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Impact of informal employment on individuals' psychological well-being: microevidence from China

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Abstract

Objective The number of workers engaged in informal employment in China has reached 200 million individuals, constituting a substantial contribution to the pursuit of high-quality development and the attainment of stable employment objectives. Nevertheless, the psychological well-being of informal workers cannot be overlooked. Therefore, this study aims to investigate the impact of informal employment on individuals' psychological well-being.

Methods Drawing on data from the 2020 China Family Panel Studies (CFPS) survey, this work employs ordinary least squares (OLS) models and instrumental variable analysis to empirically examine the impact of informal employment on the psychological well-being. Furthermore, different tests were utilised to analyse the mediating pathway through which informal employment affects the psychological well-being.

Results Informal employment exhibits a significant negative impact on the psychological well-being, particularly among samples characterised by low educational levels, limited financial resources, and non-agricultural household registration. The exploration of the underlying mechanisms indicates that informal employment negatively affects the psychological well-being of workers through pathways that include reduced access to health entitlements, increased working hours, and decreased job satisfaction, particularly with the work environment.

Conclusion A recommendation is proposed; namely, to further establish a social security system that caters to the needs of the informal employment population and supports and regulates the development of flexible employment forms, with the aim of protecting and enhancing the psychological well-being of the informal employment population.

Keywords Informal employment, Psychological well-being, Working hours, Health needs

Introduction

Strengthening the protection of rights and interests for informal workers is a vital component of China's employment priority strategy. Informal employment is a form of employment characterised by the absence of a fixed employer and the lack of a clear employment relationship, both of which distinguish it from conventional formal employment [1]. Around the world there exist over two billion informal workers, accounting for more than 60%[1] of the global population. In 2021, the number of informal workers in China exceeded 200 million [2]. Informal employment injects new vitality into the transformation of employment forms, particularly in the context of rapid development in the digital economy, and the number of

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individuals engaged in informal work may even surpass that of formal employment [3]. In 2020, the General Office of the State Council issued an opinion on supporting flexible employment through multiple channels, stating that various forms of informal employment serve as the primary means for workers to increase their income, playing a crucial role in fostering the development of new economic drivers. Informal employment facilitates the rational flow and allocation of labor resources, whilst also contributing to the continued enhancement of labor market flexibility [4]. Consequently, it serves as a vital avenue for promoting high-quality and full employment.

While the diversity and flexibility of employment methods have addressed numerous employment issues, the negative impacts they bring cannot be overlooked. The group of informal workers, composed of laid-off employees from state-owned enterprises, migrant workers from rural areas, freelancers, and others, often operates outside the legal protections of labor relations due to characteristics such as lack of registration and decentralization [5, 6]. In this situation, informal workers face problems such as excessively long working hours, high labor intensity, and lack of welfare benefits [7], inevitably leading to serious implications for their mental health.

In 2021, the State Council issued the '14th Five-Year Plan' for promoting employment, proposing to improve the social security system covering urban and rural workers and enhance workers' sense of gain and satisfaction. In the same year, the Ministry of Human Resources and Social Security, along with eight other departments, jointly issued the 'Guiding Opinions on Safeguarding the Rights and Interests of Workers in New Forms of Employment,' which further proposed the improvement of policies related to basic old-age insurance and medical insurance. However, China's labor market exhibits clear dual segmentation [8], Protection of the rights of informal employment still needs to be strengthened.

More specifically, informal workers frequently encounter heightened instability in their working conditions, which inevitably impinges on their psychological 'well-being'. The Report on National Mental Health Development in China (2021–2022) states that the psychological well-being risks amongst Chinese residents have been increasing year by year, with the detection rate of depression risk standing at 10.6%, and that of anxiety risk at 15.8%. Health serves as the foundation for all activities and is also a vital factor influencing individuals' educational opportunities, educational attainment, income, and other aspects [9]. Psychological well-being impacts individuals' employment options [10] and also contributes to promoting workers' awareness of health rights and improving their health literacy [11].The 20th Report of the Communist Party of China emphasizes

safeguarding the rights of workers in various forms of employment, promoting the healthy development of the platform economy, focusing on safeguarding the rights of workers, and preserving workers' subjective well-being. Therefore, it is crucial to investigate the determinants of individuals' psychological well-being through the lens of informal employment.

This study utilises data from the 2020 China Family Panel Studies (CFPS) survey to investigate the impact of informal employment on workers' psychological well-being from both theoretical and empirical perspectives. The work makes several contributions. First, with regard to a research perspective, it expands and enhances the existing literature base that supports the promotion of the Healthy China strategy. Specifically, it examines the influence of informal employment on the psychological well-being of workers and conducts a comprehensive analysis of the causal effects which the former has on the latter. Second, this study enhances the depth and specificity of the research findings by examining the differential impact of individual heterogeneity characteristics amongst the informal employment population, such as financial resources, educational level, and household registration status. Third, the study's findings indicate that engaging in informal employment is associated with deteriorated psychological well-being amongst individuals. This adverse effect is primarily mediated through diminished access to health entitlements, increased working hours, and reduced job environment satisfaction associated with informal employment. Consequently, this effect negatively impacts the psychological well-being of workers.

