Journal of Applied Economics

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/recs20

Economic and health impacts of China's comprehensive health care system reform

Guangya Sun & Yaping Sun

To cite this article: Guangya Sun & Yaping Sun (2024) Economic and health impacts of China's comprehensive health care system reform, Journal of Applied Economics, 27:1, 2425257, DOI: 10.1080/15140326.2024.2425257

To link to this article: https://doi.org/10.1080/15140326.2024.2425257

Published online: 18 Nov 2024.

JOURNAL OF APPLIED ECONOMICS
2024, VOL. 27, NO. 1, 2425257
https://doi.org/10.1080/15140326.2024.2425257

Routledge
Taylor & Francis Group

RESEARCH ARTICLE

OPEN ACCESS Check for updates

Economic and health impacts of China's comprehensive health care system reform

Guangya Sun[a] and Yaping Sun[b]

[a]School of Business, Shantou University, Shantou City, Guangdong Province, China; [b]School of Economics, Zhejiang University of Finance and Economics, Hangzhou City, Zhejiang Province, China

ABSTRACT

We estimate the effects of the Comprehensive Medical Reform (CMR), a large-scale and comprehensive health care system reform in China, on medical burden and health status. Leveraging a time-varying difference-in-differences methodology and utilizing micro-data from the Chinese Family Panel Study (CFPS), we demonstrate that exposure to the CMR leads to significant reduction in individuals' out-of-pocket medical expenses and an improvement in their health status. Notably, there are no substantial changes in total medical expenses. Additionally, we find that the CMR enhances medical satisfaction and level, expands health insurance coverage, and increases residents' propensity to select lower-grade hospitals. Lastly, we uncover that the economic and health effects vary among different groups of individuals.

ARTICLE HISTORY
Received 14 February 2024
Accepted 26 October 2024

KEYWORDS
Health care system; medical burden; health

1. Introduction

A central theme in the study of economic and health inequalities is the allocation of health care resources. The reform of health care systems (HCS) is crucial for addressing these inequalities and promoting the redistribution of medical and health resources. Numerous studies examine the economic and health effects of individual elements of HCS, such as health insurance, medicare, medicaid, etc.[1] Little is known, however, about the policy effects of HCS from a comprehensive perspective.

To achieve comprehensive governance of China's HCS, a holistic healthcare reform pilot program, known as the Comprehensive Medical Reform (CMR), was initiated in 2015. This initiative, grounded in a comprehensive perspective, actively encourages pilot regions to lead reforms and identify advanced practices and models that can be replicated and scaled. This paper treats the CMR policy as a quasi-natural experiment and employs a time-varying difference-in-differences estimator to empirically investigate the effects of CMR on medical burden and health status. Our findings have important implications for

CONTACT Yaping Sun 1872616965@qq.com School of Economics, Zhejiang University of Finance and Economics, No.18, Xueyuan Street, Xiasha Higher Education Park, Hangzhou City, Zhejiang Province 310018, China

[1]The latest studies examine health insurance (see, e.g., Goldin et al., 2021); Medicare (see, e.g., Einav et al., 2022); Medicaid (see, e.g., Brown et al., 2020; Miller et al., 2021).

policymakers and stakeholders interested in improving the healthcare systems in China and other countries.

The empirical results demonstrate that the implementation of CMR does not have a statistically significant influence on the overall medical expenditure and the total medical expense ratio. However, it significantly reduces the out-of-pocket medical expense and the out-of-pocket medical expense ratio, while also improves the health status of individuals. Further analysis reveals that CMR has a positive effect on medical satisfaction and level, as well as an increased likelihood of choosing lower-grade hospitals and expanding the coverage of health insurance. In addition, we explore the heterogeneous impacts of CMR on different subgroups of the population. Our results indicate that it has a more pronounced impact on urban residents, females, senior adults, those residing in the eastern region, high-income group and high-education group in terms of reducing medical burden. Additionally, the benefits of CMR are more pronounced for urban residents, females, the elderly, those residing in the central and western regions, low-income group and low-education group in terms of improving health status.

The present study offers two major contributions to the existing literature on healthcare systems. First, most of the previous studies in this field have focused on analyzing individual elements of the Chinese HCS, neglecting the fact that the Chinese HCS comprises several interrelated and complementary elements. This approach limits the capacity to draw reliable conclusions, as the analysis of a single component is often influenced by other components. A handful of studies have taken a global perspective to explore the Chinese HCS, such as Atella et al. (2015) evaluated the impact of the 1998 Chinese healthcare reform, Yang et al. (2016) assessed the initial effects of the new healthcare reform in China, L. Li and Fu (2017) discussed the progress and future prospects of China's healthcare reform since 2009. Others have discussed specific aspects of the system, such as Zhang et al. (2016) and Luan et al. (2020) both focused on China's public hospital reform. In contrast, our study adopts a comprehensive perspective to enrich the literature on China's HCS.

Second, the medical burden is an important indicator of residents' ability to pay for medical services and is closely related to economic inequality, which in turn affects health inequality. The literature has focused on residents' medical burden from the perspective of medical expenditure, with many scholars suggesting that insurance can reduce medical costs (B. Huang et al., 2016; Sepehri et al., 2006; Yang et al., 2016). Nevertheless, some studies have concluded that insurance has no impact or even increases medical costs (Frankovic & Kuhn, 2023; Lei & Lin, 2009; Liu & Zhao, 2014; Wagstaff et al., 2009). Other literature has focused on residents' medical burden from out-of-pocket medical expenditure (Atella et al., 2015; Cheng et al., 2018; Finkelstein & McKnight, 2008; Garcia-Diaz & Sosa-Rub, 2011; Limwattananon et al., 2015; Purcel et al., 2023). However, given that the increase in medical expenditure may be due to technological advances or residents' improved access to medical resources. To address this gap in the literature, this paper examines medical burden from two perspectives: absolute medical expenditure and relative medical expenditure. Moreover, the medical expenditure includes both total medical expenditure and out-of-pocket medical expenditure. Compared to previous studies, the research indicators in this paper are more comprehensive and objective.

The remainder of the article proceeds as follows. Section 2 provides institutional and theoretical background. Section 3 provides information about our data and summary statistics. Section 4 analyzes the effects of CMR on medical burden and health status.

Section 5 examines the robustness of our results. Section 6 presents the further analyses. Section 7 discusses the heterogeneity in our results. The last section concludes.

2. Institutional and theoretical background

2.1. Institutional background

Following the establishment of the People's Republic of China, the state of basic healthcare was abysmal, with communicable, endemic, and parasitic diseases posing a significant threat to the population. Against the backdrop of a socialist planned economy and public ownership, the government implemented a fundamental strategy to strengthen primary healthcare services. Through the enhancement of living conditions, such as access to clean drinking water and improved sewage systems, the incidence and mortality rates of infectious, endemic, and parasitic diseases have been significantly reduced. The mortality rates of Class A and B notifiable infectious diseases per 100,000 individuals in China declined from 18.43 in 1955 to 4.39 in 1980.

Since the initiation of China's reform and opening up, the economy has experienced a remarkable growth trajectory that has been accompanied by a notable upswing in the quality of life and health habits of the populace. However, the extant health supply has failed to keep pace with the augmenting demands of the residents. To address the heterogeneous and individualized medical requisites of the citizens, the health system has undergone a market-oriented transformation under the socialist market economy. In this context, the provisioning of medical services has been elevated markedly, with the number of health institutions escalating from 181,000 in 1980 to 100,5000 in 2002.[2]

The planned healthcare system and the new market-oriented system are in conflict, giving rise to a plethora of problems including unequal distribution of medical services, overtreatment by medical institutions, and non-standard conduct resulting in friction between doctors and patients. Moreover, the shift towards market-oriented healthcare reform has caused a slowdown in the development of community-level and public healthcare. In 2002, the coverage rate of rural cooperative medical insurance was a mere 9.5%, with 79% of rural inhabitants lacking any medical insurance.[3] In response, the New Rural Cooperative Medical system was introduced in 2003, followed by the pilot of basic medical insurance for urban residents in 2007. By 2008, the participation rate of the new rural cooperative medical system had reached 91.5%, and more than 80% of residents had basic medical insurance.

The government's financial contributions have undoubtedly enhanced the provision of healthcare services at the grassroots level. However, the marketization of certain medical services has resulted in a distortion of medical behaviors, leading to a widespread overtreatment phenomenon and a consequent rise in tension between doctors and patients. Furthermore, the issues of "difficulty in seeing a doctor" and "expensive medical care" have become increasingly prominent. The most conspicuous manifestation of these problems is the rapid increase in household health expenditures, with data indicating an average annual growth rate of 9.5% in health expenditure per capita, and a 55% and 140% increase in outpatient and inpatient expenses per capita, respectively, from 2003 to 2008.[4]

[2]The data are from China Health and Family Planning Statistical Yearbook.
[3]The data are from China Health and Family Planning Statistical Yearbook.
[4]The data are from China Health Service Survey in 2008.

Consequently, in 2009, the State Council issued "the Opinions of the CPC Central Committee and the State Council on Deepening the Reform of the Health System," which marked the beginning of a new phase of HCS reform.

