

BMJ Open Decomposing inequality in catastrophic health expenditure for self-reported hypertension household in Urban Shaanxi, China from 2008 to 2013: two waves' cross-sectional study

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ABSTRACT

Objective Despite the latest wave of China's healthcare reform initiated in 2009 has achieved unprecedented progress in rural areas, little is known for specific vulnerable groups' catastrophic health expenditure (CHE) in urban China. This study aims to estimate the trend of incidence, intensity and inequality of CHE in hypertension households (households with one or more than one hypertension patient) in urban Shaanxi, China from 2008 to 2013.

Methods Based on the fourth and the fifth National Health Service Surveys of Shaanxi, we identified 460 and 1289 households with hypertension in 2008 and 2013, respectively for our analysis. We classified hypertension households into two groups: simplex households (with hypertension only) and mixed households (with hypertension plus other non-communicable diseases). CHE would be identified if out-of-pocket healthcare expenditure was equal to or higher than 40% of a household's capacity to pay. Concentration index and its decomposition based on Probit regressions were employed to measure the income-related inequality of CHE.

Results We find that CHE occurred in 11.2% of the simplex households and 22.1% of the mixed households in 2008, and the 21.5% of the simplex households and the 46.9% of mixed households incurred CHE in 2013. Furthermore, there were strong pro-poor inequalities in CHE in the simplex households (−0.279 and −0.283) and mixed households (−0.362 and −0.262) both in 2008 and 2013. The majority of observed inequalities in CHE could be associated with household economic status, household head's health status and having elderly members.

Conclusion We find a sharp increase of CHE occurrence and the sustained strong pro-poor inequalities for simplex and mixed households in urban Shaanxi Province of China from 2008 to 2013. Our study suggests that more concerns are needed for the vulnerable groups such as hypertension households in urban areas of China.

INTRODUCTION

Protecting residents from financial risks associated with illness, and achieving health equality have been the fundamental

Strengths and limitations of this study

- Using two waves' cross-sectional data, this study estimates the trends of catastrophic health expenditure (CHE) incidence, intensity and income-related inequality of hypertension households, the specific vulnerable groups, from 2008 to 2013.
- Three indicators, CHE incidence, mean positive overshoot and overshoot, were employed to fully capture the incidence and intensity of CHE in hypertension households.
- The inequalities in CHE were further decomposed into its determinants by decomposing the concentration index of CHE.
- It cannot be interpreted as a causal effect because of the cross-sectional study design.

functions of health system, which also have become the key global health agendas.¹ Yet a high incidence of catastrophic health expenditure (CHE) implies the inadequacies of health system in achieving the goal of financial protection.^{2–4} Generally, healthcare expenditure was deemed 'catastrophic' when out-of-pocket (OOP) healthcare expenditure exceeds qualified threshold of household's income portion or household's capacity to pay (CTP) portion.^{3 4} High healthcare expenditure may also lead to a reduction of spending on basic goods (eg, food, education),^{2–5} and the patients may even choose to forgo healthcare utilisation and thus suffer from illness deterioration.^{6–10}

Prior studies of the CHE focused on measuring the occurrence of CHE and income-related inequalities, and identifying key determinants using cross-sectional data while we know very little about the CHE in specific vulnerable groups in urban areas.^{11–13} Evidence from

South Korea, India and 15 European countries indicated that households with members suffering from non-communicable diseases (NCDs) have a higher chance of experiencing CHE than households, even in some of the wealthiest countries worldwide.^{13 14} The result was consistent in both developed countries and low-income and middle-income countries. The effects differed across diseases and countries, which may be due to different socio-economic contexts and the different health systems.¹¹⁻¹⁴

Evidence indicated that rising blood pressure worldwide has shifted from developed countries to less developed countries, and there were 20% adults with increasing blood pressure living in China in 2015.^{15 16} The epidemic of hypertension has ranked first among all NCDs in China which in turn was associated with considerable amount of healthcare expenditure.¹⁷ Importantly, studies in rural China also showed that households with hypertension have 1.7–2.6 times occurrence of CHE than households without NCDs, as well as strong pro-poor inequalities.^{2 18}