Literature review

The theories of labor market segmentation and labor market competition in classical labor economics thinking explain the differences between informal and formal employment [12]. Compared to the formal employment market, which is subject to multiple constraints, such as labor unions, employment contracts, and employee insurance, the informal employment labor market, driven by profit maximisation, exhibits characteristics of unstable labor relations and low welfare levels [13]. Therefore, some scholars argue that informal employment has a certain negative impact on health. For instance, studies have indicated a link between self-employment (one of the forms of informal employment) and an increased risk of mental disorders. Specifically, self-employed individuals without labor contracts exhibit a higher incidence of mental illness. Part-time employment, short-term contracts, and hourly wages, which are commonly observed in informal employment, are significantly associated with the prevalence of depressive symptoms amongst workers

[10, 14], Overall, informal workers demonstrate lower job satisfaction compared to formal employment groups [15]. Furthermore, with the rise of emerging platform-based employment models, the blurring of boundaries between work and life has resulted in a severe risk of overwork that poses a significant threat to the physical and psychological well-being of workers [16]. Whilst the binding force of labor–management relationship agreements in informal employment is diminishing and the informal employment population is enjoying greater autonomy, the instability of work is placing workers in poorer health conditions [17].

Another perspective suggests that informal employment can have a positive impact on health. Specifically, more flexible forms of employment are associated with increased consumption of fruit and vegetables, as well as higher frequency of physical activities, both of which are positively correlated with physical well-being [18, 19]. Moreover, during population mobility, self-employment, through enhanced economic capabilities and the accumulation of social capital, can exert a positive influence on the physical well-being of workers [20]. Flexible work arrangements alleviate the impact of unemployment transitions on the subjective well-being of young people, while the flexibility of labor supply supports employment transitions [21]. Although informal employment provides limited access to/opportunities for healthcare and social protection, it does not necessarily lead to worse health outcomes compared to formal employment [22, 23]. This is because the primary reason for health disparities may lie in the working conditions rather than the informality/formality of employment in the first place [24].

In summary, the existing academic literature concerning the impact of informal employment on well-being has yet to reach a conclusive consensus. Whilst some studies have provided preliminary insights into the relationship between informal employment and well-being, further investigation is still necessary. First and foremost, with over 200 million informal workers in China, it remains to be systematically demonstrated how informal employment is associated with the psychological well-being of Chinese individuals. Second, a more comprehensive examination of the mechanisms by which informal employment influences the psychological well-being of Chinese individuals is necessary, as the existing literature has not investigated the impact of variables such as access to health entitlements, working hours, and job security on the relationship between informal employment and psychological well-being. Therefore, the research interest of this study is to investigate whether informal employment can impact the psychological well-being of workers. Specifically, the work aims to determine whether the impact of informal employment on psychological

well-being is positive or negative. Additionally, the study seeks to identify the pathways through which informal employment affects the psychological well-being of individuals. The study utilised data from the 2020 CFPS survey to examine the impact and mechanisms of engaging in informal employment in the labor market on the psychological well-being of workers.

Research hypotheses

According to the dual labor market theory, the labor market is divided into the primary labor market and the secondary labor market based on non-market factors [12]. The primary labor market typically offers higher incomes, more advancement opportunities, and better working conditions, whereas the secondary labor market provides lower incomes, fewer opportunities for advancement, and poorer working conditions [25]. Informal workers mainly comprise self-employed individuals, temporary workers, part-time workers, and short-term contract workers [26]. This segment of the population lacks the protections offered by formal employment contracts and faces challenges such as low wages and benefits, blurred institutional boundaries, and low job quality [27]. The income gap between formal and informal workers has been widening, and informal workers face institutional and market barriers to mobility, exacerbating their psychological well-being issues [28]. Based on this, the following hypotheses are proposed in this paper.

Hypothesis 1: Engaging in informal employment significantly decreases workers' mental health.

Furthermore, the Health Capital Theory posits differences between health capital and other forms of human capital, such as knowledge and skills [29]. Health capital depreciates over time, and to maintain it and reduce the probability of illness, individuals need to invest in factors related to producing health. Major determinants affecting health include age, years of education, income level, extent of medical service utilization, and investment in medical insurance. In Grossman's health demand model, consumers' choices during a certain period not only affect current utility but also future utility. Individual health demand is measured through two aspects: health as a consumption good, where illness generates negative utility, and health as an investment good, which determines the time and intensity producers allocate to market activities.

According to the comparative static model of health demand, when medical service costs rise, individuals spend more money on medical services to obtain more health relative to other commodity prices. Additionally, the informal employment population tends to work longer hours, and since each individual's disposable time is fixed, this trend decreases the amount of time they can

allocate to improve their health. Consequently, compared to formal employment groups, their health declines more quickly, leading to inverse changes in health investment costs and health status. Similarly, the relatively high speed at which the health of the informal employment population declines is also due to the poor safety conditions of their work environments, which lower their health stock and increase their consumption of health services. Therefore, this paper suggests that engaging in informal employment may lead to a chain effect as follows: 'engaging in informal employment → weakening accessibility to health rights / increasing working hours/ decreasing job satisfaction → deterioration in mental health status.' Based on this, the following hypothesis is proposed.

Hypothesis 2: Engaging in informal employment negatively impacts the mental health of workers; this occurs through the pathways of weakening accessibility to health rights, increasing working hours, and reducing job satisfaction.

Methods

(1) Data source

The data for our study were derived from the 2020 CFPS survey released by the Institute of Social Science Survey at Peking University. The participants of this study encompass all members of the sampled households. The CFPS public dataset includes individual features such as gender, age, household registration status, and depressive status, as well as individual employment characteristics, healthcare service characteristics, and social life characteristics. The survey data covered 25 provinces, municipalities, and autonomous regions across China and encompassed various research topics, including population, society, economy, culture, and health. These data have demonstrated high reliability and validity in analysing individual health conditions. This study aimed to investigate the impact of informal employment on psychological well-being, specifically focusing on individuals with work experience aged between 18 and 60. After excluding participants who did not meet the research criteria and those with missing data, a final sample of 8,391 individuals was obtained for analysis.