Following the introduction of the new HCS policy, the government of China saw a remarkable increase of 2.2 times in its health expenditure from 2009 to 2014. This surge in funding was instrumental in the significant improvement of China's health facilities and medical conditions, with the number of medical institutions augmenting by 5,569, and medical beds increasing by 2,184,600 during the same period.[5] The implementation of the HCS reform has bolstered the supply capacity of China's health services, promoted the accessibility of health services, and mitigated the perennial issue of inadequate access to medical care. Notably, the total number of visits to medical institutions rose from 5.488 billion to 7.602 billion, indicating a marked improvement in the delivery and uptake of health services.

HCS reform remains a critical issue worldwide, characterized by both shared objectives and unique approaches. A key similarity among national HCS reforms is the pursuit of universal healthcare coverage. Exemplary models include the United Kingdom's National Health Service (NHS) and Canada's Medicare System, both of which ensure healthcare access for all citizens regardless of financial status (Kutzin, 2013). These frameworks underscore the essential role of government intervention in healthcare financing and regulation, fostering equity and reducing out-of-pocket expenditures for individuals. Conversely, the United States has adopted a market-driven approach, exemplified by the Affordable Care Act (ACA) of 2010. The ACA aims to expand healthcare coverage through a combination of mandates, subsidies, and insurance exchanges, while maintaining a substantial presence of private insurance entities (Obama, 2016). This contrast reflects the complexity and heterogeneity of healthcare systems within developed countries.

In comparison to international healthcare reforms, China's public healthcare reform has progressively transitioned from a market-oriented framework to a public welfare-oriented paradigm. Since the inception of the New Cooperative Medical Scheme (NCMS) for rural populations and the Urban Resident Basic Medical Insurance (URBMI), China has made significant strides in enhancing healthcare accessibility (Yip et al., 2012). Nevertheless, the healthcare system still faces challenges, including urban-rural healthcare service disparities, substantial out-of-pocket expenses, and operational inefficiencies (Barber et al., 2014; X. Li et al., 2020; Sun et al., 2017).

In order to accelerate the reform of the HCS and facilitate the coordinated development and governance of health insurance, health care, and medicine, the State Council approved the pilot program of CMR in Jiangsu, Anhui, Fujian, and Qinghai provinces in 2015. Furthermore, Shanghai, Zhejiang, Hunan, Chongqing, Sichuan, Shanxi, and Ningxia were later incorporated as additional pilot provinces. The government is actively encouraging pilot regions to spearhead the reform and identify advanced practices and models that can be replicated and promoted. The CMR represents a critical phase in the reform of the HCS. Therefore, the key issue of health system reform at the current stage of development, and a practical concern for residents, is whether the CMR policy can effectively reduce the medical burden and improve the overall health status of the population.

[5]The data are from China Health and Family Planning Statistical Yearbook.

2.2. Theoretical background

In response to the issue of "expensive medical treatments," the CMR pilot has proposed significant reform measures. First, the CMR policy emphasizes the public welfare nature of healthcare and advances the reform of public hospitals. Second, it promotes market-based pricing of medical services and establishes a pricing system that reflects the value of medical labor and services. Third, the CMR optimizes the medical insurance system by gradually increasing government investment and stabilizing the basic medical insurance coverage rate. Fourth, by reforming the medical insurance payment methods and standardizing medical practices, it aims to control costs and improve efficiency. Therefore, we propose the following hypothesis:

Hypothesis 1: CMR can reduce the healthcare burden on residents.

The primary objective of healthcare reform is to enhance the health status of the population, which is also the ultimate goal of CMR. Various strategies within healthcare reform can directly or indirectly influence health outcomes. For example, healthcare reform initiatives can increase the accessibility of medical resources, thereby improving population health (Mooney, 1998). Consequently, we propose the following hypothesis:

Hypothesis 2: CMR can enhance the health outcomes of residents.

3. Data

The main data used in this study is the Chinese Family Panel Study (CFPS), which is a nationally representative household survey. The CFPS was first conducted in 2010 by the Institute of Social Science Survey at Peking University, followed by other waves in 2012, 2014, 2016, 2018 and 2020. The survey covers 31 provinces/autonomous regions and implements multistage probability proportional to size sampling with implicit stratification, where administrative districts and socioeconomic status serve as the main stratification variables. It contains details about each respondent's demographic characteristics, socioeconomic status, education level, medical expenditure, health-related outcomes, and many other respects. Our work uses survey data from 2012, 2014, 2016, 2018 and 2020.[6] When constructing the regression sample, we delete observations with missing values (e.g., respondents whose information on age, gender, education years, or marriage are missing) and restrict our analysis to individuals whose age is above 16.

3.1. Variable specification

The empirical analysis will be performed at individual level from two perspectives: medical burden and health status. The explained variables in this paper mainly include absolute medical expense, relative medical expense, and health. Absolute medical

[6]The wave of the CFPS conducted in 2010 don't contain information on out-of-pocket medical expenditures, and the classification criteria for self-rated health in 2010 are inconsistent with other years. Therefore, survey data from 2010 are not used in this paper.

expense refers to total medical expenditure and out-of-pocket medical expenditure. Total medical expense is the sum of medical expense, treatment expense, hospital room fee, examination fee, injury expense and so on. Out-of-pocket medical expense is defined as the difference between total medical expense and the amount of the reimbursement.[7]

Relative medical expense includes total medical expense ratio and out-of-pocket medical expense ratio. We measure the total medical expense ratio as the ration between total medical expense and personal income. We measure the out-of-pocket medical expense ratio as the ration between out-of-pocket medical expense and personal income. Personal income refers to the total income of the past year, including personal salary, bonus, cash benefits, subsidies in kind, and deducting taxes, five social insurance and one housing fund. We first convert the amount of medical expense into real terms using the provincial-level CPI (base year 2012 = 100) before transforming the value into logarithm form. Total medical expense, out-of-pocket medical expense, and personal income are expressed in RMB yuan.

Self-rated health (SRH) indicator is selected to measure an individual's health status (Antman, 2010; F. Huang & Gan, 2016). SRH is based on respondent's answer to a question about their current health. In the survey, it is derived from the question "How would you rate your health status?". The respondent is asked to rate his current health status on a five-point scale ranging from 1(very unhealthy) to 5 (very healthy). SRH is a subjective indicator, which captures quality of life and describes an individual's comprehensive picture of health. Previous literature suggests that the SRH could have high predictive power for mortality, loss of functional ability, sick and do on (Idler & Kasl, 1995; Schmitz, 2011).

We also examine other effects of CMR from the following aspects: 1) medical satisfaction, 2) medical level, 3) hospital grade, 4) medical insurance coverage. Besides these variables, we control a set of variables in our regression, including gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds. Table 1 provides detailed information on all the variables used in the analysis and Table 2 presents descriptive statistics for these variables.

Table 1. Variable descriptions.

Variable Name	Definition
Explained variables	
Total medical expenditure	Total medical expenses include medical fees, treatment costs, hospital room charges, examination fees, injury-related expenses, and so on.
Out-of-pocket medical expenditure	Out-of-pocket medical expenses are defined as the difference between the total medical expense and the reimbursement amount.
Total medical expense ratio	The total medical expense ratio is the ratio between total medical expense and personal income.
Out-of-pocket medical expense ratio	The out-of-pocket medical expense ratio is the ratio between out-of-pocket medical expenses and personal income.
SRH	The respondent is asked to rate his current health status on a five-point scale ranging from 1(very unhealthy) to 5 (very healthy).
Other variables	
Medical satisfaction	Medical satisfaction is derived from the question "Are you satisfied with the hospital conditions?". The respondent is asked to rate his satisfaction on a five-point scale ranging from 1(very dissatisfied) to 5 (very satisfied).

(*Continued*)

[7]It should be noted that the CFPS 2012 data are missing on out-of-pocket medical expense. Therefore, when studing related to out-of-pocket issues, this paper only uses data from 2014, 2016, 2018, and 2020.

Table 1. (Continued).

Variable Name	Definition
Medical level	Medical level is derived from the question "What do you think of the medical level of the clinic?". The respondent is asked to rate his evaluation on a five-point scale ranging from 1(very bad) to 5 (very good).
Hospital grade	This paper assigns a value of 1 to clinics and 5 to general hospitals, with a lower value representing a lower hospital grade.[8]
Medical insurance	Medical insurance is a dummy variable that takes the value of 1 if the respondent has any form of medical insurance at the time of the interview and 0 otherwise.[9]
Explanatory variable	
Comprehensive reform	Comprehensive reform is represented by a dummy variable, where 1 indicates that the individual is exposed to CMR, and 0 indicates otherwise.
Control variables	
Gender	Male is coded as 1 and female is coded as 0.
Hukou type	Urban is coded as 1and rural is coded as 0.
Age	Year of survey minus year of birth.
Years of education	Years of education are obtained by converting the degree level.[10]
Marital status	Married is coded as 1 and 0 otherwise.
Status of work	Employed individual is coded as 1 and 0 otherwise.
Smoking	Smoking is coded as 1and 0 otherwise.
Frequency of physical exercise	The number of exercises per month.
Drinking	Individual who consumed alcohol three or more times per week in the past month is coded as 1and 0 otherwise.
Sleeping quality	Sleeping quality is derived from the question "How often do you not sleep well?". Respondents rate their sleep quality on a four-point scale ranging from 1 to 4, with 1 indicating rarely (less than one day), 2 indicating occasionally (one to two days), 3 indicating frequently (three to four days), 4 indicating most days (five to seven days).
Industrial sulfur dioxide emissions	The unit of industrial sulfur dioxide emissions is 10,000 tons, and in logarithmic form.
Industrial wastewater discharge	The unit of industrial waste emissions is 10,000 tons, and in logarithmic form.
Industrial solid waste emissions	The unit of industrial solid waste production is 10,000 tons, and in logarithmic form.
Number of general practitioners	Number of general practitioners refer to the number of general practitioners per ten thousand people and in logarithmic form.
Number of beds	Number of beds refer to the number of hospital beds per thousand people and in logarithmic form.

