

BMJ Open Did expansion of health insurance coverage reduce horizontal inequity in healthcare finance? A decomposition analysis for China

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To cite: Wang Z, Zhou X, Gao Y, *et al.* Did expansion of health insurance coverage reduce horizontal inequity in healthcare finance? A decomposition analysis for China. *BMJ Open* 2019;**9**:e025184. doi:10.1136/bmjopen-2018-025184

► Prepublication history for this paper is available online. To view these files please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2018-025184>).

Received 3 July 2018
Revised 27 November 2018
Accepted 5 December 2018

ABSTRACT

Objectives ‘Horizontal inequity’ in healthcare finance occurs when people with equal income contribute unequally to healthcare payments. Prior research is lacking on horizontal inequity in China. Accordingly, this study set out to examine horizontal inequity in the Chinese healthcare financing system in 2002 and 2007 through two rounds of national household health surveys.

Design Two rounds of cross-sectional study.

Setting Heilongjiang Province, China.

Participants Adopting a multistage stratified random sampling, 3841 households with 11 572 individuals in 2003 and 5530 households with 15 817 individuals in 2008 were selected.

Methods The decomposition method of Aronson *et al* was used in the present study to measure the redistributive effects and horizontal inequity in healthcare finance.

Findings Over the period 2002–2007, the absolute value of horizontal inequity in total healthcare payments decreased from 93.85 percentage points to 35.50 percentage points in urban areas, and from 113.19 percentage points to 37.12 percentage points in rural areas. For public health insurance, it increased from 17.84 percentage points to 28.02 percentage points in urban areas, and decreased from 127.93 percentage points to 0.36 percentage points in rural areas. Horizontal inequity in out-of-pocket payments decreased from 79.92 percentage points to 24.83 percentage points in urban areas, and from 127.71 percentage points to 53.10 percentage points in rural areas.

Conclusions Our results show that horizontal inequity in total healthcare financing decreased over the period 2002–2007 in China. In addition, out-of-pocket payments contributed most to the extent of horizontal inequity, which were reduced both in urban and rural areas over the period 2002–2007.

INTRODUCTION

Apart from securing access to healthcare, contributions towards financing healthcare may redistribute the disposable income of households. This redistribution can be assessed on vertical and horizontal levels: ‘vertical redistribution’ occurs when

Strengths and limitations of this study

- This study was the first to evaluate the horizontal inequity in healthcare finance in China.
- The study was the first to explore the relationship between vertical and horizontal equity in healthcare financing system in China.
- Our study demonstrates that horizontal inequity also contributed to the overall inequity in healthcare finance, and that it should be simultaneously considered with vertical inequity when renovating the healthcare financing system.

healthcare payments are disproportionately related to ‘ability to pay’ (ATP); ‘horizontal redistribution’ occurs when people with equal ATP contribute unequally to healthcare payments. Vertical redistribution and horizontal redistribution are generally defined as a ‘redistributive effect’ (RE). An RE can be quantitatively decomposed into three aspects: ‘vertical’, ‘horizontal’ and ‘reranking’. The vertical effect shows how households with different incomes are affected by the financing, the horizontal effect measures the inequity generated among households with the same pre-financing income, while the reranking effect quantifies the change in the order of income distribution.

In the literature, a considerable number of studies have been published on vertical equity.^{1–5} Horizontal inequity and reranking, by contrast, were not reported in great detail until 1994. In that year, Aronson, Johnson and Lambert (hereafter, AJL) provided a decomposition method to measure the RE of income tax through pre-Gini and post-Gini coefficients, and revealed the separate contributions to the RE of income tax of (a) the effective schedule (the ‘vertical effect’), (b) the unequal treatment of equals arising from departures from this effective schedule (the



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'horizontal effect') and (c) the reranking of unequals as a result of such departures (the 'reranking effect').⁶ Later, in 1997, Wagstaff and van Doorslaer applied the AJL method to decompose the change in income inequality caused by healthcare finance into vertical, horizontal and reranking effects in the Netherlands, with each effect corresponding to a different dimension of equity: vertical equity, horizontal inequity and reranking.⁷ By simultaneously revealing these three different dimensions of equity, the AJL decomposition constitutes a useful tool for assessing the fairness of healthcare financing. Consequently, horizontal inequity has since been measured and evaluated in empirical studies using the AJL decomposition method. The findings of these studies indicated that factors such as social status, geographic distribution, employment type, insurance type, income composition, urban–rural classification, health condition and race or ethnicity may contribute to horizontal inequity and reranking.^{7–9} However, only three papers have conducted empirical evaluations of horizontal inequity in healthcare finance—for the Netherlands, Switzerland and Sweden, respectively.^{7–9} Moreover, until now, no such empirical assessments have been conducted in China. Since China launched new and extended the established health insurance schemes, a greater proportion of the population has been covered by health insurance. However, the impact on horizontal inequity in healthcare finance is uncertain. Little is known about the extent of horizontal inequity in healthcare finance during the reform of China's healthcare insurance in the past decades.