We used the 2020 CFPS data for three reasons: first, the 2020 CFPS data comprises the most recently released dataset, possessing strong representativeness and novelty in terms of temporal context; second, for cross-sectional data, instrumental variable methods can be employed to address endogeneity issues among variables, thereby mitigating endogeneity problems resulting from omitted variables or mutual causality. In this paper, we employ instrumental variable methods to overcome endogeneity issues and to some extent alleviate the omitted variable problem caused by non-panel data; third, due to the restricted nature of our study subjects, there exists a significant issue of sample loss after sample selection for tracking individual entities, which somewhat reduces the asymptotic efficiency of panel regression estimates. Therefore, this paper utilizes cross-sectional data from 2020 for research purposes.

(2) Variable Definitions

The core explanatory variable in this study is informal employment. Some scholars have defined informal workers as individuals who are not bound by formal labor contracts with employers and experience relatively precarious labor relationships with a lack of essential social security [30]. During the process of employment, the signing of a labor contract signifies a formal employment relationship, and the provision of basic employee insurance is recognised as receiving labor protection [31]. This study employed the signing of labor contracts as a criterion to differentiate between formal and informal employment. Respondents who had signed labor contracts were categorised as engaging in formal employment, whereas those without labor contracts were considered to be in informal employment. This definition encompassed self-employed individuals with employees, self-employed individuals without employees, temporary workers, and household helpers receiving wages. As presented in Table 1, the mean value for informal employment in the sample is 0.435.

Mental health is the explained variable in this study. The CFPS data employed the Centre for Epidemiologic Studies Depression Scale (CES-D8) to measure depressive status. Within the CFPS questionnaire, the negative measurement scale was utilised, comprising items such as 'I feel downhearted', 'I feel that everything I do is an effort', 'My sleep is restless', 'I feel sad', 'I feel that life is not worth living', and 'I feel lonely'. Moreover, two positive items, namely 'I feel cheerful' and 'I lead a joyful life', were included as supplementary measures. The psychological well-being status of various employment groups was assessed using the CES-D8 scale scores derived from the CFPS database. A higher CES-D8 score is indicative of a more unfavourable psychological well-being status. Therefore, in this study, the CES-D8 scores were standardised and converted to their inverse values to obtain a comprehensive indicator of psychological well-being for the analysis. A higher numerical value of the indicator signals a higher level of psychological well-being.

The selection of control variables primarily fell into four categories: First, individual and household characteristics variables, including gender, age, marital status, years of education, annual income, and chronic

Table 1 Descriptive statistics of variables

Variables	Definition	Mean	SD
CESD8	The higher the CESD8 score, the worse the mental health	13.307	3.874
Informal employment	Yes = 1, no = 0	0.435	0.495
Gender	Male = 1, female = 0	0.578	0.494
Age	Continuous variables of age	37.763	10.595
Marital status	Married = 1, unmarried = 0	0.763	0.425
Education years	The highest education level: primary school = 6, middle school = 9, high school/vocational secondary school/technical school/vocational high school = 12, junior college and university = 16, graduate and above = 19, others = 0	8.329	6.526
Household registration status	Agricultural household = 1, non-agricultural household = 0	0.352	0.478
Logarithm of annual income	Continuous variable after logarithmic annual income	10.492	0.921
Chronic disease	Had illness or injury within 6 months = 1, no illness or injury within 6 months = 0	0.085	0.279
Smoking	Yes = 1, no = 0	0.329	0.470
Exercise frequency	On average: less than once a month = 1, more than once a month but less than once a week = 2, 1–2 times a week = 3, 3–4 times a week = 4, 5 times a week or more = 5, once a day = 6, twice a day or more = 7, never = 0	1.583	2.132
Weekly working hours	Accumulated hours of work per week	52.866	18.201
Health insurance	Provided by work = 1, not provided = 0	0.441	0.497
Job security	Respondents' evaluation of job security ranges from low to high with a value of 1–5	3.874	0.923
Labors' association	Joined = 1, not joining = 0	0.039	0.193
Job autonomy	Always on duty = 1, flexible = 0	0.511	0.500
Job satisfaction	Respondents' evaluation of job satisfaction ranges from low to high with a value of 1–5	3.694	0.852
Social status	Respondents' evaluation of social status ranges from low to high with a value of 1–5	2.871	0.955
Relationship evaluation	Respondents' evaluation of relationship ranges from low to high with a value of 1–10	6.980	1.697

diseases. Specifically, the current marital status was primarily categorised into two groups. The status of 'married (with spouse)' was defined as married and assigned a value of 1, whereas 'unmarried, cohabiting, divorced, and widowed' was assigned a value of 0. The second category was behavioural characteristics variables, including smoking status and exercise frequency. Based on the questionnaire item design, the variable assignment was determined according to the response to the question 'How often did you participate in sports, fitness, and leisure activities in the past 12 months?'. Responses were assigned values spanning 1–7, ranging from never participating (assigned a value of 0) to participating frequently. The third category was employment characteristics variables, including working hours, purchase of medical insurance, job security, job autonomy, and participation in labor associations. The fourth category comprised social life characteristics variables, including job satisfaction, social status, and evaluation of interpersonal relationships. Participants were asked to rate their job satisfaction and social status on a scale of 1–5, with 1 representing the lowest level and 5 representing the highest level. Furthermore, the quality of personal relationships was assessed on a scale of 1–10. The definitions and descriptive statistics of each variable are presented in Table 1.

