

CATASTROPHIC MEDICAL PAYMENT AND FINANCIAL PROTECTION IN RURAL CHINA: EVIDENCE FROM THE NEW COOPERATIVE MEDICAL SCHEME IN SHANDONG PROVINCE

XIAOYUN SUN^{a,*}, SUKHAN JACKSON^b, GORDON CARMICHAEL^c and ADRIAN C. SLEIGH^c

^a *Health Department of Shandong Province, Jinan, China*

^b *School of Economics, University of Queensland, St Lucia, Brisbane, Australia*

^c *National Centre for Epidemiology and Population Health, The Australian National University, Canberra, Australia*

SUMMARY

Objective: To measure the impact of China's New Cooperative Medical Scheme (NCMS) on catastrophic medical payments of rural households in Linyi County, Shandong Province.

Method: In 2005, from a stratified cluster sample of 3101 rural households, we identified 375 households that might be at risk of catastrophic payments by searching through NCMS claims and interviewing key informants. We interviewed these 375 households and confirmed that 231 had had catastrophic payments ($\geq 40\%$ of the households' capacity to pay; CTP) during 2004. A validity test of our screening method found another eight cases among immediate neighbours of these 375 households; by extrapolation, we obtained an adjusted total of 289 catastrophic households in the sample of 3101. We measured the impact of the NCMS on hardship alleviation by counterfactual analysis, comparing catastrophic payments before and after NCMS reimbursements.

Result: The effect was twofold. Before NCMS intervention 8.98% of Linyi population had had catastrophic out-of-pocket payments compared with 8.25% after reimbursements. Catastrophic severity for households remaining in catastrophe after reimbursement dropped by 18.7% to an average of 6.34 times the household's CTP.

Conclusion: Out-of-pocket medical payments remain a burden for rural households. Financial protection from the NCMS, with an average reimbursement of 17.8%, was modest and should be restructured to provide better benefits that are targeted to those in most need. Copyright © 2008 John Wiley & Sons, Ltd.

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INTRODUCTION

Community-based pre-payment for medical care could be a viable option to provide financial protection for farmers in developing countries and people in the informal sector without access to the formal mechanism of health insurance (Preker *et al.*, 2001, 2002; Commission on Macroeconomics and Health, 2002). The Commission of Macroeconomics and Health of the World Health Organization (2002: 3–4) notes that 'community financing can provide an incremental, albeit first, step to improve financial protection and access to health services for the poor' in low and middle-income countries.

Several studies have found community-based health financing to be effective in extending insurance to rural and low-income people who would otherwise be without health protection (Preker *et al.*, 2001, 2002; Commission on Macroeconomics and Health, 2002). For example, Ranson (2002), who evaluated a community-based health insurance scheme in India, concluded that such schemes could protect poor

*Correspondence to: Health Department of Shandong Province, 9 Yan Dong Xin Road, Jinan 250014, China.
E-mail: sxysdcn@yahoo.com.cn

households against the risk of unexpectedly high medical expenses, although some fine-tuning of scheme design was needed. Ekman (2004: 249) has reviewed several empirical studies of community-based health insurance and found 'strong evidence that such programmes do provide effective protection to the members of the schemes by significantly reducing the level of OOP [out-of-pocket] payment for care.' However, other studies are not so positive. For example, an International Labour Organization review of 258 community-based health insurance schemes concluded that the evidence did not justify the assertion that community financing had been effective in providing financial protection in health care (ILO, 2002). One possible reason for these diverse views is the lack of consistency in the interpretation of the term 'financial protection'. The ILO study considered people to be financially protected when they did not have to draw on an excessive proportion of their income to afford medical care, whereas Ekman's study defined financial protection as any sort of reduction in out-of-pocket payments for medical care.

In this study, our definition of financial protection is that households are financially protected if their medical care payments are not catastrophic. Illness or injury is catastrophic when it is necessary for a household to cut its basic consumption for a considerable time in order to pay for medical expenses. Our interpretation of catastrophic payment is consistent with the World Health Organization (WHO) definition, which sets the threshold of catastrophic payment at 40% of 'capacity to pay' (CTP; see Methods).

The purpose of this study is to measure the impact on catastrophic medical payments (CMP) of the new rural community-based health insurance piloted in China beginning in 2002, known as the New Cooperative Medical Scheme (hereafter: NCMS). We use two indicators. The first is the 'catastrophic payment headcount', where we calculate the percentage in the rural community of households liable for a catastrophic payment; the impact of the NCMS is its capacity to reduce this percentage. The second is the 'catastrophic payment gap', which measures the average severity of catastrophic payment of each affected household. The impact of the NCMS is the reduction in CMP before and after NCMS reimbursements. Inferences for the whole community can be made from our results.

