



# Does Social Capital Promote Health?

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## Abstract

The determinants of health are influenced by genetics, lifestyle, social environment, medical conditions, etc. As an informal system, social capital plays an increasingly recognized role in individual health. The purpose of this paper is to discuss the direct and indirect effects of social capital on individual health in China. Using cross-sectional data from the China Family Panel Studies 2016, this paper explores the effects of cognitive and structural social capital on individual health from a micro perspective. The results show that both types of social capital have significant positive effects on individual health, and this effect remains after endogeneity is considered. The two types of social capital show obvious heterogeneity in age samples, urban and rural samples and north–south samples. In addition, the mechanism analysis shows that the health promotion effects of the two types of social capital are mainly derived from the effects of informal finance and access to medical resources. Based on the above findings, this paper puts forward policy recommendations.

**Keywords** Cognitive social capital · Structural social capital · Individual health · Mechanism analysis

## 1 Introduction

At present, the public crisis triggered by the COVID-19 pandemic continues to spread around the world, posing a serious threat to people's lives, safety and health. As a result, health problems have become an acute focus of concern for all countries in the world. Since health has always been regarded as an important factor that determines the economic growth and development level of a country research related to public health is extensive

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and deep. Since health is an important component of human capital and national soft power, modern economics has increasingly focused on analysing the factors and mechanisms that influence health by using micro data. From a practical point of view, with the economic development of various countries, public awareness of health issues has been enhanced, which is reflected in the increasing proportions of health consumption expenditure in total personal consumption expenditure and of total health care expenditure in the GDP of various countries. In 2019, China's total spending on health care reached 6.519.5 billion yuan, of which 26.7% was spent on government health care, 44.9% on social health care, and 28.4% on private health care, together accounting for 6.6% of GDP.

In China, the cultural tradition of social relations and networks has always been emphasized, which gives social capital, as an informal system, an important role in optimizing resource allocation (Bian & Qiu, 2000) and improving individual welfare (Liu & Zhou, 2004; Zhao & Wang, 2002). China has a unique urban–rural dual system. There are great differences in income levels and living environments among urban and rural residents. The formation of social capital depends on one's social background, and the social capital developed under different social backgrounds has different forms and functions (Lei, 2019). Therefore, there may be differences in the deployment of urban and rural social capital. At the same time, economic development in and the history and culture of the northern and southern regions (Pan et al., 2017; Sun & Xu, 2020) also have obvious differences, and social capital in the northern and southern regions may have a heterogeneous influence. In regards to age, considering the degree of individual activity and the time that it takes to accumulate social capital, we hypothesize that the youth period is a time of growth of social capital, that middle age is characterized by stable social capital levels, that old age is characterized by declines in social capital, and that the impact of social capital is heterogeneous by age level. Urban–rural, north–south and age-based heterogeneity in the impact of social capital is further discussed in a later section.

Some scholars have pointed out that social capital and health level are mutually causal (Howley, 2015; Yue & Liang, 2020), resulting in inconsistencies in the estimation of model parameters. In this paper, the instrumental variable method is used to solve the endogeneity problem. Instrumental variables are highly correlated with endogenous variables but independent of the error term, allowing a consistent estimate to be obtained. For quite a long time in the future, China will continue to face public health challenges. With the deepening of globalization, the prevention and control of public crises such as those resulting from emerging global diseases has become increasingly difficult. To improve the health of the population, the impact of social capital on individual health and its effect mechanism need to be discussed in detail with consideration of differences in economic and cultural factors.

The structure of this paper is as follows: Sect. 2 offers the literature review and theoretical hypotheses, Sect. 3 discusses variable selection and the model setting, Sect. 4 evaluates the impact of social capital on health, Sect. 5 provides the mechanism analysis, Sect. 6 presents the endogeneity analysis, and the last part offers the research conclusions and policy recommendations.

## 2 Literature Review and Research Hypotheses

### 2.1 Definitions of Cognitive and Structural Social Capital

Sociologists, economists, political scientists, managers and even historians have used the concept of social capital to explain socioeconomic phenomena. In the past 20 years, it has been one of the most prominent and controversial concepts and theories in the social sciences. This debate has mainly been caused by the inconsistency in how the concept is defined. Although there are many controversies, scholars generally agree that social capital is instantiated in social networks (Carpiano & Fitterer, 2014; Putnam, 2000; Woolcock, 1998), reciprocity (Mazelis 2015) and trust (Song & Feng, 2019). Social capital as defined by most scholars can be summarized as either structural social capital or cognitive social capital. Structural social capital refers to the externally observable behaviours and modes of participation of network participants and specifically involves social networks, civic activity (Nyqvist et al., 2012), organization membership (Agampodi et al., 2015) and so on. Cognitive social capital refers to people's perception of the level of interpersonal trust within a group and reciprocal norms. In terms of measurement of social capital, in empirical analysis, variables to measure structural social capital include social tie establishment and frequency of interaction (Levin et al., 2016), network size and diversity (Lowik et al., 2016), social ties (Ingold, 2017), information channel and moral infrastructure (Bharati et al., 2014) and centrality (Castro & Roldan, 2013), etc. The variables that measure cognitive social capital include shared goals and shared culture (García-Villaverde et al., 2018), the shared language, codes and narratives (Lefebvre et al., 2016), trust (Whiteley, 2000; Rouxel et al., 2015) and so on. Conceptually, there are two differences between the two types of capital. First, structural social capital is more formal than cognitive social capital. Second, forms of structural social capital, such as group institutions, exist objectively and are easy to measure, while cognitive social capital involves more abstract concepts and subjective feelings.

