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## Trends and socioeconomic disparities in catastrophic health expenditure and health impoverishment in China: 2010 to 2016

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### Abstract

**Objectives:** To investigate trends and socioeconomic disparities in the Catastrophic Health Expenditure (CHE) and health impoverishment in China after major reform of the health system; and to examine the impacts of the chronic disease on CHE and impoverishment.

**Methods:** We obtained data from four rounds of the China Family Panel Studies 2010-2016, with a sample size of 14,960 households. We defined CHE as the point at which annual household health payments exceeded 40% of annual capacity to pay. Impoverishment is measured by the \$1.90 per day poverty line. Multivariate logistic regression models were performed to identify impacts of the family member with chronic disease on CHE and impoverishment.

**Results:** Between 2010 and 2016, the incidence of CHE in China decreased from 19.37% to 15.11%, and from 7.39% to 5.14% for health impoverishment; however, the decrease in level of impoverishment was less in rural areas (from 6.16% down to 3.03%) than in urban areas (from 8.46% down to 7.81%). The gap between impoverishment rates across the income quartiles is growing. Multivariable analysis showed that households with two or more members suffering chronic diseases were significantly more likely to incur CHE (aOR: 2.46, 95% CI: 1.93-3.13) and impoverishment (aOR: 2.66, 95% CI: 1.87-3.78) than households with no members suffering chronic diseases, after adjusting for sociodemographic covariates.

**Conclusions:** Important advances have been made in achieving greater financial protection for Chinese

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citizens. Nevertheless, greater attention to the poor households with chronic disease members is needed. Policy-makers in China should focus on optimising integrated rural-urban health insurance by expanding the current benefit packages and strengthening poverty alleviation efforts.

**Keywords:** catastrophic health expenditure, health impoverishment, socioeconomic disparity, China

## Introduction

Under the sustainable development goals (SDG) agenda, advancing universal health coverage (UHC) is the centrepiece of health policy in many countries [1]. To achieve UHC, some developing countries have conducted a series of health system reforms in order to increase access to primary healthcare and to lower the financial burden of illness [2]. China officially launched a New Health System Reform (NHSR) in 2009, aiming to provide every Chinese citizen with access to healthcare at an affordable cost by establishing basic universal provision of safe, effective, convenient, and low-cost services. This comprehensive reform resulted in a significant increase in health insurance coverage, with 95.7% of the Chinese population being covered by three main social health insurance schemes in 2011: the Urban Employee-Based Medical Insurance (UEBMI) program, the Urban Resident-Based Medical Insurance (URBMI) program, and the New Rural Cooperative Medical Scheme (NCMS) [3]. However, strong performance in one aspect of UHC (proportion of the population covered) did not guarantee strong performance on the other (depth of financial protection). The benefits packages and degree of financial protection still vary across public insurance schemes in China, especially for people with chronic diseases [3]. The basic information on social health insurance schemes in China is shown in Box 1.

The key feature of UHC, financial risk protection, needs to be further examined. It can be captured by two indicators, namely catastrophic health expenditure (CHE) and impoverishment due to health spending [4, 5]. CHE is the official indicator for monitoring of UHC financial protection. The second widely-used indicator of financial protection is impoverishment due to health costs. Although impoverishment is not an official SDG indicator, it supplements the catastrophic payment indicator by emphasising the poverty implications of higher health expenditures [6].

Most previous studies in China have focused on socioeconomic inequality in healthcare utilisation among the general population or among people with chronic diseases [7-10]. Some studies have also examined the degree of CHE or health impoverishment at the sub-national level or in rural areas in China [11-14]. Since 2011, only three studies have focused on the trends in financial protection in China at the

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national level; they are all cross-sectional in design [15-17]. A study specifically focused on the roles of NCMS in protecting affected households from CHE in rural China in 2003-2013 found out that, even both the incidence and severity of CHE both decreased after NCMS reimbursements, the inequalities between different income groups persisted [17]. Apart from the income-related and region-related disparity in financial protection were shown previous studies, the growing prevalence of chronic disease also contributed to high out-of-pocket payments (OOP) for health services and drugs. Evidence from South Korean and 15 European countries concluded that households with members suffering from chronic diseases are more likely to experience CHE than general households, even in some of the developed countries worldwide [18, 19]. In general, the changes over the last decade of socio-economic disparity in financial protection in China at national level are still unclear.

In this article, we aim to investigate trends in the financial protection in China following the health system reform and to assess the extent of disparities in financial protection across household groups with one or more members having a diagnosis of chronic diseases. Relieving the household economic burden of chronic diseases would be a key step in efforts to alleviate global poverty and achieve the SDGs. Here we reported on the most up-to-date evidence of recent trends and socioeconomic disparities in the catastrophic health expenditure and health impoverishment using data from China nationwide household surveys. Identifying population groups at risk of catastrophic health expenditure and impoverishment is important for targeting interventions involving integrated health insurance or poverty alleviation projects.

**Panel: China's social health insurance schemes**

The China New Health System Reform, introduced in 2011, has expanded health insurance coverage, to 95.7% of the Chinese population through one of the three primary health insurance schemes [15].