Community-based health financing in China

Community health financing is not new in China. Indeed China's rural Cooperative Medical Scheme (CMS), adopted in the 1960s and 1970s by Maoist communes, was once regarded as a successful model for the developing world to ensure that health care was accessible to farmers and their families. China abandoned collective farming, the funding source of the CMS, under the post-1979 economic reform, and in 1982 abolished its communes. Consequently, the CMS collapsed and coverage fell from 90% at its peak to less than 10% in the 1990s (Liu *et al.*, 1996), and out-of-pocket payment for medical care now prevails for rural people.

It is important to know that China's health system is distinctly separated into urban and rural components, and community health financing is only applicable to the rural areas. For urban areas, measures are in place to improve the social security safety net, including a basic medical insurance scheme that began in 1998 for urban employees. It covers urban employees of enterprises in the state-owned, collective and private sectors; in enterprises with foreign investment, government departments and various institutions including those of a non-commercial nature. The richer cities also provide protection to groups not covered by the basic medical insurance scheme; for example, self-employed individuals and freelance workers.

However, the 70% of China's total population who reside in the rural areas lack adequate health protection. The Ministry of Health in 2002 reported that more than one-third of sick farmers did not seek medical treatment because of unaffordable costs, and medical payments are impoverishing many families (Wilkes *et al.*, 1997; China Daily, 2002).

There was an attempt beginning in 1994 to provide health insurance when the Chinese Ministry of Health, in collaboration with international agencies, trialled community-based health financing in a number of rural counties throughout China. However, without financial support from the central government and their own provincial governments, these rural cooperative medical schemes (RCMS) were limited in scale to risk pooling at the township level, and the premiums charged to farmers were often too low for schemes to be sustainable (Yu *et al.*, 1998; Carrin *et al.*, 1999). In due course, many broke down owing to insufficient financial and political support, but some were revived and others persisted, especially those in the richer counties (Jackson *et al.*, 2005). However, the need to provide financial protection for rural people remains a great challenge.

By 2003, 79% of the rural population were not protected by any kind of health insurance (Centre for Health Statistics and Information, Ministry of Health, 2004). Medical costs were rising along with China's high economic growth and were becoming a worrisome burden for farmers. It was reported that the average hospital admission expenditure in rural areas had increased from 613 yuan in 1993 to 2649 yuan in 2003 (Centre for Health Statistics and Information, Ministry of Health, 2004). It is acknowledged in China that medical expenditure is an important cause of rural poverty; one study found that 7.22% of the rural population were living below the locally defined poverty line,¹ and 45% of these poor households were below the poverty threshold because of out-of-pocket medical expenses (Liu *et al.*, 2003).

A priority of the Central Government was to reform rural health financing. An NCMS was initiated in 2003 as a pilot in more than 300 rural counties. The NCMS is defined as a mutual help and risk-pooling health protection system, organised and supported by four levels of government (central, provincial, county and township) and involving voluntary participation by rural people. The NCMS, now expanding beyond the initial pilot areas, will reach the majority of China's 800 million rural population by the year 2010 (Central Committee of the CPC and the State Council, 2002).

This new millennium model is an improvement on the previous model of the 1990s in two ways. Firstly, provincial governments must contribute financially to the NCMS in counties under their jurisdiction; for the less developed central and western China, the Central Government also provides an annual subsidy of 10 yuan (US\$1 = about 8 yuan) for each person who joins the NCMS. Local governments (provincial, municipal and county or township) in total pay at least 10 yuan per person to match the individual premium of around 10 yuan. Secondly, NCMS subscribers are coming from larger risk-sharing pools at the county level (population 500 000 to 1 million) in contrast to the RCMS of the 1990s, which were pooled at the township level (population 10 000–50 000).

One explicit goal of NCMS policy was to 'resolve'² the CMP that can impoverish rural households (Central Committee of the CPC and the State Council, 2002). The central government expects that the implementation of NCMS will alleviate financial hardship and help to prevent illness-induced poverty. Therefore, hospitalisation and other CMP are its specific targets.

We report on this new millennium model and focus on CMP. We measured the extent to which the NCMS provided financial protection to rural households, using a case study of an NCMS pilot in Shandong Province. To find out the effectiveness of the NCMS in reducing hardship, we collected statistical evidence to calculate (a) the catastrophic payment incidence and (b) the catastrophic payment intensity among households before and after NCMS reimbursements.

The next two sections describe the study setting and present the methods for data collection and analysis. The Results section follows and then a Discussion. Finally, we draw conclusions and discuss policy implications.