3.2. Rationalization of the method

The purpose of carrying out the pilot is to form advanced experience for the whole country, in theory, the selection of pilot provinces must be representative and random. CMR began in 2015 and was only implemented in Anhui, Jiangsu, Qinghai, and Fujian areas; In 2016, Shanghai, Zhejiang, Hunan, Chongqing, Sichuan, Shanxi, and Ningxia were added to the list of pilot provinces for CMR. The two batches of pilot provinces cover three regional provinces in eastern, central,

[8]Hospital grade refers to the type of hospital an individual usually chooses when seeking medical care, including clinic, community/village health service station, community health service hospital/township health center, specialized hospital, and general hospital. "Clinic" usually refers to a private clinic as well as a village/community clinic with poor medical facilities. "Community/village health service station" means a medical institution located at the neighborhood committee/village level for the diagnosis and treatment of common diseases. "Community health service hospital/township health center" means the medical institution located at the subdistrict/township level for the diagnosis and treatment of common diseases. "Specialized hospital" refers to a hospital dealing with certain kinds of diseases, such as a maternity hospital. "General hospital" is usually a large hospital that treats all kinds of diseases.

[9]Health insurance includes free medical insurance, medical insurance for urban employees, medical insurance for urban residents, supplementary medical insurance, and new rural cooperative medical care.

[10]0 year for illiteracy/semi-illiteracy, 6 years for primary school, 9 years for junior high school, 12 years for senior high school (vocational), 15 years for junior college, 16 for undergraduate, 19 for master's degree and 22 for doctor.

Table 2. Summary statistics of variables.

Variables	Obs.	Mean	Std. dev.	Min	Max
Explained variables					
Total medical expenditure	79585	4164.2257	17532.4400	1	300060
Out-of-pocket medical expenditure	52710	2994.0030	9811.0210	1	510000
Total medical expense ratio	21191	2.6007	81.1190	0.0001	8000
Out-of-pocket medical expense ratio	10395	0.9503	29.2311	0.0001	2500
SRH	123333	2.9203	1.2189	1	5
Other variables					
Medical satisfaction	130755	3.5625	0.7393	1	5
Medical level	130687	3.4335	0.7987	1	5
Hospital grade	132591	2.9958	1.5328	1	5
Medical insurance	153411	0.8939	0.3080	0	1
Explanatory variable					
Comprehensive reform	123333	0.0918	0.2876	0	1
Control variables					
Gender	123333	0.4955	0.4988	0	1
Hukou type	123333	0.4772	0.4989	0	1
Age	123333	47.8355	15.4197	16	96
Years of education	123333	7.0002	4.9639	0	23
Marital status	123333	0.8444	0.3577	0	1
Status of work	123333	0.7166	0.4514	0	1
Smoking	123333	0.3011	0.4590	0	1
Frequency of physical exercise	123333	2.7853	3.3754	0	50
Drinking	123333	0.1574	0.3641	0	1
Sleeping quality	123333	1.7765	0.9212	1	4
Industrial sulfur dioxide emissions	123333	3.8065	0.7775	0.1001	4.8203
Industrial wastewater discharge	123333	8.1969	1.3405	1.9459	11.0258
Industrial solid waste emissions	123333	4.9847	2.3068	0.2003	10.4840
Number of general practitioners	123333	1.6987	1.0844	0.1100	5.9400
Number of beds	123333	5.3972	1.0132	2.7200	7.9500

Data for variables related to out-of-pocket are obtained from CFPS 2014, 2016, 2018, and 2020. Data for remaining variables are obtained from CFPS 2012, 2014, 2016, 2018, and 2020. The minimum value 1 for total medical expenditure and out-of-pocket medical expense is based on observed data.

and western China, with good national representation. Therefore, we use a time-varying difference-in-differences approach to value the effect of CMR on medical burden and health status.

The difference-in-differences regression methodology requires the control group to have the similar time trends as the treatment group in the medical burden and health during the pretreatment period, so that the non-CMR provinces after the policy implementation constitutes a valid counterfactual. To identify the validity of the assumption given the small amount of data for the prior years, we follow an approach used by Gentzkow (2006) and Agarwal and Qian (2014). Specifically, we observe whether the difference of outcome variables between the treatment group and the control group are significant after controlling the covariates during the pretreatment period. In this study, we regress the outcome variables with whether the individual lives in the pilot regions using the data of CFPS 2012 and 2014.

The results are showed in Table 3. It is easy to see that none of these characteristics exhibit any statistically significant difference between the treatment and control groups, which have provided some credence to the parallel-trend assumption.

Table 3. Pre-parallel test.

	Absolute medical burden		Relative medical burden		Health
	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
T	1.7009	0.0633	0.5900	-0.1333	0.0316
	(1.0782)	(0.0847)	(0.6033)	(0.1020)	(0.5092)

1. Data in columns (1), (3), and (5) are obtained from CFPS 2012 and 2014. Data in columns (2) and (4) are obtained from CFPS 2014.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise variables, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. T is a dummy variable, which is set to 1 if the individual lives in the pilot regions and 0 otherwise.
4. Standard errors are in parentheses.

4. The effects of CMR on medical burden and health status

4.1. Estimation strategy

To evaluate the effects of CMR on medical burden and health status, we use a time-varying difference-in-differences method to analysis. We adopt a simple econometric strategy based on the estimation of the following specification:

$$Y_{ict} = \alpha + \beta R_{ct} + \gamma X_{ict} + \theta_t + \mu_c + \pi_i + \varepsilon_{ict} \quad (1)$$

Where i indexes the individual, c is the province of residence, t represents the survey year. Y_{ict} is a measure of total medical expense, out-of-pocket medical expense, total medical expense ratio, out-of-pocket medical expense ratio or health for individual i, living in province c in year t. R_{ct} represents key explanatory variable, which is a dummy variable representing whether an individual is exposed to CMR during the survey year. X_{ict} is a vector of control variables which includes gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.

π_i is an individual fixed effect which can capture unobserved and time-invariant characteristics of each respondent. Province of residence fixed effect, μ_c, absorbs any time-invariant determinants of medical burden and health for individuals living in a particular province. We also include the survey year (wave) fixed effect θ_t to control for time-varying determinants of medical burden and health common to the same year. ε_{ict} is a random error term consisting of all of the unobserved factors. We cluster the standard errors at the province level to account for correlations in outcomes between individuals in the same province.[11]

4.2. Empirical results

Table 4 reports the estimations of Equation (1) where the dependent variables are total medical expense, out-of-pocket medical expense, total medical expense ratio, out-of-

[11]We also capture the model with clustered standard errors at individual level, the statistical significance of target variables does not change.

Table 4. Effects of CMR on medical burden and health status.

	Absolute medical burden		Relative medical burden		Health
	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
R	0.0366	-0.0611**	-0.0473	-0.2296***	0.0320***
	(0.0294)	(0.0232)	(0.0704)	(0.0610)	(0.0094)
Control variables	Yes	yes	yes	Yes	yes
Year FE	Yes	yes	yes	Yes	yes
Province FE	Yes	yes	yes	Yes	yes
Individual FE	Yes	yes	yes	Yes	yes
Observations	79585	52710	21191	10395	123333
R-squared	0.0738	0.0422	0.0790	0.0211	0.0091

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. Data in columns (1), (3), and (5) are obtained from CFPS 2012, 2014, 2016, 2018, and 2020. Data in columns (2) and (4) are obtained from CFPS 2014, 2016, 2018, and 2020.

***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

pocket medical expense ratio and health. Columns from (1) to (2) report the estimated coefficients for absolute medical burden. In column (1), the effect of the CMR on the total medical expense is small in size and statistically insignificant, representing that the CMR don't affect this variable. Columns (2) demonstrates that CMR and out-of-pocket medical expense have a significantly negative relation at the 5% level, indicating that exposure to CMR can reduce individual's out-of-pocket medical expense by 6.11%.