Structural and cognitive social capital both have important theoretical and practical significance in China. Traditional Chinese society is a typical acquaintance society with a differential-pattern type of social structure built on the basis of blood relationships, geography and kinship. People who are related by blood or are from the same place have higher levels of mutual trust, engage in emotional communication and information exchange with the facilitation of social capital, and acquiesce to each other's reciprocal rights and obligations. Cultural rites are an important part of Chinese society, ranging from dining etiquette to various etiquette schemes such as seniority etiquette. Etiquette establishes the basic pattern of structural social capital, reflects the position of an individual in the social network, and determines relationship rights and obligations at the organizational level. These societal features are highly consistent with structural and cognitive social capital, which further indicates that it is feasible and meaningful to further study these two types of social capital in China.

### 2.2 Social Capital and Health

According to the WHO, health refers to "personal physical health, mental health, good social adaptation and moral health"; that is, good health refers to the absence of physical or functional abnormalities, subjective discomfort, and socially unacceptable behaviour. Social

capital has been empirically linked to both reduced mortality (Borgonovi et al., 2021; Jong et al., 2017; Riumallo-Herl et al., 2014) and increased self-rated health (Kim & Cho, 2016; Mayer, 2017; Lu & Zhang, 2019). Social capital has also been linked to various health-related behaviours, such as smoking, drinking, leisure-time physical activity and dietary habits (Timokolja & Bart, 2015; Stewart et al., 2017; Kang et al., 2018; Sakai-Bizmark et al., 2020) and to the prevalence of various diseases, such as cancer (Shelton et al., 2016), heart disease (Fang et al., 2017), HIV (Afzali et al., 2015), depression (Lee et al., 2019) and COVID-19 (Pitas & Ehmer, 2020).

Empirical studies in China mostly focus on the health of vulnerable groups such as the elderly, migrant workers and rural groups. Huang et al. (2015) find that social capital has a direct impact on improving the physical, psychological and social health of the elderly, and has an indirect impact through the mediating variable of lifestyle. The research of Mi et al. (2016) shows that social capital of migrant workers has a significant health-promoting effect, and cognitive social capital has a stronger health-promoting effect than structural social capital. The study of Jiang and Wang (2020) finds that connected social capital can promote the physical and mental health of the poor. In terms of heterogeneity analysis, scholars conduct studies from the perspectives of urban and rural areas, gender and age, etc. (Jiang & Kang, 2019; Mi et al., 2016; Zhang & Lu, 2019). Due to the differences in economic development between the north and the south of China, empirical studies on the heterogeneity between the north and the south need to be enriched.

Some scholars have analyzed the mechanism by which social capital influences health. The mechanisms by which social capital affects health are not yet fully understood. Kawachi and Berkman (2000) discuss four plausible pathways, by which social capital exerts a contextual effect on individual health, including diffusion of knowledge on health promotion, maintenance of healthy behavioral norms through informal social control, promotion of access to local services and amenities, and psychological processes that provide affective support and mutual respect. Han (2013) believes that social networks exert influence on health mainly through three aspects of social support, including emotional support, tool support and information support. Huang et al. (2015) find that social capital influences health level through lifestyle and economic level. The research of Lu et al. (2018) shows that medical treatment, health care and human capital are important paths by which social capital influences health. Paul et al. (2019) argue that many mechanisms link social capital to health, including shared access to food and nutritional behaviors, social status and race.

From the review above we can conclude that, although there has been much discussion about the mechanisms by which social capital influences health, there are few researches on the influence mechanism of cognitive social capital and structural social capital. And the mediating variables in the existing studies are mostly measured by a single dimension, which has certain limitations. In addition, few studies have considered north–south samples in heterogeneity analysis. Thus north and south regions are included in the heterogeneity analysis, and the mediating variables are constructed by integrating multiple dimensions to explore the influence mechanism of cognitive social capital and structural social capital on health.

### 3 Research Hypotheses

In recent years, the number of studies aiming to investigate the relationship between social capital and SRH has increased (He & Meng, 2015; Meng & Chen, 2014; Nyqvist et al., 2014). Some studies provide evidence on the positive correlation between social

capital and self-rated health at both individual and collective levels, among which trust has always been the core of most scholars' studies (Moore & Kawachi, 2017). Kawachi et al. (2018) find that family support and neighborhood trust are important correlates of self-rated health in adolescents. Pan and Wu (2020) focus on the results of age heterogeneity in the elderly and find that there is no significant relationship between cognitive social capital and self-rated health existed in the young-old group, and trust exhibits a significant correlation with self-rated health in the old-old group. A community-based study of Mayer et al. (2020) finds that trust in supervisors improves self-reported health. Research on structural social capital has reached a similar conclusion. The relationships between community-based structural social capital, family social capital and self-rated health are statistically significant, whereas the relationship between community-based cognitive social capital and self-rated health is statistically nonsignificant (Lu et al., 2021). Younsi and Chakroun (2017) shows that high levels of social participation can generate better health outcomes for individual and community health.

Therefore, we propose Hypothesis 1: Structural social capital and cognitive social capital can promote health. However, through what channels do the two types of social capital affect health?

In China, borrowing through nonfinancial institutions is called informal borrowing. This form of financing plays an economic role mainly because of the information advantages, frequent contact between lenders and borrowers, low financing threshold, flexible collateral (Li et al., 2016) and low transaction costs that characterize it (Nie, 2012). The studies on cognitive social capital and informal finance find that creditors with a higher level of social trust are more willing to provide relationship financing and that the influence of social trust on informal financing is mainly concentrated in rural rather than urban areas (Ding & Dong, 2020). The type of trust has a heterogeneous effect on the type of financing, general trust has a significant positive effect on formal household borrowing, while special trust plays a major role in informal channel selection (Chai & Ye, 2019). The researches on structural social capital and informal financing find that social network has a significant promoting effect on the possibility of obtaining informal loans (Dai & He, 2018), and social networks seem to have a greater influence on financing behavior of formal financial institutions than financing behavior through informal channels (Hu & Chen, 2012). Yan and Liu (2015) further confirm that family social network maintenance and "relationship" can help to improve the dilemma of family credit constraints and improve the borrowing capacity of farmers, especially formal financial credit. However, family social network maintenance has a certain "threshold" effect on households' private borrowing behavior. The two types of social capital have different effects on informal financing. With the expansion of financing scope, the role of social network in reducing financing risk is weakened, while the incentive and constraint functions of social norms and trust are more conducive to reducing financing risk (Lin & Wang, 2018). Structural social capital plays a greater role in informal financing, while cognitive social capital plays a promoting role in both formal and informal financing (Qin et al., 2019).