With the rapid economic growth in the last 30 years, high financial risks of healthcare faced by households and health inequality challenges in China are rather daunting.^{19 20} Therefore, China proposed the ambitious healthcare reform in 2009, the most important policy agenda regarding financial protection in the past decade, aiming at reducing OOP health expenditures as well as providing affordable and equitable basic healthcare for all residents by 2020.²¹⁻²³ The basic health insurance system includes the Urban Employee Basic Medical Insurance (UEBMI) since 1998 (covering 190 million urban employees), the Urban Resident Basic Medical Insurance (URBMI) since 2007 (covering 420 million urban residents) and the New Rural Cooperative Medical Insurance (NRCMI) since 2003 (covering 750 million rural residents). Till the end of 2009, the UEBMI enrolled 28.24% urban residents, the URBMI enrolled 28.20% urban residents, and the NRCMI enrolled 92.97% rural residents in Shaanxi. Importantly, the comprehensive healthcare reform extended basic health insurance coverage to more than 92% of the population till 2011.²⁰⁻²² Furthermore, the healthcare reform established a national essential medicine system in China, aiming at providing basic prescription drugs at zero markup in primary care facilities.^{24 25} The national essential medicine system reduced the price of basic prescription drugs for patients seeking care in primary care facilities, and then aimed to reduce the healthcare expenditure of households in China.

Given the high level of prevalence, awareness and treatment of hypertension in urban China, as well as the high risks of CHE,^{15 16} it is urgent to estimate the number of hypertension households (households with one or more than one hypertension patient) incurring CHE and its income-related inequality in urban areas of China, especially the trend of CHE covering the healthcare system reform of China in 2009. We hypothesise that there would be a decreasing proportion of hypertension households incurring CHE, and that there would be less inequality in CHE for hypertension households from 2008 to 2013.

Using two waves of cross-sectional data in urban Shaanxi, China, this study aims to estimate the trends of CHE incidence, intensity and income-related inequality of self-reported hypertension households from 2008 to 2013. Our findings may contribute to providing policy implications for health system reform in China.

METHODS

Data source

This study used two waves of cross-sectional data from the fourth and the fifth National Health Service Surveys (NHSS) of Shaanxi, conducted in June 2008 and September 2013. NHSS is a national representative survey directed by the National Health and Family Planning Commission of China every 5 years from 1993 to 2013. The NHSS of Shaanxi included subsamples of the National Household Health Service Surveys of China and extending parts conducted by Shaanxi to achieving representation of the whole population in Shaanxi.^{4 11} The multistage, stratified, random sampling method was adopted, and the standardised questionnaire was employed to collect information on socio-economic and demographic characteristics of households, insurance, self-reported illness and healthcare utilisation of residents.^{2 25 26} Finally, 5960 households in 2008 and 20 700 households in 2013 were identified, including 3239 households in rural areas and 2721 households in urban areas in 2008, and 13 200 households in rural areas and 7500 households in urban areas in 2013. Three questions in the survey were employed to identify whether the interviewees have chronic diseases: whether you were diagnosed with (1) hypertension, (2) diabetes and (3) other chronic diseases (eg, cancer, stroke) by doctors in the last 6 months? Considering the complications of hypertension, we identified hypertension households as simplex household (households with hypertension only) and mixed household (households with hypertension plus other NCDs), see attachment 1. There were 347 simplex households and 114 mixed households identified in the sample of 2008, and 726 simplex households and 563 mixed households in the sample of 2013.

Patient and public involvement

Patients and the public were not involved in this study.

Measuring CHE and the definitions of major variables

CHE was defined as the OOP health expenditure was equal to or higher than 40% of a household's CTP.²⁻⁵ OOP health expenditure in this study only covered the direct medical expenditure, excluding direct non-medical costs (eg, transportation, accommodation) and indirect costs (eg, income foregone by morbidity or mortality). CTP was defined as a household's consumption subtracting basic subsistence expenditure adjusted by household size, and the household subsistence expenditure was the minimum requirement to maintain basic life in a society.²⁻⁴ We used the poverty line

based on food share to estimate household subsistence expenditure. The poverty line was defined as the food expenditure of the household whose food expenditure share of total household expenditure was at the 50th percentile in the sample household.^{2,3} Furthermore, we estimate the mean of food expenditure of the household whose food expenditure share of total household expenditure ranges from the 45th to the 55th percentile in order to minimise measurement error.³⁻⁵

$$CHE = \begin{cases} 0 & \text{if } \frac{OOP}{CTP} < \text{threshold} \\ 1 & \text{if } \frac{OOP}{CTP} \geq \text{threshold} \end{cases} \quad (1)$$