China has established new types of health insurance since 1998. Health insurance coverage has been expanded to include individuals with different socioeconomic statuses. In each socioeconomic group, individuals with diverse social statuses, urban–rural classifications and geographic access to healthcare joined health insurance schemes. Until recently, though, there has been no reliable evidence with which to evaluate whether China's expansion of health insurance coverage has been successful in reducing horizontal inequity in healthcare finance. The present study examines the RE and horizontal inequity in the Chinese healthcare financing system in 2002 and 2007 for four different sources of financing; namely, general taxes, public health insurance, private health insurance and out-of-pocket (OOP) payments.

The remainder of the paper proceeds as follows: the Introduction section provides a brief overview of Chinese health insurance reform. The Methods section outlines our data sources and describes the computational methods used in this study. The Results section presents the findings of the study and delineates how empirical results in different financing sources, areas and times may be compared. Finally, the Discussion section and the Conclusions section discuss the empirical results and attempt to draw some conclusions in relation to broad lessons from the Chinese experience.

CHINA'S HEALTH INSURANCE REFORM

Influenced by social and economic transitions since the early 1980s, China's healthcare system was reformed to transit from one based on a planned economic model to a market-based system. Government health input rapidly decreased with the decentralisation of healthcare financing.^{10–12} Subsequently, the share of public funding in the healthcare system decreased and the proportion of private financing increased.^{13 14} For instance, under China's planned economy, healthcare in urban areas had been financed primarily through the Government Welfare Insurance Scheme and the Labor Insurance Scheme. The former covered mainly civil servants and government employees, college students and veterans, whereas the latter was for workers and their dependents across all formal sectors of the economy.^{10 15} However, these schemes faced challenges during the market-oriented economic reforms, which resulted in huge changes in healthcare financing patterns. Along with the higher demand by employees for quality care, and corresponding financial pressures making these demands unaffordable, financing from the Government Welfare Insurance Scheme and the Labor Insurance Scheme decreased markedly and citizens had to pay much higher OOP expenses for healthcare.¹⁶ Meanwhile, for the majority of the rural population, and the poor in particular, the Cooperative Medical Scheme (CMS) played a key role in guaranteeing access to basic health services.^{17 18} However, the CMS began to collapse after the initiation of China's Household Contract Responsibility System in the early 1980s, which decreed that healthcare would be funded at the household level. Only 9.3% of rural farmers were still enrolled in the CMS, and >80% had no health insurance coverage by 2002.¹⁹ Rural residents without health insurance had to pay for their healthcare by direct payment, which created barriers to basic health services and made medical expenses unaffordable to the poor and vulnerable groups, especially in respect of health services that had become more expensive.²⁰

Such transformations greatly changed China's healthcare financing structure. Between 1980 and 2002, the percentage of government spending for healthcare dropped from 36.24% to 15.69% and the percentage of citizens covered by public health insurance plummeted from 42.57% to 15.64%. Conversely, the share of healthcare spending as OOP payments increased from 21.19% to 57.72%.²¹ Such a heavy dependence on OOP payments resulted in a segmented and tiered healthcare financing system.²² Results from China's third National Health Services Survey showed that, in 2002, 48.9% of outpatients (57.0% and 45.8% in urban and rural areas, respectively) did not visit any health institution. Among those who were admitted but did not use inpatient services, 75.4% could not afford hospital expenses.¹⁹

In order to decrease OOP and provide basic health insurance to the general population, China's government took steps to establish and extend insurance coverage. In 1998, Urban Employee Basic Medical Insurance (UEBMI) was

introduced to cover urban workers in the formal sector. UEBMI coverage was gradually extended from covering employees in the larger formal sector to those working in all forms of organisations, such as government institutions, state-owned and collective enterprises, private enterprises, enterprises with foreign investment, social organisations and private non-profit units.²³ However, only providing coverage to urban workers raised equity concern in relation to the remaining urban residents who were not covered by the UEBMI scheme. Thus, in 2007, the Urban Residents' Basic Medical Insurance (URBMI) scheme was launched to extend urban health insurance coverage to an additional 155 million uninsured citizens, including the unemployed, children, students and elderly persons without pensions.²⁴ Meanwhile, in rural areas, the New Rural Cooperative Medical Scheme (NCMS) had been initiated in 2003 with the purpose of rebuilding rural health insurance coverage. Since its formation, China's authorities have provided additional public spending on NCMS, which has achieved a high coverage level for rural residents, with the insured rate increasing from 9.64% in 2002 to 94.44% in 2007.²⁵