Loans obtained through the two types of social capital are a component of current income, and an increase in income can significantly improve health (Grossman, 1972; Miething & Yngwe, 2014). Miething and Yngwe (2014) suggest that income changes and the time dimension of income are important for self-rated health, the effects of economic factors on health accumulate over time.

Therefore, Hypothesis 2 is proposed: Cognitive and structural social capital influence health by facilitating access to borrowing.

In the Chinese context, people with more structural and cognitive social capital are more likely to seek help from others to obtain economic support and high-quality medical resources when they are ill. In other words, the allocation of medical resources in China is not completely dependent on the market mechanism, and human relationships still strongly intervene in this allocation (Zhou et al., 2014; Liu & Wang, 2017). There is a significant relationship between social capital and health care behavior, especially in health care expenditure and health insurance. In the studies of cognitive social capital, social interaction and social trust have positive effects on residents' medical insurance participation behavior (Liu & Wu, 2019). Social interaction can provide a channel for residents to acquire knowledge of medical insurance, contribute to the improvement of residents' subjective satisfaction with medical insurance, and produce a significant "follow-up" effect. Social trust is conducive to promoting information exchange and cooperation among different groups and improving residents' expectation of medical insurance returns. For structural social capital, social network relationships can significantly restrain family medical expenditure and reduce medical risks (Xiao & Li, 2019). The research of Fu and Kan (2017) shows that with the development of economy, the effect of social network on rural medical risks will gradually weaken. In addition, the stronger the social network, the more likely residents are to buy medical insurance. Lei (2019) believes that although social capital has a promoting effect on the participation of all residents in medical insurance, the influences of social capital are different, and the influences of social capital on insurance participation behavior from high to low are social trust, social norm and social network.

Medical resources can directly improve health (Corman et al., 2018; Pourreza et al., 2017; Saez et al., 2020). Medical insurance can reduce the expenditure of medical insurance and improve the utilization of medical services and health, especially for the poor population, secondary education level population and the elderly population's health. Moreover, people without access to health care have poorer self-reported health (Molly et al., 2017), participating in health insurance can reduce medical costs and improve self-rated health (Wu et al., 2016).

Therefore, Hypothesis 3 is proposed: Cognitive and structural social capital influence health by facilitating access to medical resources.

## 4 Data and Variables

The data used in this paper are from the China Family Panel Studies (CFPS). This database covers 25 provinces (autonomous regions and municipalities) of China (except Ningxia, Hainan, Qinghai, Xinjiang, Tibet, Inner Mongolia, and Hong Kong, Macao and Taiwan), including 95% of the national population, so CFPS samples can be regarded as nationally representative. CFPS questionnaire types include village, family, adult and child questionnaires, among which the village questionnaire mainly reflects the living environment of individual families. The family questionnaire covers living conditions, social interactions, housing, household income and expenditure, assets, activities and production. Both the adult and child questionnaires are individual questionnaires that survey social relationships and health, work, education, and financial status and so on. In this paper, data from the family and adult questionnaires for 2016 are combined and matched to obtain effective information. To study the effect of social capital on health, the explanatory variable selected in this paper is self-rated health (Finkelstein et al., 2012; Zhou et al., 2014), measured with the question "What do you think of your health?" In the questionnaire,

interviewees could specify their own physical condition as "very poor", "poor", "average", "good" or "very good", with corresponding values of 1–5. Based on the literature (Pan et al., 2013; Zhou et al., 2014), in this paper, individual and family variables are added as control variables. Individual variables include age, age squared, gender, marriage, education, and smoking and exercise habits, and family variables control for household fuel type, water source and income. Since before the age of 18, personal habits, resources and social networks are restricted by objective factors, the research population of this paper is residents over age 18.

Cognitive social capital is measured by gift income (Zhou et al., 2014). Although the trust component is one of the most commonly used measures of social capital (Whiteley, 2000; Zhang & Ke, 2002; Rouxel et al., 2015), we use gift income for two reasons. First, Chinese society attaches great importance to human relations, with gifts given during traditional festivals, birthdays, weddings and funerals as an important way to connect and maintain relationships. The amount of the gift is determined by the relationship: the closer the relationship is, the greater the amount of the gift, and the person who receives the gift carries an obligation to return the gift in the future under corresponding circumstances, consistent with the reciprocity characteristic of cognitive social capital. Second, trust is a subjective feeling, but gift income is a concrete amount that can measure cognitive social capital more accurately. Common indicators used to measure structural social capital include organization membership, social activities and social participation (Agampodi et al., 2015; De Silva et al., 2007; Nyqvist et al., 2014). This paper uses organization membership because in the Chinese context, it can reflect an individual's social network position. If the respondent is a member of the organization, the variable takes value 1; otherwise, it takes 0. Finally, a dummy variable is added to capture provincial fixed effects. Variable definitions and descriptive statistics are shown in Table 1.

As shown in Table 1, urban residents account for 46% and rural residents for 54% of the sample. Respondents' overall health is between average and good. However, there is a large gap between the gift income and family income of respondents, which reflects differences in their social capital and resources.

