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RESEARCH

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The impacts of basic medical insurance for urban–rural residents on the perception of social equity in China

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Abstract

Background Based on CSS 2019 data, this article analyzes the impact of Basic Medical Insurance for Urban and Rural Residents (BMIUR) on perceived social equity of residents.

Method Using the CSS data of 2019, this article analyzes the influence of BMIUR on the perception of social equity of residents, on the basis of 2SLS model and mediating effect model.

Results We find that BMIUR has a significantly positive impact on the perception of social equity. That is to say, BMIUR can improve residents' evaluation of social equity and further promote the level of social equity, which makes residents more happiness. The conclusion remains valid after using robustness test and propensity score matching to conduct counterfactual reasoning. The discussion of mechanism indicates that the influence of BMIUR is mediated by enhancing social capital, improving satisfaction of income distribution and reducing self-paid medical expenses. This study also finds that the influence of BMIUR is more obvious in the low-income, low-skilled and mid-west groups.

Conclusion The reform of the medical security system should be regarded as a foothold for improving people's well-being and promoting social equity; Expanding people's social capital through multiple channels and improving income distribution mechanisms; Strengthen vocational skills training, especially to provide more public services and social security for low-income groups, low-skilled groups, and groups in the western region of China, in order to improve the welfare and policy effectiveness of China's social security reform.

Keywords BMIUR, Social equity, Low-income group, Social capital, Social satisfaction

Introduction

After years of development, the basic medical insurance system in China has achieved full coverage nationwide. According to date released by the National Healthcare Security Administration, By the end of 2023, the number of people participating in China's basic medical insurance has reached 1.334 billion, with a stable coverage of over 95% and a continuous improvement in the quality of participation. Among them, 963 million people have participated in the basic medical insurance for urban and rural residents. The 19th CPC National Congress and its fifth plenary session, as well as the 14th five-year plan all have mentioned to establish a multi-level social security system covering all population in China. As an important component of the multi-level social security system, the Basic Medical Insurance for Urban and Rural Residents (BMIUR) is integrated from the New Rural Cooperative Medical Insurance (NCMS) and the Basic Medical

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Insurance for Urban Residents (BMIU), and is an important symbol of promoting the integration process of China's urban and rural social security system [1].

With the gradual establishment of a multi-level social security system, the sense of social equity among Chinese residents is increasingly improving, and promoting social equity has become one of the important topics for studying China's socio-economic issues [2]. Although the basic medical insurance system has gradually reached full coverage of all people, the long existing urban–rural dual structure in China leads to inequity between different groups and regions [3]. Viewing the group difference, as the medical system divides people by their registered residence, different policies and treatments of different medical insurances result in unfairness among different groups, The inequality between the eastern, central, and western regions is also increasing [4]. But by improving the health status and living standards of contemporary people, it can effectively promote social equity and alleviate inequality [5]. In addition, the localized management pattern makes the financing standard, treatment level and range of reimbursement are restricted by local economic development, leading to inequity between different regions [6]. In order to ensure both urban and rural residents can have equal opportunity to the rights of basic medical insurance, the State Council issued the plan to integrate BMIU and NCMS into BMIUR, following six unified principles of unified coverage, unified financing policy, unified treatment, unified medical insurance catalogue, unified fixed-point management and unified fund management. These measures are based on the optimization of the medical insurance system to enhance the coverage and treatment level of urban and rural medical insurance in China, which is of great significance for promoting social equity.

The health condition of residents and level of medical services have been greatly improved in urban and rural areas as a result. With China proposing to continuously promote economic development and gradually achieve common prosperity for everyone, the basic medical insurance system plays a significant role in reducing disparities between different groups and regions, as well as giving people a sense of gain, happiness and security. In terms of theoretical inference, BMIUR may have double influence, either promoting or inhibiting residents' perception of social equity. On the one hand, the integration of BMIU and NCMS is conducive to eliminating the problem of medical insurance system segmentation caused by China's residence registration system [7], and promoting the sharing of dividends between Chinese urban and rural residents brought by the medical insurance reform. BMIUR is especially meaningful for rural residents [8], as their treatment level and convenience of reimbursement has improved greatly, thus helps to maintain social equity. On the other hand, although BMIUR has integrated BMIU and NCMS, the payment methods and coverage of the two insurances are so different [9], as well as the great differences in the economic level and population structure between various regions in China, that the payment efficiency of the integrated medical insurance may not be significantly improved, the vulnerable groups faced with inequities still exist. Therefore, from the theoretical level, the impact of BMIUR on residents' sense of social equity remains unclear, and it needs to be further tested and demonstrated empirically. This provides the starting point for our study.