Urban workers are covered by the Urban Employee Basic Medical Insurance (UEBMI) scheme, which was launched by the Chinese State Council in 1998. All urban employees are required to join. Roughly 283 million were enrolled in UEBMI in 2014 [20]. This scheme consists of a pooled fund for inpatient stays and individual medical savings accounts for outpatient visits. It is financed by payroll income from employees (2%) and employers (6%) [21]. The per capita fund of UEBMI is US\$424.7 [22].

The Urban Resident Basic Medical Insurance scheme (URBMI) aims to ensure the rest of the urban population, including children, students, and other unemployed urban residents who were not previously covered by the UEBMI. In 2014, 315 million people were covered by the URBMI. The scheme is funded by a government subsidy (70%) and individual contributions (30%) [22]. The per capita fund of this scheme is US\$66.2 [22].

For the rural population, the Chinese government has launched the new rural cooperative medical scheme (NCMS) in 2003, which was expanded rapidly to cover about 802 million rural residents by 2013 [23]. NCMS funds are pooled at the county level. NCMS scheme is financed by enrollees' premiums (about 20%) and generous subsidies from both central and local governments (about 80%). Annual government subsidies per enrollee increased from 20 Chinese yuan (US\$2.9) in 2003 to 380 Chinese yuan (US\$55.2) in 2015. The per capita funding for NCMS is US\$61.2 [22].

China has also established a medical assistance programme for poor people, jointly funded by the central and local governments. At the end of 2015, the Chinese government announced the decision to integrate URBMI and NCMS as the urban-rural resident medical insurance (URRMI) [24], to achieve UHC [25]. This integration enabled a further extension of funding pools and narrowing in the disparities in access to healthcare services and medications which existed between different insurance schemes.

## Methods

### Data and Methods

Using the China Family Panel Studies (CFPS), this study includes the data from four rounds of follow-up interviews which were conducted in 2010, 2012, 2014 and 2016, respectively. These studies were funded by the 985 Program at Peking University and carried out by the Institute of Social Science Survey (ISSS) at Peking University. The CFPS is a nearly national-wide, comprehensive and longitudinal survey for Chinese adults aged on and above 16, aiming to identify China's social, economic, demographic, and health changes [26]. Using a multistage probability sampling approach with implicit stratification. the sample for the 2010 CFPS baseline survey gathered data across 25 provinces in China. Each sub-sample in the CFPS was drawn at three levels: county level, village level, then at the household level [27].

In the 2010 baseline survey of CFPS, 14,960 households were interviewed, eliciting a response rate of 78.5% at the household level. All the CFPS families and members have been tracked through follow-up surveys every two years. After excluding cases with missing demographic information, those with missing  
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socioeconomic information, and/or those offering no response, the numbers of households with complete data for analyses amounted to 12,982 in 2010, 11,537 in 2012, 12,199 in 2014, and 13,590 in 2016.

### **Household annual consumption expenditure**

Household annual consumption expenditure includes the amount spent on food, clothing, housing, family equipment and daily necessities, communication and transportation, cultural recreation and entertainment, medical care and other consumption spending. Particularly, medical care consumption includes direct medical expenditure, as well as expenditure on health care goods [27]. The household income and consumption expenditure in Chinese Yuan (CNY) are expressed in 2010 prices using gross domestic product deflators and then converted into US\$ using the average 2010 exchange rate (i.e. 1 US\$ = 6.62CNY) [28]. We calculate household health spending as a percentage of total household expenditure, which is more informative than simply examining raw medical expenditure.

### **Financial protection indicators**

#### *Catastrophic Health Expenditure (CHE)*

This study measures CHE by employing the approach suggested by Wagstaff and van Doorslaer [5]. Also, the capacity to pay is used non-food household consumption expenditure as the denominator which assumes that households have to meet the basic demand of food before spending on health. Additionally, according to WHO, the estimates of CHE applies 40% as the threshold. In order to facilitate comparison across different countries, we use 40% thresholds as well. Thus, CHE occurs when OOP health expenditure equals or exceeds 40% of non-food household consumption expenditure [5].

#### *Impoverishment due to healthcare payments*

We calculated the proportion of households impoverished due to large healthcare payments, which means that a non-poor household becomes impoverished after paying for healthcare. It is also defined as a binary variable, taking the value of one when household consumption expenditure per capita is equal to or higher than the poverty line, but lower than this line after subtracting per capita household health spending. This study used the international 1.90 US\$ (12.86 CNY in 2010) per day poverty line of consumption expenditure as defined by the World Bank and often referred to as the extreme poverty line. It is an update on the old \$1.25 per day poverty line and underlies the SDG target of 1.1 [29]. After adjustment of the 2010 exchange rate, this poverty line is equal to 4694.65 CNYs per year on 2010 prices [30].

