

The Effect of Labor Participation on The Health of Middle-Aged People—An Empirical Analysis From China

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Abstract

Background: China has entered into an aging society and will continue to age rapidly in the future. The middle-aged (45~59 years old) is aging, and the workforce participating in labor is shrinking. Since there is few empirical researches on the relationship between labor participation and the health of middle-aged people, the aim of this study is to study the effect of labor participation on the health of middle-aged people.

Methods: The data of CHARLS in 2015 were adopted. In this study, self-assessed health, chronic diseases and depression were used as health measurement indicators, and the work status was used to measure the labor participation. To control possible endogenousness, our study used Propensity Score Matching to match people who participated in labor and those who did not; Then logit regression analysis was used among matched data to study the association of labor participation with the health of middle-aged people.

Results: The study showed that the self-rated health of middle-aged people with labor participation was 1.3 times higher than those without labor participation. In terms of the probability of suffering from chronic diseases, middle-aged people who participated in labor were 0.6 lower than those who did not participate in labor. In terms of the probability of depression, the middle-aged people who participated in labor were 0.8 times lower than those who did not participate in labor.

Conclusions: The health of middle-aged people participating in labor was obviously better than those who did not participate in labor. Our study provided the evidence for policy making on health promotion, delayed retirement and employment promotion.

1. Background

By the end of 2018, the proportion of the elderly (aged 60 and above) have accounted for 17.88% of the total population of China, and the elderly increased significantly by 3.39% from 2009 to 2018. The rapidly aging means that the social burden in China is increasing dramatically [1]. Meanwhile, the proportion of the middle-aged people aged 45 ~ 59 increased from 21.96% in 2009 to 23.50% in 2018, showing an increase of 1.54%, which is far less than the growth rate of the proportion of the elderly[2]. Labor supply changes with the changes in population structure. The delayed retirement of the middle-aged and elderly (aged 45 and above) have become a public concern, because the huge financial burdens may seriously affect their health once they lost their jobs. Therefore, from the perspective of labor participation, study of effect of labor participation on the health among middle-aged people can not only provides an empirical basis for alleviating the pressure of aging in labor supply, but also formulates relevant realistic evidences on delay retirement and health policies.

How should we define health? Early researchers believed that the health is not disease-free, but the human body has the ability to effectively perform body functions in a specific environment[3]. The World Health Organization (WHO) defined health as a state of complete health of physical, mental and social adaptation, not just the elimination of disease or weakness (WHO, 1948)[4]. Health can be usually measured by some indicators. A number of researchers used Self-Reported Health (SRH) to reflect health [5–8]. Although SRH has subjective defects[9], it is usually adopted as an indicator reflecting the overall health of individuals. Li et al.(2019) reviewed indicators of health measurement, such as SRH, physical disability, or self-reported restricted days, BMI, hemoglobin, grip strength, daily living capacity restriction and specific diseases and concluded that SRH can comprehensively reflect physical health.[10]. At the same time, the mental health problems of middle-aged and elderly people have attracted the attention of specialists. Zhang et al.(2017) used the HSCL (Hopkins Symptoms Checklist) scale to measure mental health, and explored the influencing factors of depression in middle-aged and elderly people(aged 45 and above)[11]. Regarding the influencing factors of health, a lot of scientific researches have been conducted. Yan et al (2012) believed that factors influencing health should include employment status, which can affect health through interaction with gender and marriage[12]. Grossman (1972) believed that health depreciated with age, although this trend of depreciation slowed down with the increase in necessary health investments[13]. Arens (1982) concluded that marriage is a significant protective factor for the death and illness of the elderly, and the protective mechanism had a stronger effect on men than women[14]. Nussbaum (1993) believed that economic resources, certain investment preferences, knowledge of health investment and necessary time were critical for health investment[15]. To our best knowledge, only Stolzenberg (2001)[16] had examined the effect of working hours on the health of individuals and their spouses. The gendered division of labor displayed a vested interest in men. Higher socioeconomic status meant better nutrition, better environment and medical care, which are protective factors for health. In contrast, several studies showed that higher socioeconomic status caused health disadvantage[17]. Yu et al (2010) defined a broad social health capital and a narrow sense of health capital, and measured the impact of education, gender, and regional differences on SAH[18]. Mao et al (2011) further studied the effect of education level on health status, and found that the effect of education status on health showed an inverted-U shape relationship[19]. Empirical researches concluded that participating in various social activities had a positive effect on improving the life satisfaction and well-being of the elderly, especially reducing depression and loneliness[20–25]. Wagstaff et al. (2003) proposed a regression model of health level, and believed that health was affected by the individual's annual income, pension saving, education level and employment status and so on.[26] Previous studies provide a good reference for the selection of dependent variables, core independent variables and control variables.