Therefore, this study focuses on the role of BMIUR in improving residents' sense of social equity. We intend to answer three questions as follows. Whether BMIUR has improved the perception of social equity and indeed promoted residents more happiness? How does it exert such effect? Whether there is any difference between its impact on different groups?

Specifically, the contributions of this paper mainly lie in three aspects. Firstly, from the perspective of China's medical system reform, our study explores the impact of BMIUR on residents' perception of social equity, which provides a reference for the welfare effect of the reform. Secondly, this article further explores the mechanism by which BMIUR affects residents' sense of social equity from dimensions such as social capital and income satisfaction, and analyzes the heterogeneity of the impact of BMIUR on social equity, expanding the depth of research. Finally, the method adopted in the research is scientific and robust. We use the latest released 2019 CSS data for research, and comprehensively use instrumental variables and PSM method to overcome the endogenous problem.

Literature review

Fairness and justice are the permanent pursuit of all mankind, and it is the same with health and medical services. Rawls [10] put forward two principles of justice in his theory. Rawls believed that every citizen should enjoy fundamental freedoms, where freedom is broad and equal; For the principle of difference, Rawls pointed out the need to combine the principle of difference with the principle of equal opportunity to regulate social distribution and promote social fairness. The principle of equality requires opportunities are equal and open to all people in the society while allowing a certain degree of inequality between individuals. Positive measures should be taken to improve the condition of the least-advantaged members. Daniels [11] extended Rawls' theory to the field of health and medical services. He proposed that Rawls' principles can only be achieved under the condition that

people are able to fully perform their physiological functions during their life cycle and avoid the risks of disease, disability or premature death.

In the context of China, promoting social equity is an important foothold for the reform of China's medical security system [12]. The overall planning of urban and rural medical insurance has broken the difference of welfare treatment under the dependence of registered residence [13], realized the integration of urban and rural dual social security system, and significantly improved the sense of happiness, acquisition and security of urban and rural residents [14]. Based on the importance of coordinating urban and rural medical insurance, some scholars have pointed out that medical services contribute to the realization of equal opportunity by ensuring people's capability to participate in social, political and economic life through prevention and treatment of diseases and disabilities [15]. At the same time, as an important human capital [16], health requires the continuous improvement of the medical security system to achieve sustainable supply of health improve labor productivity of workers, and alleviate social inequality. From this perspective, equity of health and medical services lays the foundation for achieving social equity.

In addition to the above traditional research, recently, scholars have used the big healthcare data related to Covid-19 to analyze the its impact on perception of social equity. For example, some scholars believe that since the outbreak of Covid-19, the development of big healthcare data technology has greatly improved the equity of the medical system. As health information become available for people, it has indirectly promote people's perception of equity [17–19]. Moreover, some scholars have demonstrated the relationship between depression resulting from Covid-19 and social equity to analyze the impact of medical care on perceived risks and confidence of epidemic prevention. These studies found that health care provision has a positive effect on reducing the risk of infection, especially for long lasting psychological distress [20–22].

It is worth mention that there are huge differences in the impact of BMIUR on different groups, and its influence on social equity requires to be further confirmed. Study has shown that BMIUR has a more obvious influence on rural residents than urban residents [23]. From the age angle, it will intensify the health inequity of the elderly in the rural areas and further aggravate disadvantages accumulated with age [24].

From the analyses above, we can see that although there have been many studies on the policy effects of BMIUR, how it exerts its influence on social equity still needs to be further deepened. Limitations of current studies mainly exist in the following aspects. Firstly, objective indicators are used to measure the level of medical services utilization and health level, while ignoring the subjective perception or evaluation of social equity and medical services equity of residents. Secondly, when it comes to the group heterogeneity, they usually divide people by demographic features such as districts, age, income and so on, while human capital endowment of different groups has not been considered. Thirdly, a majority of researchers use quantitative models to explore the policy impact on equity, while lacking further study of its mechanism and pathway. Therefore, starting from existing problems, this paper will comprehensively investigate the impact of BMIUR on residents' perception of social equity and make residents more happiness, and further analyze its mechanism and heterogeneous influence on different groups.

Methods

Data source

The data we use in this article comes from 2019 Chinese Social Survey (CSS) released by the Institute of Sociology, Chinese Academy of Social Sciences. The data covers a wide range of 31 provinces, autonomous regions and municipalities directly under the central government, including 151 sample areas at the district and county level and 604 villages (residents) committee sample areas. The survey contents include the individual characteristics, family structure, social status mobility, social security and economic life of Chinese residents, which can lay a solid foundation for the study on the socio-economic dynamic changes during the transition period. The CSS 2019 data surveyed 10,280 family samples, and the respondents are in the age range of 18–69. After excluding missing values, the sample size is 8527. Even though panel data can better overcome the endogenous problem caused by unobservable variables, it is rather difficult to obtain years of tracking data for large-scale micro surveys, especially with the high frequency of population mobility in China. Therefore, we use the cross-sectional data of CSS in 2019 for research. The data is not only novel, but is also large in sample size, which covers 31 provinces in China and has a wide representative meaning throughout the nation. Therefore, the data provides solid support for obtaining general research conclusions.