(3) Econometric Methods

Due to the continuous nature of the explained variable, ordinary least squares (OLS) regression analysis was initially employed to examine the impact of informal employment on psychological well-being. The benchmark regression model is specified as follows:

$$Mental_i = \beta_0 + \beta_1 Informal_i + \beta_2 X_i + U_i + \varepsilon_i \quad (1)$$

where $Mental_i$ is the explained variable, which represents psychological well-being. $Informal_i$ is the core explanatory variable, representing informal employment. X_i denotes control variables. β_1 and β_2 are the corresponding regression coefficients. β_0 is the constant term. U_i controls for individual-level regional characteristics that do not vary across different regions. ε_i represents the random error term.

Based on the sample of 8,391 observations from the CFPS 2020 survey, this study empirically analysed the relationship between informal employment and psychological well-being using the OLS model in the Stata 17.0 software program. In the regression equation, as well as the employment option of informal employment, the control variables included behavioural characteristics, employment characteristics, and social life characteristics variables. Table 2 presents the regression results

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Table 2 Benchmark regression of the impact of informal employment on mental health

Variables	(1)	(2)	(3)	(4)
Informal employment	− 0.082***	− 0.066***	− 0.066***	− 0.062***
	(− 3.51)	(− 2.83)	(− 2.84)	(− 2.73)
Gender	0.070***	0.115***	0.125***	0.154***
	(3.10)	(4.30)	(4.68)	(5.96)
Age	0.004**	0.002	0.003*	0.000
	(2.14)	(1.33)	(1.77)	(0.11)
Marital status	0.190***	0.209***	0.209***	0.182***
	(6.45)	(7.06)	(7.08)	(6.32)
Education years	0.007***	0.005*	0.005*	0.004
	(2.59)	(1.71)	(1.83)	(1.51)
Logarithm of annual income	0.069***	0.066***	0.069***	0.045***
	(4.99)	(4.82)	(5.02)	(3.34)
Chronic disease	− 0.371***	− 0.381***	− 0.378***	− 0.313***
	(− 8.61)	(− 8.84)	(− 8.81)	(− 7.52)
Household registration status	0.083***	0.054**	0.053**	0.069***
	(3.51)	(2.26)	(2.22)	(2.97)
Smoking		− 0.090***	− 0.081***	− 0.080***
		(− 3.24)	(− 2.91)	(− 2.97)
Exercise frequency		0.035***	0.036***	0.026***
		(6.86)	(7.07)	(5.34)
Labors' association			− 0.110*	− 0.170***
			(− 1.78)	(− 2.69)
Job autonomy			− 0.114***	− 0.135***
			(− 5.26)	(− 6.39)
Job satisfaction				0.154***
				(11.20)
Social status				0.102***
				(8.15)
Relationship evaluation				0.065***
				(9.87)
Region feature	YES	YES	YES	YES
Constant term	− 1.039***	− 1.000***	− 1.013***	− 1.926***
	(− 6.70)	(− 6.46)	(− 6.55)	(− 12.19)
Observed value	8,391	8,391	8,391	8,391

***, ** and * represent 1%, 5%, and 10% significance level, respectively. The robust standard error is shown in parentheses

regarding the effects of informal employment on psychological well-being, as reported by the model.

Subsequently, to examine the mediating pathways through which informal employment affects the psychological well-being of workers, we introduced access to health entitlements, job satisfaction, and weekly working hours as mediating variables. The mediating effect was examined using a step-by-step approach following several stages. First, the significance of the coefficient β in Model (1) was tested to assess whether informal employment significantly influences psychological well-being. Second, the significance of the coefficient α_1 in Model (2) was examined to determine whether informal employment has a significant impact on the mediating variable. Third, both informal employment and the mediating variable were simultaneously included in Model (3) for regression analysis, to investigate whether the mediating variable plays a complete or partial mediating role when it comes to the effects of informal employment on psychological well-being. The specific models are as follows:

$$Mediat_i = \alpha_0 + \alpha_1 Informal_i + \alpha_3 X_i + U_i + \varepsilon_i \quad (2)$$

$$Mental_i = \mu_0 + \mu_1 Informal_i + \mu_2 Mediat_i + \mu_3 X_i + U_i + \varepsilon_i \quad (3)$$

whereas $Mediat_i$ represents the potential mediating variables, which include access to health entitlements (represented by whether the workplace provides medical insurance and job security), job satisfaction, and weekly working hours.

Furthermore, the aforementioned benchmark regression model may suffer from endogeneity issues, where the potential problem of simultaneous causality can lead to estimation biases in the results. On the one hand, there may be unobservable variables, such as personality traits and family background, that have an impact on both psychological well-being and the choice of engaging in informal employment. On the other hand, a reverse causality relationship may exist between employment choice and psychological well-being, implying that informal employment affects psychological well-being, whilst psychological well-being, per se, may also influence the decision to engage in informal employment. For example, prolonged mental illnesses might increase the likelihood of both men and women engaging in self-employment in the informal sector. The mental stress experienced by individuals can lead to frequent job changes, and there exists a reverse causality relationship between job changes and psychological well-being issues [32]. Specifically, when family members experience unexpected illnesses, women tend to opt for more flexible work arrangements [33, 34]. Additionally, individuals with mental illnesses are more inclined to seek informal social support, despite facing unique challenges, they tend to have higher job satisfaction in informal employment [35]. This suggests that psychological well-being can also influence the choice of informal employment. Therefore, to mitigate potential endogeneity issues, the current study identified instrumental variables for informal employment to address any resulting biases and inconsistencies in the research findings attributable to endogeneity.