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A person with chronic diseases defined as an individual self-reported to have been diagnosed with diabetes, hypertension, heart disease, malignant tumour, rheumatoid arthritis, stroke, digestive disease, liver disease, kidney disease and/or other chronic diseases during the last six months. These conditions cover the vast majority of people with chronic diseases in China. The number of household members suffering from chronic diseases was divided into three groups: none, one, and two or more members.

### **Statistical analysis**

A chi-square test was used to estimate the difference in catastrophic health expenditure and impoverishment due to health spending across household location groups and NCD family groups. For improving financial risk protection, at the end of 2015, China had officially announced the merger of the UEBMI and the NCMS, which was representing a commendable milestone towards UHC in China [24, 25]. Therefore, we used the newest 2016 wave of CFPS survey for multivariate logistic regression analysis to examine the impact of household NCD members on CHE and health impoverishment (binary outcome variables). The main covariates included: the number of household members with chronic diseases (that is, any member had doctor-diagnosed chronic diseases in the past six months); household location (rural or urban); income quartiles (per-capita household annual income); geographical region (east, central and west); household size (1-2, 3-4, and over 5 family members); having children (that is, individuals younger than 15 years in the household); and having older people (that is, individuals aged 60 or older in the household). Households were ranked according to family income per capita and grouped into four quartiles.

Several variables of the household head were also taken into account, including gender (female, male), age (<45, 46–60, 60+), marital status (married and partnered, single, and other), education (illiterate, primary school, middle school, college and above), employment status (yes, no), and having health insurance (yes, no). We presented the adjusted odds ratio (aOR) and 95% confidence intervals (CI) for results in logistic regression analysis. All statistics were weighted to account for the multistage sample design of the CFPS survey and non-responsive families. All statistical analyses were conducted using STATA 15.0. P-values less than 0.05 are used as statistically significant.

## **Results**

### ***Descriptive characteristics***

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The basic characteristics of households interviewed in 2010, 2012, 2014, and 2016 are presented in Table 1. From 2010 to 2016, the proportion of households in the rural area decreased from 51.12% to 44.05% across four survey rounds. Surveyed households in the eastern region are most prevalent, accounting for around 40% of households across the four surveys, followed by the central region (around 35%) and western region (around 22%). Concerning households with only one or two members, there was an increase from 22.95% in 2010 to 30.62% in 2016. A fluctuation was observed for the households with at least one member suffering from chronic diseases, which started from 22.24% in 2010 and declined to 21.42% in 2012 then grew to over 28% in 2016. Overall, the total annual household income in China grew with survey year, from 4,960\$ in 2010 to 8,735\$ in 2016. It is remarkable that the total household consumption expenditure and health spending increased by nearly 2.5 times (from 1264 \$US in 2010 to 9284 \$US in 2016) and almost twice (490 \$US in 2010 to 935 \$US in 2016) throughout the seven-year period (Table 1).

### ***Trends in financial risk protection***

Table 2 illustrates that household health spending as a percentage of total household consumption expenditure decreased from 12.75% in 2010 to 10.85% in 2014, followed by an increase to 11.21% in 2016. A similar trend was found for the incidence of CHE, which declined from 2010 (19.37%) to 2014 (14.35%) then increased up to 15.11% in 2016 when a threshold of 40% of the non-food consumption expenditure is applied. Specifically, households in rural areas suffered a higher proportion of CHE (17.70% in 2016) than those in urban areas (13.06% in 2016). Families with members suffering from chronic diseases were more likely to incur CHE than healthy households.

Based on the World Bank poverty line (\$1.90 per day), a total of 966 of 12,982 households in 2010 were pushed into poverty due to paying for healthcare. The impoverishment rate steadily decreased from 7.34% to 5.14 % between 2010 and 2016. Similarly, families in rural areas and those with a chronically ill member had higher impoverishment rates than households in urban areas and than those without chronically ill members (Table 2).

### ***Socioeconomic disparity in financial protection***

Figure 1 shows the disparities in CHE and impoverishment due to health spending across household groups between 2010 and 2016. Figure 1A indicates that, overall, the trends between 2010 and 2014 were roughly parallel between all groups, among which rural households with chronic disease members were dominant in each year. Except for the incidence of CHE among rural households with chronically ill members, which

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gradually declined each year, the incidence of CHE in the other three groups rose after 2014, particularly among urban households with members having chronic diseases. The incidences of impoverishment due to health spending by the corresponding groups are shown in Figure 1B. Rural households with members having NCDs still accounted for the largest proportion of impoverishment, with a fluctuation at around 12% in each year. In general, the rural-urban disparity in CHE and impoverishment remained constant for both healthy families and families with chronically ill members.

In terms of income inequality, a large reduction in CHE incidence occurred among the poorest (quartile 1) households from 2010 to 2014, followed by an increase in 2016. However, the gap between the poor (quartile 1 and quartile 2) and the wealthy (quartile 3 and quartile 4) persisted throughout the seven years, with little progress as expected being made (Figure 1C). The difference in the incidence of impoverishment across the income quartiles was growing, with a decreasing trend for the rich (quartile 3 and quartile 4) but an increasing trend for the poorest (quartile 1) households from 2010 to 2016 (Figure 1D). The confidence intervals of CHE and health impoverishment incidence for each household group are shown in Table S1.