Many researchers had studied the relationship between labor participation and health, proving an influential relationship. Most researchers in developed countries have studied the impact of health on the labor participation of the elderly, and most believed that adverse health conditions have reduced the labor participation of the elderly. Breslaw et al. (1987) analyzed the health effects on Canadian labor supply for people over 50 years old. They found that for the elderly, unhealthy status reduced the probability of entering the labor market, and reduced pensions or other benefits, which would cause the elderly to enter the labor market again or postpone their retirement age[27]. Maren et al. (2018) found that unemployment was associated with involuntary retirement timing and mental health declined in retirement[28]. Chinese researchers have concluded a lot of empirical research on health and labor supply. Ren et al. (2006) adopted the multi-valued policy effect method and concluded that the health status had a significant impact on the labor participation rate of Chinese workers[29]. Tong et al. (2017) found that health status could affect the labor participative decision-making of the elderly in China[30]. Tian et al. (2010) analyzed the impact of the health status of people aged 45 and over on labor participation, and their results showed that the health status had a significant positive effect on the labor participation of people aged 45 and over, and labor participation was conducive to good health[31]. Wang (2011) concluded that

the impact of residents' health on labor participation was essential[32]. Wei et al. (2013) found that from low-age group or high-age group, the health status significantly affected non-agricultural employment participation[33]. Li et al. (2014) found that hypertension had a significant effect on the labor participation of middle-aged and elderly in urban, but it had no significant effect on rural residents. Urban residents engaged in manual labor had higher requirements for physical health, and if they got sick, they would leave the labor market[34]. Wang et al. (2016) found that improving healthy human capital was conducive to promoting rural residents' labor participation, as well as increasing their agricultural labor time and raising their agricultural labor income. Labor income had no obvious impact on rural residents' labor participation, and the decline in long-term health status had a greater impact on rural residents' labor participation than short-term health shocks[35]. Liu et al. (2012) found that residents' labor participation increased significantly with the improvement of health conditions, [36]. Zhu et al. (2019) analyzed the impact of health on labor supply, and the results showed that the overall health status had a significant impact on the labor supply of the elderly[37].

Researchers mainly focused on the impact of health on labor participation, while the impact of labor participation on health is still in its infancy. At the same time, few studies focused on the effect of labor participation on the health of middle-aged people. This study investigates whether labor participation significantly affects the health of middle-aged people. Based on the conclusions about the relationship between health and labor participation in previous studies, we propose the following research hypotheses:

Hypothesis 1: Labor participation has a positive effect on the SAH of middle-aged people.

Hypothesis 2: Labor participation has a positive effect on the chronic diseases of middle-aged people.

Hypothesis 3: Labor participation has a positive effect on the depression of middle-aged people.

2. Methods

2.1. Data

In this study, we used the 2015 CHARLS data. CHARLS is a set of high-quality micro-data representing households and individuals aged 45 and above in China, to analyze the problem of population aging in China and promote interdisciplinary research on aging. The CHARLS national baseline survey was launched in 2011, covering 150 county-level units, 450 village-level units, and 17,000 of approximately 10,000 households. These samples can be tracked every two to three years in the future, and one year after the survey, the data is open to the academic community[38].

Our study focused on the middle-aged people. According to the WHO's division on age, we defined that the middle-aged people were those of 45~59 years old[39].

2.2. Health Status Measurement

SAH is an indicator used to reflect health status. The CHARLS questionnaire set up two surveys on SAH. Each survey set questions on SAH twice. The first was at the beginning of the survey and the second was at the end of the health survey. The respondent may not be very familiar with the survey at the beginning of the investigation. After asking about many health-related questions, the respondent would have a certain understanding of their own health, so we thought that the second one is more reliable, which is used in our study. In the CHARLS questionnaire, the SAH can be reflected as the following two questions:

Question 1: How would you rate your health status? Would you say your health is very good, good, fair, poor or very poor?