Valid instrumental variables must simultaneously satisfy two conditions: being uncorrelated with the random disturbance term and having a meaningful relationship with the endogenous variables. As such, this study employed a 2SLS model to address the endogeneity issue and examine the robustness of the regression results. In the current work, the provincial-level coverage rate of old-age insurance in China was utilised as the instrumental variable for informal employment. The coverage rate of old-age insurance amongst the sample's respective provinces served as a higher-level aggregated data variable. A higher old-age insurance coverage rate in a region corresponds to better labor protection enforcement, reducing the likelihood of individuals engaging in informal employment. Therefore, the instrumental variable satisfied the requirement of correlation with the explanatory variable. Additionally, it is assumed that an individual's personal psychological well-being typically does not have a direct impact on the policy-level coverage rate of the old-age insurance; as such, the exogeneity assumption holds for the instrumental variable. The IV-2SLS model is specified as follows:

$$Informal_i = \gamma^* IV + \beta^* X_i + \delta \qquad (4)$$

$$Mental_i = \gamma + \gamma_1 Informal_i + \gamma_2 X_i + U_i + \varepsilon \qquad (5)$$

where IV represents the instrumental variable for informal employment, and γ^* represents its corresponding coefficient. If γ^* is statistically significantly positive, it indicates a strong correlation between the instrumental variable and the endogenous explanatory variable, thereby validating the effectiveness of the instrumental variable.

Results

(1) Benchmark Regression

Table 2 presents the test results for Hypothesis. In the benchmark regression analysis, considering the potential influence of different control variables on the variation of core variables, this study employed a stepwise approach to incorporate individual characteristics, health behaviour characteristics, employment characteristics, and social life characteristics variables to examine the impact of informal employment on psychological well-being. The estimation results in Table 2 indicate that, when controlling for regional fixed effects, regardless of the estimation method employed, the coefficient β_1 is significantly negative at the 1% level. This implies that engaging in informal employment significantly undermines individuals' psychological well-being, thus validating Hypothesis 1.

From an economic perspective (taking Column 4 in Table 2 as an example), when controlling for other influencing factors, individuals engaging in informal employment experience a negative attenuation of 0.062 units when it comes to their psychological well-being levels. In the surveyed sample, the average level of psychological well-being was found to be 13.307, indicating an approximate decline of 2.31% in the psychological well-being of individuals engaged in informal employment. As the scale of informal employment expands, the inherent health needs of the workforce also receive widespread attention. Therefore, the frequency of experiencing a 2.31% reduction in mental well-being becomes a crucial consideration influencing individuals' decisions regarding engaging in informal employment. Therefore, focusing on supporting and regulating the development of informal employment and strengthening the protection of the psychological well-being of informal workers is of great practical significance for promoting the construction of a healthy China and advancing the employment priority strategy.

The other control variables in Table 2 also exert a significant influence on psychological well-being. Taking Column (4) in Table 2 as an example, the gender variable exhibits a significant positive effect on the psychological well-being of workers at a 1% level of statistical significance, indicating that men have relatively better psychological well-being compared to women. Marital status and household registration status (hukou) also have significant effects on the psychological well-being of informal workers. In contrast, age and educational level do not demonstrate significant effects. Smoking, membership in labor associations, and chronic illness have significant negative effects on individuals' psychological well-being. Moreover, as annual income increases, there is a continuous improvement in psychological well-being. Variables such as exercise frequency, job satisfaction, social status, and interpersonal relationships are all significantly positively correlated with psychological well-being.

(2) Endogeneity Treatment: Instrumental Variables

The regression results in Table 2 indicate that engaging in informal employment significantly decreases the psychological well-being of workers. However, the presence of potential endogeneity issues in the benchmark regression may lead to biased estimation results. Therefore, this study employed a 2SLS model based on instrumental variables to address endogeneity concerns. Old-age insurance is an essential component of social security and serves as a distinguishing factor between formal and informal employment [36]. Therefore, it is associated with the endogenous explanatory variable of informal employment. Furthermore, as a social policy,

Table 3 Endogeneity processing: a two-stage model

Variables	11) Second stage regression mental health	21) First stage regression informal employment
Informal employment	− 1.398***	
	(0.357)	
Instrumental variable		− 0.954***
		(0.137)
Other variables	Control	Control
Constant term	0.600	2.760***
	(0.731)	(0.130)
Wald test		48.177***
Sample size	8,391	8391

***, ** and * represent 1%, 5%, and 10% significance level, respectively. The robust standard error is shown in parentheses

Table 4 Sub sample regression results of education and physical capital

Variables	Education level grouping		Physical capital grouping	
	Low	High	Low	High
Informal employment	− 0.064***	− 0.015	− 0.113***	− 0.044*
	(− 2.35)	(− 0.37)	(− 2.54)	(− 1.71)
Other variables	control	control	control	control
Constant term	− 2.206***	− 1.429***	− 1.528***	− 1.701***
	(− 11.08)	(− 5.99)	(− 5.34)	(− 9.05)
Sample size	5,643	2,748	2,427	5,927

***, ** and * represent 1%, 5%, and 10% significance level, respectively. The robust standard error is shown in parentheses

the provincial-level coverage rate of old-age insurance is not influenced by the health status of individual workers and, therefore, does not directly or indirectly affect the explained variable. After estimation, the estimated value of the Wald test statistic rejected the critical value at the 1% significance level, indicating the absence of a weak instrumental variable problem. The results of the second-stage regression suggested that, after addressing endogeneity issues using instrumental variables, choosing to engage in informal employment significantly lowers the psychological well-being of workers. Engaging in informal employment is a vital factor that influences the psychological well-being of workers. Choosing informal employment leads to a significant reduction in their psychological well-being, thereby supporting the findings presented in Table 3.