Columns from (3) to (4) show the estimated coefficients for relative medical burden. Columns (3) demonstrates the estimation is insignificant, suggesting that CMR don't affect total medical expense ratio. In column (4), we find that the estimated coefficient is negative and significant at the 1% level, indicating that out-of-pocket medical expense ratio is reduced by 22.96% for individuals exposed to CMR. Columns (5) represents the estimated coefficient for health status. As discussed in columns (5), the estimated coefficient for health outcome is positive and significant at the 1% level, which implies that CMR significantly increases the likelihood for the treated group to have better health status.

To sum up, CMR can significantly reduce residents' burden, especially from a relative point of view, and also significantly improve residents' health.

5. Robustness analysis

To examine that our empirical results are not driven by idiosyncratic model specifications and measurement errors of the variables, we conduct a battery of robustness checks, which are showed in this section.

5.1. Event study

The validity of our identification strategy relies on the assumption that in the absence of the CMR, the trend in medical burden and health outcome would have been similar

across regions at different times. In the following, we test parallel trend assumptions through the event study model. The event study model allows us to explore the timing of CMR more systematically and to evaluate the validity of the research design. The model is designed as follows:

$$Y_{ict} = \alpha + \sum_{k=-2}^{k=1} \beta_k R_{ck} + \gamma X_{ict} + \theta_t + \mu_c + \pi_i + \varepsilon_{ict} \quad (2)$$

Where the dummy variable, R_{ck}, is equal to 1 in the c area with CMR k period before or after the reform, and equal to 0 otherwise. In particular, $k = 0$ denotes the period when province c carried out CMR. The reference period is $k = -1$. The parameters of interest β_k identify the effects of CMR k period following or preceding its implementation, relative to the last pre-CMR event period in the sample. The other variables in equation (2) are the same as in equation (1).

Table 5 presents the results of the regression analysis. As demonstrated by the estimates in columns (1), (3), and (5), none of the regression coefficients prior to the implementation of the policy display statistical significance. This indicates that both CMR and non-CMR regions experienced similar trends over time with respect to total medical expenses, total medical expense ratios, and SRH prior to the introduction of the CMR reform. Upon examining the post-implementation results in columns (1) and (3), we find no statistically significant effects on total medical expenses and total medical expense ratios, suggesting that the policy had no discernible impact on these outcomes. However, the results in column (5) are significantly positive, indicating that CMR has had a positive effect on health outcomes.

Furthermore, upon analyzing the coefficients in columns (2) and (4), we find that the estimates for out-of-pocket medical expenses are statistically significant and gradually

Table 5. Event study.

	Absolute medical burden		Relative medical burden		Health
	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
R_{-2}	0.0043		0.1282		-0.0128
	(0.0281)		(0.1300)		(0.0144)
R_0	0.0459	-0.0711**	0.0168	-0.3122***	0.0401**
	(0.0308)	(0.0250)	(0.0771)	(0.0866)	(0.0140)
R_1	0.0457	-0.0467	-0.0018	-0.2709***	0.0233*
	(0.0430)	(0.0488)	(0.0863)	(0.0694)	(0.0138)
Control variables	Yes	yes	yes	Yes	yes
Year FE	Yes	yes	yes	Yes	yes
Province FE	Yes	yes	yes	Yes	yes
Individual FE	Yes	yes	yes	Yes	yes
Observations	79585	52710	21191	10395	123333
R-squared	0.0738	0.0422	0.0793	0.0220	0.0079

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. Data in columns (1), (3), and (5) are obtained from CFPS 2012, 2014, 2016, 2018, and 2020. Data in columns (2) and (4) are obtained from CFPS 2014, 2016, 2018, and 2020.

***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

decrease over time. This implies that the effect of CMR on out-of-pocket medical expenses diminishes in the long run. In contrast, the coefficients for out-of-pocket medical expense ratios are statistically significant, indicating that CMR has a long-term effect on reducing the proportion of medical expenses that patients must pay out-of-pocket.

5.2. Remeasure the explained variable

First, it is noteworthy that medical expenses form a significant part of the overall family expenditure, and the ratio between medical expenses and family expenses can be employed as a measure of the medical burden on the family.[12] In this part, we have identified two key indicators, namely the ratio between total medical expenses and family expenses, and the ratio between out-of-pocket medical expenses and family expenses, to gauge the relative medical burden of the family. Second, it is imperative to acknowledge that SRH is subject to individual heterogeneity and may be prone to errors (Campolieti & Goldenberg, 2007; Disney et al., 2006). Moreover, given that SRH relies on subjective evaluations, we have incorporated the objective evaluation index of body mass index (BMI) to assess the overall health of the residents.[13] Third, based on the relevant literature (Bird et al., 2010; Chiu et al., 2001), we have included indicators of illness, chronic conditions, and instrumental activities of daily living (IADL) as metrics of physiological health.[14]

The estimation results pertaining to different measures of relative medical burden and health status are presented in Table 6. The findings indicate that the implementation of CMR significantly reduces out-of-pocket medical expenses, illness, chronic, IADL while improving BMI. However, it does not decrease the total medical expense ratio. These results are consistent with the main regression findings presented in Table 4, thereby affirming the robustness of our primary empirical analysis.

5.3. Adding family-level control variables

The 2020 wave of the CFPS survey did not include family-level variables, and therefore, only individual-level variables were controlled for in the baseline

[12]Household expenditure refers to the total expenditure of the family in the past 12 months, including expense on clothing, food, housing, transportation, education, medical care, cultural leisure, social gifts and so on. The wave of the CFPS conducted in 2020 don't contain information on household expense, so we only uses data from 2012, 2014, 2016 and 2018 in this part.

[13]BMI is a widely used indicator to measure health. BMI is defined as one's weight in kilograms divided by the square of the body height in meters. The related information of respondent's weight and height can be found in CFPS. Many studies indicates that the value of BMI which is too high or too low could increase the incidence of diseases (Ellekjaer et al., 2001; Kalmijn et al., 1999; Wu et al., 2008). BMI is a dummy variable, which takes the value of 1 if his/her BMI is greater than 25 or less than 18 and 0 otherwise.

[14]The illness indicator is derived from the question "Have you experienced any physical discomfort in the past two weeks?", with 1 indicating "Yes" and 0 otherwise. The chronic condition is based on the question "Have you been diagnosed with any chronic diseases by a doctor in the past six months?", with 1 indicating "Yes" and 0 otherwise. The IADL score is derived from the question "Which of the following activities can you not complete independently: outdoor activities, eating, kitchen tasks, using public transportation, shopping, housekeeping, and laundry?". A higher IADL score signifies a greater number of daily activities that cannot be completed independently, indicating a lower level of physiological health.

Table 6. Robustness analysis: remeasure the explained variable.

	Relative medical burden		Health	Physiological health		
	Total medical expense ratio (1)	Out-of-pocket medical expense ratio (2)	BMI (3)	Illness (4)	Chronic (5)	IADL (6)
R	-0.0347	-0.0693**	0.0129**	-0.0121*	-0.0770**	-0.1100**
	(0.0353)	(0.0277)	(0.0049)	(0.0060)	(0.0265)	(0.0407)
Control variables	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Province FE	yes	yes	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes	yes	yes
Observations	66001	40009	91198	126699	126683	80772
R-squared	0.0620	0.0235	0.0101	0.0020	0.0130	0.0380

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. Data in columns (1) and (3)-(6) are obtained from CFPS 2012, 2014, 2016 and 2018. Data in columns (2) are obtained from CFPS 2014, 2016 and 2018.

***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

regression. To address the potential bias caused by the omission of family-level variables, we included control variables that may affect an individual's medical burden and health status at the family level. These control variables encompassed household income, the use of safe water (represented by a dummy variable assigned a value of 1 for tap water, mineral water, purified water, or filtered water and 0 otherwise), and the use of clean fuels (represented by a dummy variable assigned a value of 1 for gas, liquefied gas, natural gas, solar energy, biogas, or electricity and 0 otherwise). The regression results are presented in Table 7, which reveals that the estimated coefficients for medical burden and health outcomes are consistent with the baseline results reported in Table 4, indicating the robustness of our main regression findings.

5.4. PSM-DID estimation

To address potential confounding factors arising from differences in individual characteristics between the treatment and the control group, we employed the propensity score matching-difference-in-differences (PSM-DID) method to assess the effects of CMR on medical burden and health status. Specifically, we estimated the propensity score, which represents the likelihood of individuals migrating to pilot provinces, using a logit regression model (Eq.(1)). The dependent variable was a binary indicator of whether individual*i*resided in a pilot province, while the covariates included gender, age, hukou types, marital status, years of education, work status, smoking status, and frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.

Table 7. Robustness analysis: adding family-level control variables.

	Absolute medical burden		Relative medical burden		Health
	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
R	0.0317	-0.0602*	-0.0552	-0.2099***	0.0297***
	(0.0355)	(0.0317)	(0.0621)	(0.0477)	(0.0070)
Control variables	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
Province FE	yes	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes	yes
Observations	66500	40411	16117	6104	100029
R-squared	0.0683	0.0387	0.0988	0.0220	0.0107

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds, household income, safe water, and clean fuel.
3. Data in columns (1), (3) and (5) are obtained from CFPS 2012, 2014, 2016, and 2018. Data in columns (2) and (4) are obtained from CFPS 2014, 2016, and, 2018.

