BMJ Open Relationship between household financial debt and depressive symptoms: a longitudinal study in China

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ABSTRACT

Objectives To examine the impacts of household financial debt on depressive symptoms and its possible mediating mechanisms.

Design A nationally representative longitudinal study using the ordinary least squares regression model, fixedeffects model, and instrumental variable approach to explore the relationship between household financial debt and depressive symptoms and further using structural equation models and the Bootstrap method to analyse the mediating effects.

Setting The China Family Panel Studies (CFPS) database. Participants Three waves of longitudinal data in 2012, 2016, and 2018 from CFPS were used. A total of 103,247 individuals over the age of 18 were included in our study sample.

Outcome measures Depression symptoms were assessed using an eight-item version of the Center for Epidemiologic Studies Depression Scale (CES-D8). We summed these eight items to conduct a depressive symptoms index to measure depressive symptoms. Results Among the sample, 35.3% of the households have financial debt, 49.7% of the sample are male, 73.2% of them have rural hukou, and the average age was 46.6. Regression results showed that household financial debt had a negative effect on depressive symptoms (β =0.655, 95% CI 0.602 to 0.707, p<0.01). This result remained robust after using instrumental variables with fixed effects (β=0.483, 95% CI 0.311 to 0.656, p<0.01). Household financial debt could affect depressive symptoms through mediating variables such as working pressure (p<0.05) and life happiness (p<0.01).

Conclusion Our study showed that household indebtedness in China had a negative effect on depressive symptoms. Also, we found some mediating mechanisms for this effect, which might help provide new guidance for psychological interventions to promote the mental health of indebted residents.

INTRODUCTION

Depression is a major global mental health problem and a social issue of great concern.¹ Among the total burden of diseases in China, depressive symptoms rank first, which accounts for around 20% of the total burden of diseases. There are around 16 million Chinese who have been suffering from severe mental disorders, and the incidence

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depressive symptoms, and obesity by using data from Germany from 1999 to 2009.⁸ Clayton *et al*^{θ} (2015) used survey data from 17 European countries between 1995 and 2012 and found that total household financial debt affected health outcomes and its level varied by debt maturity.⁹ Recently, a new study has also indicated that over-indebtedness was related to poor mental health by using data from a cohort study in Sweden.¹⁰

These previous studies have provided a good basis for this paper, but they may have certain limitations. First, although existing studies have analysed the impact of household financial debt on depressive symptoms, few have explored the intermediary mechanism. Second, existing research mainly carries out correlation analysis, but few studies consider endogenous problems such as omitted variables and reverse causality, and it is difficult to conclude causal inference. Third, most of the existing studies are based on samples from developed countries. Compared with developed countries, the demand for loans, work stress and mental health of residents in developing countries can be very different, which may make the findings of existing studies not applicable in developing countries.

In this paper, we took China, the world's largest developing country, to explore the impact of household financial debt on depressive symptoms, and used instrumental variables to solve endogenous problems. In addition, the mediating mechanisms of working pressure and life happiness are further analysed to draw relevant conclusions and make recommendations.

METHODS

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting or dissemination plans of our research.

Data source

The longitudinal data used in this paper are from the China Family Panel Studies (CFPS). CFPS is a nationwide representative dynamic tracking survey organised and implemented by the China Social Science Survey Center of Peking University, which reflects China's social and economic changes by tracking data at the individual, household and village levels, covering a wide range of information on the economy, education and health.¹¹ CFPS has been approved by the Biomedical Ethics Review Committee of Peking University (ID: IRB00001052-14010).

CFPS has been conducted every 2 years since the official survey in 2010, and now has 5 years of complete survey data. For the 2010 CFPS, a multistage probability distribution was used to stratify the sample. As a result, five provinces/regions (Gansu, Guangdong, Henan, Liaoning, and Shanghai) were selected for initial oversampling (1600 households in each, or an aggregate of 8000) to obtain regional comparisons, and another

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8000 households were selected by weighting from the remaining provinces/regions to make the overall CFPS sample nationally representative.^{11 12} The response rates each year were more than 80% both at the household level and individual level.

This paper used the longitudinal data from CFPS of 2012, 2016, and 2018. We kept the respondents of the adult database who were older than 18 years old and merged the adult database with the family economic database. In addition, we excluded observations that answered **-**'unable to judge,' 'missing,' 'not applicable,' 'refused to answer,' 'don't know' or 'no data' for the independent, dependent, and mediating variables used in our study. å Among our final sample, a total of 103247 individuals copyright, includ were included, 49.9% of the individuals were male, 73.2% of them had rural hukou, and the average age was 46.6.

