ORIGINAL RESEARCH

Social Medical Insurances, Choices of Medical Institutions and the 'Siphon Effect' in the Health Service Market: Evidence from 2021 Yangtze River Delta Region of China

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Purpose: The siphon effect in the health service market is notably pronounced in many countries. How to measure and identify the determinants contributing to the siphon effect presents a substantial challenge. This study aimed to analyse the effect of two different social medical insurances, the Basic Medical Insurance System for Urban Employees (BMISUE), and the Basic Medical Insurance System for Urban and Rural Residents (BMISURR), on the siphon effect in the health services market.
Methods: The data used in this study were from the 2021 Health Life Satisfaction Survey of Yangtze River Delta (HLSSYRD) conducted by Shanghai Jiao Tong University. The logistic model was used to evaluate the association between social medical insurances and individual choices of medical institutions, and the Propensity Score Matching method (PSM) was used to check the robustness of basic results.
Results: Residents covered by BMISUE were more likely to choose a general hospital when they first sought medical treatment (OR = 5.377, 95% CI: 4.887, 5.915) relative to those insured by BMISURR. Further analysis showed that BMISUE would accelerate the siphon effect of general hospitals, people insured by BMISUE were still more likely to choose general hospitals despite being close to primary hospitals compared to those insured by BMISURR (OR = 3.240, 95% CI: 2.945, 3.565). Heterogeneity analysis indicated BMISUE had a greater impact on residents aged 15–59 years and those with high income compared to older people and individuals with low income.
Conclusion: Different social medical insurances can substantially affect residents' first choice of medical institutions. BMISUE with higher benefits level could exacerbate the siphon effect in the health service market. More equitable medical security system should be strengthened to bridge the benefits gap between BMISUE and BMISURR.
Keywords: BMISUE, BMISURR, choice of medical institutions, siphon effect, Yangtze River Delta, China

Introduction

Expensive and difficult access to health care has been a common public health concern in most countries.[1–3] The reform of China's health care system also faces significant challenges in reducing individuals' financial access to health care, improving their access to health services, and promoting their overall health status.[4,5] The Chinese government, since 2009, launched a new round of health reform to alleviate the problem of expensive and difficult access to health care and to improve individuals' healthcare experience.[6,7] The reform's main initiative is to increase the supply of healthcare resources and establish a basic universal healthcare system to improve the accessibility to health services, thereby improving people's overall health level. Presently, the Chinese government has established a basic social medical insurance system covering the entire population. Data from China National Health Insurance Administration (CNHIA) in 2023 showed that the number of people covered by China's social medical insurances has reached 1.36 billion, with the participation rate remaining stable

at over 95% for four consecutive years.[8] Numerous studies have shown that China's health reform has significantly increased health service usage and improved the population's overall health.[9–11]

Nonetheless, despite significant improvements in the overall health of Chinese residents, the new health reform has also created new issues in the health services market, one of the main challenges is the siphon effect from the overconcentration of healthcare resources in general hospitals.[12,13] Siphon effect in health service market is a general term used to denote the phenomenon where larger hospitals, by leveraging superior resources and job opportunities, attract higher-level medical teams, subsequently drawing talent that could have worked at the grassroots level and patients who might have sought treatment at primary healthcare institutions.[16,17]

Contrary to integrated healthcare systems based on primary care (such as UK), China has not set up a comprehensive 'gatekeeper' systems and patients seem inclined toward larger and more reputable hospitals.[2,17–19] As a result, patients previously treated in smaller facilities are easily attracted once they seek treatment at larger medical institutions.[20,21] In China, the hospital classification system comprises three tiers: primary, secondary, and tertiary hospitals (secondary and tertiary hospitals are commonly categorized as general hospitals). Primary hospitals serve as local medical hubs, focusing on basic medical care including diagnosis, treatment for common ailments, and routine medical procedures. Secondary hospitals, located at the city/county level, feature specialized departments and advanced technologies, which mainly provide a higher standard of medical services. Tertiary hospitals, as regional or national medical centres, feature the most advanced medical equipment and technologies. These institutions provide comprehensive and high-quality medical services. The main aim of classification regarding hospitals is to streamline patients' access to appropriate medical care according to the severity of their conditions and treatment needs, and thus meeting their specific healthcare requirements.[21–23]