***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

We employed a kernel matching technique for PSM analysis.[15] Subsequently, we applied the DID method to estimate the impacts of CMR on medical burden and health status. Regression results are presented in Table 8, and the estimated coefficients align with those reported in Table 4, suggesting the robustness of our baseline regression results.

5.5. Removing part of pilot provinces

The implementation of CMR began in 2015 and was initially only implemented in Anhui, Jiangsu, Qinghai, and Fujian. Subsequently, in 2016, Shanghai, Zhejiang, Hunan, Chongqing, Sichuan, Shanxi, and Ningxia were added to the list of pilot provinces for CMR. In this study, we primarily employ a time-varying difference-in-differences estimator to empirically investigate the effects of CMR. Here, we focus on the seven pilot provinces of CMR in 2016 as the treated group and employ DID regression to evaluate the impacts of CMR.[16] Our analysis, presented in Table 9, reveals that the estimated coefficients are consistent with the results of regression in Table 4, providing evidence for the robustness and validity of our baseline regression.

6. Further analysis

In this section, we endeavor to delve into the various other effects that impact the CMR and strive to uncover the underlying mechanisms that influence healthcare expenditure and overall health outcomes. Given that CMR encompasses a multitude of reform

[15]The kernel function used for kernel matching in this paper is quadratic kernel, and the bandwidth is 0.06.
[16]We also deleted the pilot provinces in 2016, and only retained the pilot provinces in 2015. The results have not changed significantly.

Table 8. Robustness analysis: PSM-DID estimation.

	Absolute medical burden		Relative medical burden		Health
	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
R	0.0389	-0.0630**	-0.0466	-0.2407***	0.0336***
	(0.0401)	(0.0235)	(0.0577)	(0.0660)	(0.0100)
Control variables	yes	yes	Yes	yes	yes
Year FE	yes	yes	Yes	yes	yes
Province FE	yes	yes	Yes	yes	yes
Individual FE	yes	yes	Yes	yes	yes
Observations	78498	50990	21005	10221	120082
R-squared	0.0744	0.0488	0.0802	0.0228	0.0103

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. Data in columns (1), (3) and (5) are obtained from CFPS 2012, 2014, 2016, 2018, and 2020. Data in columns (2) and (4) are obtained from CFPS 2014, 2016, 2018, and 2020.

***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

Table 9. Robustness analysis: removing part of pilot provinces.

	Absolute medical burden		Relative medical burden		Health
	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
R	0.0341	-0.0594*	-0.0439	-0.2172***	0.0301**
	(0.0399)	(0.0330)	(0.0602)	(0.0492)	(0.0122)
Control variables	yes	yes	Yes	yes	yes
Year FE	yes	yes	Yes	yes	yes
Province FE	yes	yes	Yes	yes	yes
Individual FE	yes	yes	Yes	yes	yes
Observations	69678	47003	16880	8205	102649
R-squared	0.0701	0.0401	0.0688	0.0201	0.0112

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. Data in columns (1), (3) and (5) are obtained from CFPS 2012, 2014, 2016, 2018, and 2020. Data in columns (2) and (4) are obtained from CFPS 2014, 2016, 2018, and 2020.

***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

measures spanning health insurance, medicine, and hospitals, it is inevitable that it will engender a multifarious set of effects. Our analysis focuses on four critical effects, namely medical satisfaction, medical level, hospital grade, and health insurance. To ensure the veracity of our questionnaire data, we use data from the CFPS for the years 2010, 2012, 2014, 2016, 2018, and 2020.[17] Employing the same estimation strategy as the baseline analysis, we present the regression results in Table 10.

[17]Regression analysis is also performed using data from CFPS 2012, 2014, 2016, 2018, and 2020. The results are unchanged.

Table 10. Further analysis.

	Medical satisfaction (1)	Medical level (2)	Hospital grade (3)	Health insurance (4)
R	0.0320***	0.0463***	-0.0541***	0.0104**
	(0.0099)	(0.0108)	(0.0176)	(0.038)
Control variables	yes	yes	Yes	yes
Year FE	yes	yes	Yes	yes
Province FE	yes	yes	Yes	yes
Individual FE	yes	yes	Yes	yes
Observations	130755	130687	132591	152284
R-squared	0.0252	0.0224	0.0304	0.0259

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking and frequency of physical exercise variables.
3. Data are obtained from CFPS 2010, 2012, 2014, 2016, 2018, and 2020.
***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

6.1. Medical satisfaction

Satisfaction with medical care is a fundamental aspect of residents' experiences with medical and health services, serving as a reliable indicator of the challenges they face in accessing medical care. One of the primary objectives of CMR is to alleviate such difficulties for residents. Accordingly, this study examines the impact of CMR policies on residents' medical satisfaction, utilizing a time-varying difference-in-differences model with medical satisfaction as the explanatory variable. Our finding, presented in column (1) of Table 10, demonstrates that the estimated coefficient of medical satisfaction is both positive and significant at the 1% level, indicating that CMR significantly enhances respondents' medical satisfaction. This outcome may be an important factor contributing to CMR's success in enhancing residents' self-rated health.

6.2. Medical level

In addition to medical satisfaction, the level of medical care also plays a crucial role in determining an individual's treatment status and overall health. To examine the impact of CMR policy on medical care level, we use residents' perceptions of the medical level provided by the hospitals they visit as a proxy variable. Our result, presented in column (2) of Table 10, shows a statistically significant and positive coefficient for medical level at the 1% level, indicating that CMR policy has effectively promoted the level of medical services provided by hospitals.

6.3. Hospital grade

The implementation of hierarchical diagnosis and treatment can effectively allocate medical resources and improve medical service efficiency. More specifically, this policy can effectively alleviate the burden of large hospitals and facilitate easier access to medical care for the public. This approach encourages residents to seek medical attention at lower-tier hospitals for routine health issues, which aligns with the primary goal of CMR initiative. The correlation between hospital grade and the effectiveness of CMR is

presented in column (3) of Table 10, where the estimated coefficient is statistically significant at the 1% level. This finding indicates that the probability of patients selecting lower-tier hospitals has increased significantly after the introduction of the CMR policy, which may account for the observed reduction in overall medical expenses.

6.4. Health insurance

A substantial body of literature has demonstrated the capacity of health insurance to alleviate medical costs and enhance the overall health of the population.[18] Health insurance's impact is primarily manifested through its coverage and reimbursement ratio. In this study, we investigate the potential of CMR to enhance health insurance coverage. Our finding, presented in column (4) of Table 10, indicates that the estimated coefficient is 0.0104, with statistical significance at the 5% level. This suggests that CMR facilitates the expansion of health insurance coverage and enables greater access for residents, thereby reducing the medical burden on residents by reducing out-of-pocket medical expenses.

7. Heterogeneity

In this section, we seek to explore the heterogeneous effects of CMR on various subgroups of the population. Specifically, we investigate the impacts of the reform on vulnerable groups in terms of their hukou status, gender, age, regional location, income and education.

7.1. Hukou difference

It is widely acknowledged that China is plagued by a dual development structure, with a stark urban-rural divide. The health and medical standards of residents in rural areas have long lagged behind their urban counterparts, making it a major and challenging area of focus for medical and health system reform (Fu et al., 2020). Hence, we delve deeper into the question of whether the HCS reform has helped to reduce health inequality between urban and rural hukou residents. To this end, we present the results for urban and rural hukou residents in Table 11, Panel A and B, respectively.

Our analysis reveals that the estimated coefficients of urban residents are more significant than those of rural residents, suggesting that the CMR system has a greater impact on urban residents. For instance, the coefficient of out-of-pocket medical expenses for urban residents is significant at the 5% level and has a larger absolute value than that of rural residents. These findings suggest that China's healthcare reform efforts should prioritize the needs of rural hukou residents moving forward.

[18]From a medical burden perspective, the relevant classic literature see Finkelstein and McKnight (2008), Garcia-Diaz and Sosa-Rub (2011), Finkelstein et al. (2012). From a health perspective, the relevant classic literature see Chen and Jin (2012), Goldin et al. (2021).

Table 11. Heterogeneous: hukou.

	Absolute medical burden		Relative medical burden		Health
	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
Panel A: Urban					
R	0.0110	-0.0922**	-0.0512	-0.2481***	0.0464***
	(0.0336)	(0.0401)	(0.0800)	(0.0420)	(0.0120)
Control variables	yes	yes	yes	yes	Yes
Year FE	yes	yes	yes	yes	Yes
Province FE	yes	yes	yes	yes	Yes
Individual FE	yes	yes	yes	yes	yes
Observations	36449	22890	12445	6020	58060
R-squared	0.0668	0.0339	0.2144	0.0277	0.0198
Panel B: Rural					
R	0.0525	0.0044	-0.0199	-0.1955	0.0277
	(0.0550)	(0.0339)	(0.0277)	(0.2077)	(0.0283)
Control variables	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
Province FE	yes	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes	yes
Observations	43136	29820	8746	4375	65273
R-squared	0.0881	0.0451	0.0766	0.0330	0.0337

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. Data in columns (1), (3), and (5) are obtained from CFPS 2012, 2014, 2016, 2018, and 2020. Data in columns (2) and (4) are obtained from CFPS 2014, 2016, 2018, and 2020.