¹ Actual poverty line was not specified in the article by Liu *et al.* (2003). Locally classified poverty as listed by the County Civil Affair officials is more extreme than poverty detected using the national poverty line.

² 'jie jue' (in Chinese) means to resolve, or eliminate or substantially reduce.

NCMS in Linyi County

The pilot NCMS county of Linyi in Shandong was chosen for several reasons (Sun, 2007). First, Linyi County is a typical agricultural county with a total population of 519 300, of whom 81% are farmers. Secondly, Linyi's economy ranks in the middle of the Shandong county range; the net annual income of the agricultural population averaged 3031 yuan, or about US\$380, in 2003 (Bureau of Statistics of Linyi County, 2004). Thirdly, funding resources available to the NCMS in Linyi were also around the middle level for the seven Shandong pilot counties at 23 yuan per person per year: 10 yuan from the farmer and a total of 13 yuan from governments at different levels (provincial, county and township). Fourthly, coverage of the NCMS in Linyi was relatively high; when it started in August 2003 coverage was 93.5%, and it increased to 94.6% in 2004. Finally, the benefits package of Linyi's NCMS was similar to those of most other counties, covering hospital outpatient and inpatient services. Outpatient reimbursements averaged 20% of total expenses. Inpatients received discounts of 20–80% of total expenses; the higher the expenses, the higher the benefit up to a ceiling of 10 000 yuan per person per year.

METHODS

Definitions of CTP and CMP

Capacity to pay (CTP). CTP is defined by the World Bank and WHO as the household's disposable income, calculated as total income minus subsistence expenditure (Wagstaff and van Doorslaer, 2003; Xu *et al.*, 2003b). We used food expenditure as a proxy for subsistence expenditure. Data were collected from the catastrophic households on food expenditure, medical care payments and income using a detailed household questionnaire. Medical care payments included all household members' medical expenses for both outpatient and inpatient care during the year 2004. For this study, we excluded non-medical direct expenses related to treatment seeking, such as transport and food, and other indirect costs such as loss of income due to illness.

We measured 2004 income as the aggregate of household production (10 categories), wage incomes of household members, transfer income (gifts, pensions, remittances, welfare) and property income (interest, rents). Income is the basis of CTP, and direct measures avoid the pitfalls of rapid estimates of 'effective income' based on household non-subsistence expenditure. For China, non-essential expenditure is distorted by the propensity to save for emergencies and thus is not a good proxy for household income. China has the highest saving rate in the world (Qian, 1988; Kraay, 2000); and savings is security against illness costs (Wu, 2001).

Catastrophic medical payment (CMP). Payment is considered catastrophic when a household has to cut its basic living expenses over a period (1 year in this study) in order to afford the medical expenses of its household member(s).

CMP threshold. In the literature there is no definitive threshold (based on the relationship between payment and income) that distinguishes what is catastrophic and what is not. We adopted the approach used in several WHO studies (Murray *et al.*, 2003b; Xu *et al.*, 2003a,b), which sets the catastrophic threshold at 40% of the household's CTP, but we have also conducted a sensitivity analysis for other thresholds at 20, 30, 50 and 60% of CTP.

Measuring the impact of the NCMS using the catastrophic headcount (incidence) and catastrophic payment gap (severity)

We have followed the approach of Wagstaff and van Doorslaer (2003) in our analysis of CMP in China and adapted two indices to measure the impact of the NCMS. They are catastrophic payment

headcount (incidence) and mean catastrophic payment gap (severity), which captures the average severity of payment above the catastrophic threshold.

CMP headcount (incidence). CMP headcount describes the frequency of households with a CMP in proportion to the sample (3101 households). We calculate the catastrophic headcount in a situation before NCMS reimbursement (Equation (1)) and after NCMS reimbursement (Equation (2)).

The impact of the NCMS was reflected in the difference in catastrophic headcount before and after reimbursement (Equation (3)). The reduction in CMP headcount after reimbursement, as a percentage of the CMP headcount before reimbursement (Equation (4)) reflects the impact of the NCMS on financial protection. The equations are presented below.

Catastrophic headcount before reimbursement:

$$CH_{\text{before}} = \frac{1}{N} \sum CI_{\text{before}} \quad (1)$$

Catastrophic headcount after reimbursement:

$$CH_{\text{after}} = \frac{1}{N} \sum CI_{\text{after}} \quad (2)$$

where CH is the catastrophic headcount and CI the catastrophe index. If a household's medical payment as a proportion of its CTP \geq the catastrophic threshold (CMP threshold), then $CI_i = 1$; otherwise $CI_i = 0$. N is the total number of households in the sample (3101 households).