1. Very good
2. Good
3. Fair
4. Poor
5. Very poor

Question 2: Next I have some questions about your health. Would you say your health is excellent, very good, good, fair, or poor?

1. Excellent
2. Very good
3. Good
4. Fair
5. Poor

We defined Excellent, Very good, and Good as 1, and Fair, Poor, and Very poor as 0. We set SAH as 0-1 variable.

Regarding the indicators of suffering from chronic diseases, the CHARLS questionnaire asked the respondent that whether they had a series of chronic diseases diagnosed by doctors, such as hypertension, diabetes, asthma, etc. We defined suffering from chronic disease as 1, and no chronic disease as 0.

The depression scale(CES-D10) was used to measure depression in the CHARLS questionnaire[40]. There was 10 items in the depression scale with 8 negative items and 2 positive items. We used a 4~point rating. Regarding respondent's feelings and behaviors last week, those with less than 1 day was "rarely or not at all", 1~2 days was "not too much", 3~4 days was "sometimes or half the time", 5~7 days was "most of the time", negative statements were positive questions,

and the corresponding scores were: 1 point, 2 points, 3 points, 4 points. The positive statements were just the opposite. The corresponding scores were: 4 points, 3 points, 2 points, 1 point, respectively. The score range of CES-D10 was from 0 to 40. The lower score meant lower depression. 0~20 points indicated no depression, 21~40 points indicated suffering from depression[41]. We defined depression as 1 and no depression as 0.

2.3. Variables

Considering the previous study, we used socioeconomic status, demographic characteristics and living environment as core explanatory variables and control variables[42~44].

1. Independent Variables

The core explanatory variable of this study is labor participation. In the CHARLS questionnaire, the respondent was asked whether he/she had engaged in agricultural production or business activities for more than 10 days in the past year. If the respondent replied less than 10 days, the respondent would be asked whether he worked more than one hour last week. The work status included employment or self-employment, such as civil servants, enterprise employees, self-employment, and help for their own companies without remuneration; while domestic work and volunteer services were excluded. If the respondent replied that he/she wasn't engaged in farming and other work, he/she would be asked whether he/she temporarily stopped working because of temporary leave, sick leave, or receiving on-the-job training. Then the respondent would be asked whether it was more than 6 months. When he/she can return to his/her original job position, he/she also was defined that he currently had a job. In the CHARLS questionnaire, the measurement of this variable was obtained by comprehensive calculation of the following four questions:

Question 1: Did you engage in agricultural work (including farming, forestry, fishing, and husbandry for your own family or others) for more than 10 days in the past year?

Yes

No

Question 2: Did you work for at least one hour last week? We consider any of the following activities to be work: earn a wage, run your own business and unpaid family business work, et.al. Work does not include doing your own housework or doing activities without pay, such as voluntary work.

1.Yes

2.No

Question 3: Do you have a job but are temporarily laid-off, or on sick or other leave, or in-job training?

1.Yes

2.No

Question 4: Do you expect to go back to this job at a definite time in the future or within 6 months?

1.Yes

2.No

According to International Labor Organization (2013) [45], we define the following three types as not participating in labor: (1) not engaged in the past year agricultural production and operation activities; (2) be engaged in other work for less than 1 hour per week; (3) be engaged in temporarily stopped working for various reasons, at the same time, there is no certainty that they will return to their original jobs within six months. We define the participation of labor in the state of work with the exception of the three types.

2. Control Variables

Previous studies showed that economic resources had a positive impact on health[46]. Only with a certain economic strength is it possible to participate in health clubs, obtain adjuvant treatment for quitting smoking and drinking and so on.[47]. Based on previous researches, our study selected individual demographic characteristics (gender, age, marriage and education), social activities, drinking, smoking, health before the age of 15 and family property as control variables. The definition and measurement of specific variables are shown in Table 1.