However, as individual's income and the benefits level of medical insurances continue to rise, the demand for high-quality health services increased drastically among Chinese residents. Consequently, the siphon effect is increasingly becoming serious in high-grade hospitals. Individuals tend to choose general and special hospitals for medical treatment, and primary hospitals failed to play the role of 'gatekeeper'. The siphon effect has broken the division of labour among hospitals at different levels, aggravated the tension in quality medical resources, and affected the efficiency of the healthcare service system. In addition, the price and costs of tertiary hospitals are higher than that of primary hospitals, and medical sources are limited, which will further aggravate the problem of 'difficult and expensive access to health care'.[16,17,25,26] Furthermore, studies have shown that long waiting time and overworked doctors have become the norm in general hospitals, with over 90% of doctors working overtime.[27,28]

Regarding the determinants of siphon effect in health service market, scholars have argued that the lack of an effective hierarchical medical system (HMS) contributed to the siphon effect in general hospitals at the macro level.[19,29,30] Although the differential reimbursement ratios at different hospital levels have a particular effect in guiding residents to seek medical treatment in primary hospitals, the current disparity in the reimbursement rate of health insurance is insufficient to guide residents to seek medical treatment rationally.[31] On the micro level, increasing household income, lacking of trust in primary care, increasing individual health awareness, disease severity, and higher education attainment were the key factors contributing to people's preference for general hospitals.[32,33] Shen & Zhang (2016) found that the inadequate capacity and equipment of medical services were the main reason for the low willingness of residents to seek treatment in primary hospitals.[30] Meanwhile, the accessibility of healthcare facilities can also influence patients' choices of medical institutions, the distance and the time taken to the hospital were the primary consideration factors. Previous studies showed that long waiting time for patients to access healthcare would affect their decision to medical institutions, and some studies even suggested that sensitivity for waiting time is higher than quality.[28,34]

Some scholars also explored the impact of medical insurance on residents' healthcare choices, and found that medical insurance not only directly affected the accessibility to healthcare, but also significantly influenced their healthcare decisions.[35–38] For instance, in the early years of the New Rural Cooperative Medical System (NRCMS), the insured residents preferred township health centres because of higher health insurance subsidies.[39–41] A wealth of studies assessed the utilization of medical services among residents covered by NRCMS in rural China, and found that NRCMS could significantly increase the utilization of inpatient services.[42] Hadley et al (1997) compared the effects of different health insurance systems on the choice of medical institutions for young women with breast cancer in the United States and found that female enrolled in health maintenance organizations were more likely to bypass the nearest cancer hospital.[43] Jiang and Zheng (2022) verified that the proportion of

residents visiting primary care facilities decreased by 1.5% after the NRCMS was integrated into the Basic Medical Insurance System for Urban and Rural Residents (BMISURR).[44]

Presently, the Chinese government has established two basic social health insurance systems covering all residents: the Basic Medical Insurance System for Urban Employees (BMISUE) and BMISURR (See Figure 1). However, these two programs are significantly different in financing and benefits levels. Specifically, BMISUE is financed mainly by individuals and enterprises, but BMISURR is mainly funded by government subsidies and individuals. Overall, the benefits level of BMISUE are higher than BMISURR when residents use same medical services, the data from China's National Health Insurance Bureau showed that the average reimbursement rate for hospitalization in BMISUE is about 80%, which is higher than that of BMISURR (approximately 70%). Nevertheless, whether these differences will cause the differences in medical institution choice between BMISUE and BMISURR need more empirical evidence.

The siphon effect in healthcare market is notably pronounced in many countries, and undeveloped 'gatekeeper' systems exacerbate disparities in accessing healthcare services and resources. How to measure this effect within healthcare markets presents a substantial challenge. Currently, to our knowledge, there is nearly no literature exploring how social medical insurances influence siphon effect of general hospitals. Therefore, bridging this research gap would provide crucial insights to Chinese healthcare systems reform. The marginal contributions of this study are as follows: first, by utilizing representative regional survey data (2021 Health Life Satisfaction Survey of Yangtze River Delta), we introduced a new metric denoted the "distance-healthcare choice" variable. This metric comprehensively quantified the prevalent siphon effect within healthcare service market. Second, this study further explored the influence of different medical insurances on the siphon effect of general medical institutions by using the maximum likelihood method (logit model), which had substantial implications for Chinese healthcare system reforms.

Materials and Methods
Data Source
The data used in this study were from the "Health Life Satisfaction Survey of Yangtze River Delta (HLSSYRD)", implemented by Shanghai Jiao Tong University in 2021. The survey used all urban residents in the Yangtze River Delta in China (YRDC) as the basic sampling frame and used a stratified, multistage, and population size-proportional method for sampling. The survey comprised 10 sections, including basic demographic information, medical insurance, choices of medical institutions, health environment, and health society of residents in the YRDC.