### **Determinants**

Multivariable analysis shows, after adjusting for other covariates, that the odds of CHE in a household with one or two or more chronically ill members compared to a household without chronic disease members was 1.88 (95% CI: 1.63-2.17) and 2.46 (95% CI: 1.93-3.13), respectively (Table 3). Households with one member reporting an NCD (aOR: 1.76, 95% CI: 1.42-2.19) and with at least two chronic disease members (aOR: 2.66, 95% CI: 1.87-3.78) were significantly more likely to experience medical impoverishment compared to households without chronic disease members (Table 4).

Households in rural areas were at higher risk of experiencing CHE (aOR: 1.26, 95% CI: 1.09-1.45) and impoverishment because of health spending (aOR: 1.57, 95% CI: 1.24-2.00). The risk of CHE and impoverishment were also increased among households with an older or unemployed head. However, households with more family members, and those belonging to the rich quartile and with a highly educated head were significantly associated with decreased CHE and less medical impoverishment (Table 3 and Table 4).

### **Discussion**

Using the dataset of the China Family Panel Studies (CFPS) which was collected after the New Health System Reform in 2009, this study provides new evidence on nationwide trends in the incidence of CHE and This article is protected by copyright. All rights reserved

impoverishment due to health spending in China after the reform. At the threshold of 40% of non-food consumption expenditure, the estimated proportion of households experiencing CHE decreased from 19.37% in 2010 to 15.11% in 2016. In relation to the international poverty line (\$1.90 per day), the impoverishment rate dropped from 7.34% in 2010 to 5.14 % in 2016. Such estimates are consistent with previous research findings in China. In a cross-sectional study Meng et al. (2012) found 12.9% of families in China suffering from CHE in 2011 [15]. A study using data from the Fourth National Health Service Survey 2008, found that 7.5% of non-poor households became poor as a consequence of OOP payments for healthcare [31]. Findings from the WHO Study on Global Ageing and Adult Health (WHO-SAGE) also pointed out that 7.4% of the population fall below the poverty line due to OOP health expenditure in China [32].

After the reform, there was a significant increase in insurance coverage, with 95.7% of the Chinese population being covered by social health insurance schemes by 2011 [15]. Alongside the expansion of benefit packages from public insurance schemes, the effectiveness of financial protection has been improved in China [3]. Furthermore, reduction in impoverishment is consistent with the pattern of the National Poverty Alleviation Project and health system reform launched by China's central government. Since 2012, China has tailored more effective measures to individuals and households to ensure that targeted poorer populations, including people with serious diseases, received the assistance they needed. Increased poverty alleviation efforts continue through the development of severe disease health insurance and the Medical Assistance System for the poor.

Compared with other developing countries, China generally encounters higher CHE incidence and impoverishment from health expenditure [33-40], while the occurrence of CHE and health impoverishment is slightly less than the rates in India:18.2% in 2012 and 8.0% in 2010, respectively [40]. A cross-sectional survey in Nepal showed that about 14% of households faced catastrophic health expenditure when the threshold is 40 % of the capacity to pay [37]. A study in the West of Iran indicated that the rate of households facing CHE was 4.8% after the implementation of its Health Sector Evolution Plan (HSEP) in 2014 [38]. The potential main reasons for a relatively high incidence of CHE in China are the rapid increase of health spending due to the current Fee-For-Service payment system and low level of benefit packages from the fragmented social health insurance schemes.

We compared the degree of financial risk protection among urban and rural households. Rural households were at greater risk of experiencing catastrophic health expenditure and impoverishment than were urban households. Although there was a declining trend both in the rural areas and urban areas from 2010, the rural CHE rate was 1.36 times higher than the rate in urban areas and the rate of impoverishment This article is protected by copyright. All rights reserved

was about 2.58 times higher. Meng et al. (2012), using data from the National Health Services Survey, also observed that rural households (13.8%) experienced CHE more often than urban households (10.9%), at the 40%-threshold [15]. With the data obtained from the National Health Services Survey (NHSS) in Shaanxi Province, Xu et al. (2018) concluded that the overall level of CHE occurrence in households with chronic disease patients remained stable between 2008 and 2013 at about 24% [41]. Specifically, the incidence of CHE in rural areas declined from 29% to 24% [41].

For the income disparity, our research found that the occurrence of CHE and impoverishment from health spending was more common in the poorest population quartile. With respect to income-related inequality, studies in China [15, 31, 41] and other countries, such as Vietnam, Nepal, Kenya and Georgia, showed similar results to this study [42]. In this study, the income disparity of CHE incidence was alleviated dramatically between 2010 and 2012, then stayed at a stable level. Impoverishment in the richest and middle-income groups declined from 2010 to 2016, while the rate for the poorest groups exhibited growth over the same period. Consequently, a growing disparity in impoverishment between the poor and the rich was apparent during this period. The increased income and reductions in CHE (particularly in middle and high-income groups) directly influence this trend. Because of the great impetus from China's health system reform, the risk of CHE and impoverishment was reduced to some extent; however, it appears that the 2009 reforms mostly benefitted middle-and-high income households, while even some reverse effects were experienced by the poorest income households. In other words, the improvement of NCMS played a limited role in the reduction of economic burdens from chronic diseases for the poorest families in this period. The continuous growth in health spending and high rates of CHE in China also suggest that the support provided by benefits packages from health insurances may have been outweighed by increased utilisation of healthcare and by higher charges.