2.4 Propensity Score Matching Method

The labor participation of middle-aged people may be affected by health factors, some unobserved factors of their own, endogeneity and so on. As the regression model using cross-sectional data may cause data bias and confounding variables, Propensity Score Matching (PSM) was used to match those who participated in labor and those who did not. PSM is aimed to reduce the influence of these biases and confounding variables in our study. In order to explore the relationship between a certain factor (exposure or intervention, hereinafter collectively referred to as treatment factor) and health outcome, we should build a control group for comparison. The purpose of our study is to control the interference of non-treatment factors and highlight the effect of treatment factors (Average Treatment effect on the Treated, ATT). The calculation formula of ATT is as follows:

$$ATT = E[h_{i1}|work_i = 1] - E[h_{i0}|work_i = 1] \quad (1.1)$$

h_{i1} and h_{i0} indicate the health status of those who participated in labor and those who did not. The logit model is generally used to estimate the probability of whether the respondents enter the treatment group, that is, the probability of middle-aged labor participation. The propensity score estimation model is as follows:

$$P(work_i = 1) = \exp(\beta x_i) / [1 + \exp(\beta x_i)] \quad (1.2)$$

PSM includes nearest neighbor matching, radius matching, kernel matching, local linear regression matching, and spline matching. We used three methods of radius matching method, caliper matching method and kernel matching method to match in our study, mainly focusing on the nearest neighbor matching method. The nearest neighbor matching method refers to setting a radius r in advance. If the radius value is smaller, the matching number is fewer.

2.5 Logistic Regression

Logistic regression deals with bivariate dependent variables or multivariate variables. In our study, the dependent variable is a 0-1 binary variable. In order to explore the effect of labor participation on the health of middle-aged people, we combined with the regression equation of health and health level proposed by Wagstaff (2003), and we set the logit model as follows:

$$P(h_i) = f(\alpha + \beta work_i + \gamma x_i) \quad (1.3)$$

h is a binary variable that represents the health status of individual; i represents SAH, chronic diseases and depression. Work status represents labor participation and it is the core explanatory variable in this study. x is the control variable, including gender, age, educational status, etc.

2.6 Statistical Analysis

We defined the middle-aged people who don't participate in labor as a control group (no labor participation = 0), and the middle-aged people who participate in labor as a treatment group (participation labor = 1). Then we matched the two groups to improve the comparability. The descriptive statistics of the variables are shown in Table 2. 4.40% in control group and 24.49% in treatment group of middle-aged people reported that they were healthy. 80.84% of the middle-aged people participated in work, and 19.16% of middle-aged people did not participate in work.

3. Result

3.1. PSM analysis results

In lines with Aladie et al (2004), the Mean Square Error (MSE) can be minimized under normal circumstances in one-to-four matching[48]. We used nearest neighbor matching within caliper with $k=4$ for one-to-four matching estimation, to perform replacement matching and allow ties. Among a total of 4418 observations, 3 observations in the control group (Untreated) were not in the common value range, 920 observations were in the value range, and 7 observations in the treatment group (Treated) were not included. In the value range, 3488 observations were in the value range.

Table 3 showed the matching result. It can be seen that the standardized deviations (% bias) of all variables after matching were mostly less than 10%. From the results of t test before matching, gender, age squared/100, education status, marital status, middle, urban and rural, drinking, smoking variables were statistically significant. After matching, the differences of the four variables of gender, educational status, social activities, and drinking disappeared significantly. It showed that PSM significantly alleviated the self-selection problem. In addition, after matching, the standardized deviations of all variables were greatly reduced.

As Table 4 shows, after matching, the estimated value of ATT is 0.08, and the corresponding t value is 3.70 (>1.96), which is statistically significant. We also used the nearest neighbor matching method, caliper matching method and nuclear matching method to conclude the matching. Table 4 shows the matching results, and the results of the three matching methods all showed that labor participation had a significant impact on the health of middle-aged people. And the matching results were very similar, indicating that the matching results were robust.

3.2. Regression statistical results

We used the matched data for logit regression analysis to analyze the association between labor participation and the health of middle-aged people. We showed the normal standard errors and robust standard errors in Table 5.

From the model 1 in Table 5, the SAH of middle-aged people with labor participation was 1.3 times higher than those without labor participation. In terms of the probability of suffering from chronic diseases, middle-aged people who participated in labor were 0.67 lower than those who did not participate in labor; and in terms of the probability of depression, the middle-aged people who participated in labor were 0.84 times lower than those who did not participate in labor. From the results of Model 2-3 in Table 5, the SAH and chronic diseases of middle-aged people in urban and rural areas were statistically significant, but depression was not statistically significant. According to the results of age-based models 4-6, the SAH, chronic disease and depression in 45-49 years old and 50~54 years old were not statistically significant, while the 55~59 years group was statistically significant.