A total of 19,870 questionnaires were distributed in HLSSYRD, and 18,031 people participated in this survey. The response rate was 90.74%. According to research needs of this study, we cleaned the data as follows (see Figure 2): First, the main aim of this study was to analyze the effect of social medical insurance programs on the siphon effect in the
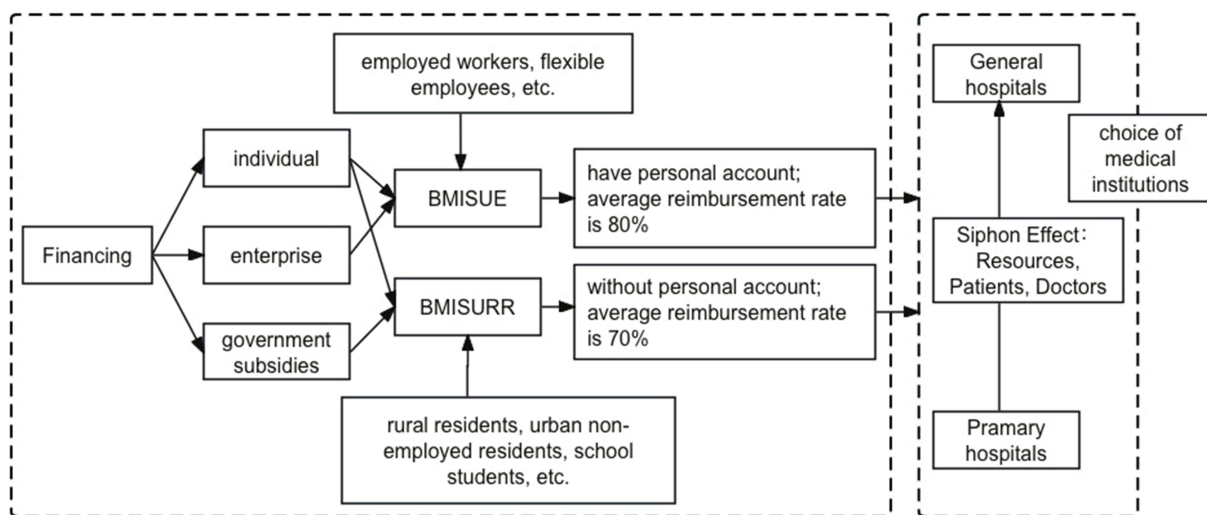
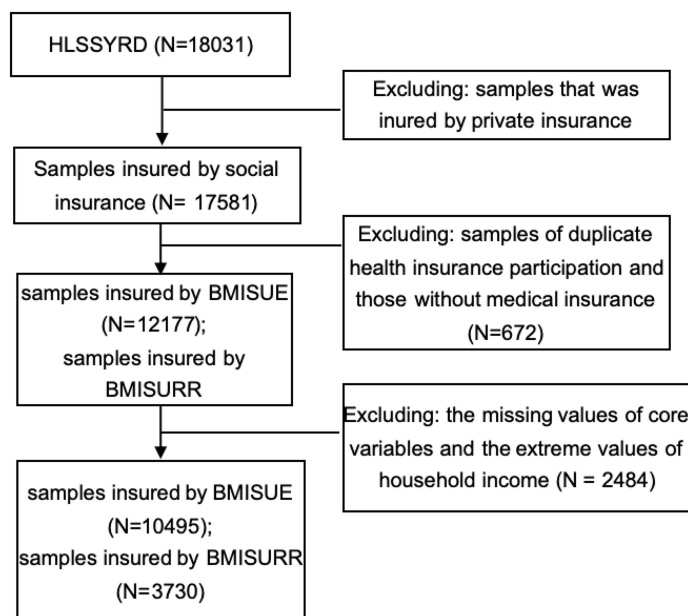**Figure 1** The framework of China's social medical insurance systems.

Figure 2 The flowchart of sample selection.

health service market, so we only retained these samples covered by BMISUE and BMIISURR. Second, we removed duplicate enrolment samples to get a sample size of 14,591. Finally, after removing those samples with responses such as "I don't know", "I refuse to answer" and those with missing values of key variables (such as income and the choices of medical institutions), the final sample used for this study was 14,425.