METHODS

Data source

The data for the analysis were drawn from two rounds of the National Health Services Survey conducted in Heilongjiang Province, China. The two rounds were conducted between August and October in 2003 and 2008 in the sample regions, with the information recorded in 2002 and 2007, respectively. Heilongjiang Province, located in the northeast of China, is a middle-income province in terms of per capita gross domestic product and has a population of >20 million people.²⁶ The per capita gross domestic product was US\$1152.72 and US\$2943.37 in Heilongjiang Province in 2002 and 2007, respectively. Adopting a multistage stratified random sampling method, the survey randomly selected 13 cities or counties. In every city or county, eight communities or villages were randomly selected. Then, about 30 households were randomly selected from each community or village. Finally, 3841 households with 11 572 individuals in 2003 and 5530 households with 15 817 individuals in 2008, respectively, were selected in the survey. [Tables 1 and 2](#) present detailed data about the descriptive and socioeconomic characteristics for the urban and rural samples, respectively.

We adopted the same questionnaire in the two rounds of the survey. The national survey gathers extensive information about households' socioeconomic and demographic characteristics, including urban-rural classification, number of household members, age, gender, educational attainment, professions of household members and household expenditures. Monthly household expenditures on food, housing, clothing, traffic, electricity, water, fuel, communication, education, exercise, entertainment, medical care and other types of expenditure were

queried through the household head or the member most familiar with the home's affairs. Unexpected expenditures during the previous year were also recorded. Regarding healthcare payments, information was obtained through two sources of data: one was the survey above, while other data were taken mainly from the local statistic yearbook of tariffs, taxes and contribution rates for public health insurance. With regard to general taxes, specific taxes that were considered included taxes on the purchase of cigarettes, alcohol, entertainment, electricity, gas and any excise taxes on restaurants, bars, lodging and other consumption taxes. Taxes were approximated by applying specific tax rates to the corresponding expenditures. The proportion of government expenditure on health was 4.12% and 5.19% of government expenditure in 2002 and 2007, respectively.²⁷ Since the government expenditure mainly came from general taxes, we assumed that the health financing took 4.12% and 5.19% of the total general taxes in 2002 and 2007, respectively. With regard to public health insurance, flat rate contributions were recorded directly in household interviews with respondents covered by the UEBMI, CMS and NCMS. For respondents covered by the UEBMI, the contribution was estimated by applying contribution rates to the earnings of covered workers. Private health insurance premiums were obtained directly via household interviews. Information about OOP payments included healthcare expenditures on outpatient care and prescriptions that were paid by individuals during the two weeks prior to the household interview. Inpatient OOP expenditures during the preceding 12 months were also recorded.²⁸

Data analysis

Measurement of ATP

The unit of healthcare finance was on the household level, based on which expenditures and healthcare payments were aggregated. The amount of household expenditure was used as the measurement of ATP.²⁸ Adjustment was made according to the size and age structure of the household to both ATP and each component of healthcare financing. The scale of 'adult equivalents' (AE) in the household was calculated as

$$AE = (A + 0.5K)^{0.75} \quad (1)$$

where A was the number of adults in the household and K the number of children (0–14 years).

AJL decomposition

An AJL decomposition that measured the RE of healthcare payments on income distribution was used to compare the inequality—as measured by the Gini coefficient—of pre-payment income with that in post-payment incomes.⁷ The 'redistributive impact' can be defined as the reduction in the Gini coefficient caused by the healthcare payments.⁶ Thus:

$$RE \equiv G^X - G^{X-P} \quad (2)$$

Table 1 Descriptive statistics and socioeconomic characteristics for the urban sample

Variable	2002			2007		
	Obs	Mean	SD	Obs	Mean	SD
Gender (female)	2613	0.50		3140	0.51	
Age (years)	5265	38.86	18.96	6188	43.25	19.11
0–14	699	8.41	4.14	579	8.13	4.11
14–59	3738	38.07	11.41	4332	40.36	11.74
60+	828	68.14	6.43	1277	68.99	6.65
Number of household members (average)	1923	2.74	0.91	2433	2.67	0.97
Equivalent household income	1923	806.33	1031.35	2433	1285.26	1061.11
1st quintile	383	197.22	46.95	485	492.12	108.42
2nd quintile	385	344.72	42.55	489	772.76	68.33
3rd quintile	385	511.15	58.14	486	1038.58	87.83
4th quintile	385	787.23	108.75	487	1412.04	128.86
5th quintile	385	2188.16	1648.92	486	2712.05	1610.68
Equivalent OOP expenditure	1923	107.49	345.85	2433	172.81	290.63
Incidence of catastrophic health expenditure	513	26.68%		869	35.72%	
Health insurance						
None	3120	59.26%		2909	47.01%	
Any	2145	40.74%		3279	52.99%	
Public health insurance types	1922	36.51%		2988	48.29%	
UEBMI	1374	26.10%		2100	33.94%	
URBMI	0	0.00%		273	4.41%	
CMS (NCMS)	6	0.11%		50	0.81%	
Other insurance	542	10.29%		565	9.13%	
None	3343	63.49%		3200	51.71%	
Private health insurance types	359	6.82%		297	4.80%	

All expenditures are presented in US\$.