4. Discussion

Compared to most researchers focused on the labor participation and health of the elderly group, this study focuses on the effect of labor participation on the health of middle-aged people, because this group is more susceptible to policies such as delay retirement.

Our research shows that the health of middle-aged people participating in labor was better than those without participating in labor. Labor participation is the main means for middle-aged people to earn income and increase social communication activities, therefore, it is less likely for them to suffer psychological problems and depression compared to unemployment. It was in lined with the conclusions of Zhang et al.(2017)[49]. The aging society has prompted people to focus more on the health and health policies of the elderly, but ignores the policies of the middle-aged. Based on it, this article is a supplementary study of the relationship between labor participation and health. Our study found that labor participation had a significant impact on the health of middle-aged people. Middle-aged people are a potential group that will develop to the elderly people, and the total supply of labor in an aging society would be relatively reduced. From this perspective, public policies should be paid more attention to the employment security and health promotion of middle-aged people.

Researchers often explored the relationship between labor participation and health of the middle-aged and elderly people. Our study focused on middle-aged and highlighted the middle-aged group. Previous studies focused on the impact of health on labor participation, and this study supplements the impact of labor participation on health, which is also one of the innovations in this article. This article used PSM for matching analysis and then made a logit regression analysis using the matched data, which strongly supported the important discovery that labor participation promoted the health of middle-aged people. The results validated Hypothesis 1, Hypothesis 2 and Hypothesis 3. We found that the regression results were relatively close.

At the same time, we also found that in the age-group model, labor participation in the 55 ~ 59 age group had a significant positive effect on the self-rated health, chronic diseases and depression of middle-aged people, but between 45 ~ 49 years old and 50 ~ 54 years old was no statistical significance. The result showed that age was an important factor. Growing old made the positive effect of labor participation more obvious. It also showed that the appropriate delay in retirement age was beneficial to the health of the elderly. It was consistent with the conclusion drawn by Dong et al. (2016) that retirement had a negative impact on SAH and depression, and it had a more significant impact on women, lower education levels, and people aged 45 ~ 54[50]. It was also consistent with the findings of Lei et al.(2010)[51]. Researchers in developed countries had also conducted a lot of researches on the relationship between retirement and health. Early research found that retirement was not conducive to individual health, and Hurd's research in the United States found that individual's health status deteriorated after retirement[52]. Most western countries put forward an initiative on the retirement age. European countries have delayed their retirement ages since 2000. Taking Germany as an example, starting from January 2012, the legal retirement age of Germans has gradually delayed from 65 to 67. Before 2030, the 67-year-old retirement system will be fully implemented[53]. It shows that labor is an important requirement for health. Grip et al.(2012) also found that retirement reduced the contact between individuals and society, and the resulting depression is not conducive to physical health[54]. Mein et al. (2003) found that for most people, work and work-related activities may be the main daily physical activities, and nearly one-third of individuals would not participate in physical exercise after work[55]. Moderate exercise can reduce the incidence of chronic diseases such as coronary heart disease, diabetes, hypertension, and even alleviate psychological anxiety. If retirement reduces work as well as related physical activity, then retirement is not conducive to individual health. From the result of empirical research on the impact of social activities on health, foreign studies have shown that participation in various social activities can improve the life satisfaction and elderly' well-being, especially reducing depression and loneliness. Research on the effect of labor participation on health is directly related to the determination of retirement age. Unlike many developed countries implemented a flexible retirement system, China implemented a mandatory retirement system[56–57], which may not be appropriate. We suggest that a flexible retirement age policy can be formulated based on job characteristics and individual's need in China. At present, many studies have confirmed that it is feasible to delay the retirement age appropriately. For example, Tan et al. (2016) found that the healthy working ages in China were close to 62 and 58 years old in 2005 and 2010, respectively, which indicated that it would be feasible to delay the retirement age appropriately in China[58].