Measures

Explained variable: depressive symptoms

Depressive symptoms were measured by the Center for Epidemiologic Studies (CES-D) scale.¹³ The CES-D scale was a commonly used measure of depression symptoms¹⁴ and was the only measure of depression symptoms in the CFPS.¹⁵ The CFPS has three waves (2012, 2016, and 2018) of data using the CES-D8 to investigate the depressive symptoms of respondents. We examined the reliability coefficient of the CES-D8 scale and the results showed that Cronbach's alpha was greater than 0.7.

at Cronbach's alpha was greater than 0.7. Respondents in each wave were asked how often they for an not get going felt sad, enjoyed life felt lonely were can not get going, felt sad, enjoyed life, felt lonely, were happy, slept restlessly, felt that everything was an effort and felt depressed; these items are scored from 1 (none of the time) to 4 (all or almost all of the time). Referring to the methods of previous scholars,¹² we summed these eight items to conduct a depressive symptoms index, with ing, Al training, higher scores of the depressive symptoms index indicating greater severity of depressive symptoms.

Core explanatory variables: household financial debt

In this paper, household financial debt is used as the core , and similar technol explanatory variable. The variable takes the value of 1 if a household has financial debt and 0 if a household has no financial debt.

Instrumental variables

To eliminate the endogenous problems caused by omitted variables and the reverse causality between household financial debt and depressive symptoms, an instrumental **g** variable was consequently chosen. Based on the principle of 'Peer Effect',¹⁶ we developed the instrumental variable of the community average household financial indebtedness ratio, which means the average household financial debt status in the same community. Previous research indicates that neighbourhood-level income is related to individual-level income,¹⁷ while income is proved to be associated with debt,^{18–20} so we could conclude that neighbourhood debt level is related to individual debt level. Moreover, the behaviours of individuals are

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influenced not only by their economic interests such as debt and income but also by other individuals in the same community as them,²¹ which also means that the community's average debt condition is related to an individual's financial debt status. Additionally, as a macro indicator, it has no direct link to the depressive symptoms of an individual.²² Thus, it can be considered an effective instrument variable.

Mediating variables

Working pressure and life happiness were chosen as mediating variables.

Working pressure

We used the length of time off during the workday to measure working pressure. CFPS survey asked respondents about the length of time off during the workday, with responses ranging from 0 to 24 hours. We constructed the variable working pressure based on this question. If the length of time off during the workday is longer, then it means that the working pressure is less.

Life happiness

The CFPS database surveyed respondents about their happiness in life and asked respondents 'How happy are you?'. Respondents are asked to give a response using a score between 0 and 10, with higher scores indicating a higher level of happiness in life for residents. We used this question in CFPS to develop the life happiness variable.

Control variables

Referring to the empirical studies on household financial debt and health status,^{8 23 24} we controlled the variables such as household registration, gender, age, education, marital status, and net income per capita. For the household registration variable, 'agricultural' was assigned a value of 1 while 'non-agricultural' was assigned 0. For education, 'illiterate/semiliterate' was assigned a value of 0, while 'elementary school' was 1, 'middle school' was 2, 'high school' was 3 and 'university or above' was 4. For marital status, 'married' was assigned a value of 1 while 'unmarried' was 0. For gender, 'female' was assigned a value 0 while 'male' was 1. For the family size variable, it is equal to the number of members that the household has. For income, because the range of values for income is too large compared with other variables, we take the logarithm of the net income per capita variable in CFPS, so as to reduce the impact on the regression results due to too large fluctuations in income.

Statistical analysis

The statistical analysis was divided into four stages. In the first stage, we conducted a descriptive statistical analysis of the data. In the second stage, we explored the relationship between household financial debt and depressive symptoms using ordinary least squares (OLS) regression models. In the third stage, to verify the robustness of the results, two approaches were chosen for robustness testing: (1) Fixed effects model.^{25 26} To mitigate the effect

of unobservable variables on regression results, we developed the fixed-effects model with yearly time fixed effects as well as individual fixed effects to show the robustness of the results. (2) Instrumental variables. An instrumental variable was added for two stage least square,^{26 27} so as to solve the endogenous problems such as the omitted variables problem and the reverse causality problem between debt and depressive symptoms. In the fourth stage, we explored the mediating effect of working pressure and life happiness in the relationship between household **v** financial debt and depressive symptoms. To improve the clarity and readability of the paper, we provided a visual analysis using the structural equation models method^{28 29} to draw the pathway map of household financial debt 2