The threshold of the catastrophic health expenditure is 25% of non-food household expenditure in this study.

Source: Authors' calculations from 2003 to 2008 National Health Services Survey data.

NCMS, New Rural Cooperative Medical Scheme; OOP, out-of-pocket; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Residents' Basic Medical Insurance.

where G^X and G^{X-P} are the pre-payment and post-payment Gini coefficients, respectively, wherein X denotes pre-payment income, or, more generally, some measure of ATP, and P denotes healthcare payments. The AJL approach demonstrated that the RE can be decomposed as

$$RE = V - H - R \quad (3)$$

The first term, which AJL refer to as V , measures the inequality reduction that would have been obtained if there had been no differential healthcare payment. The second term, which AJL refer to as H , measures the extent of classical horizontal inequity—the unequal treatment of equals. The third term, which AJL refer to as R , measures the extent of reranking in the move from the pre-payment income distribution to the post-payment income distribution.⁷ To distinguish and compute these components, groups of pre-payment equals are required to be artificially created. This is

done by defining certain pre-payment income intervals, and then labelling all households with incomes in that range as equals. All households within an interval are attributed the mean within-interval income, x_j ; V itself can be decomposed into a 'payment rate effect' and a 'progressivity effect',

$$V = \left(\frac{g}{1-g} \right) K_E \quad (4)$$

with g the sample average healthcare payment rate (as a proportion of income) and K_E being the Kakwani index of payments computed under the assumption of within-group equality; that is, in all households in the same (predefined) bandwidth of (equal) pre-payment income, everyone pays the same amount (ie, under horizontal equity conditions).

Horizontal inequity H is measured by the weighted sum of the group (j) specific post-payment Gini coefficients, G_j^{X-P} , where weights are given by the product of the

Table 2 Descriptive statistics and socioeconomic characteristics for the rural sample

Variable	2002			2007		
	Obs	Mean	SD	Obs	Mean	SD
Gender (female)	3063	0.49		4808	0.50	
Age (years)	6307	33.39	18.02	9638	36.57	19.17
0–14	1133	8.22	4.42	1497	7.33	4.22
14–59	4704	35.92	11.91	7080	37.95	12.33
60+	470	68.70	7.06	1061	68.57	7.46
Number of household members (average)	1918	3.29	1.12	3097	3.25	1.16
Equivalent household income	1918	408.49	334.99	3097	975.97	708.17
1st quintile	383	155.97	35.45	619	426.42	87.44
2nd quintile	385	243.28	23.37	620	640.02	49.12
3rd quintile	383	326.94	27.49	620	826.73	57.68
4th quintile	384	443.90	45.74	619	1075.66	93.17
5th quintile	383	873.13	492.62	619	1911.79	1079.40
Equivalent OOP expenditure	1918	56.28	153.78	3097	126.78	296.75
Incidence of catastrophic health expenditure	485	25.29%		694	22.41%	
Health insurance						
None	5311	84.21%		905	9.39%	
Any	996	15.79%		8733	90.61%	
Public health insurance types	597	9.47%		8627	89.50%	
UEBMI	71	1.13%		34	0.35%	
URBMI	0	0.00%		4	0.04%	
CMS (NCMS)	347	5.50%		8401	87.16%	
Other insurance	179	2.84%		188	1.95%	
None	5710	90.53%		1012	10.50%	
Private health insurance types	402	6.37%		773	8.02%	

All expenditures are presented in US\$.

The threshold of the catastrophic health expenditure is 25% of non-food household expenditure in this study.

Source: Authors' calculations from 2003 to 2008 National Health Services Survey data.

NCMS, New Rural Cooperative Medical Scheme; OOP, out-of-pocket; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Residents' Basic Medical Insurance.

group's population share and its post-payment income share, a_j :

$$H = \sum_j a_j G_j^{X-P} \quad (5)$$

R captures the extent of reranking of households that occurs in the move from pre-payment to post-payment income distributions. It is measured as the difference between the post-payment Gini coefficient G^{X-P} and the post-payment concentration index C^{X-P} . The latter differs from the former in that households are ranked by their pre-payment income, not their post-payment income. If there is no reranking, R is zero.

$$R = G^{X-P} - C^{X-P} \quad (6)$$

In sum, the total RE can be decomposed into four components: an average rate effect (g), the departure-from-proportionality or progressivity effect (K_E), a horizontal inequity effect H and a reranking effect R .

Patient and public involvement

All data in this study were derived from the household survey, so no patients and the public were involved in the study design, the outcome measures, data analysis or interpretation of the results. Results will be disseminated to study participants via this publication.