At the same time, middle-aged people in late-career should be properly protected. Once middle-aged people are unemployed, it is more difficult to return to work for them, and unemployment will cause economic and psychological problems for them. For instance, Maren et al. (2018) concluded that older employees who had returned to work after experiencing a late career had difficulties in new work. Middle-aged people would lose income after they lost their jobs. What is worse, it was difficult to reach the original level of income after reworking. Getting new job skills and other obstacles would have a negative impact on the mental health of the elderly after unemployment[59]. The unemployment of middle-aged people is an important social problem faced by China, and the other countries. The British government has launched the "50-year-old new policy" plan aimed at reducing the unemployment rate of middle-aged people and promoting the re-employment of middle-aged unemployed people since 1999. Good economic and social benefits have been achieved, which also provided important references for China to explore and solve related problems[60].

In this article, we used SAH, chronic diseases and depression as indicators of health measurement to comprehensively reflect the individual's perception of their own health. However, only the three indicators may not fully reflect health, which is a limitation of this article. Regarding the measurement indexes of health, BMI, actual blood pressure value, actual blood glucose value and other objective indexes reflecting physiological health could be introduced in the future.

5. Conclusions

This study focused on middle-aged people in China, and showed that the labor supply of middle-aged people had not been completely released. The health in SAH, chronic diseases and depression of middle-aged people participating in labor was obviously better than those who did not participate in labor. The finding may help provide evidences for social policies and intervention strategies in health promotion and employment promotion in an aging society. At the same time, the study also provided reference for relevant researches on labor participation and health.

Abbreviations

CHARLS China Health and Retirement Longitudinal Study

SAH Self-assessed of Health Status

PSM Propensity Score Matching

ATT Average Treatment effect on the Treated

ATU Average Treatment effect on the Untreated

Declarations

Ethics Approval and Consent to Participate: Ethics approval for the study was granted by the Ethics Review Committee of Peking University, and all the participants provided signed informed consent at the time of participation. The study methodology was carried out in accordance with approved guidelines.

Consent for publication: Not applicable.

Availability of data and materials: The datasets analysed during the current study are available in the CHARLS, [<http://charls.pku.edu.cn/en>].

Conflicts of Interest The authors declare that they have no competing interests.

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Authors' contributions Jian Zhang and Jianmin Gao designed the study. Jian Zhang managed the literature review, conducted the analysis, and wrote the first draft. Dan Li, Wanyue Dong, Chi Shen and Dan Cao helped to draft the manuscript. Wei Yang participated in the design of the study and helped draft the manuscript. All authors contributed to and have approved the final manuscript.

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Tables

Table 1
Definition and measurement of variables

Variable	Variable definition and measurement
<i>Dependent variable</i>	
SAH	0 = No = fair / bad / very bad, 1 = Yes = excellent / very good / good
Chronic diseases	0 = No, 1 = Yes
Depression	0 = No, 1 = Yes
<i>Core explanatory variable</i>	
Labor participation	0 = No, 1 = Yes
<i>Control variable</i>	
Gender	0 = Female, 1 = Male
Age	Age squared / 100
Educational status	0 = junior high school and below, 1 = high school and above
Marital status	0 = Living alone (separated, no longer living together / divorced / widowed / never married), 1 = Living together (married, living together / married, short-term separation / cohabitation)
Urban and rural	0 = rural, 1 = urban
Region	Set the dummy variable with reference to the east
East	Reference group
Middle	0 = East, 1 = Middle
West	0 = East, 1 = West
Social activities	0 = No, 1 = Yes
Drinking	0 = No, 1 = Yes
Smoking	0 = No, 1 = Yes
Health before the age of 15	0 = bad, 1 = good
Family property	The value of household fixed consumer goods is logarithmic

Table 2
Descriptive statistics of variables

Variable	Sample size(N)	Control group (no participation labor = 0)		Treatment group (participation labor = 1)	
		%/M	SD	%/M	SD
<i>Dependent variable</i>					
SAH	9338				
Yes		4.40%		24.49%	
No		14.76%		56.35%	
Chronic diseases	5407				
Yes		8.42%		29.17%	
No		9.01%		53.41%	
Depression	9320				
Yes		6.52%		23.94%	
No		12.59%		56.95%	
<i>Core explanatory variable</i>					
Labor participation	9338	19.16%		80.84%	
<i>Control variable</i>					
Gender	9338				
Male	4472	4.92%		42.97%	
Female	4866	14.24%		37.87%	
Age squared / 100	9338	28.76 (19.16%)	4.44	26.94 (80.84%)	4.48
Education status	8412				
Junior high school and below	6663	15.25%		63.96%	
High school and above	1479	4.15%		13.43%	
Marital status	9338				
Live together	8814	17.59%		76.79%	
Live alone	524	1.56%		4.05%	
Urban and rural	9338				
Urban	3764	11.09%		29.21%	
Rural	5574	8.06%		51.63%	
Region	9338				
East	3150	6.68%		27.05%	
Middle	3299	7.16%		28.18%	
West	2889	5.32%		25.62%	
Social activities	9336				
Yes	5623	11.54%		48.70%	
No	3713	7.62%		32.16%	
Drinking	9332				
Yes	3674	4.43%		34.94%	
No	5658	14.73%		45.90%	
Smoking	9337				
Yes	3775	4.97%		35.46%	
No	5562	14.19%		45.38%	