***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

7.2. Gender difference

Gender differences in work type, physiological structure, and susceptibility to diseases lead to higher demand for health care among females.[19] However, social and economic factors often place females at a disadvantage in accessing medical resources (Rose & Bird, 1994). Recognizing this issue, China has taken steps to promote female health through programs such as the "Women's Health Care Action" and the "Screening for Two Cancers". In light of these efforts, it is important to evaluate whether the ongoing CMR reform can help reduce gender inequality.

We present the results of our analysis in Table 12, with Panel A displays the outcomes for males and Panel B for females. Our results indicate that total medical expense and total medical expense ratio remain insignificant for both genders, and out-of-pocket medical expense is only significant at the 10% level for females. However, both out-of-pocket medical expense ratio and SRH are significant in both genders, with the coefficients' absolute value being greater among females than males. These findings suggest that the implementation of CMR reform is likely to benefit females more than males, and may help narrow the gender gap in health care access.

[19]For example, females have a large number of medical needs such as women's health care, health examination of childbearing age and maternal health care.

Table 12. Heterogeneous: gender.

	Absolute medical burden		Relative medical burden		Health
Males	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
Panel A: Males					
R	-0.0119	-0.0492	-0.0340	-0.1971**	0.0201**
	(0.0130)	(0.0506)	(0.0410)	(0.0703)	(0.0087)
Control variables	yes	yes	yes	Yes	yes
Year FE	yes	yes	yes	Yes	yes
Province FE	yes	yes	yes	Yes	yes
Individual FE	yes	yes	yes	Yes	yes
Observations	35998	23806	12001	5807	59894
R-squared	0.1007	0.0626	0.1200	0.0336	0.0883
Panel B: Females					
R	0.0438	-0.0664*	-0.0707	-0.2440***	0.0391**
	(0.0443)	(0.0390)	(0.0811)	(0.0655)	(0.0120)
Control variables	Yes	yes	yes	Yes	yes
Year FE	Yes	yes	yes	Yes	yes
Province FE	Yes	yes	yes	Yes	yes
Individual FE	Yes	yes	yes	Yes	yes
Observations	43587	28904	9190	4588	63439
R-squared	0.0990	0.1003	0.0990	0.0557	0.0189

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. Data in columns (1), (3), and (5) are obtained from CFPS 2012, 2014, 2016, 2018, and 2020. Data in columns (2) and (4) are obtained from CFPS 2014, 2016, 2018, and 2020.

***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

7.3. Age difference

The aging population is a salient demographic trend in China, which has led to a rapid and diverse increase in medical needs among the elderly. In this study, we aim to investigate the impact of CMR on the elderly population. To achieve this objective, we have dichotomized the respondents into senior adults and the elderly, based on a cut-off age of 60 years old. Our analysis is presented in two panels (A and B) in Table 13. In Panel A, we report the results for the elderly, while Panel B presents the outcomes for senior adults.

Our findings reveal that CMR has no statistically significant effect on medical burden for the elderly. However, for senior adults, CMR has a significantly negative relationship with medical burden. Furthermore, our results show that both senior adults and the elderly experience a statistically significant impact on health status due to CMR. However, the estimated effect size for the elderly is larger than that for senior adults. This finding implies that CMR enhances the health status of the elderly, but also exacerbates their medical burden. This may be attributed to the fact that CMR has stimulated the demand for medical services among the elderly.

Table 13. Heterogeneous: age.

	Absolute medical burden		Relative medical burden		Health
	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
Panel A: Elderly					
R	0.0447	0.0201	0.0378	0.1022	0.0502**
	(0.0468)	(0.0330)	(0.0400)	(0.3309)	(0.0200)
Control variables	yes	yes	yes	yes	yes
Year FE	Yes	yes	yes	yes	yes
Province FE	Yes	yes	yes	yes	yes
Individual FE	Yes	yes	yes	yes	yes
Observations	22440	15166	3240	1013	29228
R-squared	0.1154	0.0774	0.5200	0.1882	0.0220
Panel B: Adults					
R	-0.0182	-0.0808**	-0.0702	-0.3401***	0.0277**
	(0.0225)	(0.0303)	(0.0722)	(0.0906)	(0.0098)
Control variables	Yes	yes	yes	yes	yes
Year FE	Yes	yes	yes	yes	yes
Province FE	Yes	yes	yes	yes	yes
Individual FE	Yes	yes	yes	yes	yes
Observations	57145	37544	17951	9382	94105
R-squared	0.1005	0.1103	0.0449	0.0203	0.0096

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. Data in columns (1), (3), and (5) are obtained from CFPS 2012, 2014, 2016, 2018, and 2020. Data in columns (2) and (4) are obtained from CFPS 2014, 2016, 2018, and 2020.

***indicates significance at 1%.
**indicates significance at 5%.
* indicates significance at 10%.

7.4. Region difference

China's economic development has been plagued by severe regional inequalities, with the eastern regions exhibiting faster growth and the central and western regions lagging behind. Similarly, there are disparities in healthcare conditions across the nation. In this study, we endeavor to assess the heterogeneity of the effect of the China CMR policy across regions. To this end, we classify Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan as eastern provinces, and the rest as central and western provinces, based on China's geographical characteristics.[20]

Our findings, presented in Table 14, indicate that the CMR policy has a greater impact on reducing medical burden in eastern provinces, as compared to central and western provinces. This effect is both statistically significant and of a larger magnitude. Moreover, when examining the impact on residents' health status, we find that the estimated coefficient for the eastern region is not significant, while that for the central and western regions is significantly positive. Taken together, these results suggest that the CMR policy has the potential to reduce medical burden in the eastern region and promote health in the central and western regions.

[20]We classify Chongqing, Sichuan, Guizhou, Yunnan, Xizang, Shanxi, Gansu, Qinghai, Ningxia, Xinjiang, Shaanxi, Jilin, Heilongjiang, Anhui, Inner Mongolia, Jiangxi, Henan, Hubei, Hunan and Guangxi as the central and western provinces.

Table 14. Heterogeneous: region.

	Absolute medical burden		Relative medical burden		Health
	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
Panel A: Eastern					
R	-0.0173	-0.0744**	-0.0613	-0.3181***	0.0229
	(0.0201)	(0.0281)	(0.0729)	(0.0901)	(0.0237)
Control variables	yes	yes	Yes	yes	yes
Year FE	yes	yes	Yes	yes	yes
Province FE	yes	yes	Yes	yes	yes
Individual FE	yes	yes	Yes	yes	yes
Observations	33080	21504	10144	4801	53080
R-squared	0.1021	0.0772	0.1134	0.0103	0.0443
Panel B: Central and Western					
R	0.0504	-0.0302	-0.0402	-0.1044*	0.0566***
	(0.0547)	(0.0336)	(0.0411)	(0.0800)	(0.0121)
Control variables	Yes	yes	Yes	yes	yes
Year FE	Yes	yes	Yes	yes	yes
Province FE	Yes	yes	Yes	yes	yes
Individual FE	Yes	yes	Yes	yes	yes
Observations	46505	31206	11047	5594	70253
R-squared	0.0990	0.0884	0.1058	0.0229	0.0338

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. Data in columns (1), (3), and (5) are obtained from CFPS 2012, 2014, 2016, 2018, and 2020. Data in columns (2) and (4) are obtained from CFPS 2014, 2016, 2018, and 2020.

***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

7.5. Income difference

Numerous studies have indicated that there is widespread inequity in the utilization of healthcare services that favors the wealthy (Brinda et al., 2016; Channon et al., 2012), thereby exacerbating health inequalities. In our study, we assess the impact of CMR on residents with varying income levels. To accomplish this objective, we stratified the sample into high-income and low-income groups. The high-income group consists of individuals with incomes above the sample mean, while the low-income group includes those with incomes at or below the sample mean. The regression results are presented in Table 15. Panel A displays the results for the high-income group, whereas Panel B presents the results for the low-income group.

Our empirical analysis indicates that the CMR policy significantly alleviates the medical burden more for the high-income demographic than for the low-income demographic. Additionally, in evaluating the policy's impact on health status, we find that the estimated coefficient for the high-income group is statistically insignificant, whereas it is significantly positive for the low-income group. These findings suggest that the CMR policy is effective in reducing the medical burden for high-income individuals while concurrently promoting health improvements among low-income individuals.

Table 15. Heterogeneous: income.