Variable description

The Dependent variable is residents' perception of social equity. The corresponding design in the questionnaire is "generally speaking, your evaluation of the current overall social equity", and the score is "1–10" accordingly. Higher score indicates higher sense of social equity. Sample mean of social equity is 6.7126, indicating that residents' perception of social equity is located above medium

level. In the following study, we use residents' perception of medical services equity, happiness and social trust as alternative variables to test the robustness of social equity, so as to further support the research conclusion.

The explanatory variable is BMIUR. Since it is the combination of NCMS and BMIU, we define that if the respondent is in either of the two, he is covered by BMIUR, and the value is assigned as 1. Otherwise, the assigned value is 0. Sample mean of BMIUR is 0.6210, indicating that BMIUR has covered most respondents.

Combined with existing literature research ideas [25], our study also a series of control variables. As for individual characteristics, age is a continuous variable, with the average of 46.76. Gender is a binary variable, and men are assigned as 1 while women are assigned as 0. The variable of education level takes primary school and below as the reference group, and junior high school, senior high school, university and above are assigned as 1 in turn, otherwise are assigned as 0. As for marriage, being married is assigned as 1 and unmarried is assigned as 0. Party member status assigns Party members as 1 and non-party members as 0. As for family characteristics, family size represents how many people are in the respondents' families. Self-owned housing is a binary variable. Respondents in the family with self-owned housing are assigned as 1 and otherwise are assigned as 0. The socio-economic characteristics includes the Internet use (using the Internet = 1, not using = 0), endowment insurance (with endowment insurance = 1, not using = 0), and income variables. In addition, we control the regional effects in the form of virtual variable. The specific descriptive statistics are shown in Table 1.

Measuring method

In view of the explained variable, perception of social equity, is discrete and ordinal, we first use the model of Ordered logit for analysis in the benchmark regression. We set the following equation:

$$Fairness^* = \alpha_i + \gamma_i Medicare_i + \rho_i X_i + \mu_i \quad (1)$$

$Fairness^*$ represents the perceived social equity of the random sample i. $Medicare_i$ is the explanatory variable BMIUR, which means the coverage of BMIUR. X_i

Table 1 Descriptive statistics of main variables in this study

Variable name	Variable definition	Mean	Standard deviation
Explained variable			
Perception of social equity	The evaluation of perceived social fairness is very unfair to very fair, with a score of 1–10. The higher the score, the higher the sense of social fairness	6.7126	2.1146
Perception of equity in medical services	The evaluation of medical services provided by the government is not good, not very good, relatively good and very good, and corresponding values are 1, 2, 3 and 4 in turn	2.8212	.7745
Happiness	The acceptance of being a happy person is totally disagree, disagree, agree and totally agree, and they are assigned as 1, 2, 3 and 4 in turn	3.1494	.8298
Social trust	The evaluation of social trust level is 1–10 points. The higher the score, the higher the degree of social trust	6.3691	2.1374
Explanatory variable			
BMIUR	BMIUR = 1, no = 0	0.6210	0.4852
Individual characteristics			
Age	Continuous variable of respondents' age	46.7647	14.1722
Gender	Male = 1, female = 0	0.5716	0.4949
Education level (primary school and below)			
Junior high school	Junior high school = 1, no = 0	0.3111	0.4630
High school	High school = 1, no = 0	0.1830	0.3867
University	University and above = 1, no = 0	0.1747	0.3797
Marriage	Married = 1, no = 0	0.8068	0.3947
Party membership	Party Membership = 1, no = 0	0.1005	0.3007
Family characteristics			
Family size	Number of respondents' families	4.6379	1.9759
Self-owned housing	Own house = 1, no = 0	0.8473	0.3597
Socio-economic characteristics			
Internet use	Use Internet = 1, not use = 0	0.6416	0.4796
Endowment insurance	Endowment insurance = 1, no = 0	0.5794	0.4937
Income	Continuous variables of respondents' income	8196.22	22,520.71

represents a series of control variables. α_i represents the intercept. γ_i and ρ_i indicates the solve-for parameters. μ_i represents the random error term. What we pay attention to in this article is the significance and positive and negative directionality of the coefficient γ_i.

