alone, and 746 elderly individuals (87.5%) not living alone.

In this study, 352 (41.3%) elderly individuals were identified as frail, while 501 (58.7%) were non-frail. Additionally, 419 elderly individuals (49.1%) were categorized as having high social capital, whereas 434 individuals (50.9%) had low social capital.

3.2 Scores of Social Capital and Frailty

The scores of social capital, frailty, and its various dimensions are detailed in Table 1.

Table 1: Scores of Social Capital and Frailty

	Minimum	*Maximum*	*mean*	*Standard Deviation*
Physical Frailty	*0*	*8*	*1.84*	*1.69*
Psychological Frailty	*0*	*4*	*1.51*	*1.21*
Social Frailty	*0*	*3*	*1.21*	*0.42*
Total Frailty Score	*0*	*14*	*4.48*	*2.42*
Values	*4*	*8*	*7.38*	*0.92*
Social Network	*5*	*10*	*8.26*	*1.47*
Social Participation	*3*	*6*	*3.64*	*0.84*
Total Social Capital Score	*12*	*24*	*19.28*	*2.362*

3.3 Factors Influencing Frailty

To explore the impact of individual characteristics on frailty, the 853 elderly participants were divided into a frail group and a non-frail group based on their frailty scores. A chi-square (χ^2) analysis was conducted to compare the differences between the frail and non-frail groups regarding gender, age, place of residence, educational level, living conditions, types of chronic diseases, marital status, pre-retirement occupation, per capita monthly household income, smoking, drinking, three meals a day, physical exercise, self-rated health, and social capital. The results indicated that all these variables were statistically significant ($P < 0.05$). Detailed results are presented in Table 2.

Table 2: Univariate Analysis of Frailty

Variable		*Non-Frail Group*	*Frail Group*	*Statistic*
Gender	*Male*	*256*	*149*	*χ^2=6.374**
	Female	*245*	*203*	
Age		*68.19±5.69*	*71.74±6.30*	*t=-8.433***
Place of Residence	*Rural*	*198*	*214*	*χ^2=37.42***
	Urban	*303*	*138*	
Chronic Diseases	*0*	*73*	*193*	*χ^2=36.93***

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	1	*235*	*115*	
	>2kinds	*193*	*209*	
Education	*Illiterate*	*77*	*105*	$\chi^2=41.21^{**}$
	Primary School	*227*	*167*	
	Junior High School	*109*	*48*	
	Technical Secondary/High School	*74*	*22*	
	College and Above	*14*	*10*	
Living Situation	*Non-Single*	*470*	*276*	$\chi^2=44.71^{**}$
	Single	*31*	*76*	
Marital Status	*Married*	*434*	*247*	$\chi^2=34.78^{**}$
	Single/Divorced/Widowed	*67*	*105*	
Pre-Retirement Occupation	*Mental Work*	*90*	*35*	$\chi^2=28.04^{**}$
	Physical Work	*280*	*259*	
	both	*131*	*58*	
Monthly Household Income Per Capita	*≤1000*	*9*	*35*	$\chi^2=31.69^{**}$
	1001-2999	*89*	*75*	
	3000-4999	*212*	*127*	
	>5000	*191*	*115*	
Smoking Status	*Non-Smoker/Former Smoker*	*387*	*297*	$\chi^2=6.615^{*}$
	Smoker	*114*	*55*	
Drinking Status	*Non-Drinker/Former Drinker*	*294*	*252*	$\chi^2=14.95^{**}$
	Drinker	*207*	*100*	
Meal Regularity	*Regular*	*480*	*323*	$\chi^2=6.14^{*}$
	Irregular	*21*	*29*	
Sleep Duration	*<4h/d*	*11*	*19*	$\chi^2=16.04^{**}$
	4-6h/d	*117*	*111*	
	6-8h/d	*294*	*167*	
	>8h/d	*79*	*55*	
Physical Exercise	*Never*	*36*	*55*	$\chi^2=26.04^{**}$

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	Occasionally	*197*	*162*	
	Regularly	*268*	*135*	
Self-Rated Health	*Self-Rated Health*	*126*	*46*	*χ^2=81.79a***
	Healthy	*336*	*198*	
	Basically Healthy	*38*	*103*	
	Unhealthy but Self-Sufficient	*1*	*5*	
Social Capital		*19.94±2.11*	*18.33±2.24*	*t=10.67***

PS:*:P<0.05,**:P<0.001

3.4 Correlation between Capital and Frailty

As shown in Table 3, the results indicate that the Pearson correlation coefficient between frailty and social capital is -0.428, with a P-value < 0.01, demonstrating statistical significance. This suggests a significant negative correlation between frailty and social capital, with the social network dimension having the highest correlation coefficient with frailty.