Overshoot and mean positive overshoot (MPO) were used to measure the intensity of CHE consistent with former studies. Consistent with former researches, overshoot indicates the extent to which the average OOP health expenditure exceeded the given threshold if the household incurred CHE;

$$\text{Overshoot} = \frac{1}{N_1} \sum_{i=1}^{N_1} \left(\frac{OOP}{CTP} - \text{threshold} \right) \times CHE_i \quad (2)$$

where N_1 is the sample size of household incurred CHE, and CHE_i means the probability of household i incurring CHE (0—No, 1—Yes). The threshold is 40% consistent with other related researches.²⁻⁵ Thus, overshoot indicates the extent to which health expenditure of a household exceeds the given catastrophic threshold if the household incurred CHE. A higher value of overshoot means heavier burden for the household incurred CHE, and vice versa. The calculation of MPO can be specified as:

$$\text{MPO} = \frac{1}{N_2} \sum_{i=1}^{N_2} \left(\frac{OOP}{CTP} - \text{threshold} \right) \times CHE_i \quad (3)$$

where N_2 is the total sample size (households incurring CHE or not), and $Z_{1-\frac{\alpha}{2c}} = Z_{1-\frac{0.05}{2*2}} = Z_{1-0.0125} = 2.24$ means the probability of household i incurring CHE (0—No, 1—Yes). Thus, MPO means the burden of health expenditure of households incurring CHE on the whole society. A higher value of MPO means heavier CHE burden of for the whole society, and vice versa.^{2,12}

In this study, we included variables such as economic status, household size, having supplement health insurance or not and time length going to the nearest medical station (minutes) and living areas to control confounding factors based on the literature review and data availability.²⁻¹⁴ We also controlled for household head's gender, health status (the self-reported health score, measured by scores ranging from 0 to 100; the interviewee was required to report their score of health on the day of survey), educational attainment and marriage status, given the important role of household head in intra-household decision-making. As income is more likely to be misreported, consumption was used to measure the economic status.^{26,27} Furthermore, to measure households' economic status excluding variations in household size, we deployed the per capita consumption which

was defined as household consumption expenditure subtracting OOP health expenditure.^{28,29}

Statistical analysis

Concentration index (CI) was used to measure the extent of socio-economic inequality in CHE,²⁸⁻³⁰ which is calculated as:

$$CI = \frac{2}{\mu} cov(y_i, r_i) \quad (4)$$

where CI is concentration index, y_i is CHE indicator, μ is the mean of CHE indicator and r_i is the fractional rank of household in the economic status distribution. The concentration index ranges from -1 to 1 and the positive value indicates that CHE incidence is more concentrated among the rich household, and vice versa. The larger the absolute value of the concentration index, the greater the inequality in CHE.²⁸ Furthermore, the inequality in CHE can be decomposed into its determinants. The linear approximation to the non-linear model was calculated by estimating the partial effects evaluated at the covariate means and Probit model was employed here to conduct the decomposition because CHE incidence was a binary variable^{28,31}:

$$y = \alpha^m + \sum_j \beta_j^m x_j + \varepsilon \quad (5)$$

where y is CHE indicator (1—Yes, 0—No), β_j^m is partial effects (ie, dy/dx_j) of each variable and evaluated at sample means; α^m is the constant term in the regression, ε is the error term. Based on calculation of the concentration index of Equation 5, the decomposition of the CI could be specified as:

$$CI = \sum_j \left(\frac{\beta_j^m \bar{x}_j}{\mu} \right) C_j + \frac{GC_\varepsilon}{\mu} \quad (6)$$

where μ is the mean value of the dependent variable, C_j is the concentration indices for x_j , \bar{x}_j is mean of x_j and $\frac{\beta_j^m \bar{x}_j}{\mu}$ is the elasticity of x_j in CHE. The contribution of x_j is defined as the product of the elasticity of x_j in CHE and the concentration index of x_j . The first term on the right side of Equation 3 denotes the contribution of observable variables to inequality, the last term is the generalised concentration index of ε . A positive contribution to socio-economic inequality means that the relevant variables will increase inequality, and vice versa.²⁸ All analyses were performed with Stata V.13.0.