However, Due to the possibility of endogeneity issues that are mutually causal, regression results may be biased. As far as this article is concerned, the higher the evaluation of social equity among residents, the more likely they are to be influenced by BMIUR, that is, a higher sense of social equity comes from the optimization and improvement of the social security system. In addition, measurement errors and omitted variables can also cause endogeneity issues due to the correlation between explanatory variables and random disturbance terms. The common method to solve endogeneity problems is to select a suitable instrumental variable, we use the causal identification method of finding instrumental variables for BMIUR. Therefore, drawing on existing literature ideas [26], This article uses the URI MI of individuals other than myself in the village (neighborhood committee) where the interviewee is located as an instrumental variable, which can increase the degree of exogenous disturbance of IV to a certain extent, assuming exogeneity holds. The regional level participation rate, as an instrumental variable, can reflect the popularity of local medical insurance policies and is related to the degree of promotion and implementation of local medical insurance policies, which will affect individuals' participation choices. However, the participation rate at the regional level is often not affected by the sense of social equity at the individual level. Specifically at the micro level of this article, Respondents in the same village and neighborhood often share the same policy and economic development environment, and the peer effect makes the coverage rate of other residents closely related to the respondents, meeting the correlation requirements. Meanwhile, BMIUR coverage rate of others will not have a direct impact on the evaluation of the respondents' perception of social equity, making the assumed exogeneity valid.

We continue to use the propensity score matching proposed to make counterfactual estimation to obtain consistent and robust estimation results. Specifically, it divides the samples into two groups, in which the samples covered by BMIUR are regarded as the participation group while the samples outside are regarded as the control group. This method calculates the score factor and pairs the samples in the two groups according to similar characteristics. We conduct counterfactual reasoning on their perceived social equity under the consumption that they are covered by BMIUR. We estimate the average treated effect (ATT) of the BMIUR on resident's sense of social equity. The specific expression formula of propensity score is as follows.

$$P(\mathrm{X_i}) = Pr(exp_i = 1|X_i) \tag{2}$$

X_i is a covariate, which controls variables such as gender, age, marital status, registered residence, education level, family size, family property, income, Internet use and pension insurance. $P(\mathrm{X_i})$ is the calculated propensity score, which refers to the conditional probability that the respondent accepts a policy or chooses a behavior when a set of covariates X_i are assigned. Under the assumption of conditional expectation independence, the propensity score $P(\mathrm{X_i})$ of the respondents is estimated, and the residents covered by BMIUR and not covered by BMIUR are matched, so as to estimate ATT (Average treatment effect for the treated) of the samples covered by BMIUR. The specific formula of ATT is as follows:

$$ATT = \mathrm{E}(Y_{1i}|\mathrm{P} = 1) - \mathrm{E}(Y_{0i}|\mathrm{P} = 1) \tag{3}$$

In Eq. (3), $(Y_{1i}|\mathrm{P} = 1)$ indicates the social equity of the sample within the coverage of BMIUR, $\mathrm{E}(Y_{0i}|\mathrm{P} = 1)$ represents that of samples outside the coverage. Since the latter cannot be observed directly, a "counterfactual" framework is constructed to estimate it. $\mathrm{E}(Y_{0i}|\mathrm{P} = 1)$ is the counterfactual effect of ATT estimation.

In addition, We using the testing procedure of the mediating effects by Baron and Kenny (1986) for reference, test equations are set as follows.

$$Mediator^* = \kappa_i + \beta_i Medicare_* + \epsilon_i X_i + \theta_i \tag{4}$$

$$Fairness^* = \lambda_i + \sigma_i Medicare_i + \zeta_i Mediator_i + \varphi_i X_i + \varpi_i \tag{5}$$

The Eq. (4) is consistent with the variable interpretation in Eq. (1). $Mediator_i$ in the Eq. (4) represents a mediation variables. α_i, κ_i, λ_i are intercepts. μ_i, θ_i, ϖ_i represents the residuals. The coefficient symbols in front of other variables represent relevant interpretation coefficients.

Results

Baseline regression of BMIUR's effect on residents' perceived social equity

After controlling a series of variables, we estimate the impact of BMIUR on residents' perception of social equity. In the baseline regression, the results of Ologit model and 2SLS model are reported respectively. Table 2 shows that the estimated results of Ologit model are significantly positive at 5% statistical level, indicating that URBMIcan significantly improve residents' sense of social equity. After taking endogeneity into consideration, the columns (4) to (6) estimated by 2SLS model show that BMIUR is significant at the statistical level

Table 2 Baseline regression of BMIUR's effect on residents' perceived social equity