Table 3: Correlation Analysis between Frailty and Scores of Social Capital and its Dimensions

	Values	*Social Participation*	*Social Network*	*Social capital*	*Physical Frailty*	*Psychological Frailty*	*Social Frailty*	*Frailty*
Values	*1*							
Social Participation	*0.096***	*1*						
Social Network	*0.322***	*0.231***	*1*					
Social capital	*0.641***	*0.550***	*0.851***	*1*				
Physical Frailty	*-0.154***	*-.222***	*-0.247***	*-0.300***	*1*			
Psychological Frailty	*-0.297***	*-0.126***	*-0.333***	*-0.378***	*0.244***	*1*		
Social Frailty	*-0.179***	*-.075**	*-0.106***	*-0.167***	*0.109***	*0.191***	*1*	
Frailty	*-0.288***	*-0.232***	*-0.358***	*-0.428***	*0.840***	*0.705***	*0.346***	*1*

PS:*:P<0.05,**:P<0.001

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3.5 Logistic Regression Analysis of Social Capital and Frailty

Table 4: Variable Assignment Situation

Variable	*Assignment Method*
Gender	*1=Male, 2=Female*
Residence	*1=Rural, 2=Urban*
Pre-retirement Occupation	*1=Mental Work, 2=Physical Work, 3=both*
Monthly Household Income per Capita	*1=<1000 RMB, 2=1001-2999 RMB, 3=3000-4999 RMB, 4=>5000 RMB*
Smoking	*1=Non-smoker (Quit smoking, Never smoked), 2=Smoker*
Drinking	*1=Non-drinker (Quit drinking, Never drank), 2=Drinker*
Regular Meals	*1=Yes, 2=No*
Chronic Diseases	*1=0, 2=1 type, 3=2 or more types*
Sleep Duration	*1=<4 hours/day, 2=4-6 hours/day, 3=6-8 hours/day, 4=>8 hours/day*
Physical Exercise	*1=Never, 2=Occasionally (<3 times/week), 3=Regularly (≥3 times/week)*
Living Alone	*0=Not living alone, 1=Living alone*
Self-rated Health	*1=Healthy, 2=Basically healthy, 3=Unhealthy but self-sufficient, 4=Unhealthy and not self-sufficient*
Social Capital	*Original values entered*
Frailty Status	*0=Not frail, 1=Frail*

A binary logistic regression analysis was conducted to explore the impact of social capital on frailty. Individual characteristics that were statistically significant factors for frailty were included as control variables, with frailty as the dependent variable. The results indicate a significant negative correlation between social capital and frailty (OR=0.796, P<0.001). See Table 4 and Table 5 for details.

Table 5: Logistic Regression Analysis of Frailty

	B	*SE*	*Waldχ^2*	*P*	*OR*
Age	*0.083*	*0.015*	*30.033*	*<0.001*	*1.086*
Residence					*1*
Rural					
Urban	*-0.905*	*0.188*	*23.183*	*<0.001*	*0.404*
Drinking					
Non-drinker					*1*
Drinker	*-0.724*	*0.215*	*11.31*	*0.001*	*0.485*
Living Alone					
Not living alone					*1*

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living alone	*1.401*	*0.298*	*22.151*	*<0.001*	*4.058*
Social Capital	*-0.228*	*0.043*	*28.757*	*<0.001*	*0.796*
Self-rated Health			*25.682*	*<0.001*	
Healthy					*1*
Basically healthy	*0.051*	*0.232*	*0.049*	*0.825*	*1.053*
Unhealthy but self-sufficient	*1.216*	*0.313*	*15.133*	*<0.001*	*3.374*
Unhealthy and not self-sufficient	*2.437*	*1.216*	*4.016*	*0.045*	*11.433*
Constant	*-0.54*	*1.56*	*0.12*	*0.729*	*0.583*

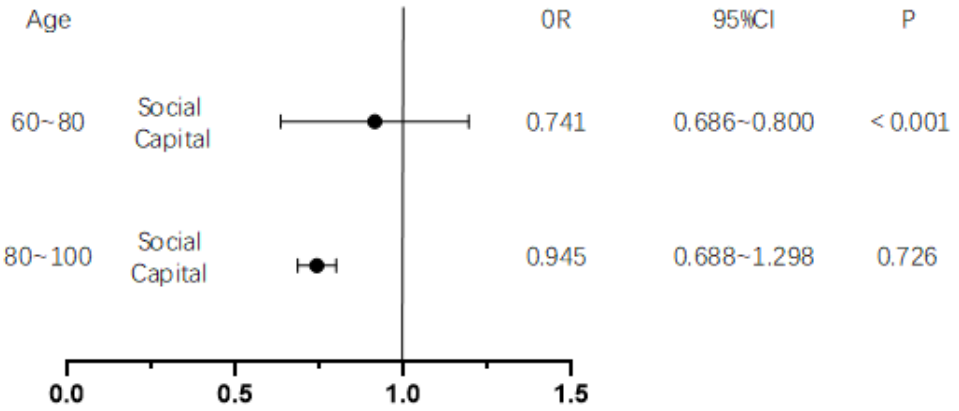

Figure 1: Binary logistics regression analysis after age stratification

3.6 Logistic Regression Analysis Results on Age and Frailty

Based on the results of the logistic regression analysis, age is identified as an influencing factor for frailty. Age groups were divided into 60-80 years and 80-100 years. After adjusting for place of residence, living conditions, drinking habits, and self-rated health, the results indicate that in the 60-80 age group, social capital acts as a protective factor against frailty; higher social capital scores are associated with a lower likelihood of frailty. However, in the 80-100 age group, the difference was not statistically significant. See Figure 1 for details.