Our multivariate analysis shows that the number of chronic disease members in a household is a key determinant of catastrophic health expenditure, after adjusting for other covariates. Households with one and two or more chronic disease members are 1.76 and 2.66 times more likely to suffer catastrophic health expenditure. The impoverishment risk for families having one chronic disease member and two or more members is 1.88 and 2.46 times higher respectively than for those with no chronic disease members. This finding is also consistent with a China study which concluded that CHE risk is associated with the number of family members with chronic disease and their utilisation of medical treatment and healthcare expenditure [43]. Hwang et al (2001) also supported this conclusion, as well as revealing the persistence of an almost linear relationship between OOP payments and chronic diseases [44]. The risks of CHE and impoverishment

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are closely linked with households' economic status. Households in rich quartiles are at less risk of suffering CHE and impoverishment, a finding consistent with other studies. [45, 46] Moreover, logistic regression models show that demographic factors such as household size, residence location, age, education, and employment status of the household head exert an influence on financial protection, as reported in other studies [47, 48]. Rural households and those with an older or unemployed head were significantly more likely to experience CHE and impoverishment.

Optimising a health insurance system plays an extremely important role in improved financial risk protection. At the end of 2015, China had officially announced the merger of the UEBMI and the NCMS [24], representing a commendable milestone towards universal health coverage [25]. However, the current health insurance system still leaves much financial risk for households to bear, and a relatively high incidence (5.14%) of health impoverishment. In the implementation of this integration, the most critical element was the further extension of funding pools and narrowing of disparities in covered services and medications between the Unified Resident Health Insurance and UEBMI [3]. This new phase in China's reform needs special attention devoted to disadvantaged groups, particularly the poor and households with members suffering chronic diseases. Extending insurance coverage to include long-term care for chronically ill patients, outpatient services, essential medications, and rehabilitation services should be a priority. The reform of the Public Medical Assistance System could be deeply integrated with National Poverty Alleviation Projects, giving priority to a comprehensive benefits package with services and cost-sharing mechanisms for poor households and those with two or more chronic diseases members.

This study had important strengths. Unlike previous studies in China, this one analysed the panel data at the national level, assessing catastrophic health expenditure and medical impoverishment at the same time. This study provided a more complete understanding of the trends in financial protection following the NHR in China by using the international definition of CHE and the 1.90\$ per day poverty line. It will contribute to a deeper understanding of reform policies related to universal healthcare coverage in China while offering further analysis of the economic burden of chronic diseases in developing countries. The major limitation of this study is that it is based on repeated cross-sectional data. Ideally, longitudinal or panel studies would be conducted to estimate the causal effect of financial risk resulting from family members with chronic diseases. For the questionnaire of CFPS survey used in this study, the spending on disease treatment and healthcare are lumped in one question rather than separated prompts for inpatient and outpatient care, drugs, etc, which is limited to compare the results of this research to results from other previous studies. Additionally, about 25% of families were missing income-related information

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between the 2010 and 2016 surveys. To account for non-response bias and loss of follow-up, we adjusted our analysis by using the created weights for households.

While important advances have been made in achieving increased financial protection in China, the protection of vulnerable groups from the experience of CHE and health-related impoverishment remains a challenge. Programs should specifically target susceptible populations, such as the poor, people in rural areas, and families having members with chronic diseases. Policymakers in China should focus on developing more effective expenditure control strategies by payment system reform and by optimising the integrated Rural-Urban Resident Health Insurance scheme to improve its effectiveness.

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**Table 1.** Characteristics of survey households from the China Family Panel Studies in 2010, 2012, 2014 and 2016.