## 5 Empirical Strategy

### 5.1 Model Setting

In terms of the estimation method, since individual health is measured by ordered discrete variables, strictly speaking, ordered probit or ordered logit models should be used for estimation. However, studies have shown that the signs and significance of regression coefficients obtained by using ordered probit or ordered logit estimation methods are consistent with those obtained by using OLS estimation methods (Ferrer-i-Carbonell et al 2004; Angrist & Pischke, 2008; Knight & Gunatilaka, 2010). Given that OLS estimation results are more intuitive and easier to explain, this paper adopts the OLS estimation method; the model is set as follows:

$$Srh_{icj} = \alpha + \beta S_{icj} + \theta X_{icj} + \text{prov}_j + \mu_{icj}$$

where  $i$  represents the individual,  $c$  is the city where the individual lives,  $J$  is the province,  $Srh_{icj}$  measures individual health in city  $C$  of province  $j$ ,  $S_{icj}$  is the measure of individual

**Table 1** Descriptive statistics

Variable	Definition	Observations	Mean	SD	Min	Max
Health	Self-rated health	36,196	2.956	1.237	1	5
Cognitive social capital	Log of gift income	33,314	7.889	1.088	1.386	12.766
Structural social capital	Organization membership	36,050	0.280	0.449	0	1
Marriage	Married = 1	36,048	0.850	0.357	0	1
Urban	Urban area = 1	35,535	0.466	0.499	0	1
Gender	Male = 1	35,990	0.499	0.500	0	1
Age	Respondents over 18 years of age	35,154	46.867	17.215	18	104
Age squared	Square of the age of respondents over 18	35,154	2436.078	1725.964	324	10,816
Education1	High school education or above = 1	33,700	0.205	0.404	0	1
Education2	College education or above = 1	33,700	0.029	0.169	0	1
Smoke	Smoker = 1	32,634	0.278	0.448	0	1
Exercise		36,043	0.472	0.499	0	1
Family income	Log of family income	35,401	10.399	1.301	1.609	16.156
Water	Tap water = 1	36,049	0.715	0.451	0	1

Dummy variables for type of fuel used as are not reported here because they have no practical significance



social capital,  $X_{icj}$  represents the control variables at the individual and family levels, and  $prov_j$  is the province dummy variable.

## 5.2 Baseline Estimates

Table 2 presents the OLS and ordered probit full-sample estimates of the impact of social capital on individual health. As seen from the results in the table, both cognitive and structural social capital have a significant positive correlation with health, though structural social capital plays a greater role. One possible explanation is that structural social capital provides more frequent one-to-many connections and wider social networks than cognitive social capital. The results for the control variables show that men have better health than women, that the relationship between age and health is not linear, that exercise can significantly improve one's health, and that the higher the family income, the better is individual health (because people with higher family income are more able to access and afford medical resources), and that people who use tap water in their daily lives have better health.

## 5.3 Age Subsamples

Personal health worsens with age (Bolin et al., 2003). Compared with young people, middle-aged and elderly people have lower social capital. Therefore, the full sample regression results may be driven by young individuals. In addition, when social capital drops to a certain level, the marginal impact of a unit of social capital may increase, which would be reflected by effect heterogeneity at the age level. For example, Sun et al. (2016) find that the higher the age, the lower is self-rated health and that the health promotion effect of social capital is significantly higher among middle-aged people than among elderly people. In view of the above two points, and based on the age bins of the WHO, this paper divides the respondents into those below 44 years old, those from 45–59 years old and those above 60 years old, which correspond to young, middle-aged and old individuals, respectively. Due to the weak social resources and decision-making ability of respondents under 18 years old, this part of the sample is excluded in this paper. Table 3 shows that for young people, only cognitive social capital has a significant effect on health. For the elderly population, only structural social capital exerts a significant health promotion effect. For the middle-aged group, both cognitive and structural social capital have a positive effect on health, though the effect of structural social capital is more obvious.

## 5.4 Urban and Rural Subsamples

China's urban and rural areas present the characteristics of a dual-structure social network, in which the same economic behaviour may have different impacts in the two types of areas (Sun et al., 2016). To investigate whether there is urban–rural heterogeneity in the impact of social capital on health, this paper divides the whole sample into urban and rural subsamples for further regression analysis. Table 4 reports the results for these subsamples. As a whole, both structural and cognitive social capital significantly promote respondents' health, and within the same sample, structural social capital has a greater impact than cognitive social capital. According to the regression results in columns (1) and (3), cognitive

**Table 2** Baseline results

	Dependent variable: self-rated health			
	OLS		Ordered probit	
	(1)	(2)	(1)	(2)
Cognitive social capital	0.035*** (0.010)		0.033*** (0.009)	
Structural social capital		0.046** (0.021)		0.044** (0.019)
Gender	0.223*** (0.019)	0.215*** (0.019)	0.209*** (0.017)	0.202*** (0.017)
Marriage	0.040 (0.029)	0.073** (0.030)	0.036 (0.027)	0.067** (0.029)
Urban	- 0.019 (0.037)	- 0.017 (0.037)	- 0.015 (0.034)	- 0.013 (0.035)
Age	- 0.051*** (0.003)	- 0.052*** (0.003)	- 0.047*** (0.003)	- 0.047*** (0.003)
Age squared	0.000259*** (0.0000254)	0.000267*** (0.0000288)	0.000233*** (0.0000258)	0.000238*** (0.0000288)
Middle school and above	0.017 (0.014)	0.012 (0.013)	0.013 (0.013)	0.0083 (0.012)
College and above	- 0.096*** (0.022)	- 0.098*** (0.017)	- 0.095*** (0.019)	- 0.097*** (0.016)
Smoke	0.073*** (0.024)	0.083*** (0.024)	0.070*** (0.023)	0.079*** (0.023)
Exercise	0.068*** (0.019)	0.063*** (0.018)	0.067*** (0.019)	0.061*** (0.0170)
Family income	0.023*** (0.006)	0.026*** (0.006)	0.022*** (0.006)	0.025*** (0.006)
Water	0.072** (0.033)	0.065** (0.030)	0.067** (0.031)	0.061** (0.028)
Fuel	- 0.003 (0.002)	- 0.002 (0.002)	- 0.002 (0.002)	- 0.002 (0.002)
Prov. FE	Yes	Yes	Yes	Yes
Observations	27,571	29,794	27,517	29,764

(1) The ordered probit model in the table reports regression coefficients rather than mean marginal effects. (2) The contents in parentheses are standard errors. \*\*\*, \*\*, and \* correspond to 1%, 5%, and 10% confidence levels, respectively. In the estimation, the standard errors are clustered and adjusted at the province level

*Prov. FE* province fixed effects

social capital has a greater positive effect on urban residents than on rural residents. The regression results in columns (2) and (4) show that structural social capital has a positive effect on the health of urban residents only.