RESULTS

Table 1 shows the summary statistics for general characteristics of hypertension households. The average annual household consumption expenditures by simplex households (households with hypertension only) and mixed households (households with hypertension plus other NCDs) were 5710 CNY and 5161 CNY in 2008, respectively, which increased to 6610 CNY and 7253 CNY in 2013, respectively. Health status of household head and the time length going to the nearest medical station increased slightly from 2008

Table 1 Description of variables and general characteristics of hypertension households

	2008				2013			
	Simplex		Mixed		Simplex		Mixed	
	Mean (N)	SE (%)	Mean (N)	SE (%)	Mean (N)	SE (%)	Mean (N)	SE (%)
Economic status (CNY)	5710	4338	5161	3858	6610	5211	7253	7061
OOP (CNY)	2677	3490	3345	3904	4528	6451	8655	8620
Time (minutes)	9.2	5.8	9.9	6.8	10.0	8.2	10.9	8.41
Illness in the last 2 weeks								
Yes	116	33.4	45	39.8	579	79.8	506	89.9
No*	231	66.6	68	60.2	147	20.2	57	10.1
Inpatient healthcare use in the last year								
Yes	30	8.7	33	29.2	101	13.9	171	30.4
No*	317	91.4	80	70.8	625	86.1	392	69.6
Having elder members in household								
Yes	116	33.4	52	46.0	304	41.9	334	59.3
No*	231	66.6	61	54.0	422	58.1	229	40.7
Supplementary insurance								
Yes	24	6.9	6	5.3	43	5.9	21	3.7
No*	323	93.1	107	94.7	683	94.1	542	96.3
Household size								
≤2*	155	44.8	57	50.9	427	58.8	400	71.1
3–4	147	42.5	42	37.5	233	32.1	125	22.2
≥5	44	12.7	13	11.6	66	9.1	38	6.7
Area								
South	30	8.7	7	6.2	171	23.6	130	23.1
Middle*	304	87.6	100	88.5	476	65.6	351	62.3
North	13	3.7	6	5.3	79	10.1	82	14.6
Gender of household head								
Male	203	58.5	75	66.4	487	67.1	332	59.0
Female*	144	41.5	38	33.6	239	32.9	231	41.0
Education of household head								
Illiteracy *	45	13.0	17	15.0	93	12.8	89	15.8
Primary school	65	18.7	20	17.7	176	24.2	133	23.6
Middle school	105	30.3	35	31.0	229	31.6	168	29.8
High school and above	132	38.0	41	36.3	228	31.4	173	30.7
Marriage of household head								
Single*	81	23.3	31	27.4	134	18.5	141	25.0
Married	266	76.7	82	72.6	592	81.5	422	75.0
Score	70.6	15.2	64.2	16.9	75.9	13.4	66.5	15.6

Time means time length going to the nearest medical institution (minutes); score means self-report health score of household head, 0–100; dummy variables were generated for category variables in regression models; CNY means Chinese Yuan.

*Indicated reference levels; mean and SEs were calculated for continuous variables and observations (N) and percentage (%) was used for category variables.

OOP, out-of-pocket.

to 2013. Meanwhile, inpatient healthcare utilisation in the last year, having an illness in the last 2 weeks, and having elderly members also increased in the households with hypertension from 2008 to 2013.

CHE and the income-related inequality

Table 2 shows the trends of CHE incidence, intensity and income-related inequality of hypertension households in

2008 and 2013. As we can see in table 2, the CHE incidence of simplex households at 2008 was 11.2%, indicating that 11.2% of simplex households experienced CHE in 2008. The overshoot of simplex households was 14.1% in 2008, indicating that if a simplex household experienced CHE in 2008, the estimated average extent of exceeding given threshold was 14.1%. Thus, we can infer that the average

Table 2 CHE incidence, intensity and income-related inequality for hypertension households

		CHE			Inequality in CHE		
		Incidence (%)	Overshoot (%)	Mean positive overshoot (%)	Concentration index	95% Confidence Interval	
						Lower	Upper
2008	Simplex	11.2	14.1	1.6	-0.279	-0.465	-0.092
	Mixed	22.1	17.8	3.9	-0.283	-0.496	-0.069
2013	Simplex	21.5	17.4	3.7	-0.362	-0.450	-0.271
	Mixed	46.9	21.1	9.9	-0.262	-0.311	-0.210

CHE, catastrophic health expenditure.

proportion of OOP/CTP for a household experiencing CHE in 2008 was 54.1% (40%+14.1%). The MPO for simplex households was 1.6% in 2008, indicating that if the burden of overshoot was divided equally by the whole society, each household should account for 1.6% of overshoot for simplex households in 2008. Each row can be interpreted as the same style for simplex/mixed households in 2008/2013.