2010			2012			2014			2016		
N	%	95% CI	N	%	95% CI	N	%	95% CI	N	%	95% CI
12,982			11,537			12,199			13,590		
6,729	51.12	44.82 57.38	6,253	49.05	43.35 54.77	6,460	49.47	44.67 54.28	6,746	44.05	39.12 48.98
6,253	48.88	42.62 55.18	5,284	50.95	45.23 56.65	5,739	50.53	45.72 55.33	6,844	55.95	51.12 60.78
5,908	39.66	30.97 49.05	5,142	40.56	31.77 50.00	5,517	43.53	35.20 52.25	6,148	44.80	36.12 53.48
3,810	36.37	27.66 46.07	3,442	36.25	27.65 45.84	3,646	33.93	26.10 42.75	3,957	33.23	25.12 41.34
3,264	23.97	16.55 33.38	2,953	23.19	15.88 32.57	3,036	22.54	15.64 31.35	3,485	21.97	15.12 28.82
2,901	22.95	20.85 25.19	2,745	25.56	23.23 28.05	3,419	27.17	24.86 29.61	4,051	30.62	28.12 33.12
6,198	49.57	47.75 51.40	5,212	46.16	44.20 48.13	5,129	43.11	41.30 44.94	5,388	40.88	39.12 42.64
3,883	27.48	24.59 30.57	3,580	28.28	25.47 31.26	3,651	29.72	26.92 32.68	4,151	28.50	26.12 30.88
7,415	56.86	54.07 59.60	6,401	57.02	54.21 59.79	6,979	56.41	53.82 58.97	8,047	60.50	58.12 62.88
5,567	43.14	40.40 45.93	5,136	42.98	40.21 45.79	5,220	43.59	41.03 46.18	5,543	39.50	37.12 41.88
10,100	78.89	77.54 80.18	8,597	74.07	72.34 75.73	8,567	70.96	69.33 72.54	9,263	68.43	66.12 70.74

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	2,882	21.11	19.82	22.46	2,940	25.93	24.27	27.66	3,632	29.04	27.46	30.67	4,327	31.57	30.9
<b>Disease members</b>															
	9,872	77.76	75.83	79.58	8,905	78.58	76.80	80.25	8,632	72.69	70.55	74.73	9,626	71.93	70.1
	2,539	18.50	17.04	20.05	2,219	18.19	16.88	19.56	2,939	22.48	20.88	24.16	3,253	23.14	21.1
	571	3.74	3.16	4.43	413	3.24	2.62	3.99	628	4.83	4.13	5.65	711	4.93	4.3
<b>Income (US\$), mean, 95CI</b>															
	-	4960	4503	5447	-	5935	5534	6335	-	6810	6308	7312	-	8735	760
	-	3760	3495	4048	-	5724	5297	6151	-	7061	6562	7559	-	9284	808
	-	1264	1186	1349	-	2179	2043	2314	-	2422	2236	2608	-	2928	256
	-	490	449	534	-	571	520	621	-	706	638	774	-	935	805

CI, confidence interval; THI, total annual household income; THE, total household annual consumption expenditure.

Table 2. Trends in the financial protection in 2010-2016, by the household location and chronic diseases member group.

	2010			2012			2014			2016						
	%	95% CI	P value	%	95% CI	P value	%	95% CI	P value	%	95% CI	P value				
<b>Percentage of THE</b>																
	12.75	11.89	13.61	10.97	10.24	11.70	10.85	10.23	11.46	11.21	10.68	11.74				
	14.21	12.87	15.55	<0.001	11.91	10.77	13.04	<0.001	12.67	11.80	13.53	<0.001	12.96	12.20	13.72	<0.001
	11.22	10.41	12.04		10.07	9.37	10.77		9.07	8.46	9.67		9.83	9.29	10.38	
	11.15	10.30	12.00	<0.001	9.72	8.96	10.49	<0.001	8.89	8.32	9.47	<0.001	9.10	8.59	9.60	<0.001

Expenditure

Health spending, 1.9 US\$/day

17.42	15.96	18.88		15.12	14.01	16.22		15.44	14.41	16.46		15.80	14.91	16.69
22.81	20.27	25.36		17.95	15.20	20.70		18.89	16.75	21.03		20.57	18.08	23.05
19.37	17.81	20.93		16.28	14.82	17.74		14.35	13.16	15.55		15.11	14.09	16.12
22.13	19.95	24.31	<0.001	18.61	16.32	20.89	<0.001	17.14	15.32	18.96	<0.001	17.70	16.27	19.13
16.48	14.62	18.34		14.03	12.44	15.63		11.62	10.38	12.86		13.06	11.84	14.29
16.70	15.09	18.31	<0.001	13.65	12.22	15.08	<0.001	10.92	9.74	12.11	<0.001	11.48	10.54	12.43
27.25	24.42	30.07		25.49	22.41	28.57		22.39	20.24	24.53		23.08	21.13	25.02
35.79	30.46	41.11		28.28	22.35	34.21		28.53	22.66	34.41		30.58	25.75	35.41
7.34	6.54	8.14		6.78	5.91	7.65		5.54	4.83	6.24		5.14	4.53	5.74
8.46	7.31	9.62	0.004	8.60	7.56	9.64	<0.001	7.87	6.89	8.86	<0.001	7.81	6.91	8.71
6.16	5.12	7.21		5.03	4.01	6.04		3.25	2.54	3.96		3.03	2.38	3.69
6.40	5.61	7.19	<0.001	5.97	5.17	6.78	<0.001	4.54	3.87	5.21	<0.001	3.82	3.29	4.36
9.84	8.18	11.50		9.96	7.83	12.09		7.86	6.60	9.13		7.83	6.45	9.21
14.53	10.28	18.77		8.44	4.76	12.11		9.67	6.10	13.23		11.72	8.66	14.79

CI, confidence interval; THE, total household annual consumption expenditure.