Variable	Ologit model			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
BMIUR	0.0937**	0.0826**	0.1010**	0.8008***	0.7599***	0.9961***
	(0.0378)	(0.0380)	(0.0441)	(0.1539)	(0.1682)	(0.2129)
Individual characteristics						
Age	0.0099***	0.0093***	0.0062***	0.0140***	0.0134***	0.0113***
	(0.0016)	(0.0016)	(0.0020)	(0.0019)	(0.0020)	(0.0026)
Gender	− 0.2156***	− 0.2174***	− 0.1704***	− 0.2196***	− 0.2210***	− 0.1285***
	(0.0356)	(0.0357)	(0.0399)	(0.0429)	(0.0429)	(0.0498)
Education level						
Junior high school	− 0.1616***	− 0.1558***	− 0.1099*	− 0.0623	− 0.0680	− 0.0503
	(0.0532)	(0.0533)	(0.0612)	(0.0610)	(0.0610)	(0.0683)
High school	− 0.0896	− 0.0836	− 0.0287	0.1300	0.1152	0.1693*
	(0.0582)	(0.0584)	(0.0682)	(0.0794)	(0.0803)	(0.0898)
University and above	0.1040*	0.1111*	0.1516**	0.5149***	0.4857***	0.5501***
	(0.0631)	(0.0638)	(0.0745)	(0.1053)	(0.1075)	(0.1197)
Marriage	− 0.0414*	− 0.0378	− 0.0333	− 0.0314	− 0.0320	− 0.0270
	(0.0251)	(0.0252)	(0.0269)	(0.0293)	(0.0293)	(0.0311)
Party membership	0.2274***	0.2221***	0.2307***	0.3258***	0.3211***	0.3032***
	(0.0515)	(0.0514)	(0.0549)	(0.0634)	(0.0634)	(0.0660)
Family characteristics						
Family size		0.0075	0.0153		− 0.0107	0. 0137
		(0.0095)	(0.0117)		(0.0119)	(0.0134)
Self-owned housing		0.1613***	0.1664***		0.1369**	0.1391**
		(0.0450)	(0.0506)		(0.0565)	(0.0630)
Socio-economic characteristics						
Internet use			− 0.1804***			− 0.1465**
			(0.0573)			(0.0654)
Endowment insurance			0.1181**			0.1590***
			(0.0469)			(0.0546)
Income			0.0100			0.0806***
			(0.0164)			(0.0234)
Area dummy variable			control			control
R-square						
Sample size	10,283	10,283	8527	10,283	10,283	8527

***, ** and * represent significant at the statistical level of 1%, 5% and 10% respectively, with the standard error of robustness in the brackets

of 1%, indicating that if the endogenous problem is not controlled, its impact on social equity will be underestimated. Moreover, the F-value of the instrumental variable based on 2SLS estimation in the first stage is higher than the empirical value, so there does not exist the problem of weak instrumental variable. Hypothesis 1 of this article has been validated.

From the economic point of view, BMIUR significantly enhances residents' sense of social equity, With the development of social security and other constructions of people's livelihood, the perception of social equity, as a subjective feeling and evaluation of residents, depends on the equity of social security. BMIUR not only promotes the equity of social security, but also improve the overall perception of social equity. The rise of social equity perceived by residents is the specific reflection of the equity of BMIUR. However, due to the differences between the regression results of Ologit model and 2SLS model, it can be confirmed that variable of BMIUR is an endogenous explanatory variable. Therefore, in the following research, we will report the results estimated by 2SLS model.

The control variables in Table 2 are also worth attention. Take the results of column (6) of 2SLS model as an example, the age variable is significantly positive,

indicating that residents' perception of social justice increases with age. Compared with women, male residents have a significantly lower sense of social justice. The variable of education level shows that having received junior middle school education has no significant impact on the sense of social justice, while high school education is significant at the statistical level of 10%, and university education or above can significantly improve the sense of social justice at the statistical level of 1%. Marriage condition has no significant impact on the sense of social equity. Party membership can significantly improve the perception of social justice. In terms of family characteristics, family size has no significant impact while whether they have self-owned housing in the city can significantly improve the sense of social justice. As for the socio-economic characteristics, the use of the Internet will significantly reduce the sense of social fairness, while endowment insurance will improve the sense of social fairness. The higher the income level, the greater people perceive about social equity. For the regression results of control variables are mainly consistent with our expectations, we will not do too much explanatory discussion here as they are not the core concern of this paper.

Robustness test

We make robustness tests from two aspects. Firstly, different variables are used to measure residents' perception of social equity. Residents' perception of the equity of public medical services, self-rated happiness and trust in society are all important constituent elements of social justice, which will directly affect the overall evaluation of social equity of residents. Especially with the improvement of people's sense of happiness and social trust, the effectiveness of the construction of people's livelihood can be directly measured. The reform of the social security system is based on enhancing people's well-being and promoting social equity, which is also an inherent requirement for promoting the high-quality development of China's livelihood. Therefore, in the robustness test, this article selected the above three variables as substitutes, which can effectively complement the sense of social fairness. Therefore, we test how BMIUR affect these variables. The second is to eliminate the influence of outliers. In order to exclude the outliers, we further winsorize all variables by 5% (column 4). Thirdly, reducing the sample interval. As the perception of social equity is often affected by regional differences, especially in the areas with high levels of economic development. These areas will form the choice effect of BMIUR and economic development itself will also affect the positive evaluation of social equity. Therefore, we exclude the samples from Beijing, Shanghai, Guangzhou and Shenzhen. Fourthly, using the 2021 CSS data, we further tested the impact of urban–rural medical insurance integration on social equity by controlling for other variables.