	Absolute medical burden		Relative medical burden		Health
	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
Panel A: High					
R	-0.0708	-0.1764*	-0.0874	-0.2802**	0.0280
	(0.0692)	(0.0909)	(0.0985)	(0.1022)	(0.0267)
Control variables	Yes	yes	Yes	yes	yes
Year FE	yes	yes	Yes	yes	yes
Province FE	yes	yes	Yes	yes	yes
Individual FE	yes	yes	Yes	yes	yes
Observations	19565	11513	7351	4015	33815
R-squared	0.0779	0.0592	0.0391	0.0465	0.0140
Panel B: Low					
R	0.0679	-0.0057	0.0593	-0.0753	0.0384**
	(0.0771)	(0.0405)	(0.1064)	(0.1400)	(0.176)
Control variables	yes	yes	Yes	yes	yes
Year FE	yes	yes	Yes	yes	yes
Province FE	yes	yes	Yes	yes	yes
Individual FE	yes	yes	Yes	yes	yes
Observations	60020	41197	13840	6380	89518
R-squared	0.0727	0.0431	0.1155	0.0255	0.0089

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. Data in columns (1), (3), and (5) are obtained from CFPS 2012, 2014, 2016, 2018, and 2020. Data in columns (2) and (4) are obtained from CFPS 2014, 2016, 2018, and 2020.

***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

7.6. Education difference

Education and health are vital components of human capital, with the influence of education on health potentially being as significant, if not more so, than its impact on income (Grossman, 2000). To evaluate the effects of the CMR policy on residents with different educational backgrounds, we stratified the sample into two groups based on educational attainment: those with education beyond high school are classified as the high-education group, while those with education at or below high school form the low-education group. The regression analysis results are presented in Table 16, with Panel A showing the results for the high-education group and Panel B illustrating the outcomes for the low-education group.

Our findings indicate that CMR has no statistically significant effect on total medical expenditures and the total medical expense ratio for both the high-education and low-education groups. However, out-of-pocket medical expenses and the out-of-pocket medical expense ratio are statistically significant for both groups, with the absolute values of the coefficients being greater for the high-education group. Furthermore, the low-education group experiences a statistically significant impact on health status due to CMR. Collectively, these results suggest that the CMR policy has the potential to alleviate the medical burden for the high-education group and improve health outcomes for the low-education group.

Table 16. Heterogeneous: education.

	Absolute medical burden		Relative medical burden		Health
	Total medical expense (1)	Out-of-pocket medical expense (2)	Total medical expense ratio (3)	Out-of-pocket medical expense ratio (4)	SRH (5)
Panel A: High					
R	-0.0178	-0.0580*	-0.0779	-0.2484*	-0.0132
	(0.0949)	(0. 0352)	(0.1440)	(0.1805)	(0.0392)
Control variables	yes	yes	Yes	yes	yes
Year FE	yes	yes	Yes	yes	yes
Province FE	yes	yes	Yes	yes	yes
Individual FE	yes	yes	Yes	yes	yes
Observations	6587	4475	4058	2327	11735
R-squared	0.0840	0.0659	0.0442	0.0525	0.0278
Panel B: Low					
R	0.0420	-0.0244*	-0.0526	-0.2406**	0.0406**
	(0.0312)	(0.1084)	(0.0823)	(0.1086)	(0.0155)
Control variables	yes	yes	Yes	yes	yes
Year FE	yes	yes	Yes	yes	yes
Province FE	yes	yes	Yes	yes	yes
Individual FE	yes	yes	Yes	yes	yes
Observations	72998	48235	17133	8068	111598
R-squared	0.0744	0.0426	0.0958	0.0239	0.0089

1. Robust standard errors in parenthesis are clustered at the province levels.
2. Control variables include gender, age, hukou types, marital status, years of education, status of work, smoking, frequency of physical exercise, drinking, sleeping quality, industrial sulfur dioxide emissions, industrial wastewater discharge, industrial solid waste emissions, number of general practitioners and number of beds.
3. Data in columns (1), (3), and (5) are obtained from CFPS 2012, 2014, 2016, 2018, and 2020. Data in columns (2) and (4) are obtained from CFPS 2014, 2016, 2018, and 2020.

***indicates significance at 1%.
**indicates significance at 5%.
*indicates significance at 10%.

8. Conclusion

This paper investigates the impact of the health system reform on economic outcomes and health status by exploiting the introduction of the CMR in China. Unlike previous literature that primarily focuses on individual components of the health system reform, we adopt a more comprehensive perspective. Using a nationally representative dataset on household and individual information, we compare medical burden and health status between a treatment group and a control group. Our econometric results reveal two main findings. First, we find that the CMR has no significant effect on total medical expenses or total medical expense ratios. However, we observe a significant decrease in out-of-pocket medical expenses and out-of-pocket medical expense ratios following the implementation of the CMR. Second, we demonstrate that the CMR has a significant positive impact on individuals' health status. Our results are robust to several sensitivity tests, including an event study, alternative measures of medical expenses and health status, the inclusion of family-level control variables, the use of PSM-DID estimation, and the removal of the first batch of pilot provinces.

Furthermore, this study sheds light on the underlying mechanisms behind the effectiveness of the China's medical reform policy, known as the CMR. Specifically, our results indicate that the CMR program improves medical satisfaction and level, increases the likelihood of residents choosing hospitals with lower grade, and expands the coverage of health insurance. In addition, we conduct a subgroup analysis to investigate the

heterogeneous effects of the program. The results show that the reduction in medical expenses is greater for the urban cohort, females, senior adults, those living in the eastern region, the high-income group and the high-education group. On the other hand, the improvement in health status is greater for the urban cohort, females, the elderly, those living in the central and western regions, the low-income group and the low-education group. Overall, our findings are consistent with the existing literature on HCS reform. The Chinese HCS is currently undergoing a critical stage of reform, with the goal of controlling medical burden and improving health status. Our study is among the few that examines the effects of the recent CMR policy on medical expenses and health status, providing a useful reference for the development of the reform.

Based on the research findings, we propose the following policy recommendations:

(1) From the perspective of health and medical burden, the comprehensive medical reform pilot policy has yielded substantial outcomes. Pilot provinces should systematically document and disseminate replicable and scalable reform experiences and advanced models. Non-pilot provinces should promptly learn from the advanced experiences of pilot provinces and implement corresponding reform measures to reduce residents' medical burden and improve health levels.
(2) Given the heterogeneity in outcomes, future comprehensive healthcare reform policies should prioritize rural areas, central and western regions of the country, and low-income populations. These policies should focus on alleviating the healthcare burden and enhancing the health outcomes of these groups. This approach will help bridge the disparities in healthcare access among diverse demographic groups and facilitate the equitable distribution of medical resources.
(3) Initiate comprehensive healthcare system reform by deepening the coordinated reform of "medical services, medical insurance, and pharmaceuticals" and strengthening the integrated development of "hospitals, doctors, and traditional Chinese medicine". These measures aim to alleviate the economic burden on patients seeking medical care and control unreasonable growth of medical expenses.

This study still has several limitations. First, some variables are absent from the CFPS database, such as those related to dietary habits. Future research should utilize databases with more comprehensive variables to mitigate bias in the research results. Second, although this study employs the latest data from CFPS 2020, the analysis is confined to the short-term effects of the CMR policy due to the frequency of updates in microdata. Future research should continue to monitor the release of the latest data and seek to acquire more timely data from other sources to provide management insights and policy recommendations that align with current trends. Third, considering that the CMR policy is an integrated policy, its impact mechanism on medical burden and health is complex. This study only examines the effects of the CMR policy on medical burden and health from the perspectives of medical satisfaction, medical service level, hospital grade, and medical insurance. Additional impact mechanisms require further exploration.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

STU Scientific Research Initiation Grant [STF23043T]; National Natural Science Foundation of China [72273076].

Notes on contributors

Guangya Sun, male, is a lecturer at the School of Business, Shantou University. His research interests are income distribution and healthcare reform.

Yaping Sun, female, is a PhD candidate at the School of Economics, Zhejiang University of Finance & Economics. Her research interests are industrial organization and medical policy analysis.

References

Agarwal, S., & Qian, W. (2014). Consumption and debt response to unanticipated income shocks: Evidence from a natural experiment in Singapore. *The American Economic Review*, *104*(12), 4205–4230. https://doi.org/10.1257/aer.104.12.4205

Antman, F. M. (2010). Adult child migration and the health of elderly parents left behind in Mexico. *The American Economic Review*, *100*, 205–208. https://doi.org/10.1257/aer.100.2.205

Atella, V., Brugiavini, A., & Pace, N. (2015). The health care system reform in China: Effects on out-of-pocket expenses and saving. *China Economic Review*, *34*, 182–195. https://doi.org/10.1016/j.chieco.2015.02.003

Barber, S. L., Borowitz, M., & Bekedam, H. (2014). The hospital of the future in China: China's reform of public hospitals and trends from industrialized countries. *Health Policy and Planning*, *29*(3), 367–378.

Bird, S., Noronha, M., & Sinnott, H. (2010). An integrated care facilitation model improves quality of life and reduces use of hospital resources by patients with chronic obstructive pulmonary disease and chronic heart failure. *Australian Journal of Primary Health*, *16*(4), 326–333. https://doi.org/10.1071/PY10007

Brinda, E. M., Attermann, J., & Gerdtham, U. G. (2016). Socio-economic inequalities in health and health service use among older adults in India: Results from the WHO study on global ageing and adult health survey. *Public Health*, *141*(11), 32–41.