The overall CHE occurrence increased from 11.2% to 21.5% in simplex households and increased from 22.1% to 46.9% in mixed households. The overshoot increased from 14.1% to 17.4% in simplex households and increased from 17.8% to 21.1% in mixed households. Meanwhile, The MPO increased from 1.6% to 3.7% in simplex households, and increased from 3.9% to 9.9% in mixed households.

The CIs of incurring CHE were -0.279 (95% Confidence Interval -0.465 to -0.092) for simplex households and -0.283 (95% Confidence Interval -0.496 to -0.069) for mixed households in 2008, which skipped to -0.362 (95% Confidence Interval -0.450 to -0.271) and -0.262 (95% Confidence Interval -0.311 to -0.210) in 2013, respectively. The CIs of incurring CHE in simplex and mixed households were all negative, indicating that the low-income households were more likely to incur CHE than the high-income households in urban areas of Shaanxi both in 2008 and 2013. However, no significant dominance was found among the concentration curves

between the two waves (figure 1), indicating the sustained inequalities in CHE of simplex and mixed households.

Decomposition of CHE inequality

Table 3 shows the results of estimated partial effects (dy/dx), corresponding SEs in Probit models, absolute contribution to Concentration Index of CHE (Cont.) and relative contributions of each determinant of CHE inequality (percentage of contribution, %) in hypertension households. These results indicated a significant negative association between CHE incidence and household economic status, and between CHE and household size, implying that CHE were more likely to occur in low-income smaller households in urban Shaanxi. Health status of the household head was negatively associated with CHE incidence in 2013. Having elderly household members significantly increased the incidence of CHE and this effect was estimated to be greater in mixed households than simplex households. While the time length going to the nearest medical institution and supplementary medical insurance did not significantly affect the incidence of CHE. The CHE incidence was significantly higher when household members went to hospitals for inpatient services. However, among mixed households, CHE incidence was not significantly affected by household members with illness in the last 2 weeks. Meanwhile, CHE incidence

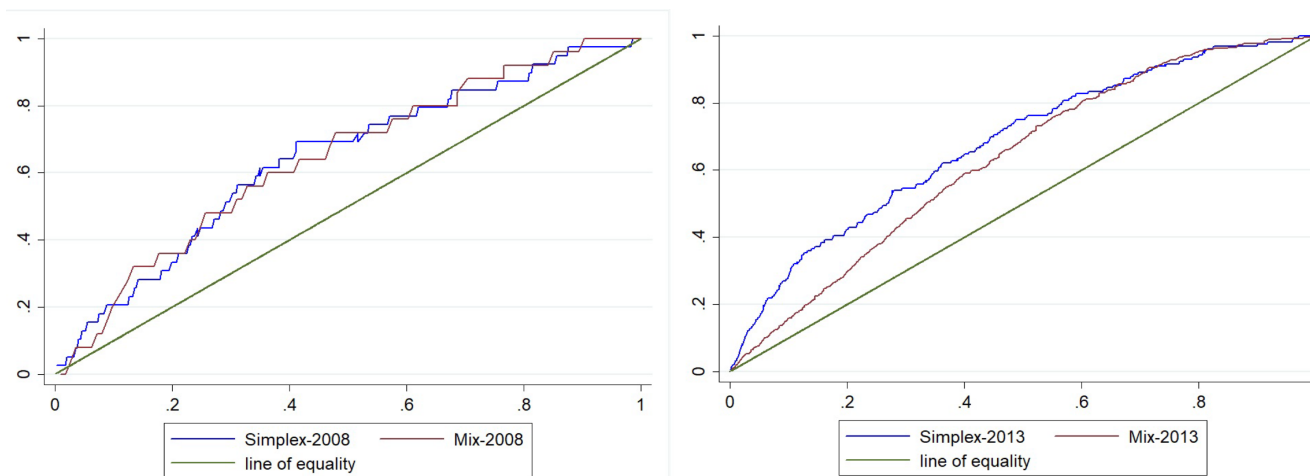

Figure 1 Concentration curves of catastrophic health expenditure incidence of hypertension households from 2008 to 2013.