to draw the pathway map of household financial debt **9** affecting depressive symptoms. Moreover, we also tested for mediating effects using the bootstrap method.³⁰ P values below 0.05 were considered to be statistically significant. The analysis was performed using STATA statistical software package, V.16 SE. **RESULTS Descriptive analysis** Descriptive statistics are shown in table 1. The mean value of the explained variable 'depressive symptoms' was

value of the explained variable 'depressive symptoms' was 14.075, with a SD of 3.897; the mean value of the independent variable 'household financial debt' was 0.353, with a SD of 0.478, indicating 35.3% of the sample have finan- of cial debt and there is a large variation in financial debt status among households. Moreover, 49.7% of the sample tand is men, 73.2% of the sample is rural households, 79.2% of the sample is married and the average age was 46.6.

Basic regression results

The regression results of the OLS model are shown in table 2. Without control variables, the coefficient of household financial debt in the OLS regression model training, and similar was 0.504 and was significant at the 1% level. After adding control variables, the regression coefficient of household financial debt became 0.655 and was still significant at the 1% level.

Robustness tests

Fixed-effects model

We developed the fixed-effects model with yearly time fixed effects as well as individual fixed effects to show the robustness of the results. The regression results are shown in table 3. In the fixed-effects model regression results, the household financial debt had a significant positive effect, which confirmed the relationship that household financial debt had a significant effect on depressive symptoms.

Instrumental variable regression

Table 4 shows the results of the first-stage and secondstage regressions with instrumental variable. Column 1 shows the regression results without control variables, the regression coefficient of household financial debt is significant at the 1% level, which demonstrates the

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Variable	N	Mean (%)	SD	Min	Max
Depressive symptoms	91 859	14.075	3.897	8	32
Household financial debt	103247	0.353	0.478	0	1
Community average household financial indebtedness ratio	103247	0.353	0.214	0	1
Working pressure	45346	7.581	1.443	0	24
Life happiness	30 05 1	7.495	2.165	0	10
Gender	103233	49.7%	0.500	0	1
Age	103229	46.608	17.053	18	104
Household registration	95757	73.2%	0.443	0	1
Marital status	99429	79.2%	0.406	0	1
Education	101 093	1.604	1.293	0	4
Net income per capita	102107	9.350	1.106	1.609	15.549
Family size	103247	4.338	2.024	1	21

robustness of our results. Column 2 shows the regression results with control variables, the regression coefficient of household financial debt is still significant at the 1% level, which further demonstrates the robustness of our results. Additionally, in the first stage of regression, the F-statistics in column 1 and column 2 are 9510.000 and 8993.510, respectively, which proves the fitness of the instrumental variable.

Intermediary mechanism testing

Structural equation models

We used structural equation modelling to construct a pathway diagram of the effect of household financial debt on depressive symptoms, and the results are shown in figure 1. We found the following results. First, the regression coefficients of household financial debt on working pressure, depressive symptoms and life happiness were significant at the 1% level, with coefficients of -0.028, 0.582 and -0.293, respectively. Second, the regression coefficient of working pressure on depressive symptoms was -0.183 and the regression coefficient was significant at the 1% level. Third, the regression coefficient of life happiness on depressive symptoms was -0.061 and was significant at the 1% level.

Table 2 Regression results of household financial debt on depressive symptoms

1 71			
Variables	Depressive symptoms		
	(1)	(2)	
Household financial debt	0.504***	0.655***	
	(0.451, 0.556)	(0.602, 0.707)	
Constant term	13.899***	20.427***	
	(13.868, 13.931)	(20.151, 20.704)	
Control variables		\checkmark	

***P<0.01. Numbers in (parentheses) are 95% CIs. Control variables include household registration, gender, age, education, marital status, family size and net income per capita. √ means that these variables are controlled

Bootstrap intermediary mechanism test

We further chose the bootstrap mediation mechanism ₫ test to explore the mediating effect size and significance, the results are shown in (online supplemental table S1). For working pressure, the indirect effect was 0.006 and the direct effect was 0.782, and both effects were signif-<u>e</u> icant at the 5% level. As for life happiness, the indirect effect was 0.183 and the direct effect was 0.617, and both effects were significant at the 1% level.