Difference in the catastrophic headcount before and after reimbursement:

$$D_{CH} = CH_{\text{before}} - CH_{\text{after}} \quad (3)$$

D_{CH} as a percentage of the catastrophic headcount before reimbursement:

$$D_{CH}\% = (D_{CH}/CH_{\text{before}}) \times 100 \quad (4)$$

CMP gap. CMP gap measures catastrophic severity. It describes how much a household's medical payment (as a percentage of its CTP) is in excess of the catastrophic threshold of 40% of its CTP. The size of the excess reflects severity. The mean CMP gap refers to the average of the sum of the total excesses from all the catastrophic households in the sample, before NCMS reimbursement (Equation (5)) or after NCMS reimbursement (Equation (6)).

Mean catastrophic payment gap before reimbursement:

$$MCG_{\text{before}} = \sum CG_{\text{before}} / \sum CI_{\text{before}} \quad (5)$$

Mean catastrophic payment gap after reimbursement:

$$MCG_{\text{after}} = \sum CG_{\text{after}} / \sum CI_{\text{after}} \quad (6)$$

where CG is the catastrophic payment gap and CI the catastrophe index. If a household's medical payment as a proportion of its CTP \geq the catastrophic threshold (CMP threshold), then $CI_i = 1$; otherwise $CI_i = 0$. MCG is the mean catastrophic payment gap. The sum of all catastrophic payment gaps divided by the total number of catastrophic households.

The ability of the NCMS to reduce the severity of catastrophic payment among households whose catastrophes it does not eliminate is measured by the change in the mean CMP gap before and after NCMS reimbursement for those households as a percentage of the original mean CMP gap before reimbursement (Equations (7) and (8)).

The observation group in these calculations is the group of households that still had catastrophic payments after reimbursement. The impact of the NCMS on each of these households was indicated by how much the CMP gap was reduced.

For households remaining in catastrophe after reimbursement, the difference in the mean catastrophic payment gap before and after reimbursement is calculated as follows:

$$D_{MCG} = \left(\sum CG_{\text{before}} - \sum CG_{\text{after}} \right) / \sum CI_{\text{after}} \quad (7)$$

D_{MCG} is also expressed as a percentage of the mean catastrophic payment gap before reimbursement:

$$D_{MCG}\% = \left(D_{MCG} / \left(\sum CG_{\text{before}} / \sum CI_{\text{after}} \right) \right) \times 100 \quad (8)$$

It should be noted that the element $\sum CG_{\text{before}}$ in Equations (7) and (8) has a different meaning from Equation (5). In Equation (5) the sum is over *all* households in catastrophe before reimbursement. In Equations (7) and (8) it is only over those households that *remained* in catastrophe after reimbursement. The rationale is that measures of the capacity of the NCMS to alleviate, as opposed to eliminate, catastrophes should be confined to those households whose catastrophic status is not eliminated. NCMS capacity to eliminate catastrophe is measured by Equation (4).

Data collection

Sampling method. We used a stratified random cluster sampling method to obtain the sample of 3101 households from a total of 19 villages located in the 10 townships under the jurisdiction of Linyi County. The households were randomly selected as follows.

- (1) We divided the 10 townships into three groups (strata) according to their socio-economic status (SES) as indexed by mean per capita income estimated by the County Health Bureau: high (two townships), middle (four townships) and low (four townships). The high SES stratum included 23.1% of Linyi households, the middle SES stratum 48.9% and the low SES stratum 28.0%. From each stratum, we randomly selected one township.
- (2) From each of the three selected townships, we randomly selected villages until the number of households cumulated to about 1000 households. Consequently, we obtained a sample of 3101 households (consisting of 12 725 people), accounting for 10.1% of the total population in the three study townships. Our study was limited to this sample of 3101 households, from which we identified households that had potentially incurred CMP. We then calculated weighted means across stratum estimates of catastrophic headcounts and payment gaps. This required multiplying each stratum estimate by the fraction of total households represented and then summing the weighted component estimates for the three SES strata. The weighted means for the 3101 sample households provided estimates for the whole population of Linyi County.

How did we identify potential catastrophic households in the sample? Because of limited resources, it was not possible to interview all 3101 households. A total of 375 potential catastrophic households were identified in this sample of 3101 households using (i) NCMS claims data and (ii) interviews with key informants (village heads, village doctors and women's leaders). We defined potential catastrophic households as those belonging to one or more of the following three categories.

The first category, identified by either claims data or key informants, comprised households whose members had been hospitalised during 2004. The assumption was that hospitalisation usually is expensive, so that households with members who had been hospitalised were at high risk of incurring catastrophic medical bills.