Variable Measurement

Dependent Variable

Based on existing research and questionnaire design, this study used the first choice of medical institutions to measure residents' willingness to choose medical institution when seeking for medical treatment.[45,46] Specifically, the question "What type of medical institutions is your first choice for daily consultations?" was utilized to determine the respondents' willingness to seek for medical treatment. Respondents were asked to choose from four options: tertiary hospitals, secondary hospitals, community health centres/township health centres and private clinics. A value of 1 was assigned when the respondent selected tertiary and secondary hospitals (general hospitals) and a value of 0 was assigned when the respondent selected primary hospitals.

We used the following two questions to identify the siphon effect in the health service market, namely, "What type of medical institutions is your first choice for daily consultations (tertiary hospitals, secondary hospitals, community health centres/township health centres and private clinics)?" and "What's the nearest medical institutions in your residence (tertiary hospitals, secondary hospitals, community health centres/township health centres and private clinics)?". Specifically, if the nearest medical institution to a respondent is a primary institution, but their first choice of medical institution is a general hospital (tertiary hospitals and secondary hospitals), we suggest that siphon effect of preferring general hospitals may exist. Therefore, we construct a "distance-first visit choice" variable, assigning a value of 1 when the respondent chose a general hospital when the nearest medical institution is a primary hospital. Otherwise, we assigned a value of 0. Table 1 presented the values of new synthetic variables.

Independent Variables

The core explanatory variable of this study was the types of social medical insurance. The social medical insurance in China includes BMISUE and BMISURR. Owing to China's universal medical insurance reform, only 0.5% samples were

Table 1 The Values of Distance-First Visit Choice Variable

The First Choice The Nearest Hospital	Primary Hospitals	General Hospitals
Primary hospitals General hospitals	0 was valued (4518) 0 was valued (180)	1 was valued (6390) 0 was valued (3137)

Note: Data source: HLSSYRD.

not covered by medical insurance, so we dropped these samples. We generated a "social medical insurance" dichotomous variable and assigned a value of 1 when a respondent was covered by BMISUE. Otherwise, we gave a value of 0 when people insured by BMISURR.

Control Variables

In order to prevent estimation bias in the model due to missing variables, we applied the Anderson Health Model,[47] which has been widely used to analyse the factors influencing health service utilization behaviour, to select control variables. Three types of control variables were selected in this study: predisposing characteristics, enabling factors, and need factors. Specifically, predisposing characteristics included age, gender, education, occupation and marital status; enabling factors included household income; needs factors included chronic diseases and self-rated health. The definition and descriptive results of variables are shown in Table 2.

Table 2 Definition and Descriptive Results of Variables

Variables	Definitions	Frequency/Mean	Percent/SE
Choice of medical institution	Primary hospital = 0	4698	33.03%
	General hospital = 1	9527	66.97%
Siphon effect	No = 0	7835	55.08%
	Yes = 1	6390	44.92%
Social medical insurance	BMISURR = 0	3730	26.22%
	BMISUE = 1	10,495	73.78%
Age	15–29 = 1	2845	20.00%
	30–44 = 2	4963	34.89%
	45–59 = 3	3437	24.16%
	≥60 = 4	2980	20.95%
Gender	Female = 0	7060	49.63%
	Male = 1	7165	50.37%
Marital status	Unmarried = 0	2347	16.50%
	Married = 1	11,878	83.50%
Education level	Middle school and below = 1	1419	9.98%
	High school/Vocational school = 2	4687	32.95%
	Three-year college = 3	4987	35.06%
	Four-year college and above = 4	3132	22.02%
Working status	No work = 0	4765	33.50%
	Having a work = 1	9460	66.50%
Monthly household income	0–10,000 CNY = 1	2700	18.98%
	10,001–20,000 CNY = 2	7915	55.64%
	20,001–40,000 CNY = 3	3189	22.42%
	40,001 CNY and above = 4	421	2.96%
Chronic disease	No = 0	10,763	75.66%
	Yes = 1	3462	24.34%
Self-rated health	Poor = 0	3667	25.78%
	Good = 1	10,558	74.22%

Note: Data source: HLSSYRD.

Analytical Plan

Stata 14.0 was used to analyze the relationship between social medical insurance and choices of medical institution among urban residents in YRDC. Firstly, we used descriptive statistics to describe the overall sociodemographic characteristics of the samples, and Chi-square test was used to investigate the differences between choice of medical institution and social medical insurances. Finally, we conducted logistics regression model to explore the association between social medical insurance and choices of medical institution, and propensity score matching (PSM) method was used to examine the robustness of the regression results.