Table 3 Partial effect of each determinant and its contribution to concentration index of hypertension households

	2013											
	Simplex						Mixed					
	dy/dx	SE	Cont.	Per cent	dy/dx	SE	Cont.	Per cent	dy/dx	SE	Cont.	Per cent
Lower income	0.0120	0.0445	-0.0085	3.03	-0.1018*	0.0481	0.0366	-12.76	-0.1103***	0.0306	0.0408	-11.28
Middle income	-0.0523	0.0300	-0.0003	0.10	-0.1679***	0.0630	-0.0004	0.15	-0.1553***	0.0279	0.0000	0.01
Higher income	-0.0824**	0.0261	-0.0581	20.74	-0.1838***	0.0556	-0.0659	22.94	-0.1654***	0.0276	-0.0612	16.93
Highest income	-0.0867**	0.0253	-0.1227	43.81	-0.1441***	0.0548	-0.1037	36.10	-0.2082***	0.0233	-0.1545	42.75
In Score	-0.0523	0.0426	-0.0017	0.62	0.1405	0.0994	0.0024	-0.83	-0.1639**	0.0697	-0.0131	3.61
In Time	-0.0008	0.0226	0.0002	-0.05	0.0304	0.0404	-0.0031	1.09	0.0261	0.0216	-0.0054	1.50
Male	-0.0399	0.0333	0.0042	-1.49	0.0192	0.0859	-0.0010	0.35	-0.0164	0.0351	0.0007	-0.19
Inpatient	0.2409***	0.0919	0.0064	-2.28	0.4136***	0.1236	0.0056	-1.94	0.1471***	0.0508	0.0000	-0.01
Illness	-0.0001	0.0309	0.0000	0.00	-0.0875	0.0591	0.0042	-1.45	0.0619*	0.0338	0.0018	-0.50
Elder member	0.0926**	0.0466	-0.0106	3.79	0.2073**	0.0927	-0.0121	4.21	0.0928***	0.0354	-0.0156	4.31
Insurance	0.0480	0.0785	0.0078	-2.79	0.0761	0.2265	0.0063	-2.20	0.0342	0.0686	0.0012	-0.34
Primary school	-0.0453	0.0341	0.0109	-3.88	0.0128	0.1088	-0.0016	0.54	-0.0330	0.0458	0.0068	-1.88
Middle school	-0.0341	0.0441	0.0124	-4.42	-0.1111	0.0912	0.0205	-7.14	0.0122	0.0505	-0.0011	0.30
High school	-0.0191	0.0482	-0.0151	5.40	-0.0987	0.0974	-0.0398	13.86	-0.0485	0.0526	-0.0214	5.91
Married	0.0410	0.0297	0.0010	-0.35	-0.0051	0.0833	-0.0001	0.02	-0.0028	0.0417	-0.0004	0.11
3-4	-0.0574*	0.0293	0.0190	-6.77	-0.0750	0.0637	0.0126	-4.39	-0.0526	0.0330	-0.0030	0.83
≥5	-0.0836***	0.0203	0.0341	-12.18	-0.0579	0.0536	0.0120	-4.18	-0.0145	0.0491	0.0009	-0.24
Middle	-0.0549	0.0647	-0.0079	2.82	0.0693	0.0534	0.0051	-1.77	-0.0704*	0.0393	-0.0024	0.65
North	0.0027	0.0869	0.0004	-0.16	0.8328**	0.2133	0.0705	-24.54	0.0100	0.0565	0.0019	-0.52

In Score means natural logarithm of self-report health score of household head, 0-100; In Time means natural logarithm of time length going to the nearest medical institution; dy/dx means partial effects of each variable and evaluated at sample means; per cent means the percentage of contribution to CI (Cont./CI); Cont. means contribution to CI.
*p<0.1, **p<0.05, ***p<0.01.

significantly increased when household members had illness in the last 2 weeks in simplex households.

The income-related inequalities can be decomposed into the contributions of each variable. As shown in [table 3](#), the majority of the observed inequalities in simplex households in 2008 could be attributed to economic status (highest income, 43.8%; higher income, 20.7%), education attainment of household head (high school, 5.4%) and having elder member in households (3.8%). The major contribution to inequality in simplex households in 2013 was associated with economic status (highest income, 36.1%; higher income, 22.9%), education attainment of household head (high school, 13.9%) and having elder member in households (4.2%). In mixed households, the major contribution to inequality was associated with economic status (highest income, 42.8%; higher income, 16.9%), household head's education attainment (high school, 5.9%) and having elderly members (4.3%) in 2008. The main contribution to inequality in mixed households in 2008 was associated with economic status (highest income, 67.6%; higher income, 23.5%), having elderly members (4.0%) and health status of household head (3.9%).