RESULTS

Decompositions of the RE of healthcare financing sources are presented in tables 3-6. The distribution of healthcare financing sources across equivalent income deciles, along with the corresponding values of g , V , H , R and RE , V , H and R , is also presented as a percentage of RE.

RE of urban areas in 2002

In urban areas in 2002, payments to healthcare accounted for 15.70% of the total household expenditures (g for total payments in table 3). The RE value was positive,

Table 3 Decomposition of the REs of the Chinese urban healthcare financing system in 2002

Decile	Per capital household expenditure	General taxes	Public health insurance	Private health insurance	OOP	Total payments
1 (poorest)	1.97%	2.07%	0.52%	1.01%	1.53%	1.44%
2	2.95%	3.12%	0.81%	4.92%	2.19%	2.18%
3	3.86%	4.08%	1.33%	6.00%	2.83%	2.86%
4	4.76%	4.97%	2.83%	3.65%	3.94%	3.92%
5	5.74%	5.89%	3.82%	4.54%	5.28%	5.12%
6	6.98%	7.22%	4.91%	6.45%	5.87%	5.95%
7	8.64%	9.09%	8.40%	14.02%	6.91%	7.70%
8	10.86%	11.33%	17.03%	9.31%	8.70%	10.60%
9	14.60%	14.85%	34.95%	28.02%	13.24%	17.58%
10 (richest)	39.64%	37.38%	25.40%	22.10%	49.51%	42.66%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
<i>g</i>		0.003789	0.011082	0.008820	0.133309	0.157001
<i>V</i>		-0.000063	0.001162	-0.000666	0.014464	0.015376
<i>H</i>		0.000021	0.000173	0.000382	0.003487	0.004015
<i>R</i>		0.000000	0.000019	0.000301	0.006615	0.007083
<i>RE</i>		-0.000084	0.000970	-0.001349	0.004363	0.004278
<i>RE/RE</i>		100.00%	100.00%	100.00%	100.00%	100.00%
<i>V/RE</i>		75.32%	119.77%	49.40%	331.53%	359.42%
<i>H/RE</i>		-24.68%	17.84%	-28.32%	79.92%	93.85%
<i>R/RE</i>		0.00%	1.93%	-22.28%	151.62%	165.57%

g, payments as fraction of income; *H*, horizontal inequity; OOP, out-of-pocket; *R*, reranking; *RE*, redistributive effect; *V*, vertical effect.

indicating healthcare financing had a pro-poor redistribution. The *V/RE* ratio was 359.42%, which indicated that the positive *RE* would be 259.42% greater in the absence of horizontal inequity (ie, *H*+*R*). In terms of specific healthcare financing source, general taxes and private health insurance exhibited pro-rich redistribution, while public health insurance and OOP payment showed the opposite effect. In addition, the negative *RE* of general tax and private health insurance would be 24.68% and 50.60% smaller in the absence of horizontal inequity, while the positive *RE* of public health insurance and OOP payment would be 19.77% and 231.53% greater in the absence of horizontal inequity.

RE of rural areas in 2002

In rural areas in 2002, payments to healthcare accounted for 14.61% of the total household expenditures (*g* for total payments in table 4). The *RE* value was negative, indicating healthcare financing had a pro-rich redistribution. The *V/RE* ratio was -311.62%, which indicated that the negative *RE* would be 411.62% smaller in the absence of horizontal inequity. In terms of specific healthcare financing source, all healthcare payments were pro-rich distributed. The negative *RE* of general taxes, public and private health insurance and OOP payment would be 15.41%, 215.17%, 124.18% and 462.90% smaller in the absence of horizontal inequity.

RE of urban areas in 2007

In urban areas in 2007, 19.30% of household expenditure was paid to healthcare (*g* for total payments in table 5). The *RE* value was negative, indicating healthcare financing had a pro-rich redistribution. The *V/RE* ratio was -21.70%, which indicated that the negative *RE* would be 121.70% smaller in the absence of horizontal inequity. In terms of specific healthcare financing source, general taxes, private health insurance and OOP payment were pro-rich redistributed, while public health insurance was pro-poor redistributed. In addition, the negative *RE* of general taxes, private health insurance and OOP payment would be 52.60%, 306.03% and 88.42% smaller in the absence of horizontal inequity, while the positive *RE* of public health insurance would be 40.92% greater in the absence of horizontal inequity.