Variable	Sample size(N)	Control group (no participation labor = 0)		Treatment group (participation labor = 1)	
		%/M	SD	%/M	SD
Health before the age of 15	9230				
Good	6768	14.17%		59.15%	
Bad	2462	4.96%		21.71%	
Family property	5151	8.45 (20.03)	1.67	8.58 (79.97)	1.55

Table 3
Differences in covariates before and after matching

	Before matching				After matching			
	Labor participation	Non labor participation	%Bias	p-value	Labor participation	Non labor participation	%Bias	p-value
Gender	0.520	0.275	51.7	< 0.001	0.519	0.487	6.8	< 0.001
Age squared / 100	27.591	29.055	-34.1	< 0.001	27.604	27.410	4.5	0.056
Education status	0.196	0.247	-12.2	< 0.05	0.197	0.163	8.2	< 0.001
Marital status	0.909	0.876	10.6	< 0.05	0.909	0.898	3.7	0.103
Region								
Middle	0.344	0.390	-9.5	0.010	0.345	0.359	-2.8	0.234
West	0.313	0.283	6.6	0.079	0.313	0.318	-1.1	0.638
Urban and rural	0.351	0.609	-53.3	< 0.001	0.352	0.330	4.6	0.050
Social activities	0.617	0.645	-5.8	0.118	0.617	0.590	5.6	0.022
Drinking	0.420	0.245	37.9	< 0.001	0.419	0.381	8.2	< 0.05
Smoking	0.426	0.272	32.7	< 0.001	0.427	0.404	4.8	0.057
Health before the age of 15	0.725	0.746	-4.9	0.192	0.725	0.712	3.0	0.218
Family property	8.522	8.416	6.6	0.069	8.519	8.450	4.3	0.060

Table 4
Comparison of the results of the three matching methods

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
<i>Nearest neighbor matching</i>						
SAH	Unmatched	0.281	0.216	0.066***	0.016	4.01
	ATT	0.282	0.202	0.080	0.021	3.70
	ATU	0.216	0.259	0.043	.	.
	ATE			0.072	.	.
<i>Caliper matching</i>						
SAH	Unmatched	0.281	0.216	0.066***	0.016	4.01
	ATT	0.282	0.212	0.070	0.020	3.40
	ATU	0.216	0.255	0.039	.	.
	ATE			0.063	.	.
<i>Kernel matching</i>						
SAH	Unmatched	0.281	0.216	0.066***	0.016	4.01
	ATT	0.282	0.214	0.067	0.020	3.44
	ATU	0.216	0.265	0.049	.	.
	ATE			0.064	.	.

Note: * p < 0.05, ** p < 0.01, *** p < 0.001; A significance level of 0.05 corresponds to critical values of 1.96 and - 1.96.