(3) Heterogeneity Analysis

The previous analysis was conducted using regression on the entire sample, thereby yielding conclusions regarding the average effect of engaging in informal employment on the psychological well-being of all workers. However, given the presence of heterogeneity across different groups, the impact of engaging in informal employment on psychological well-being may vary amongst individuals with different characteristics. Different groups characterised by contrasting educational levels, financial resources, age, and hukou may experience varying degrees of impact on psychological well-being from informal employment due to regional disparities in development levels and patterns. In this section, we will conduct heterogeneity tests to examine these differences.

First, we conducted heterogeneity tests based on educational level and financial resources. In this study, the sample was divided into two groups based on educational

levels: the 'low educational level' group, comprising individuals with educational levels of illiteracy, primary school, junior high school, and senior high school; and the 'high educational level' group, comprising individuals with educational levels of college and above. The financial resources element, as per the questionnaire design, was measured by asking respondents to rate their income position locally. Responses indicating 'lower' or 'lower-middle' were categorised as the 'low financial resources' group, whilst those indicating 'middle', 'upper-middle', or 'upper' were categorised as the 'high financial resources' group.

The results in Table 4 demonstrate that, amongst the 'low educational level' group, informal employment significantly and negatively affects individuals' psychological well-being at the 1% significance level. In contrast, the coefficient value amongst the 'high educational level' group is not statistically significant. This suggests that engaging in informal employment significantly reduces the psychological well-being of individuals with lower educational levels. Concerning financial resources, the estimated coefficient for the effect of informal employment on psychological well-being is negative and statistically significant at the 1% level in the 'low financial resources' group, whereas the coefficient is negative and significant at the 10% level in the 'high financial resources' group. This indicates that engaging in informal employment has a greater negative impact on the psychological well-being of individuals in the 'low financial resources' group compared to the 'high financial resources' group. This, in turn, suggests that the groups of individuals engaged in informal employment within low education levels and low financial resources tend to face greater challenges in terms of psychological well-being.

Second, we conducted heterogeneity tests based on hukou and age. The entire sample was divided into two groups: agricultural hukou and non-agricultural hukou.

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Table 5 Sub sample regression results of household registration status and age

Variables	Household registration status grouping		Age grouping	
	Agricultural household	**Non-agricultural household**	**18–45 years old**	**46–60 years old**
Informal employment	− 0.042	− 0.109***	− 0.058**	− 0.055
	(− 1.54)	(− 2.84)	(− 2.25)	(− 1.21)
Other variables	Control	Control	Control	Control
Constant term	− 1.892***	− 1.790***	− 1.522***	− 3.580***
	(− 9.58)	(− 7.48)	(− 9.19)	(− 8.57)
Sample size	5,438	2,953	6,021	2,370

***, ** and * represent 1%, 5%, and 10% significance level, respectively. The robust standard error is shown in parentheses

Concerning age, the total sample was divided into two sub-samples: below 45 years old and 46–60 years old. The results are presented in Table 5. Amongst the groups categorised based on hukou, the impact of informal employment on the psychological well-being of non-agricultural household samples is statistically significant at the 1% level. In contrast, the effect of informal employment on agricultural household samples is not significant, indicating that the negative impact of engaging in informal employment on the psychological well-being of individuals is more pronounced amongst the non-agricultural household group. Concerning age heterogeneity, the impact of engaging in informal employment on psychological well-being varies amongst different age groups. The results in Table 5 indicate that the effects of informal employment on the psychological well-being of samples aged 46 and above are not significant. In contrast, amongst the samples aged 18–45, engaging in informal employment significantly reduces their psychological well-being at a 5% statistical level.

(4) Examination of Mechanisms of Effects

Based on the analysis and arguments presented earlier, this study has concluded that, compared to formal employment, engaging in informal employment negatively impacts the psychological well-being of workers. In this section, we further examine the mechanisms through which engaging in informal employment affects the psychological well-being of workers to expand the depth of the research. We achieve this by considering access to health entitlements, job security satisfaction, and weekly working hours as mediating variables. Drawing on the research methodology of Baron and Kenny [37], after incorporating the mediating factors, the coefficient for informal employment remains statistically significant. This suggests that the variables of accessibility to healthcare rights, job security, and weekly working hours partially attenuate the impact of informal employment on mental health. In

terms of access to health entitlements, we employed whether respondents are provided with medical insurance as a proxy variable. Regarding job security, this study measured respondents' job security satisfaction by assigning values of 1–5, from least to most, for dissatisfied, satisfied, fair, relatively satisfied, and very satisfied, respectively. Regarding weekly working hours, the current study calculated the cumulative count of respondents' weekly working hours, resulting in a continuous variable.