P values reported for family group differences. Annual change, Absolute annual proportion of change between 2010 and 2016. Chi-square test for catastrophic health expenditure and impoverishment due to health spending across household groups.

**Table 3** The determinants of catastrophic health expenditure, using multivariable regression.

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Variables, reference	95% CI			P value	95% CI			P value
	Unadjusted OR				Adjusted OR			
Members of chronic disease members, none	2.33	2.05	2.67	<0.001	1.88	1.63	2.17	<0.001
Urban	3.38	2.69	4.23	<0.001	2.46	1.93	3.13	<0.001
East	1.38	1.22	1.56	<0.001	1.26	1.09	1.45	0.002
Age, one-two	1.00	0.87	1.14	0.961	0.91	0.78	1.05	0.187
Age, three-four	0.87	0.74	1.03	0.105	0.87	0.73	1.04	0.131
Age, five-six	0.34	0.30	0.40	<0.001	0.53	0.44	0.63	<0.001
Age, seven-eight	0.40	0.34	0.47	<0.001	0.48	0.38	0.59	<0.001
Age, nine-ten	0.42	0.37	0.48	<0.001	0.75	0.62	0.90	0.002
Age, eleven-twelve	3.06	2.71	3.47	<0.001	1.73	1.46	2.04	<0.001
Household income per capita, quartile 1 (lowest)	0.71	0.60	0.83	<0.001	0.96	0.80	1.14	0.617
Household income per capita, quartile 2	0.52	0.44	0.62	<0.001	0.71	0.59	0.86	<0.001
Household income per capita, quartile 3	0.51	0.43	0.61	<0.001	0.62	0.50	0.77	<0.001
Household income per capita, quartile 4 (highest)	2.31	1.92	2.79	<0.001	1.72	1.40	2.11	<0.001
Household head, <45 years								
Household head, 45-64 years	2.31	1.92	2.79	<0.001	1.72	1.40	2.11	<0.001

rs	5.99	5.02	7.15	<0.001	1.90	1.52	2.39	<0.001	
f household head, female	1.04	0.92	1.17	0.562	0.97	0.85	1.11	0.674	
atus, married & partnered	1.24	1.06	1.46	0.007	0.74	0.62	0.89	0.002	
of household head, illiterate									
y school	0.64	0.55	0.75	<0.001	0.88	0.74	1.04	0.137	
s school	0.40	0.34	0.46	<0.001	0.70	0.59	0.83	<0.001	
& above	0.25	0.19	0.34	<0.001	0.73	0.51	1.05	0.085	
d head employed, Yes	2.50	2.21	2.84	<0.001	1.72	1.48	2.02	<0.001	
health insurance, No	1.02	0.80	1.30	0.861	1.00	0.78	1.30	0.975	

CI, confidence interval; OR, odds ratio; AOR, the adjusted odds ratio - adjusted for place of residence, region, family size, having children, having elderly members, household annual income, and the age, gender, marital status, education level, employment and health insurance of household head.

**Table 4** The determinants of impoverishment due to health spending, using multivariable regression.

s, reference	95% CI			P value			95% CI			P value		
	Unadjusted OR			Adjusted OR								
f chronic disease members, none												
	2.17	1.77	2.67	<0.001	1.76	1.42	2.19	<0.001				
	3.53	2.55	4.89	<0.001	2.66	1.87	3.78	<0.001				
urban	2.52	2.05	3.09	<0.001	1.57	1.24	2.00	<0.001				
ast	1.20	0.96	1.49	0.103	1.05	0.84	1.32	0.652				

	1.16	0.91	1.49	0.239	0.90	0.70	1.17	0.453
<b>Age, one-two</b>								
Four	0.44	0.35	0.56	<0.001	0.59	0.44	0.78	<0.001
	0.78	0.62	0.98	0.030	0.69	0.51	0.94	0.019
<b>Children, no</b>	0.78	0.64	0.95	0.013	1.02	0.78	1.32	0.898
<b>Elderly members, no</b>	2.25	1.86	2.72	<0.001	1.16	0.91	1.47	0.234
<b>Annual income per capita, quartile 1 (lowest)</b>								
Quartile 2	0.68	0.54	0.84	0.001	0.85	0.67	1.07	0.170
Quartile 3	0.34	0.26	0.44	<0.001	0.48	0.36	0.63	<0.001
Quartile 4 (highest)	0.08	0.05	0.12	<0.001	0.13	0.08	0.22	<0.001
<b>Household head, &lt;45 years</b>								
18-24 years	2.07	1.56	2.76	<0.001	1.45	1.08	1.94	0.014
25-34 years	4.27	3.25	5.60	<0.001	1.68	1.20	2.36	0.002
<b>Household head, female</b>	1.12	0.93	1.36	0.227	1.07	0.87	1.32	0.494
<b>Marital status, married &amp; partnered</b>	1.04	0.80	1.35	0.761	0.83	0.61	1.11	0.210
<b>Education of household head, illiterate</b>								
Below primary school	0.65	0.51	0.82	<0.001	0.85	0.66	1.08	0.186
Primary school	0.32	0.25	0.40	<0.001	0.62	0.47	0.80	<0.001
High school & above	0.03	0.01	0.11	<0.001	0.16	0.04	0.66	0.011
<b>Household head employed, Yes</b>	1.50	1.22	1.84	<0.001	1.38	1.07	1.78	0.014