According to our thinking of robustness test above, Table 3 shows that the test result of BMIUR is significantly positive, indicating that there has strong robustness in the conclusion that overall planning of urban and rural medical insurance can promote residents' sense of social equity.

Counterfactual reasoning of PSM

Due to the non-randomness of the objects covered by BMIUR, some unobservable factors (such as individual ability, personality traits, etc.) affecting individual perception of social equity will also affect the coverage of the insurance. We continue to use PSM based on the "counterfactual" framework to conduct counterfactual reasoning, so as to improve the robustness of the conclusion. The premise of PSM is to meet the requirements of sample balance. The test results are shown in Table 4. The standard deviation (% bias) of most variables after matching is less than 10%. Mean Bias decreases by 3.8, and the B-value is 17.2, which is less than 25 as considered by Rosenbaum. The results indicate that the individual deviation between the treatment group and the reference group has been greatly eliminated, meeting the requirements of PSM estimation.

Table 5 shows the ATT results estimated by different matching methods, which are the ATT values of samples in the treatment group and the control group. The results show that after eliminating the significant differences between samples, BMIUR has a significant

Table 3 robustness test of BMIUR affecting residents' sense of social equity

	Public medical services equity	Happiness	Social trust	Front and rear 5% tail reduction	Eliminate development differences
BMIUR	0.6391**	0.1995*	0.7209***	0.7252***	0.9831***
	(0.2752)	(0.1188)	(0.2276)	0.2283	0.2261
Other variables	control	control	control	control	control
Sample size	10,283	10,283	8527	6405	10,283

***, ** and * represent significant at the statistical level of 1%, 5% and 10% respectively. 2SLS estimation is adopted. Standard error of robustness in the brackets

Table 4 Sample balance test of propensity score matching

Balance test		Ps R2	Mean Bias	P	B	R
Perception of social equity	Before matching	0.142	26.4	0.000	93.6	0.58
	After matching	0.005	3.8	0.000	17.2	0.99

Table 5 ATT results of different matching methods

Matching method	Quasi experiment of urban–rural BMIUR		
	ATT	Standard deviation	T statistic
Nearest neighbor matching (1:1)	0.2103***	0.0725	2.90
Nearest neighbor matching (1:4)	0.1979***	0.0592	3.34
Radius matching (0.005)	0.2150***	0.0546	3.93
Kernel matching (default)	0.2003***	0.0537	3.73

***, ** and * represent significant at the statistical levels of 1%, 5% and 10% respectively

positive impact on residents' sense of social equity. Specifically, in the counterfactual reasoning of BMIUR, the ATT values of nearest neighbor matching (1:1), nearest neighbor matching (1:4), radius matching and kernel matching are 0.2103, 0.1979, 0.2150 and 0.2003 respectively. Although there are some differences in the matching values between different methods, they are relatively close to each other on the whole, and are basically consistent with the conclusion of baseline regression results. It further confirms the conclusion that BMIUR can significantly improve residents' sense of social equity.

Test on the mechanism of BMIUR promoting residents' perception of social equity

This part will further explore the mechanism of how BMIUR plays its role in the sense of social equity. In view of this, we test the mechanism of BMIUR affecting residents' sense of social equity based on the mediating effect model. In terms of the definition of mediators, we refer to the definition of social capital, and select residents' participation in the voting of village or residence committees as the defined variable of social capital. For the satisfaction of income distribution, according to the design of the questionnaire "how satisfied are you with the current social income distribution", the corresponding answer are "1 very dissatisfied, 2 dissatisfied, 3 relatively satisfied, 4 very satisfied". Self-paid medical expenses refer to the medical expenses paid by the respondents after deducting the medical insurance reimbursement.