Results

Descriptive Results

Table 2 presented the status of choice of medical institution, participation of social medical insurance and control variables of the study samples. More than 66.97% of total residents prefer to chosen general hospital when seeking for medical treatment. Furthermore, nearly 45% of people chosen general hospitals although they were close to primary hospitals. In terms of medical insurance participation, BMISUE had the highest participation rate of 73.78%, and 26.22% of people insured by BMISURR.

In terms of control variables, male and female accounted for 50.37% and 49.63% of the total sample, respectively. More than 83% of total adults were married with a spouse, and only 16.5% of people remained unmarried. The education attainment of all residents was extremely optimistic, more than 57% of all urban residents had attended college and above, and followed by high school and vocational school, accounting for 32.95%, the lowest was middle school and below, with only 9.98% of total samples.

From socio-economic indicators, the ratio of people having a job was 66.50%. More than 55% of residents' monthly household income ranging from 10,001 to 20,000 CNY, the ratio of monthly household income ranging from 20,001 to 40,000 CNY was 22.42%, and followed by 0–10,000 CNY. Only 2.96% of total samples' monthly household income was 40,001 CNY and above. In terms of health status, the ratio of people with chronic disease was 24.34%, and more than 75% of total samples did not suffer from chronic disease. The overall health status was optimistic, over 74% of all residents reported good health level, and only 25.78% of residents had poor health conditions.

Table 3 showed the Chi-squared test between social medical insurances and medical institution choice. There were significant differences in the choice of medical institution and siphon effect between BMISUE and BMISURR (P < 0.001).

Table 3 The Results of the Chi-Square Test

	Social Medical Insurance		Chi-Square Test	*P*-value
	BMISURR	**BMISUE**		
Choice of medical institution			2.0e+03	<0.001
Primary hospital	2343 (49.87)	2355 (50.13)		
General hospital	1387 (14.56)	8140 (85.44)		
Siphon effect			922.53	<0.001
No	2847 (36.34)	4988 (63.67)		
Yes	883 (13.82)	5507 (86.18)		
Age			461.69	<0.001
15–29	1121 (39.40)	1724 (60.60)		
30–44	951 (19.16)	4012 (80.84)		
45–59	733 (21.33)	2704 (78.67)		
≥ 60	925 (31.04)	2055 (68.96)		
Gender			0.03	0.856
Female	1856 (26.29)	5204 (73.71)		
Male	1874 (26.15)	5291 (73.85)		

(Continued)

Table 3 (Continued).

	Social Medical Insurance		Chi-Square Test	*P*-value
	BMISURR	**BMISUE**		
Marital status			140.24	<0.001
Unmarried	846 (36.05)	1501 (63.95)		
Married	2884 (24.28)	8994 (75.72)		
Education level			648.81	<0.001
Middle school and below	756 (53.28)	663 (46.72)		
High school/Vocational school	1258 (26.84)	3429 (73.16)		
Three-year college	1084 (21.74)	3903 (78.26)		
Four-year college and above	632 (20.18)	2500 (79.82)		
Working status			527.29	<0.001
No	1818 (38.15)	2947 (61.85)		
Yes	1912 (20.21)	7548 (79.79)		
Monthly household income			451.89	<0.001
0–10,000	1133 (41.96)	1567 (58.04)		
10,001–20,000	1891 (23.89)	6024 (76.11)		
20,001–40,000	632 (19.82)	2557 (80.18)		
40,001 and above	74 (17.58)	347 (82.42)		
Chronic disease			3.35	0.067
No	2781 (25.84)	7982 (74.16)		
Yes	949 (27.41)	2513 (72.59)		
Self-rated health			735.86	<0.001
No	1584 (43.20)	2083 (56.80)		
Yes	2146 (20.33)	8412 (79.67)		

Note: Percent were reported in brackets; Data source: HLSSYRD.