The mechanism of effects is examined in Table 6. Columns (1) to (2) of Table 6 report the results of the mediation analysis for access to health entitlements. In Column (1) of Table 6, the regression results indicate that engaging in informal employment significantly decreases workers' access to health entitlements at a 1% significance level. Furthermore, when the access to health entitlements element was included as a control variable in the regression equation (Column (2)), the coefficient of informal employment remained significantly negative at a 5% level, whereas the coefficient of access to health entitlements was significantly positive at a 1% level. To examine this, the present study conducted a Sobel test, which yielded a Z-value of − 3.188. Moreover, the absolute value of the coefficient for informal employment in Column (2) is significantly smaller than that in the benchmark regression. This indicates that informal employment negatively impacts psychological well-being through the mediating mechanism of decreased access to health entitlements for individuals.

The mediation analysis results for job security satisfaction are presented in Columns (3) and (4) of Table 6. Column (3) indicates that informal employment significantly reduces job security satisfaction for workers at a 1% significance level. Furthermore, in Column (4), when job security satisfaction is included as a control variable, the coefficient for informal employment remains significantly negative, whereas job security itself has a significant positive effect on the

Table 6 Mediation test results

	(1) Accessibility to health rights	(2) Mental health	(3) Job security	(4) Mental health	(5) Weekly working hours	(6) Mental health
Informal employment	− 0.979***	− 0.051**	− 0.069***	− 0.063***	3.082***	− 0.059***
	(− 21.81)	(− 2.22)	(− 3.68)	(− 2.82)	(7.21)	(− 2.62)
Accessibility to health rights		0.016***				
		(2.82)				
Job security satisfaction				0.062***		
				(4.49)		
Weekly working hours						− 0.003***
						(− 3.99)
Control variable	Control	Control	Control	Control	Control	Control
Region	Control	Control	Control	Control	Control	Control
Constant term	− 2.074***	− 1.825***	1.893***	− 1.979***	55.571***	− 1.711***
	(− 6.08)	(− 11.97)	(14.90)	(− 12.95)	(17.47)	(− 10.88)
N	8,391	8,391	8,389	8,389	8391	8,391
R^2	0.160	0.101	0.266	0.103	0.109	0.103
Sobel test Z value	− 3.188***		− 2.940***		− 3.983***	

***, ** and * represent 1%, 5%, and 10% significance level, respectively. The robust standard error is shown in parentheses

psychological well-being of workers. Furthermore, the Z-value obtained from the conducting of the Sobel test supports the mediation effect, indicating that job security partially mediates the relationship between informal employment and psychological well-being. This suggests that informal employment reduces individuals' job security satisfaction, which in turn negatively affects their psychological well-being.

The results of the mediation analysis for weekly working hours are presented in Columns (5) and (6) in Table 6. Column (5) indicates that the coefficient of informal employment is significant and positive, suggesting that engaging in informal employment increases weekly working hours by 3.082 units. Column (6) demonstrates that informal employment has a significant negative effect on psychological well-being, and that the coefficient of weekly working hours is also significantly negative. The Sobel test, with a Z-value of -3.983, confirms the mediation effect, indicating that weekly working hours partially mediate the relationship between informal employment and psychological well-being. This suggests that engaging in informal employment results in increased working hours, which in turn negatively affect the psychological well-being of individuals. In summary, informal employment weakens accessibility to health rights, increases working hours, and decreases job satisfaction, thus negatively impacting the mental health of practitioners; this finding confirms Hypothesis 2.

Although the results of the Sobel tests suggest that accessibility significantly mediates health rights, job safety satisfaction, and weekly working hours, this study added the bootstrap method to retest the mediating effects in light of the limitations associated with the normality assumptions of the Sobel tests (Table 7). The results show that the confidence intervals for the indirect effects of accessibility to health rights, job safety satisfaction, and weekly working hours do not include zero, and the p-values remain significant; this finding indicates the presence of mediating effects and further confirms their validity.

Discussion

The theory of health demand suggests that health capital differs from other forms of human capital, such as knowledge and skills [29]. Specifically, health capital depreciates over time, and individuals need to invest in the production of health-related factors to maintain their health capital and reduce the probability of falling ill. The factors influencing health encompass various elements, such as age, years of education, income level, utilisation of healthcare services, and the extent of investment in health insurance. The choices which individuals make at a given point in time affect their current utility and impact their future well-being over different periods. Individuals' health needs are measured in two aspects. First, health is considered a consumer good, whereas falling ill leads to negative utility. Second, health is viewed

Table 7 Informal employment and mental health: bootstrap mediation effects test

Effect		Coefficient	95% confidence interval (Lower Bound)	95% confidence interval (Upper Bound)	P-value
Accessibility to health rights	Direct effect	− 0.055	− 0.028	− 0.006	0.019
	Indirect effect	− 0.017	− 0.029	− 0.006	0.002
Job security	Direct effect	− 0.068	− 0.113	− 0.022	0.003
	Indirect effect	− 0.004	− 0.008	− 0.002	0.005
Weekly working hours	Direct effect	− 0.063	− 0.107	− 0.019	0.005
	Indirect effect	− 0.008	− 0.014	− 0.004	0.000

Bootstrap resampling = 1000, 95% confidence interval

as an investment good that determines the time and intensity of market activities for producers. To uphold a sound health status and enhance competitiveness in the labor market, individuals engaged in informal employment need to prioritise their psychological well-being and be continually motivated to invest in psychological well-being [38]. However, informal workers face challenges in the labor market, such as inadequate social protection, employment discrimination, unstable income, work fatigue, and physical ailments [39]. Addressing the psychological well-being issues faced by informal workers is an inherent requirement for promoting the implementation of the employment priority and Healthy China strategies.