**Table 3** Social capital and health: age subsamples

	Dependent variable: self-rated health					
	Under 44 years old		44~59 years old		More than 60 years old	
	(1)	(2)	(3)	(4)	(5)	(6)
Cognitive social capital	0.046*** (0.014)		0.033*** (0.009)		0.018 (0.017)	
Structural social capital		0.012 (0.021)		0.081* (0.041)		0.055* (0.028)
Gender	0.173*** (0.020)	0.179*** (0.0190)	0.309*** (0.030)	0.295*** (0.030)	0.207*** (0.028)	0.183*** (0.028)
Marriage	-0.038 (0.036)	-0.020 (0.036)	-0.024*** (0.003)	0.242* (0.140)	-0.138 (0.162)	0.024 (0.146)
Urban	-0.063** (0.026)	-0.063** (0.026)	0.038 (0.058)	0.032 (0.059)	-0.025 (0.053)	-0.012 (0.051)
Age	-0.017* (0.010)	-0.019 (0.012)	-0.203*** (0.056)	-0.197*** (0.064)	-0.082** (0.035)	-0.122*** (0.030)
Age squared	-0.000208 (0.000145)	-0.000183 (0.000171)	0.00170*** (0.000547)	0.00165** (0.000629)	0.000519** (0.000248)	0.000805*** (0.000214)
Middle school and above	0.003 (0.017)	0.002 (0.017)	0.051 (0.034)	0.042 (0.035)	-0.025 (0.037)	-0.017 (0.038)
College and above	-0.119*** (0.034)	-0.109*** (0.035)	0.059 (0.065)	0.021 (0.074)	0.110 (0.134)	0.043 (0.158)
Smoke	0.025 (0.033)	0.026 (0.031)	0.072** (0.033)	0.079** (0.033)	0.135*** (0.045)	0.156*** (0.048)
Exercise	0.059*** (0.017)	0.061*** (0.015)	0.059 (0.038)	0.046 (0.038)	0.102*** (0.037)	0.0125 (0.045)
Family income	0.004 (0.008)	0.003 (0.009)	0.043*** (0.007)	0.047*** (0.007)	0.031** (0.0113)	0.035*** (0.009)
Water	0.055* (0.029)	0.045 (0.028)	0.039 (0.054)	0.037 (0.053)	0.132*** (0.045)	0.119*** (0.036)
Fuel	-0.005** (0.002)	-0.004* (0.002)	-0.002 (0.003)	-0.001 (0.003)	0.002 (0.007)	0.001 (0.006)
Prov. FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,335	13,123	8499	8987	6683	7654

The contents in parentheses are standard errors. \*\*\*, \*\*, and \* correspond to 1%, 5%, and 10% confidence levels, respectively. In the estimation, the standard errors are clustered and adjusted at the province level  
*Prov. FE* province fixed effects

## 5.5 Northern and Southern Subsamples

In recent years, the economic growth rate of the north has on average been lower than that of the south, resulting in an imbalance between these two regions of China. Based on the climatic characteristics of China, with the Qinling Mountains and Huaihe River as the boundary, there are 16 provinces and regions to the south of this line, including

**Table 4** Social capital and health: urban and rural subsamples

	Dependent variable: self-rated health			
	Rural		Urban	
	(1)	(2)	(3)	(4)
Cognitive social capital	0.031*** (0.011)		0.057*** (0.010)	
Structural social capital		0.033 (0.023)		0.064** (0.028)
Gender	0.255*** (0.024)	0.247*** (0.024)	0.183*** (0.023)	0.176*** (0.020)
Marriage	0.074** (0.030)	0.101*** (0.031)	- 0.011 (0.047)	0.026 (0.041)
Age	- 0.056*** (0.003)	- 0.056*** (0.002)	0.014 (0.023)	- 0.045*** (0.005)
Age squared	0.000294*** (0.0000264)	0.000294*** (0.0000228)	- 0.0628** (0.0245)	0.000222*** (0.0000512)
Middle school and above	0.047 (0.032)	0.039 (0.037)	0.014 (0.023)	0.017 (0.023)
College and above	- 0.160** (0.069)	- 0.169** (0.070)	- 0.063** (0.025)	- 0.057*** (0.021)
Smoke	0.098*** (0.023)	0.105*** (0.023)	0.046 (0.037)	0.063 (0.037)
Exercise	0.054* (0.031)	0.042 (0.029)	0.078*** (0.027)	0.079*** (0.025)
Family income	0.041*** (0.007)	0.045*** (0.008)	0.002 (0.012)	0.006 (0.011)
Water	0.079 (0.048)	0.067 (0.044)	0.067* (0.038)	0.069* (0.035)
Fuel	- 0.003 (0.005)	- 0.003 (0.004)	- 0.002 (0.001)	- 0.001 (0.001)
Prov. FE	Yes	Yes	Yes	Yes
Observations	14,671	15,614	12,846	14,150

The contents in parentheses are standard errors. \*\*\*, \*\*, and \* correspond to 1%, 5%, and 10% confidence levels, respectively. In the estimation, the standard errors are clustered and adjusted at the province level

*Prov. FE* province fixed effects

Chongqing, Sichuan, Jiangsu, Zhejiang, Jiangxi, Hubei, Hunan, Anhui, Fujian, Guangdong, Guangxi, Hainan, Shanghai, Yunnan, Guizhou and Xizang, which together form the southern region. The provinces to the north of this line form the northern region. The differences between the northern and southern regions are directly linked to typical regional differences in social networks (Pan, 2010). Since the CFPS does not include the Hong Kong or Macao Special Administrative Regions or Taiwan Province, this paper divides the remaining 31 provinces into the northern and southern regions and conducts an empirical test.