Regression Results

We adopted the maximum likelihood method to evaluate the association between social medical insurance and individual's choice of medical institutions. Column (1) in Table 4 showed that compared to residents insured by BMISURR, those covered by BMISUE were more likely to choose general hospital when seeking medical treatment (OR = 5.377, 95% CI:4.887, 5.915). Column (2) in Table 4 reported the regression results for the impact of social medical insurances on the siphon effect in medical service market. The results showed that compared to people insured by BMISURR, those residents

Table 4 The Regression Results for the Association Between Health Insurance and Choices of Medical Institution

Variables	(1)		(2)	
	Choice of Medical Institutions		**Siphon Effect**	
BMISUE (Ref: BMISURR)	5.377***	(4.887, 5.915)	3.240***	(2.945, 3.565)
Age (Ref: 15–29)	1.008***	(1.003, 1.013)	0.998	(0.993, 1.002)
30–44	1.182*	(1.030, 1.357)	0.881*	(0.778, 0.999)
45–59	1.197*	(1.017, 1.409)	0.744***	(0.649, 0.865)
60 and above	1.339**	(1.076, 1.666)	0.656***	(0.538, 0.799)
Gender (Ref: Female)				
Male	1.003	(0.922, 1.085)	1.057	(0.984, 1.135)
Martial status (Ref: Unmarried)				
Married	2.315***	(1.967, 2.724)	0.966	(0.850, 1.097)

(*Continued*)

Table 4 (Continued).

Variables	(1)		(2)	
	Choice of Medical Institutions		**Siphon Effect**	
Education level (Ref: Middle school and below)				
High school/Vocational school	1.002	(0.854, 1.171)	1.145	(0.988, 1.327)
Three-year college	1.211*	(1.012, 1.450)	1.336***	(1.132, 1.578)
Four-year college and above	1.203	(0.986, 1.469)	1.454***	(1.213, 1.743)
Work status (Ref: no work)				
Having a job	0.789***	(0.693, 0.899)	0.679***	(0.606, 0.763)
Monthly family income (Ref: 0–10,000)				
10,001–20,000	4.465***	(3.998, 4.987)	2.625***	(2.363, 2.916)
20,001–40,000	3.495***	(3.066, 3.983)	1.440***	(1.271, 1.632)
40,001 and above	2.628***	(2.039, 3.385)	0.810	(0.633, 1.036)
Chronic disease (Ref: No)				
Yes	1.141*	(1.003, 1.298)	1.370***	(1.219, 1.540)
Self-rated health (Ref: Poor)				
Good	0.512*	(0.237, 1.102)	0.237***	(0.124, 0.453)
Constant	0.077***	(0.032, 0.188)	0.422***	(0.199, 0.897)
Observations	14,225		14,225	
Pseudo R2	0.182		0.093	

Notes: 1) OR, odds ratio; 2) CI, confidence interval; 3) *P < 0.05; **P < 0.01; ***P < 0.001; 4) Data source: HLSSYRD.

covered by BMISUE were more likely to choose general hospitals despite the fact that they were close to primary hospitals (OR = 3.240, 95% CI:2.945, 3.565). In other words, participating in BMISUE was more likely to cause siphon effect in medical service market.

Among controlled variables, increasing age (OR = 0.881, 95% CI: 0.778, 0.999; OR = 0.744, 95% CI: 0.649, 0.865; OR = 0.656, 95% CI: 0.538, 0.799) was negatively associated with the siphon effect of general hospitals. Conversely, higher education level was positively related to the siphon effect of general hospitals (OR = 1.336, 95% CI: 1.132, 1.578; OR = 1.454, 95% CI: 1.213, 1.743). In terms of socio-economic conditions, higher monthly household income was positively associated with choosing general hospitals (OR = 2.625, 95% CI: 2.363, 2.916; OR = 1.440, 95% CI: 1.271, 1.632). Conversely, having a job was negatively related to choosing general hospitals relative to those without a job (OR = 0.679 CI: 0.606, 0.763). From health status, chronic disease would exacerbate siphon effect (OR = 1.370, 95% CI: 1.219, 1.540), people with chronic disease were more likely to choose general hospitals despite they were closed to primary hospitals. Conversely, self-rated health was negatively associated with siphon effect, the better the health level of a resident, the lower the likelihood of siphon effect.

Robust Test

In order to reduce the potential selective bias caused by social medical insurance participation behavior and examine the robustness of basic regression results, the PSM method was used to analyzed the relationship between social medical insurance and choices of medical institutions. We used the K-nearest neighbor matching (one to four), Caliper matching and Kernel matching to calculate the average treatment effect (ATT) of BMISUE and BMISURR on medical institution choice. Column (1) in Table 5 showed that the ATT coefficients for K-nearest neighbor matching, Caliper matching, and Kernel matching were 0.329, 0.332, and 0.335, respectively (P < 0.001), which indicated that people insured by BMISUE were more likely to choose general hospitals when seeking medical treatment. Column (2) in Table 4 showed that the ATT coefficients for K-nearest neighbor matching, Caliper matching, and Kernel matching were 0.247, 0.243, and 0.244, respectively (P < 0.001), implying that people insured by BMISUE were more likely to cause siphon effect relative to those covered by BMISURR.