The mediating effect test results are shown in Table 6. Using the 2SLS model for investigation,according to the steps of successive regression, firstly, columns (1), (3) and (5) are to test the impact of BMIUR on mediation variables. The results show that the policy has a significantly positive impact on social capital, satisfaction of income distribution and self-paid medical expenses, which means that BMIUR can improve social capital of people, promote satisfaction of income distribution and reduce self-paid medical expenses. Secondly, after columns (2), (4) and (6) respectively including social capital, satisfaction of income distribution and self-paid

Table 6 Test results of mediating effect

	(1)	(2)	(3)	(4)	(5)	(6)
BMIUR	0.3814***	0.9567***	0.5598***	0.7573***	-0.6382***	0.9918***
	(0.0483)	(0.2211)	(0.1058)	(0.2088)	(0.1821)	(0.2578)
Social capital		0.1034*				
		(0.0566)				
Income distribution				0.4265***		
				(0.0256)		
Self-paid medical expenses						− 0.0546***
						(0.0191)
Constant	− 0.2597***	4.7761***	2.3778***	3.7350***	8.1298***	5.1772***
	(0.0858)	(0.3950)	(0.1912)	(0.3828)	(0.3519)	(0.5235)
Sample size	8527	8527	8527	8527	6325	6325

***, ** and * represent significant at the statistical level of 1%, 5% and 10% respectively. 2SLS estimation is adopted. Standard error of robustness in the brackets

medical expenses into the regression model, the impact of BMIUR is still significant. Meanwhile, the social capital, satisfaction of income distribution and self-paid medical expenses in columns (2), (4) and (6) all have passed the significance test, which shows that after controlling BMIUR, the mediator still have a significant impact on residents' perception of social equity.

From the significance of each variable in the mediating effect test, the mediation effects of social capital, satisfaction of income distribution and self-paid medical expenses constructed in this study do exist, though they are partial mediating effects. The mediating effect of above variables accounts for 0.0396, 0.2396 and 0.0349 respectively of the total effect. ($\beta_i^* \zeta_i/\gamma_i$) It means that 3.96% of the effects of BMIUR on residents' sense of social equity exert through social capital effect, 23.96% through improving the satisfaction of income distribution, and 3.49% through reducing self-paid medical expenses. That is to say, BMIUR can increase the accumulation of social capital, improving satisfaction of income distribution and reducing self-paid medical expenses, therefore indirectly affects residents' sense of social equity. This validates hypothesis 2 in this article.

The impact of BMIUR on the perception of social equity of different groups

Previous research has shown that BMIUR can improve people's perception of social equity. However, due to the differences between individuals, its impact may not be consistent between different groups. On the one hand, there are differences in human capital endowments among different groups, which are reflected in the ability to obtain income and master vocational skills. On the other hand, due to the unbalanced development between different regions in China, it will affect the policy effect and lead to the differences in the evaluation of social equity. In this regard, we group people by income level and digital skills from the perspective of human capital endowment, and investigate the influence of different regions, so as to test the impact of BMIUR between different groups.

Panel A in Table 7 is based on income division. We classify respondents with a monthly income of less than 2000 yuan as the low-income group, and those with more than 2000 yuan as the middle and high-income group. The results based on 2SLS estimation show that BMIUR can significantly improve social equity of the low-income group by 1.46 times, and that of middle and high-income group by 0.7 times. The impact on the social equity of low-income group is twice as much as that of the middle and high-income group, which has significant economic meaning. Panel B is divided according to the digital skills of respondents. According to the frequency of respondents using the Internet to "work or study", "several times a week or almost every day" is defined as the high skill group, and "several times a month and several times a year" are defined as the low skill group. The results show that in the low skill group, BMIUR significantly improves the residents' sense of social equity at the statistical level of 1%, but it is not significant in the high skill group. Panel C is divided into east, middle and west regions. Results show that BMIUR is not significant in the eastern sample, but it has a significant positive impact in the middle and western sub samples. The results mentioned above show that the impact of BMIUR on residents' sense of social equity is more significant in low-income, low skilled and mid-west groups. These analyses validate hypothesis 3 in this article.

Discussion

The relationship between medical insurance and social equity has been extensively discussed in academia. Studies show that the inequality of medical services expenditure is related to the income level to some extent, and this inequality becomes more evident as age grows [27]. Unequal opportunities of health are closely associated with the family social status, which means that the socioeconomic status and health level of parents will affect the

Table 7 Impact of BMIUR on social equity of different groups

variable	Income division (Panel a)		Skill division (panel B)		Area division (panel C)		
	Low-income	Middle and high income	Low skill	High skill	East	Middle	West
BMIUR	1.4658***	0.7027***	1.1519***	0.6203	0.4856	1.3969***	1.0190**
	(0.3894)	(0.2689)	(0.2706)	(0.4089)	(0.4528)	(0.4150)	(0.4988)
Other variables	control	control	control	control	control	control	control
Constant	4.3998***	5.8129***	4.4761***	4.8402***	5.2214***	3.7457***	4.8408***
	(0.5431)	(0.6430)	(0.4531)	(0.8090)	(0.8961)	(0.7013)	(0.8603)
Sample size	4780	3747	5413	2068	1707	2491	1761

***, ** and * represent significant at the statistical level of 1%, 5% and 10% respectively. 2SLS estimation is adopted. Standard error of robustness in the brackets

future generations through intergenerational transmission [28]. Individual health condition can also be affected by their living areas [29]. The study on European inequality of opportunities in health has found that inequality of opportunities is caused by social reproduction in most countries, and the different extend of inequality between countries indicates the importance of institutional arrangements in promoting social equity [30].