Table 5 shows that on the whole, cognitive social capital has a significant positive effect on the health of residents in both the north and the south. However, the results in (2) and (4) show that structural social capital plays a positive role in health in southern China only. A possible explanation for this result is that there are differences in trust levels due to different planting patterns in northern and southern China. In northern China, dry farming is practised, and wheat is generally cultivated. In the busy season, labour is often in short supply. Therefore, long-distance labour and employment relationships have been developed,

**Table 5** Social capital and health: Southern and northern subsamples

	Dependent variable: self-rated health			
	South region		North region	
	(1)	(2)	(3)	(4)
Cognitive social capital	0.037** (0.015)		0.032** (0.011)	
Structural social capital		0.072** (0.027)		0.026 (0.029)
Gender	0.205*** (0.030)	0.197*** (0.026)	0.234*** (0.023)	0.227*** (0.025)
Marriage	0.014 (0.044)	0.068 (0.046)	0.049 (0.040)	0.066 (0.039)
Urban	0.077* (0.042)	0.071 (0.044)	- 0.096** (0.042)	- 0.090** (0.042)
Age	- 0.050*** (0.005)	- 0.050*** (0.005)	- 0.050*** (0.003)	- 0.052*** (0.003)
Age squared	0.000272*** (0.0000450)	0.000272*** (0.0000495)	0.000233*** (0.0000262)	0.000250*** (0.0000300)
Middle school and above	0.021 (0.026)	0.014 (0.023)	0.024 (0.015)	0.021 (0.015)
College and above	- 0.095** (0.040)	- 0.107*** (0.032)	- 0.094*** (0.026)	- 0.090*** (0.022)
Smoke	0.095*** (0.030)	0.103*** (0.029)	0.057* (0.032)	0.069* (0.034)
Exercise	0.082*** (0.022)	0.069*** (0.021)	0.062** (0.027)	0.062** (0.026)
Family income	0.028*** (0.009)	0.027** (0.011)	0.019** (0.008)	0.025*** (0.006)
Water	0.061** (0.022)	0.058*** (0.019)	0.090 (0.052)	0.078 (0.048)
Fuel	- 0.005 (0.00293)	- 0.004 (0.00261)	0.0001 (0.001)	0.0003 (0.001)
Prov. FE	Yes	Yes	Yes	Yes
Observations	11,485	12,791	16,032	16,973

The contents in parentheses are standard errors. \*\*\*, \*\*, and \* correspond to 1%, 5%, and 10% confidence levels, respectively. In the estimation, the standard errors are clustered and adjusted at the province level

*Prov. FE* province fixed effects

for example between casual laborers and those whom they help harvest wheat. Southern China has a large proportion of paddy fields, and rice is generally cultivated, requiring cooperation between families and villages within a short radius. Structural social capital reflects social activities within a short radius of respondents, so the positive effect of structural social capital on health is more obvious in the south than in the north.

## 6 Mechanism Analysis

The above research reveals that on the whole, social capital can promote individual health, but there is heterogeneity across urban and rural areas, geographical regions and age groups, indicating that the influence of social capital on health level may operate through multiple channels. This paper examines the direct effect of cognitive and structural social capital on health and the mediating effect of access to borrowing and medical resources by using a three-step regression method.

$$\begin{aligned} \text{Sr}_{h_{icj}} &= \alpha + \beta S_{icj} + \theta X_{icj} + \text{prov}_j + \mu_{icj} \\ \text{Med}_{ict} &= \delta_0 + \delta_1 S_{icj} + \delta_2 X_{icj} + \text{prov}_j + \mu_{icj} \\ \text{Sr}_{h_{icj}} &= \alpha_0 + \alpha_1 S_{icj} + \alpha_2 \text{Med}_{ict} + \alpha_3 X_{icj} + \text{prov}_j + \mu_{icj} \end{aligned}$$

For simple mediation models, indirect effects are equal to mediation effects. In the mediating effect model,  $\beta$  is the total effect of social capital on health level; Med is a mediating variable;  $\delta_1$  is the effect of social capital on the mediating variable;  $\alpha_2$  is the effect of the mediating variables on health after the influence of social capital is controlled for; and  $\alpha_1$  is the direct effect of social capital on health after the influence of the mediating variables is controlled for. The mediating effect is measured by  $\delta_1 \times \alpha_2$ . In the mediating effect test, if  $\delta_1$  and  $\alpha_2$  are significant, it indicates that there is a mediating effect of social capital on health level; otherwise, the bootstrap method should be used for further testing.

The factor analysis method is used to construct comprehensive indicators of credit and medical resource access as mediating variables. The Thomson (1951) regression method is used to calculate the factor score. If the eigenvalue of the factor is greater than 1, then the factor is retained. Weighted according to the variance contribution rate of all retained factors, the comprehensive index of the intermediary variables (Med) is obtained. The calculation formula is as follows:

$$\text{Med} = \frac{1}{\sum_{i=1}^n \lambda_i} \left( \sum_{i=1}^n \lambda_i f_i \right)$$

where  $n$  is the number of retained common factors;  $\lambda_i$  is the variance contribution rate of the  $i$ th factor; and  $f_i$  is the factor score of the  $i$ th factor. Factor scores are calculated by the Thomson regression method. The cumulative variance interpretation rates of the credit and medical indicators are all greater than 60% (66.79% and 61.65%, respectively), which proves that the selected factors are highly representative (see ‘‘Appendix’’, Table 9). A CFA is used to test the unidimensionality. When the informal financing mechanism is analyzed by confirmatory factor analysis, the saturated model is obtained with 0 degrees of freedom, so the index values cannot be calculated. The results of medical resource mechanism show that  $\chi^2_{df}$  is around 5 (Marsh & Hocevar, 1985), CFI and TLI exceed 0.9 (Bentler, 1990), and RMSEA is less than 0.05 (Montazeri et al., 2009), which ensures that all constructs in