Table 5 PSM Results for the Association Between Social Medical Insurance and the Choice of Medical Institutions

		Types of matching	Treated	Controlled	ATT	S. E	T-value
(1)	Choice of medical institution	K-nearest neighbor matching	0.776	0.446	0.329	0.016	20.72***
		Caliper matching	0.776	0.443	0.332	0.011	28.93***
		Kernel matching	0.776	0.440	0.335	0.011	29.23***
(2)	Siphon effect	K-nearest neighbor matching	0.525	0.278	0.247	0.015	16.91***
		Caliper matching	0.525	0.282	0.243	0.011	22.81***
		Kernel matching	0.525	0.280	0.244	0.011	22.99***

Note: ***P < 0.001; Data source: HLSSYRD.

Heterogeneity Analysis

Table 6 delineated the relationship between social medical insurance programs and siphon effect of general hospitals, segmented by age and monthly household income. Column (1)-(2) showed that BMISUE was positively associated with siphon effect among different age groups, and this kind of positive association among individuals aged 15–59 years was higher than older people. Column (3)-(5) showed that BMISUE was positively related to siphon effect among different income groups, and the siphon effect increased gradually as income increased.

Discussion

Primary care has been the first line of defence against chronic diseases in developed countries,[48] and primary medical institutions are the best choice for chronic disease management.[49] However, most high-quality medical resources in China are concentrated in general hospitals, and patients lack trust in primary healthcare institutions. Currently, the Chinese government has not established a comprehensive HMS, so patients can easily give up primary care institutions and choose general hospitals for medical treatment. This situation will lead to a severe underutilization of primary health services and increase the pressure on general hospitals, which poses a severe threat to the efficiency and effectiveness of China's healthcare system. Although several studies have analysed the association between medical insurances and choice of medical institutions,[35–38,50,51] to the best of our knowledge, this study represented the first attempt to measure the siphon effect of medical service market and further explored the association between medical insurance programs and siphon effect of general hospitals.

By using data from 2021 HLSSYD, this study found that residents covered by BMISUE were more likely to choose a general hospital when seeking medical treatment than those insured by BMISURR. Further analysis found that BMISUE may lead to the siphon effect of general hospitals, residents covered by BMISUE were more likely to choose general hospitals despite being close to primary hospitals compared to those insured by BMISURR.

Social medical insurance can guide patients' access to care by increasing their financial accessibility and changing the price they face through differentiated reimbursement rate designs.[25,52,53] Our research supported this view.

Table 6 The Regression Results of Heterogeneity Analysis

Variables	(1)	(2)	(3)	(4)	(5)
	Age Differences		**Household Income Differences**		
	15–59 years	≥ 60 years	0–10,000	10,001–20,000	> 20,000
BMISUE	3.543***	2.462***	2.019***	3.123***	4.033***
	(3.165, 3.967)	(2.030, 2.986)	(1.565, 2.604)	(2.494, 3.918)	(3.570, 4.556)
Other variables	Yes	Yes	Yes	Yes	Yes
Observations	11,245	2980	2700	7915	3610
Pseudo R2	0.093	0.112	0.039	0.091	0.056

Notes: 1) ***P < 0.001; 2) 95% confidence interval (CI) were reported in brackets; 3) Data source: HLSSYRD.

Table 7 Reimbursement Rates in Different Hospital Levels in YRDC

Medical Institution/Province		Zhejiang (Huzhou City)		Anhui (Hefei City)	
		BMISUE	BMISURR	BMISUE	BMISURR
Primary care facilities	Outpatient	60%	55%	80%	60%
	Inpatient	90%	95%	94%	90%
Secondary hospitals	Outpatient	50%	30%	70%	60%
	Inpatient	85%	75%	92%	85%
Tertiary hospitals	Outpatient	50%	20%	60%	60%
	Inpatient	80%	60%	80%	75–80%

Notes: Data source: Huzhou healthcare Security Administration and Hefei healthcare Security Administration.

Moreover, BMISUE and BMISURR differ significantly in terms of medical financing and benefit levels, and the medical reimbursement ratio for BMISUE is significantly higher than that for BMISURR. Consequently, BMISUE can provide greater financial accessibility to patients than BMISURR, and participants covered by BMISUE were more likely to choose general medical institutions to seek high-quality health services.