DISCUSSION

Using cross-sectional data of two waves from the fourth and fifth NHSS of Shaanxi in 2008 and 2013, this study investigates the trend of incidence, intensity and inequality of CHE in hypertension households in urban Shaanxi, China. The study reveals that hypertension households have an increasing risk of incurring CHE while there are sustained strong pro-poor inequalities in CHE for hypertension households from 2008 to 2013. According to our results, 21.5% of simplex households (households with hypertension only) and 46.9% of mixed households (households with hypertension plus other NCDs) incurred CHE in 2013, which were much higher than those of simplex households (11.2%) and mixed households (22.1%) in 2008, and the sustained strong pro-poor inequalities of CHE fluctuated in simplex households (-0.279 to -0.362) and mixed households (-0.283 to -0.262) between 2008 and 2013.

To assess the extent of CHE incidence in hypertension households in urban Shaanxi, we further analysed CHE incidence in households without NCDs and found that 7.3% of households without NCDs incurred CHE in 2008 and 10.5% of households without NCDs incurred CHE in 2013. Thus, the proportion of hypertension households incurring CHE in the urban Shaanxi was considerably high and there seems an accelerating growing probability of incurring CHE of hypertension households in urban Shaanxi from 2008 to 2013. Furthermore, accompanying the rising risk of incurring CHE, both overshoot and MPO indicate a growth of CHE intensity for hypertension households in urban areas of Shaanxi, China. Therefore, more concerns need to be diverted into the increasing disease economic burden of hypertension households,

with more and more households experiencing CHE and the growth burden of disease threatening if the vulnerable groups experienced CHE from 2008 to 2013. The results also implied that in urban areas, hypertension, among all NCDs, played a remarkable role in the CHE occurrence in urban Shaanxi, China.^{2 12 25} Consistent with prior studies, a lower economic status played an important role in increasing the risk of incurring CHE, and a small size of household with more illness in last 2 weeks, having elderly members and an illiterate household head had higher risk of incurring CHE.^{2 4 11–14} Our result that health insurance coverage did not significantly affect CHE is similar to the ones of research using supplementary medical insurance as a proxy of health insurance coverage increase.^{2 4 32}

The comprehensive healthcare reform initiated in 2009 extended the basic health insurance coverage to almost the whole population of China until 2013, and the establishment of national essential medicine system aimed to provide basic prescription drugs at zero markup in primary care facilities also reduced the price of basic prescription drugs and the healthcare expenditure of households in China.^{20 21 24} Evidence indicated that the overall proportion of households incurring CHE dropped from 17.2% in 2008 to 15.8% in 2013 in rural areas of China, and CHE occurrence in households with chronic disease patients in rural areas also dropped from 29.2% in 2008 to 23.6% in 2013.⁴ Furthermore, the total expense per visit reduced by 19.0 CNY for outpatient services, 399.6 CNY for inpatient services and by 11% for both outpatient and inpatient services in rural China due to the national essential medicine system.²⁴ However, our finding is inconsistent with the results of prior studies in rural China, and several factors may result in the difference between urban areas and rural areas.

Given the benefit package aiming to cover the cost of inpatient care, the basic health insurance would increase the likelihood of residents receiving inpatient healthcare utilisation in China especially for the comparatively rich groups with sufficient payment capacity, which in turn may increase the risk of incurring CHE for the vulnerable groups.^{22 33 34} Our further analysis indicated that the inpatient rate of members in simplex households increased from 9.4% (in 2008) to 15.2% (in 2013) and the inpatient rate of members in mixed households increased from 27.5% (in 2008) to 31.9% (in 2013). Furthermore, residents living in urban areas would like to seek higher tier hospitals rather than the primary care, of which is much costlier. Therefore, the OOP health expenditure of simplex households inflated sharply from 2292 CNY in 2008 to 4528 CNY in 2013 while the OOP health expenditure of mixed households inflated drastically from 3119 CNY in 2008 to 8655 CNY in 2013. Moreover, the comprehensive healthcare reform initiated in 2009 implemented target reimbursement policies for NCDs in rural areas of China, while reimbursement policies for NCDs in urban areas of China had changed little during the progress.²⁵ Thus, with higher awareness and treatment rates,