the model are one-dimensional. Convergent discriminant and nomological validity are also assessed using the CFA results. The reliability test is also carried out, and the Cronbach's  $\alpha$  value of the latent variables ranges from 0.648 to 0.977, which is greater than 0.6, indicating that the reliability of the scale is good (Taber, 2018). Convergent validity is assessed by examining factor loadings, composite reliability and the AVEs. The results shows that, the standardized factor loadings of the observed variables are between 0.587 and 0.927, which satisfies the standard of more than 0.450 (Tabachnik et al., 2007), showing good convergence validity. In addition, the combined reliability (CR) of lending is lower than the standard value (0.7), and the other observed variables could explain the corresponding potential variables more effectively (Leguina, 2015). The average variation extraction (AVE) of borrowing, lending, objective standard and subjective standard are more than the 0.500 threshold (Fornell & Larcker, 1981), thus confirming the convergent validity of the scale. Discriminant validity is proved if none of the squared correlations between any two constructs in the model exceeded the correspondent AVEs, the square root of AVE value on the diagonal of the correlation coefficient matrix is larger than the relative value of the row and column in which it is located, indicating that the scale has good discriminative validity (Table 6).

Through empirical analysis, we find that there is no interaction between cognitive social capital and structural social capital. Therefore, we only focus on the mediating effect of cognitive social capital and structural social capital respectively.

## 6.1 Borrowing Access Mechanism

Social capital reflects the ability of individuals to mobilize resources, which plays an important role in coping with disease shocks, especially severe disease shocks (Zhou et al., 2014). Loans from friends and family, often interest-free, act as an informal insurance system in the face of an illness shock. The results in Table 7 show that there is a mediating effect of access to borrowing. The direct effect of cognitive social capital is 0.0196, and the mediating effect of borrowing access on health is 0.017, accounting for 42.86% of the total effect. The direct effect of structural social capital is 0.032, and the mediating effect of borrowing access on health is 0.013, accounting for 28.9% of the total effect. Therefore, access to borrowing is an important mechanism by which social capital influences health, which verifies Hypothesis 2.

**Table 6** Borrowing access mechanism

	Borrowing access	Self-rated health	Borrowing access	Self-rated health
Cognitive social capital	0.614***	0.0196***		
Structural social capital			0.374***	0.032***
Borrowing access		0.025**		0.036**
Control variables	Control	Control	Control	Control
Direct effects	0.020	0.032		
Mediating effects	0.015	0.013		
Proportion of mediating effect	42.86%	28.9%		
Observations	25,874	25,874	25,874	25,874

The contents in parentheses are standard errors. \*\*\*, \*\*, and \* correspond to 1%, 5%, and 10% confidence levels, respectively. In the estimation, the standard errors are clustered and adjusted at the province level

**Table 7** Medical access mechanism

	Medi- cal resource access	Self-rated health	Medi- cal resource access	Self-rated health
Cognitive social capital	0.221***	0.023**		
Structural social capital			0.251***	0.036***
Medical resource access		0.054**		0.039***
Control variables	Control	Control	Control	Control
Direct effects	0.023	0.036		
Mediating effects	0.012	0.010		
Proportion of mediating effect	34.28%	21.74%		
Observations	25,874	25,874	25,874	25,874

The contents in parentheses are standard errors. \*\*\*, \*\*, and \* correspond to 1%, 5%, and 10% confidence levels, respectively. In the estimation, the standard errors are clustered and adjusted at the province level

### 6.2 Medical Access Mechanism

In addition to providing access to an informal insurance system, social capital can also improve respondents' health by directly affecting their access to medical resources. The results in Table 8 show that there is a mediating effect of access to medical resources. The direct effect of cognitive social capital is 0.0231, and the mediating effect of access to medical resources on health is 0.0119, accounting for 34.28% of the total effect. The direct effect of structural social capital is 0.036, and the mediating effect of access to medical resources on health is 0.010, accounting for 21.74% of the total effect. This proves that access to medical resources is also an important mechanism by which social capital influences health and verifies Hypothesis 3.

**Table 8** Endogeneity analysis

	Cognitive social capital	Dependent variable: Self-rated health		Structural social capital	Dependent variable: Self-rated health	
		(1) IV-2SLS	(2) OLS		(1) IV-2SLS	(2) OLS
RZ	0.499***					
JG				0.388***		
Cognitive social capital		0.050***	0.035***			
Structural social capital					- 0.711***	0.046**
Stock-Yogo test	5360.15			387.936		
Durbin-Wu-Haus- man test	29.619***			1.560		
Observations	27,517	27,517		29,746	29,746	
Prov. FE	Yes	Yes	Yes	Yes	Yes	Yes

Prov. FE province fixed effects



## 7 Endogeneity Analysis

The benchmark model may suffer from endogeneity, which may affect the estimation results of the model. For example, the more social capital that people have, the better their health may be, and conversely, the healthier they are, the more likely they may be to interact with others and the external environment, thus accumulating more social capital. The usual way to deal with endogeneity is to find suitable instrumental variables and estimate them using two-stage regression. An effective instrumental variable needs to meet two conditions: (1) it must be related to social capital,  $\text{cov}Z_i\text{SC}_i \neq 0$ , and (2) it must not be related to the error term,  $\text{cov}Z_i\varepsilon_i \neq 0$ . This paper introduces the average cognitive social capital (RZ) and average structural social capital ownership rate (JG) of other people in the respondent's community in 2016 as instrumental variables for cognitive social capital and structural social capital, respectively. The reasons for this choice are as follows: first, the social capital of others in the community is closely related to personal social capital; second, the social capital of others in the community is not related to individual health. Since the two tools are selected according to the same logic and their number is equal to the number of endogenous variables, it is not necessary to carry out an overidentification test, only to check whether the instrumental variable is weak. In Table 8, the Stock-Yogo test results are far greater than the critical value of 16.38, indicating that there is no weak instrument problem. In addition, the Durbin-Wu-Hausman test results show that cognitive social capital has endogeneity problems, while structural social capital does not. For structural social capital, the original OLS estimation results are more reliable, while for cognitive social capital, the IV-2SLS results are more reliable.