RE of rural areas in 2007

In rural areas in 2007, 14.98% of household expenditure was paid to healthcare (*g* for total payments in table 6). The *RE* value was negative, indicating healthcare financing had a pro-rich redistribution. The *V/RE* ratio was -13.71%, which indicated that the negative *RE* would be 113.71% smaller in the absence of horizontal inequity. In terms of specific healthcare financing source, all healthcare payments were pro-rich distributed. The negative *RE* of general taxes, public and private health

Table 4 Decomposition of REs of Chinese rural healthcare financing system in 2002

Decile	Per capital household expenditure	General taxes	Public health insurance	Private health insurance	OOP	Total payments
1 (poorest)	3.09%	3.43%	1.35%	0.89%	2.17%	2.22%
2	4.53%	4.80%	1.46%	3.23%	4.43%	3.96%
3	5.46%	5.86%	3.26%	3.35%	4.58%	4.55%
4	6.46%	6.86%	6.37%	4.59%	5.34%	5.76%
5	7.38%	7.75%	14.62%	11.23%	6.07%	7.95%
6	8.59%	8.74%	13.18%	10.80%	8.90%	9.65%
7	9.93%	10.29%	8.46%	8.14%	7.91%	8.42%
8	11.81%	11.73%	12.11%	20.12%	12.55%	12.51%
9	14.97%	15.08%	7.19%	17.32%	13.22%	12.60%
10 (richest)	27.78%	25.46%	31.99%	20.33%	34.83%	32.39%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
<i>g</i>		0.003705	0.001190	0.003403	0.137787	0.146085
<i>V</i>		-0.000094	0.000038	0.000104	0.013238	0.013424
<i>H</i>		0.000017	0.000043	0.000163	0.004659	0.004876
<i>R</i>		0.000000	0.000029	0.000371	0.012227	0.012856
<i>RE</i>		-0.000111	-0.000033	-0.000431	-0.003648	-0.004308
<i>RE-RE</i>		100.00%	100.00%	100.00%	100.00%	100.00%
<i>V-RE</i>		84.58%	-115.17%	-24.18%	-362.90%	-311.62%
<i>H-RE</i>		-15.41%	-127.93%	-37.94%	-127.71%	-113.19%
<i>R-RE</i>		0.00%	-87.24%	-86.25%	-335.18%	-298.43%

g, payments as fraction of income; *H*, horizontal inequity; OOP, out-of-pocket; *R*, reranking; *RE*, redistributive effect; *V*, vertical effect.

insurance and OOP payment would be 35.42%, 0.36%, 52.01% and 152.92% smaller in the absence of horizontal inequity.

DISCUSSION

Horizontal inequity decreased over the period 2002–2007 in both urban and rural areas. Meanwhile, the extent of reranking also reduced over the same period in both urban and rural areas, indicating that the impact of healthcare finance on impoverishment was lessened.

The biggest challenge for horizontal equity in China's healthcare finance originated from OOP payments. OOP payments as fraction of income (*g*) were far larger than all other healthcare financing sources. This implied that the RE of total healthcare payment was largely dominated by OOP payments in China. Although OOP has been found to be the main reason for the pro-rich redistribution in other countries, the impact was much smaller than that in China.^{7,9} For example, in Switzerland, horizontal inequity of OOP accounted for 12.4 percentage points of the RE, whereas reranking accounted for 9.8 percentage points of the RE.⁹ Our study has shown that horizontal inequity in OOP payments has been reduced both in urban and rural areas over the period 2002–2007. The horizontal inequity in OOP payments had mainly stemmed from the different health conditions and health insurance schemes

among individuals with the same income level. As the distribution of health conditions among the population was unlikely to have changed markedly during a relatively short time period, the reduction of horizontal inequity was more likely largely attributable to the reform and establishment of the new health insurance programmes. This finding agrees with a study from the Netherlands, in which vertical and horizontal inequity were both found to be largely attributable to the different choices of benefit packages of health insurance schemes.⁷ The extent of reranking of OOP payments was much larger than other healthcare payments, and it was found that the rank order of individuals who financed healthcare through OOP payments decreased markedly.

In 2002, urban public health insurance was the UEBMI scheme, and it covered mainly workers in the public sector. In 2007, the UEBMI and URBMI schemes were both in effect, with the former covering workers in both the public and private sectors, while the latter covered citizens who were ineligible to enrol in the UEBMI scheme, such as students, the elderly and the unemployed. China's public health insurance was managed and run at the city level and UEBMI premiums were different between cities. This was the main reason for the horizontal inequity in public health insurance in urban areas in 2002. Excluding this reason, in 2007, the different financing schemes between the UEBMI

Table 5 Decomposition of REs of Chinese urban healthcare financing system in 2007