residents living in urban China experienced increasing disease economic burden attributed to the NCDs, especially to hypertension.¹⁷ Finally, the urbanisation rate of Shaanxi sharply increased from 42.1% (in 2008) to 51.3% (in 2013).³⁵ The rapid extension of urban in Shaanxi may also result in the migration of labours, leading to smaller household sizes both in urban and rural areas and less risk sharing among household members. Meanwhile, it seems that public services could not keep up with the pace of high-speed urbanisation, and therefore our results indicated that the access of medical facilities declined slightly from 2008 to 2013.

Improvement of health service availability is critical to improve residents' health in low-income countries and middle-income countries, but this could result in more households incurring CHE.⁵ Thus risk protection policies and health systems reform would be especially important in such a situation.^{4 5} China's basic health insurances has significantly increased healthcare utilisation of inpatient and outpatient,^{22 24} yet the subsidy from the government that was supposed to sustain the universal coverage factually benefited the rich more than the lower income groups.^{33 34} People, particularly in lower income households and vulnerable groups, can be protected from CHE by reducing the health system's reliance on OOP and providing more financial protection. Witnessing a sharp increase of health expenditure resulting from the large ageing population and increasingly upgraded medical technologies used in healthcare,^{11 36 37} further policy development, such as target reimbursement policies for NCDs and extending national essential medicine system to all tiers medical facilities, needs to be scheduled urgently to address the remaining health inequality issues and these vulnerable households need to be primarily concerned by the intervening policy aiming at reducing the probability of CHE.

By using annual household expenditure subtracting OOP to rule out the variation in household size as a proxy of economic status, we find that CIs in our study were much larger as expected.^{2 4} Our findings indicate that there were strong pro-poor inequalities in CHE in urban Shaanxi, which in turn imply that there still were many economic and political barriers to universal health coverage in the urban areas even though the Chinese government advanced the basic health insurance for almost all Chinese residents. The results of the decomposition analysis show that economic status, educational attainment of the household head and having elder members in households were the main contributors to pro-poor inequality in CHE in urban Shaanxi, China. The results are consistent with other similar studies, further indicating the important role of wealth, human capital and ageing of population in household financial protection.^{4 5 13 14 38} Economic status contributing to the estimated income-related inequalities in CHE were 67.67% and 48.41% in simplex households, and 46.44% and 84.03% in mixed households, in 2008 and 2013, respectively. Yet if economic status was equally distributed across income groups in urban areas or if there were no association between economic status and CHE,

the estimated income-related inequalities in CHE would be 67.67%, 48.41%, 46.44% and 84.03% lower, respectively. Each of the other determinants can be interpreted in a similar pattern.

Research limitations of this study also need be noted. First, self-reported hypertension and other NCDs used in this study may underestimate the sample size of hypertension households in urban Shaanxi, especially in households with lower socio-economic status.⁶ Second, the data for this study were obtained from Shaanxi Province only. Therefore, the conclusion drawn from this study may not be generalisable to the whole China. Third, medical and drug costs resulting from emergency and outpatient healthcare, as well as inpatient healthcare, were included in OOP expenditure in this study, yet transportation and accommodation cost attributed to diseases were excluded. The incidence of incurring CHE may thus be underestimated.⁸ Fourth, the utilisation of private healthcare not covered by basic health insurance maybe a factor leading to CHE and more efforts should be put to address this issue.³⁹ Finally yet importantly, not all factors were included in this study owing to the data availability, such as tiers of hospitals for healthcare, as well as some potential unobservable households' characteristics. The omission of these variables could lead to biased estimation of the inequality in CHE.

CONCLUSION

Monitoring OOP healthcare expenditures' impact is critical for the health system aiming at universal health coverage. We find a sharp increase of incurring CHE and sustained strong pro-poor inequalities for both simplex and mixed households in urban Shaanxi, China from 2008 to 2013. The main contributors of pro-poor inequality in CHE are economic status, educational attainment of the household head and having elder members in households. It is reasonable to believe that more concerns are needed for the vulnerable groups such as hypertension households, as well as addressing the inequality in CHE by using economic status, household head's education and ageing care effective tools in urban China. Based on our findings, we argue that better financial risk protection for the vulnerable ones in urban China should be developed, especially for the hypertension households.

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