4. Discussion

4.1 Current Status of Frailty and Social Capital among the Elderly in Zhejiang Province

This study shows that the frailty score in the region is 4.48±2.42, with 41.3% of the 853 elderly participants experiencing frailty. This prevalence is higher than that reported by Xia Weitao[14] (28.5%), which can be attributed to the higher proportion of elderly individuals with chronic diseases in our study (88.2%) compared to Xia Weitao's study (50%). Chronic diseases cause varying degrees of physiological and psychological distress in the elderly, exacerbating the occurrence of frailty[15]. The prevalence in our study is also higher than that reported in Liao Chunxia's meta-analysis[16] (12.7%), which might be due to the different frailty scales used in the included studies. The Fried Frailty Phenotype (FP) is a unidimensional scale assessing only the physical aspect of frailty, whereas the Tilburg Frailty Indicator (TFI) is a multidimensional scale that comprehensively evaluates physical, psychological, and social aspects of frailty[17]. However, the prevalence in our study is lower than that

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reported by Li Yang[18] (49%) and Lu Mengqian[15] (47.14%). This discrepancy might be due to the younger average age of the elderly in our study. As age increases, the decline in bodily functions and the worsening of cognitive impairments contribute to higher frailty levels in both physical and psychological domains[18].

The social capital score in our study is 19.28±2.30, higher than the score reported by Wang Xiaolei[19] (17.66±1.53), which involved elderly individuals solely from rural areas. In our study, 49.1% of the participants were classified as having high social capital, a proportion higher than that reported by Lin Na[12]. This difference may also be due to a higher proportion of rural elderly individuals (53.02%) in Lin Na's study. Elderly individuals living in urban areas have better access to social support networks[12].

4.2 Correlation Analysis Between Social Capital and Frailty

The results of this study indicate that the social network dimension of social capital is most closely related to frailty, suggesting that social capital can have a protective effect against frailty. This finding is consistent with the results of studies by Chinese scholar Hu Xiuling[20] and South Korean researchers[21].

On one hand, social capital impacts the mental health of the elderly. Research has shown that social networks significantly affect the mental health of older adults, correlating with their levels of loneliness and depression[22]. Souto's study[23] highlighted that social support obtained through social networks is a crucial factor in preventing and mitigating depression. High social capital facilitates the establishment of social support networks, providing emotional support through consultation and information exchange, which positively influences mental health. This aligns with findings from Chinese scholars[24].

On the other hand, social capital positively influences health behaviors. It enables elderly individuals to access more health information, actively participate in health activities, and engage in social participation, which helps them utilize community resources to address health challenges, thereby reducing the occurrence of frailty[25]. Older adults with richer social networks, such as those in diverse social networks, tend to participate in health-promoting activities. Those with high social participation and family support are more likely to use preventive health services, such as medical check-ups[26,27]. Conversely, elderly individuals with limited social networks are more prone to engage in health-damaging behaviors, which can spread through social networks, including smoking and drinking[28].Additionally, Japanese researchers found that social capital plays a significant role in reversing frailty[29]. Enhancing social capital promotes social participation and a sense of belonging among older adults. Participation in community activities and volunteer services can bring self-esteem and a sense of value to the elderly, helping to delay and reverse the frailty process. Social capital has a positive impact on the health of the elderly through social networks, intimate social connections, and active social participation. Those with high social capital have more reliable social networks, which provide substantial support and assistance in facing problems and challenges.

The decline in the reserve capacity of the individual organism of the elderly is closely related to ageing, leading to a decrease in their ability to resist adverse external stimuli, and therefore they are more prone to debility[30]. This finding is consistent with previous similar studies[18,31]. In this study, social capital only played a protective role against frailty in the 60-80 age group. Elderly individuals over 80 face greater health challenges and rely more on medical resources, reducing the impact of social capital on frailty. This could also be due to the smaller sample size of individuals over 80 in this study.

5. Conclusion

In summary, the frailty situation among the elderly in Zhejiang Province is relatively severe, and there is a negative correlation between social capital and frailty, with social networks being the most closely related dimension. Community healthcare professionals should actively conduct community activities and other interventions to expand the social networks of the elderly, promote their social participation, and enhance their social capital, thereby delaying the progression of frailty. Further studies with larger sample sizes are needed to clarify how social capital affects frailty among elderly individuals with different characteristics, providing a basis for subsequent intervention measures.

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