Decile	Per capital household expenditure	General taxes	Public health insurance	Private health insurance	OOP	Total payments
1 (poorest)	3.14%	3.49%	1.05%	5.17%	2.68%	2.59%
2	4.52%	4.80%	2.36%	2.82%	4.16%	3.85%
3	5.55%	5.66%	4.07%	4.49%	5.91%	5.37%
4	6.49%	6.59%	5.30%	6.46%	6.75%	6.36%
5	7.47%	7.46%	6.82%	5.56%	8.02%	7.51%
6	8.66%	8.57%	9.01%	4.27%	9.10%	8.77%
7	10.16%	9.95%	10.59%	10.31%	11.43%	10.83%
8	11.82%	11.48%	12.68%	15.70%	13.55%	12.92%
9	14.54%	14.62%	17.35%	16.01%	13.35%	14.70%
10 (richest)	27.66%	27.39%	30.77%	29.20%	25.04%	27.11%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
<i>g</i>		0.004710	0.045590	0.008282	0.134454	0.193035
<i>V</i>		-0.000022	0.005007	0.000428	-0.002364	0.003885
<i>H</i>		0.000024	0.000995	0.000352	0.005067	0.006355
<i>R</i>		0.000000	0.000459	0.000284	0.012975	0.015431
<i>RE</i>		-0.000046	0.003553	-0.000208	-0.020406	-0.017901
<i>RE-RE</i>		100.00%	100.00%	100.00%	100.00%	100.00%
<i>V-RE</i>		47.40%	140.92%	-206.03%	11.58%	-21.70%
<i>H-RE</i>		-52.60%	28.02%	-169.28%	-24.83%	-35.50%
<i>R-RE</i>		0.00%	12.91%	-136.75%	-63.59%	-86.20%

g, payments as fraction of income; *H*, horizontal inequity; OOP, out-of-pocket; *R*, reranking; *RE*, redistributive effect; *V*, vertical effect.

and the URBMI, as well as the disparity in financing contribution to the UEBMI between public and private sectors, also resulted in horizontal inequity. This explains why horizontal inequity in urban public health insurance increased over the period 2002–2007. In 2002, CMS provided rural public health insurance, covering <10% of rural residents. In 2007, NCMS covered >90% of rural residents. Both CMS and NCMS were based on flat rate contributions. Thus, the horizontal inequity in rural health insurance came from the different financing contribution between different cities, and came from the covered and the uncovered parties. Since almost all rural residents were covered by NCMS in 2007, the horizontal inequity in rural public health insurance was dramatically reduced over the period. Private health insurance did not play an important role in China's health insurance reform because the government decided to achieve Universal Health Coverage through public health insurance. Currently, only about 5% of the population is enrolled in private health insurance.²⁹ The insureds purchase different types of insurance from different insurance companies. Therefore, the horizontal inequities are comparatively high.

Our findings demonstrated that horizontal inequity in general taxes increased from 2002 to 2007, and that horizontal inequity was higher in urban areas than in rural areas. The main income source for households in China in our sample was wages. Taxes for households consisted

primarily of personal income tax. Because of economic development, individuals—and especially those in urban areas—earned their income from a variety of sources, and people with the same income levels had a much greater variety of income compositions than in the past. Different income types were subject to different tax rates, which resulted in increased horizontal inequity. Horizontal inequity in relation to personal income tax was found to have decreased between 1980 and 1990 in Sweden, where the ceiling of taxable income range was abolished following economic development. Overall, such a policy ensures that the tax is largely borne by the rich.⁸

Despite the fact that horizontal, vertical and reranking effects are usually expressed and explained as a percentage of the total RE, some results need to be interpreted with caution. While the horizontal inequity of OOP and total payments in relative terms decreased over the period 2002–2007, in absolute terms, horizontal inequity increased over during that period in both urban and rural areas. As horizontal inequity was measured by the weighted sum of Gini coefficients in each income quintile group,⁷⁸ the increase of horizontal inequity in the absolute term indicates a more inequitable distribution within the income quintile group. Furthermore, the RE decreased both in urban and rural areas from 2002 to 2007 in our study, indicating that the healthcare financing system had become more pro-rich over the period. In a previous

Table 6 Decomposition of REs of Chinese rural healthcare financing system in 2007

Decile	Per capital household expenditure	General taxes	Public health insurance	Private health insurance	OOP	Total payments
1 (poorest)	3.63%	3.75%	11.08%	4.30%	3.36%	5.29
2	5.10%	5.20%	9.74%	10.25%	4.97%	6.33
3	6.13%	6.27%	9.70%	5.94%	5.81%	6.84
4	6.97%	7.04%	10.05%	10.28%	7.15%	7.92
5	7.97%	8.08%	9.74%	9.46%	7.77%	8.37
6	8.98%	9.19%	9.59%	8.00%	7.94%	8.64
7	10.18%	10.43%	10.62%	10.08%	9.06%	9.80
8	11.84%	11.92%	10.08%	12.33%	11.25%	11.18
9	14.45%	14.25%	10.37%	9.58%	15.62%	13.84
10 (richest)	24.74%	23.86%	9.03%	19.78%	27.06%	21.79
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
<i>g</i>		0.004744	0.002764	0.012405	0.129908	0.149821
<i>V</i>		-0.000035	-0.000864	-0.001599	0.004933	0.002138
<i>H</i>		0.000019	0.000003	0.000770	0.004951	0.005788
<i>R</i>		0.000000	0.000000	0.000962	0.009306	0.011943
<i>RE</i>		-0.000053	-0.000867	-0.003331	-0.009323	-0.015593
<i>RE-RE</i>		100.00%	100.00%	100.00%	100.00%	100.00%
<i>V-RE</i>		64.58%	99.64%	47.99%	-52.92%	-13.71%
<i>H-RE</i>		-35.42%	-0.36%	-23.13%	-53.10%	-37.12%
<i>R-RE</i>		0.00%	0.00%	-28.88%	-99.82%	-76.59%