As China's economy transitions from high-speed growth to high-quality development, informal employment is expected to persist in the long term [36]. This study utilises Grossman's health demand theory to analyse the health needs of individuals when choosing informal employment. In addressing the negative impact of informal employment on individuals' psychological well-being, it is crucial to shift the focus towards adjusting factors that influence the health demand of informal workers, thereby promoting the sustained provision of health services to individuals.

Meanwhile, this study revealed heterogeneity in the impact of informal employment on workers' psychological well-being. For residents with low levels of education and financial resources, engaging in informal employment typically entails greater job instability [40]. This involves higher labor risks and poorer working conditions, as well as limited social security, leading to negative impacts on the residents' psychological well-being. In contrast, higher educational attainment is positively associated with income acquisition, as higher education enables individuals to accumulate human capital and gain a relative competitive advantage in the fiercely competitive labor market [41]. Individuals with higher education levels tend to have more stable incomes and are better equipped to invest in their own health [42],

thereby resulting in relatively better psychological well-being [43]. Concerning hukou heterogeneity, the impact of informal employment on the health of non-agricultural household residents is more significant compared to agricultural household residents [44]. Non-agricultural household residents tend to opt for more stable employment, whilst highly mobile jobs can lead to conflicts in daily life and greater work-related stress, potentially resulting in higher rates of emotional and anxiety disorders, as well as smoking and alcohol abuse [45, 46]. Therefore, non-agricultural household residents engaging in informal employment are more likely to experience psychological well-being issues. Concerning age heterogeneity, the impact of informal employment on psychological well-being is less pronounced amongst individuals aged 46 and above. This could be attributed to the fact that middle-aged individuals have accumulated a certain level of social capital and financial resources, as well as extensive work experience [47], which mitigates the negative impact of informal employment on their psychological well-being to some extent. Conversely, the 18–45 age group face greater economic burdens and survival pressures. The inherent instability of informal employment has a more substantial impact on this group, leading to poorer psychological well-being outcomes.

Therefore, this study proposes the following policy recommendations. First, it is essential to eliminate institutional barriers and employment discrimination that hinder equal employment opportunities, such as those based on gender, age, industry, and identity/status, in order to support and regulate the development of informal employment arrangements. The social security system for informal workers should be enhanced, and equal access to public health services ought to be promoted. Additionally, efforts should be made to reduce the dependency on labor relations and household registration in social security, aiming to improve the overall population's health status. Second, efforts should be made to provide better health protection for non-agricultural individuals and low-income informal workers.

This can be achieved by strengthening health education and training programmes for informal workers, promoting an optimistic and positive attitude towards life, and encouraging healthy lifestyles. Third, whilst providing policy support to the informal employment sector, the government should also offer incentives for work protection and ensure health entitlements for informal workers. Efforts ought to be made to enhance job satisfaction amongst individuals and minimise the adverse impact of long working hours on the psychological well-being of informal workers.

Conclusion and future research

This study utilises data from the 2020 CFPS survey to examine the impact of informal employment on individuals' psychological well-being using OLS models and instrumental variable techniques. The main findings can be summarised as follows: First, the impact of informal employment on residents' psychological well-being is significantly negative at a 1% level of statistical significance. This implies that, compared to individuals in formal employment, engaging in informal employment significantly decreases the psychological well-being of workers. Even after addressing endogeneity issues through the use of instrumental variables, the research findings remain robust and valid. Second, heterogeneity analysis reveals that the negative impact of informal employment on individuals' mental health is more pronounced amongst those with low educational levels, limited material resources, non-agricultural household registration, and the 18–45 age group. Third, the negative impact of informal employment on the psychological well-being of workers primarily arises from reduced access to health entitlements, diminished job security satisfaction, and increased working hours.

Although this study provides valuable empirical insights into the impact of informal employment on mental health, there are several limitations to acknowledge. Firstly, due to the constraints of our study subjects, we utilized cross-sectional data from the 2020 CFPS for analysis. While cross-sectional data are beneficial for exploratory analysis, they pose issues regarding examining causal relationships between variables, particularly in relation to omitted variables. Further research is needed to comprehensively investigate the effects of informal employment on mental health. Additionally, due to limitations in sample data, this study did not fully consider the influence of individual behavioral characteristics and macroeconomic variables on informal employment. Factors such as residents' willingness to contribute to pension insurance and the degree of care from labor unions can also affect workers' mental health. Therefore, in future research, we hope to investigate the effects of informal employment participation on residents' willingness to contribute to medical insurance and the degree to which care from labor unions impacts their health.

Author contributions
Deshui Zhou and Qingqing Zhang designed the study and conducted the Data collection. jingshan li and Deshui Zhou contributed to the Data analysis and interpretation、 Drafting the article and Critical revision of the article. All authors approve the paper to submission,and All authors contributed to the revisions.

Availability of data and materials
Upon request to the corresponding author.

Declarations

Ethics approval and consent to participate
We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind in any product, service and/or company that could be construed as influencing the position presented in, or the review of, the manuscript entitled*'Impact of Informal Employment on Individuals' Psychological Well-Being: Microevidence from China'*. The study was exempt from human subjects' approval (non-identifiable data; not human subjects). We confirm that all methods were carried out in accordance with relevant guidelines and regulations. We confirm that all experimental protocols were approved by a named institutional and/or licensing committee.

Consent for publication
 Not Applicable.

Competing interests
The authors declare no competing interests.

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