China's urban–rural dual structure has been existing for a long time, and it has a profound influence on all aspects of the society. BMIUR as a policy with evident Chinese characteristics, has attracted extensive attention after it was adopted. Up till now, a large number of studies have shown its positive effects. Analyses of China Labor-force Dynamic Survey (CLDs) data show that the implementation of URBMIcan improve the objective and self-rated health level of residents [23]. In rural areas, this policy can encourage medical care seeking behaviors and increase the utilization of medical services. It can also reduce the medical burden of middle-income rural residents [30, 31]. Apart from the health effects, BMIUR also plays an effective role in preventing poverty and effectively improves the resilience from poverty of the permanent population [32]. At the metal level, it can also encourage psychological integration of transient population from countryside [33], therefore stimulating the flow of rural labor force within the city [34].

Studies related to the equity of BMIUR mainly rely on the equal opportunity theory put forward by Roemer and health economics theory to analyze the inequality of medical services utilization and health inequity. Ma et al. [35] linked the compensation and encouragement rules of Roemer to the concept of equity in health economics, and indicated how to use the rules in the BMIUR background. The compensation rule accommodates horizontal equity, which means that when the urban and rural residents are faced with same medical needs, rural residents should be compensated for the limited medical resources so as to ensure their equal opportunities to get medical services as urban residents. Individuals should also be encouraged to seek medical treatment according to his needs so that residents with different requirements can get the needy medical services accordingly. Empirical study shows that discrimination and income gap between rural and urban areas are the most important factors leading to unequal opportunities. By implementing BMIUR, unequal opportunities in medical services utilization and health inequity can be significantly alleviated [31].The empirical analysis results of this article indicate that BMIUR significantly enhances residents' sense of social equity, which is also a concrete manifestation of the effectiveness of China's healthcare system reform.

This article also analyzes the mechanism by which BMIUR affects residents' sense of social equity. From the perspective of positive mechanism, people's expectation of city development comes from their evaluation of public affair. The improvement of social security system can enhance the public confidence in participating in social public affairs, coupled with the income distribution effect of social security itself. Therefore, BMIUR may enhance the sense of social equity by increasing people's confidence in participating in social public affairs and improving the satisfaction of income distribution. Moreover, BMIUR has further improved the treatment level and reimbursement proportion of insured persons, which is conducive to alleviating the financial burden of families and reducing self-paid medical expenses. These results have also been validated in this article, clarifying the specific pathways through which BMIUR affects residents' sense of social equity.

Conclusion

Using the CSS data of 2019, this article analyzes the influence of BMIUR on the perception of social equity of residents and make residents more happiness, on the basis of 2SLS model and mediating effect model. The results show that BMIUR has a significantly positive impact on residents' perceived social equity. That is to say, BMIUR can promote residents' evaluation of social equity and improve the degree of social equity. Even if the explained variables are defined in different ways and taking the influence of sample outliers into consideration, the conclusion remains consistent. We also use the propensity score matching method for counterfactual reasoning, and the research conclusions still remain stable. Mechanism discussion shows that BMIUR can enhance social capital, improve satisfaction of income distribution and reduce self-paid medical expenses, therefore indirectly affecting the perception of social equity. The study also has found that the impact is more obvious in low-income, low skilled and mid-west groups.

This study has important policy implications. Firstly, as an important component of people's livelihood, BMIUR provides a good observation point for the evolution of residents' perception of social equity and make residents more happiness. We should focus on improving people's well-being and promoting social equity, improve the treatment level and financing mechanism of China's basic medical insurance, and better leverage the welfare effect of urban–rural medical insurance coordination. Secondly, We should improve the social security system correspondingly, enhance confidence of residents in participating in public affairs, increase social capital accumulation, Expand people's social networks, and improve

savings of income redistribution, especially by leveraging the regulatory role of social security in income distribution, reducing income inequality, and enhancing people's satisfaction with income distribution. So as to further drive people's evaluation of social equity. Enhance people's self-development ability from the optimization level of social security system, and solve people's worries. In addition, we should pay attention to providing more public services and social protection for the low-income groups, low skilled groups and west part groups in China, so as to improve the welfare effect and policy effect of BMIUR reform.

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Author contributions
XW, LL and DZ designed the study and conducted the primary statistical analysis. LL and XC contributed to the writing. All authors contributed to the revisions.

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Availability of data and materials
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Declarations

Ethics approval and consent to participate
The study design was approved by the ethical review committee of Renmin University of China. All participants gave written informed consent. All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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