g, payments as fraction of income; *H*, horizontal inequity; OOP, out-of-pocket; *R*, reranking; *RE*, redistributive effect; *V*, vertical effect.

study in the same area, Chen *et al* found that the Kakwani index of the total healthcare payments decreased from 2002 to 2007.²⁹ This is consistent with our study's finding that vertical equity (*V*) decreased over the period 2002–2007. We have also found that horizontal inequity (*H*) increased in both urban and rural areas over the same time period. In addition, reranking (*R*) decreased in rural areas but increased in urban areas from 2002 to 2007. When considering *V*, *H* and *R* together, RE decreased in both urban and rural areas. This finding indicates that improving both vertical and horizontal equity in healthcare financing system could improve pro-poor redistribution to a large extent in the study population. However, equitable vertical and horizontal distributions are hard to achieve simultaneously. Taking NCMS as an example, a flat rate premium could result in an equitable horizontal distribution, but at the cost of worsened vertical equity, as all insured individuals would pay the same premium, irrespective of their incomes. In addition, some public insurance schemes are financed at the county level and it is also important to consider other amenable factors such as sex, age and location in policy interventions. Therefore, we should weigh horizontal equity against vertical equity in healthcare financing system reform. Future work is warranted to investigate the optimal trade-off between horizontal and vertical equity to achieve a more pro-poor redistribution in the healthcare financing system.

Healthcare financing has changed dramatically since the initiation of health insurance reform within the study region. The proportion of general taxes in the healthcare financing system increased from 15.15% in 2002 to 27.26% in 2015.²⁷ During this time, with the help of information technology, a strict tax supervision policy was implemented and tax avoidance was hard to achieve. This resulted in the reduction of horizontal inequity in respect of general tax. Meanwhile, the proportion of public health insurance in the healthcare financing system increased from 19.12% in 2002 to 36.76% in 2015.²⁷ However, due to the policy goal of universal health coverage and an increasing rate of urbanisation, the URBMI and NCMS schemes were gradually integrated. This suggests that many more individuals with different natural and social characteristics were covered in the same insurance schemes, which in turn brought about an increase of horizontal inequity. On the contrary, the proportion of OOP payments notably decreased from 65.73% in 2002 to 35.98% in 2015.²⁷ Consequently, the horizontal inequity in respect of total healthcare finance was reduced by the decreasing impact of OOP payments.

The current study has only examined data from one province in China, which is unlikely to fully represent horizontal equity in China's healthcare financing system overall. Studies using nationally representative data are warranted to evaluate horizontal equity following the national health insurance reforms in China.

CONCLUSIONS

Overall, horizontal inequity in China's total healthcare financing has decreased during the period 2002–2007. In addition, OOP payments were found to have contributed most to the overall healthcare payments and horizontal inequity in OOP payments has decreased. These findings have important implications for future healthcare financing reforms: China's further health insurance reform should target cost and service coverage in order to decrease the impact of OOP payments.

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Acknowledgements The authors thank the National Health and Family Planning Commission, People's Republic of China, for its support and cooperation, and the Health and Family Planning Commission of Heilongjiang Province for its cooperation and organisation in relation to the field data collection. They also like to thank all study participants for their time during the interview stages.

Contributors ZW led the study; designed the study and led the data analysis and interpretation. MC contributed to the study design and wrote the manuscript. XZ analysed the data and helped in the writing of the final draft of the manuscript. YG contributed to the study design and analysed the data. LS supervised the study, contributed to the study design and wrote the manuscript. AP contributed to the study design, reviewed the manuscript and helped in the writing of the final draft of the manuscript. All authors read and approved the final manuscript.

Funding This study was funded by the National Natural Science Foundation of China (grant number: 71503137). LS was supported by a NHMRC Early Career Fellowship (GNT1139826).

Competing interests None declared.

Patient consent Not required.

Ethics approval This study was approved by the Academic Research Ethics Committee of Nanjing Medical University. All procedures were undertaken in accordance with the ethical standards of the Helsinki Declaration.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The data sets used in this study are not publicly available due to a confidentiality policy, but they are available from the corresponding author on reasonable request.

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