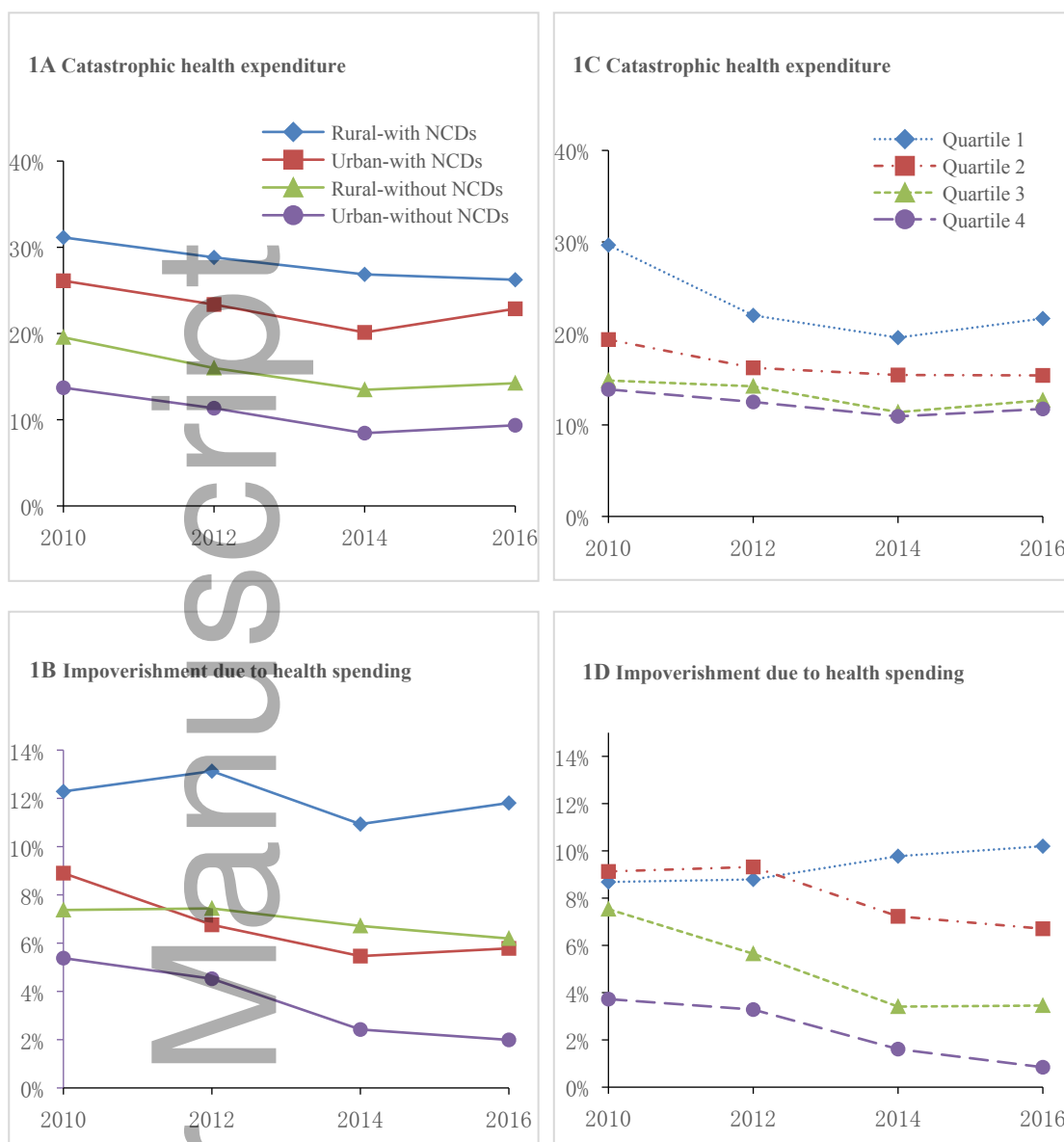
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<b>Health insurance, No</b>	1.73	1.09	2.73	0.020	1.52	0.93	2.50	0.097
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OR: odds ratio; AOR: the adjusted odds ratio - adjusted for place of residence, region, family size, having children, having elderly members, household annual income, and the age, gender, marital status, education level, employment and health insurance of household head.

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**Figure 1** Trends and disparities in catastrophic health expenditure and impoverishment due to health spending across household groups, 2010-2016

Notes: 1A, incidence of catastrophic health expenditure between households with chronic disease members and those without chronic disease members within rural and urban areas. 1B, incidence of impoverishment due to health spending between households with chronic disease members and those without chronic disease members within rural and urban areas. 1C, incidence of catastrophic health expenditure across per capita household income quartile. 1D, incidence of impoverishment due to health spending across per capita household income quartile.

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