Second, this study suggested that BMISUE may exacerbate the siphon effect of preferring general hospitals. Although people insured by BMISUE were close to primary medical institutions, they were still more likely to choose general medical institutions when they first seek medical treatment. Previous studies suggested that differentiated reimbursement rates of health insurance among different medical institutions can reduce the siphon effect of higher medical institutions and effectively guide price-sensitive patients to primary hospitals.[16,19,31] Although the Chinese government has established different reimbursement rates among different levels of medical institutions, the reimbursement rate for BMISUE is significantly higher than that for BMISURR when seeking healthcare service at the same medical institution (see Table 7). This differentiated reimbursement treatment can cause BMISUE participants to prefer higher-rated medical institutions for health services, thus exacerbating the siphon effect of general hospitals.

More importantly, moral hazard is common in the health insurance market. The Chinese government stipulates that, except for urban employees, residents can also participate in BMISUE as flexible employees if they afford all the premiums (8% of the average local social wage). Residents with poor health status are more likely to participate in BMISUE to enjoy higher medical insurance benefits and better medical services. Consequently, this exacerbates the siphon effect of high-rated medical institutions. Feng et al (2018) found that the medical expenditure of flexible workers who chose to join BMISUE was 78% higher than that of urban employees.[54] Furthermore, the medical expenditure of those who chose to join BMISUE was approximately 45% higher than that of those who chose to join BMISURR.

Finally, aligning with previous research, household income exhibits positive correlations with the inclination towards general hospitals.[25,55] This might stem from income's multifaceted influence on medical preferences, encompassing socioeconomic status and people with higher incomes tend to have more opportunities to participate in BMISUE.[53,55,56] Furthermore, prior studies suggested that the elderly were more likely to choose general hospitals,[56] which was contrary to our findings. This might be attributed to poorer health conditions resulting in increased healthcare needs and frequent hospital visits, where general hospitals involve longer waiting time. Additionally, limitations in daily living abilities and financial constraints restrict the elderly's access to larger medical facilities.[56]

Conclusion and Limitation

This study has several limitations. First, due to data limitations, this study only verified the impact of social medical insurances on the siphon effect of higher medical institutions in the YRDC. However, considering the significant differences in economic and social development between the eastern, central and western regions of China, further research is needed to determine whether there are regional differences. Moreover, this study only analyzed the effect of medical insurances on urban residents' first choice of medical treatment, and more evidence is needed to regarding rural residents. Third, this study used cross-sectional data, so we failed to verify the causal relationship between social medical

insurance, the first choice of medical treatment and the siphon effect of general hospitals. Finally, this article included three types of variables in the Anderson Health Model, such as predisposition characteristics, enabling resources and needs. However, due to data limitation, this study failed to add all variables related to the Anderson Health Model variables. We will continue to conduct relevant research once data available.

Despite the acknowledged limitations, this study has significant implications for the Chinese government to further improve its health reform system. First, effectively solving the "expensive and difficult access to health care" issue is a prerequisite for achieving the "Health China Strategy". The government should continue to enhance the health reform system, improve the quality of medical services of primary hospitals and maintain their role as gatekeepers. Furthermore, health reform should also highlight the fairness of the medical security system, and measures should be taken to narrow the gap between BMISUE and BMISURR, strengthen the subsidies for poor residents caused by disease and provide more medical resources transfer payments to the vulnerable groups.

Abbreviations

BMISUE, Basic Medical Insurance System for Urban Employees; BMISURR, Basic Medical Insurance System for Urban and Rural Residents; YRDC, Yangtze River Delta in China; HLSSYRD, Health Life Satisfaction Survey of Yangtze River Delta; HMS, Hierarchical Medical System; NRCMS, New Rural Cooperative Medical System.

Ethics Approval

The data was collected using a semi-structured questionnaire contained participants' socio-demographics and healthy lifestyle information in Yangtze River Delta. Obtained informed consent from all study participants before the start of the study. The study protocol was approved by the ethics review committee of Shanghai University of Medicine & Health Sciences, China based on the assessment of design and process of the study and was conducted in accordance with the principles of the Declaration of Helsinki. The approval number is 2021-gskyb-02-372424198012222511. Before starting the research study, the respondents were informed about the anonymity of this study with relevant details. The questionnaire-related information is as follows: "In order to ensure the authenticity and confidentiality of the research, this research is anonymous, and the content of the survey is only used for relevant research, and the content of your answers will be kept confidential in accordance with the requirements of the Statistical Law of the People's Republic of China".

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

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