DISCUSSION

Using the longitudinal data of CFPS, our study empirically analysed the impact of household financial debt on residents' depressive symptoms, as well as explored the impact of mediating mechanisms. The results are articulated as follows.

First, there was a significant negative effect of household financial debt on residents' personal depressive symptoms (β =0.655, 95% CI 0.602 to 0.707, p<0.01) and this conclusion was still held after using the instrumental vari-, and ables methods with fixed effects (β =0.483, 95% CI 0.311 to 0.656, p<0.01) for robustness tests, which indicated similar technologies

Table 3 Fixed-effects model regression results					
	Depressive symptoms				
	(1)	(2)			
Household financial debt	0.201***	0.210***			
	(0.135, 0.266)	(0.144, 0.277)			
Constant term	15.284***	8.677***			
	(15.246, 15.322)	(5.918, 11.437)			
Control variables		\checkmark			
Year fixed effects	\checkmark				
Individual fixed effects	\checkmark	\checkmark			

***P<0.01. Numbers in (parentheses) are standard errors. Control variables include household registration, gender, age, education, marital status, family size and net income per capita. $\sqrt{}$ means that these variables or effects are controlled



Figure 1 Pathway diagram of the effect of household financial debt on depressive symptoms. Note: ***p<0.01.

that household financial debt had a significant negative effect on personal mental health. This result was consistent with the findings in several studies from developed countries such as the USA, England, and Sweden.^{7 10 23}

Second, household financial debt could have a negative impact on depressive symptoms by affecting working pressure (indirect effect=0.006, p<0.05) and life happiness (indirect effect=0.183, p<0.01). First, people with debt may be forced to work harder to pay off their debts, which in turn leads to greater working pressure.³¹ Moreover, increased stress at work can further lead to depressive symptoms.³² This finding is consistent with research on debt and work stress³³ and with research on work stress and depressive symptoms.³² Second, household financial debt makes individuals bear the pressure of repayment and reduces their life happiness, while life happiness is often considered to be related to depressive symptoms.³⁴³⁵ This conclusion is consistent with the research on the impact of debt on mental health from other countries.³⁶

There are certain research limitations in this paper. First, our findings rely on self-reported depressive symptoms measures, which may lead to bias in the associations between household financial debt and depressive symptoms. Second, more exact explanatory variables measures can be developed to reflect other perspectives of debts, such as debt structure and attitudes towards debt. Third,

Table 4 Two-stage regression results for instrumental variables

	Depressive symptoms		
	(1)	(2)	
Household financial debt	0.437***	0.483***	
	(0.269, 0.605)	(0.311, 0.656)	
First-stage results			
Instrumental variable	0.888***	0.833***	
	(0.870, 0.906)	(0.865, 0.901)	
First stage F statistic	9510.000	8993.510	
Control variables		\checkmark	
Year fixed effects	\checkmark		
Individual fixed effects			

***P<0.01. Numbers in (parentheses) are 95% CIs. Control variables include household registration, gender, age, education, marital status, family size and net income per capita, $\sqrt{\text{means that these variables or effects are controlled}}$

Protected by copyright limited by the availability of data, the analysis of the mediating mechanism in this paper may not be comprehensive, which deserves further exploration in the future.

Meanwhile, the strengths of this paper are mainly reflected in the following aspects. First, previous studies have paid less attention to theoretical mechanisms,^{7 37} this paper further expands to examine the mediating mechanisms and enriches the theoretical mechanisms of action between household financial debt and depressive sympð toms. Second, most previous studies have only conducted r uses correlation studies, this paper solves possible endogenous issues using an instrumental variable with fixed effects and conducts causal inference. Third, most previous studies have taken developed countries as samples,^{78 37} while this 6 paper takes China, the world's largest developing country, text as a sample, so as to provide relevant policy recommendations for other developing countries.

CONCLUSION

This paper studied the effect of household financial debt on depressive symptoms. We found that there was a significant negative effect of household financial debt on depressive symptoms, and the results remained significant after robustness checks. In addition, we found that working pressure and life happiness were mediating variables of this effect. The policy implication of this paper is that government and communities should strengthen mental health for highly indebted families and hold regular community recreational activities or exchange sessions to guide residents to express their emotions and technologies communicate their problems, thus helping to alleviate depressive symptom levels and improve their mental health.

Correction notice Article is updated since it is first published for second author's first name spelling.

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Patient consent for publication Not applicable.

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Data availability statement Data are available upon reasonable request. The CFPS datasets for this study can be found in http://www.isss.pku.edu.cn/cfps/.

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