## 8 Conclusions and Policy Implications

The baseline estimates in this paper indicate that cognitive and structural social capital can significantly promote individual health. According to the age subsample tests, cognitive social capital has a significant positive effect on the young and middle-aged population, while structural social capital has a more significant health promotion effect on the middle- and old-aged population. Therefore, social capital has different degrees of influence among people of different ages, so young people should focus on the cultivation of cognitive social capital. Both kinds of social capital are very important for middle-aged people, and elderly people should focus on the development of structural social capital. In regards to the urban and rural subsamples, cognitive structural capital has a positive and significant effect on health in both urban and rural areas, while structural social capital has a significant effect on health in urban areas only. The government should promote the development of cognitive social capital in urban and rural areas, cultivate trust among residents, improve the public service infrastructure, especially through construction of public facilities with social attributes, and promote the formation of social capital in the form of mutual aid at the community level. For urban areas, structural social capital is also important. Support should be provided for the formation and development of organizations, social support networks should be built in a planned way, and internal and interorganizational communication mechanisms should be improved. The results for the regional subsamples show that cognitive social capital has a significant positive effect on health in both the northern and southern regions,

while structural social capital has a significant impact on health in the southern regions only. Thus, policy needs to be differentiated. In the whole country, a good atmosphere should be created to promote harmonious interpersonal relations and foster cognitive social capital. In the southern region, extra attention should be paid to standardizing and simplifying the process of establishing organizational institutions and encouraging residents to participate in legal and healthy activities.

The mechanism analysis shows that the positive effect of social capital on health comes from access to borrowing and medical resources. Therefore, first, policies should guide the standardization of private lending and borrowing, promote the transformation of financial trust from individual-level to institutional-level trust, and reduce transaction costs and risks. Second, the government should attach importance to the role of medical resources. Taking into account current disease patterns in the population, it should steadily increase the coverage, benefits and compensation level of medical insurance.

We use average cognitive social capital and average structural social capital levels of other people in the respondent's community as instrumental variables and use IV-2SLS to deal with the endogeneity problem in this paper. On the whole, cognitive social capital has a greater impact on health than structural social capital after we address endogeneity. This result shows that informal contacts, which capture the constructs of reciprocity and trust, play a larger role in China, which is also consistent with the custom of Chinese people of seeking help from people whom they think they are close to, rather than seeking help through organizations, when facing difficulties. This finding is consistent with the conclusions of relevant studies (Ju, 2020; Liang & Ju, 2019).

Although we tried our best to improve the research, there are still some limitations. First, due to the limitations of the data in the questionnaire, we can select only certain dimensions of cognitive and structural social capital to represent the whole. Second, other channels through which social capital influences health may not have been identified and verified. Third, due to data limitations, we failed to find other appropriate instrumental variables at the individual level. Fourth, results of reliability tests in CFA and the dimensions of mediating variables need to be improved. Therefore, in future studies, we will use more complete databases to optimize and enrich the dimensions of indicators to make the results more reliable, further optimize our instrumental variables, and explore other channels through which social capital influences health.

## Appendix

See Table 9.

**Table 9** Mediating variables

Mediating variable	Indicators	Standardized factor loading	Reliability	CR <sup>a</sup>	AVE <sup>b</sup>
Informal finance	Borrowing				
	How much financial help, in cash or in kind, have you received from relatives who live in different places?	0.763	0.977	0.879	0.708
	How much financial help has your family received, in cash or in kind, from other people (e.g., friends, colleagues)?	0.743			
	How much does your family owe relatives and friends?	0.734			
Medical resource	Objective standard				
	If your family needs to borrow a large sum of money (for example, to buy a house, to facilitate business turnover, etc.), who would be your first choice to borrow money from?	0.587			
	In addition to banks, relatives and friends, how much money does your family now owe to organizations or individuals (such as private credit institutions, acquaintances, etc.)?	0.755			
	Lending				
Subjective standard	How much do relatives, friends or private lenders owe your family?	0.800	0.648	0.478	0.717
	What is the total value of financial assistance, in cash or in kind, that your family provides to others (e.g., friends, colleagues)?	0.758			
	What level of hospital do you go to when you are sick?	0.972	0.681	0.972	0.945
	Are there any clinics near your community?	0.970			
Subjective standard	How much did your family spend on health care in the past 12 months?	0.542			
	How much does your family pay for commercial insurance?	0.713			
	What do you think of the standard of care at the clinic?	0.866	0.693	0.865	0.763
	How satisfied are you with the clinic conditions?	0.879			
	How serious do you think the medical problem is in China?	0.577			

$\chi^2 = 11.301, df = 2, CFI = 0.998, TLI = 0.993, RMSEA = 0.028$

Combinational reliability<sup>a</sup> =  $(\sum \lambda)^2 / ((\sum \lambda)^2 + \sum \delta)$

Average variation extraction<sup>b</sup> =  $\sum \lambda^2 / n$ , Where  $\lambda$  and  $\delta$  are the factor loading amount and error variation, respectively, and n is the number of measurement indicators

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**Availability of data and material** The datasets used or analysed during the current study are available from the corresponding author on reasonable request.

**Code availability** Data derived from public domain resources.

## Declarations

**Conflict of interest** The authors declare that they have no competing interests.

**Consent for publication** Consent for publication was obtained from all participants.

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