Table 5
Logit regression results of labor participation and middle-aged health

	Model 1			Model 2						Model 3				
	All		Chronic diseases		Depression		urban		Chronic diseases		Depression		rural	
	SAH	St.Err.	OR	St.Err.	OR	St.Err.	OR	St.Err.	OR	St.Err.	OR	St.Err.	OR	St.Err.
Labor participation	1.35***	0.132	0.67***	0.074	0.835**	0.071	1.342**	0.174	0.674***	0.102	0.835	0.102	1.338*	0.132
Gender	1.377***	0.153	0.724**	0.099	0.541***	0.059	1.333*	0.221	0.866	0.177	0.550***	0.100	1.449**	0.153
Age squared / 100	0.978**	0.009	1.062***	0.011	1.010	0.008	0.973**	0.013	1.065***	0.017	1.000	0.013	0.983	0.009
Education status	1.389***	0.124	0.988	0.109	0.676***	0.065	1.465***	0.176	0.998	0.147	0.680***	0.089	1.262*	0.124
Marital status	0.857	0.107	1.033	0.149	0.626***	0.067	0.878	0.163	1.239	0.276	0.669**	0.113	0.854	0.107
Urban and rural	1.162*	0.089	1.052	0.096	0.654***	0.048								
Region														
Middle	0.922	0.078	1.241**	0.127	1.275***	0.105	0.805*	0.103	1.282	0.201	1.448***	0.196	1.016	0.078
West	0.682***	0.062	1.715***	0.183	1.706***	0.143	0.625***	0.087	1.447**	0.238	1.637***	0.230	0.718***	0.062
Social activities	1.069	0.083	1.145	0.104	1.031	0.072	1.052	0.131	1.105	0.161	1.127	0.138	1.08	0.083
Drinking	1.468***	0.122	0.928	0.094	0.993	0.080	1.618***	0.202	0.874	0.133	0.937	0.123	1.337**	0.122
Smoking	0.786	0.084	1.115	0.147	0.965	0.103	0.726**	0.118	1.173	0.232	1.251	0.223	0.836	0.084
Health before the age of 15	3.216***	0.317	1.004	0.098	0.843**	0.063	2.455***	0.359	1.083	0.172	0.926	0.118	3.968***	0.317
Family property	1.222***	0.03	0.977	0.029	0.885***	0.021	1.234***	0.043	1	0.042	0.891***	0.032	1.204***	0.03
Constant	0.033***	0.013	0.171***	0.076	2.556***	0.894	0.054***	0.032	0.106***	0.072	1.562	0.893	0.026***	0.013

Table 5
(continued)

	Model 4 45 ~ 49 years old						Model 5 50 ~ 54 years old						Model 6 55 ~ 59 years	
	SAH		Chronic diseases		Depression		SAH		Chronic diseases		Depression		SAH	
	OR	St.Err.	OR	St.Err.	OR	St.Err.	OR	St.Err.	OR	St.Err.	OR	St.Err.	OR	St
Labor participation	1.117	0.283	0.7	0.199	0.890	0.207	1.242	0.201	0.738	0.139	0.930	0.134	1.58**	0..
Gender	1.405	0.335	0.631	0.191	0.455***	0.116	1.603***	0.286	0.642*	0.152	0.484***	0.089	1.137	0..
Education status	1.561*	0.374	1.193	0.337	1.055	0.277	1.361**	0.187	1.086	0.194	0.672***	0.102	1.393**	0..
Marital status	1.001	0.321	1.006	0.374	0.746	0.220	0.867	0.187	0.816	0.201	0.544***	0.101	0.687*	0.
Urban and rural	0.745	0.147	0.806	0.197	1.356	0.273	1.016	0.138	1.136	0.196	1.127	0.153	0.888	0.
Region														
Middle	0.607**	0.124	1.595**	0.37	1.470*	0.295	0.707**	0.106	1.816***	0.329	1.675***	0.232	0.683**	0.
West	1.082	0.198	0.726	0.155	0.580***	0.107	1.247*	0.152	1.235	0.186	0.671***	0.080	1.284	0.
Social activities	0.864	0.159	1.172	0.249	1.128	0.198	1.124	0.144	1.265	0.196	0.977	0.114	1.135	0.
Drinking	1.537**	0.294	1.217	0.277	1.027	0.198	1.413**	0.19	0.976	0.169	1.013	0.135	1.653***	0..
Smoking	0.897	0.217	1.257	0.388	1.043	0.271	0.692**	0.12	1.131	0.256	1.016	0.183	0.818	0.
Health before the age of 15	4.129***	1.052	0.721	0.168	0.942	0.178	2.578***	0.393	1.054	0.173	0.786**	0.096	3.629***	0..
Family property	1.269***	0.074	1.085	0.075	0.899*	0.051	1.278***	0.052	0.929	0.048	0.881***	0.034	1.146***	0..
Constant	0.014***	0.009	0.374	0.272	1.942	1.156	0.014***	0.006	1.177	0.576	4.194***	1.584	0.028***	0..

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; in order to conduct a robustness test, we made regression analysis on urban and rural areas, age groups, and region