Brown, D., Kowalski, A., & Lurie, I. (2020). Long-term impacts of childhood Medicaid expansions on outcomes in adulthood. *Review of Economic Studies*, *87*(2), 792–821. https://doi.org/10.1093/restud/rdz039

Campolieti, M., & Goldenberg, J. (2007). Disability insurance denial rates and the labor force participation of older men and women in Canada. *Atlantic Economic Journal*, *35*(1), 59–75. https://doi.org/10.1007/s11293-006-9061-7

Channon, A. A., Andrade, M. V., & Noronha, K. (2012). Inpatient care of the elderly in Brazil and India: Assessing social inequalities. *Social Science & Medicine*, *75*(12), 2394–2402.

Chen, Y., & Jin, G. Z. (2012). Does health insurance coverage lead to better health and educational outcomes? Evidence from rural China. *Journal of Health Economics*, *31*(1), 1–14. https://doi.org/10.1016/j.jhealeco.2011.11.001

Cheng, L., Liu, H., Zhang, Y., & Zhao, Z. (2018). The health implication of social pension: Evidence from China's new rural pension scheme. *Journal of Comparative Economics*, *46*(1), 53–77.

Chiu, L., Shyu, W. C., & Liu, Y. H. (2001). Comparisons of the cost-effectiveness among hospital chronic care, nursing home placement, home nursing care and family care for severe stroke patients. *Journal of Advanced Nursing*, *33*(3), 380–386.

Disney, R., Emmerson, C., & Wakefield, M. (2006). Ill health and retirement in Britain: A panel data-based analysis. *Journal of Health Economics*, *25*(4), 621–649. https://doi.org/10.1016/j.jhealeco.2005.05.004

Einav, L., Finkelstein, A., Ji, Y., & Mahoney, N. (2022). Voluntary regulation: Evidence from medicare payment reform. *Quarterly Journal of Economics*, *137*(1), 565–618.

Ellekjaer, H., Holmen, J., & Vatten, L. (2001). Blood pressure, smoking and body mass in relation to mortality from stroke and coronary heart disease in the elderly: A 10-year follow-up in Norway. *Blood Pressure*, *10*(3), 156–163.

Finkelstein, A., & McKnight, R. (2008). What did medicare do? The initial impact of medicare on mortality and out of pocket medical spending. *Journal of Public Economics*, *92*(7), 1644–1668. https://doi.org/10.1016/j.jpubeco.2007.10.005

Finkelstein, A., Taubman, S., & Wright, B. (2012). The Oregon health insurance experiment: Evidence from the first year. *Quarterly Journal of Economics*, *127*(3), 1057–1106.

Frankovic, I., & Kuhn, M. (2023). Health insurance, endogenous medical progress, health expenditure growth, and welfare. *Journal of Health Economics*, *44*(2), 1–23.

Fu, M., Liu, C., & Yang, M. (2020). Effects of public health policies on the health status and medical service utilization of Chinese internal migrants. *China Economic Review*, *62*, 101464. https://doi.org/10.1016/j.chieco.2020.101464

Garcia-Diaz, R., & Sosa-Rub, S. G. (2011). Analysis of the distributional impact of out-of-pocket health payments: Evidence from a public health insurance program for the poor in Mexico. *Journal of Health Economics*, *30*(4), 707–718. https://doi.org/10.1016/j.jhealeco.2011.04.003

Gentzkow, M. (2006). Television and voter turnout. *Quarterly Journal of Economics*, *121*(3), 931–972. https://doi.org/10.1162/qjec.121.3.931

Goldin, J., Lurie, I. Z., & McCubbin, J. (2021). Health insurance and mortality: Experimental evidence from taxpayer outreach. *Quarterly Journal of Economics*, *136*(1), 1–49.

Grossman, M. (2000). *The human capital model[m]//handbook of health economics*. Elsevier.

Huang, B., Lian, Y., & Li, W. (2016). How far is Chinese left-behind parents' health left behind? *China Economic Review*, *2016*(37), 15–26. https://doi.org/10.1016/j.chieco.2015.07.002

Huang, F., & Gan, L. (2016). The impacts of China's urban employee basic medical insurance on healthcare expenditures and health outcomes. *Health Economics*, *26*(2), 149–163. https://doi.org/10.1002/hec.3281

Idler, E. L., & Kasl, S. V. (1995). Self-ratings of health: Do they also predict change in functional ability? *Journals of Gerontology*, *50*(6), S344.

Kalmijn, S., Curb, J. D., Rodriguez, B. L., Yano, K., & Abbott, R. D. (1999). The association of body weight and anthropometry with mortality in elderly men: The Honolulu heart program. *International Journal of Obesity and Related Metabolic Disorders*, 23, 395–420. https://doi.org/10.1038/sj.ijo.0800832

Kutzin, J. (2013). Health financing for universal coverage and health system performance: Concepts and implications for policy. *Bulletin of the World Health Organization*, *91*(7), 602–611.

Lei, X., & Lin, W. (2009). The new cooperative medical scheme in rural China: Does more coverage mean more service and better health? *Health Economic*, *18*(S2), 25–46.

Li, L., & Fu, H. (2017). China's health care system reform: Progress and prospects. *The International Journal of Health Planning and Management*, *32*(3), 240–253. https://doi.org/10.1002/hpm.2424

Li, X., Krumholz, H. M., & Yip, W. (2020). Quality of primary health care in China: Challenges and recommendations. *Lancet*, *395*(10239), 1802–1812.

Limwattananon, S., Neelsen, S., & O'Donnell, O. (2015). Universal coverage with supply-side reform: The impact on medical expenditure risk and utilization in Thailand. *Journal of Public Economics*, *121*, 79–94. https://doi.org/10.1016/j.jpubeco.2014.11.012

Liu, H., & Zhao, Z. (2014). Does health insurance matter? Evidence from China's urban resident basic medical insurance. *Journal of Comparative Economics*, *42*(4), 1007–1020. https://doi.org/10.1016/j.jce.2014.02.003

Luan, M., Shao, X., & Dou, F. (2020). Financial conditions, health care provision, and patient outcomes: Evidence from Chinese public hospitals. *Economics Letters*, *186*, 10–16. https://doi.org/10.1016/j.econlet.2019.108876

Miller, S., Johnson, N., & Wherry, L. R. (2021). Medicaid and mortality: New evidence from linked survey and administrative data. *Quarterly Journal of Economics*, *136*(3), 1783–1829. https://doi.org/10.1093/qje/qjab004

Mooney, G. (1998). *The economics of health reconsidered by Thomas Rice*. Health Administration Press. No. of pages: 195. ISBN 1-5679-073-5[J]. 1999.

Obama, B. (2016). United States health care reform: Progress to date and next steps. *JAMA*, *316*(5), 525–532. https://doi.org/10.1001/jama.2016.9797

Purcel, A., Dragos, C. M., Mare, C., & Dragos, S. L. (2023). Voluntary health insurance and out-of-pocket payments in European OECD countries. *Economic Modelling*, *120*, 1–12. https://doi.org/10.1016/j.econmod.2023.106190

Rose, C. E., & Bird, C. E. (1994). Sex stratification and health lifestyle: Consequences for men's and women's perceived health. *Journal of Health & Social Behavior*, *35*(2), 161–178.

Schmitz, H. (2011). Why are the unemployed in worse health? The causal effect of unemployment on health. *Labour Economics*, *18*(1), 71–78. https://doi.org/10.1016/j.labeco.2010.08.005

Sepehri, A., Sarma, S., & Simpson, W. (2006). Does non-profit health insurance reduce financial burden? Evidence from the Vietnam living standards survey panel. *Health Economics*, *15*(6), 603–616. https://doi.org/10.1002/hec.1080

Sun, Q., Santoro, M. A., Meng, Q., Liu, C., & Eggleston, K. (2017). Pharmaceutical policy in China. *Health Affairs*, *27*(4), 1042–1050.

Wagstaff, A., Lindelow, M., Jun, G., Ling, X., & Juncheng, Q. (2009). Extending health insurance to the rural population: An impact evaluation of China's new cooperative medical scheme. *Journal of Health Economics*, *28*(1), 1–19. https://doi.org/10.1016/j.jhealeco.2008.10.007

Wu, Y., Huxley, R., Li, L., Anna, V., Xie, G., Yao, C., Woodward, M., Li, X., Chalmers, J., Gao, R., Kong, L., & Yang, X. (2008). Prevalence, awareness, treatment, and control of hypertension in China: Data from the China national nutrition and health survey 2002. *Circulation: An Official Journal of the American Heart Association*, *118*(25), 2679–2686.

Yang, J., Hong, Y., & Ma, S. (2016). Impact of the new health care reform on hospital expenditure in China: A case study from a pilot city. *China Economic Review*, *39*(5), 1–14. https://doi.org/10.1016/j.chieco.2016.03.005

Yip, W. C. M., Hsiao, W. C., & Chen, W. (2012). Early appraisal of China's huge and complex health-care reforms. *Lancet*, *379*(9818), 833–842.

Zhang, Y., Ma, Q., Chen, Y., & Gao, H. (2016). Effects of public hospital reform on inpatient expenditures in Rural China. *Health Economics*, *26*(4), 421–430.