The second category, identified by key informants, comprised households not in the first category but which had members who had chronic and/or serious illnesses but were not hospitalised. These

households might have consumed multiple outpatient services. Cumulated outpatient costs could be catastrophic for the family.

The third category, also identified by key informants, was poverty-stricken households that were known in 2004 to have incurred medical payments, but not large enough ones to be listed in the other two categories. Relatively low expenses could be catastrophic for the very poor.

Household interviews. All the 375 potential catastrophic households identified from our sample of 3101 households were interviewed to establish if they were truly catastrophic. Respondents were either household heads or their spouses. The interviews averaged 1½ hour and were conducted during May 2005 when it was not a busy time for farmers in Shandong.

Demographic data collected from the interviews for all household members included ages, relationship to household head, gender, education level, occupation and marital status. Whether a member was earning income, household income and expenditure, health service utilisation and medical expenses were also collected (Tables I and II).

After the interviews, we found that only 231 of the 375 potential catastrophic households truly had CMP in 2004; the remaining 144 were not catastrophic households by our definition (see the Section Definitions of CTP and CMP).

Validity test of our screening method (to ensure that we had not missed any catastrophic payment households in the sample). As the 375 potential catastrophic households were identified through manually screening the NCMS claims data and speaking to key informants, we conducted a validity test of our method to ensure robustness of our results. The test was a rapid appraisal of neighbouring households of the 375 potential catastrophic households and was conducted as follows.

Each of the 375 potential catastrophic households was matched with one screen-negative neighbour (whose dwelling was located nearest to opposite the households that had been interviewed) to confirm that this neighbour did not have a CMP in 2004. Rapid appraisal questions were put forth to the neighbours to determine if they might in fact have had catastrophic payments but been missed by our

Table I. Profile of 239 catastrophic households interviewed, Linyi County, 2004

Characteristics	Percentage
<i>Household head</i>	
<i>Sex</i>	
Male	88.7
Female	11.3
<i>Marital status</i>	
Married	91.2
Other marital status	8.8
<i>Education level</i>	
No formal schooling	28.5
Primary school (6 years)	33.9
Junior high school (3 years)	30.5
High school or above (3 years or more)	7.1
<i>Occupation</i>	
Farmer	71.1
Casual labourer	17.6
Self-employed business	4.6
Other	6.7
<i>Number of persons in household</i>	
1–2 persons	29.7
3–6 persons	65.7
≥ 7 persons	4.6

Table II. Per capita income (in yuan) and NCMS reimbursement (in yuan) on medical payments of 239 catastrophic households interviewed, Linyi County, 2004

	Annual per capita income	Total medical payment	Out-of-pocket payment	NCMS reimbursement	Reimbursement rate (%)
Mean	1780	5521	4597	924	17.8
Median	1400	3050	2459	547	20.0
Std deviation	1515	6493	5790	1353	0.1
Minimum	75	190	160	0	0.0
Maximum	15 112	47 200	46 440	8000	44.0
<i>Quartiles</i>					
25%	912	1850	1520	160	9.5
75%	2156	6480	5430	923	25.4

Note: US\$1 = approx 8 yuan.

screening method. If rapid appraisal results were positive, then the household head (or spouse) was interviewed using the same questionnaire as used for the 375 potential catastrophic households. Eight households (2.1%) turned out to be false negative, and this meant that we had to adjust the estimated total number of catastrophic households in our sample.

We extrapolated from the eight false-negative households actually detected to obtain an estimated total of 58 false-negative households among the remaining 2726 households in the sample (3101 – 375). Consequently, the adjusted total number of catastrophic households in our sample of 3101 households was 289 (231 + 58). Our analysis of the impact of the NCMS was based on 289 catastrophic households. For the 231 screen-positive households, the information was derived from interviews of each household. For the 58 false-negative households, the information was derived from a sample of eight households and was extrapolated to the whole 58.

The screening method for detecting households with CMP was valid. False positives were quickly identified at interview and reclassified as negative. Negative screening tests were rarely false; 97.9% of negative results were correct. We could thus assess 3101 representative Linyi households with interviews needed for only 383 (375 + 8). Such efficiency made time-consuming detailed estimates of income and expenditure feasible.

Figure 1 is a summary of our methods, showing the various stages in the sampling process and data collection undertaken in May 2005.

The conceptual framework of counterfactual analysis

Counterfactual analysis entails comparing the situation of all the catastrophic households before NCMS reimbursement (as if they were not covered by the NCMS) and the situation after NCMS reimbursement. The situation of the households after receiving reimbursements from the NCMS was factual; the ‘before reimbursement’ situation was regarded as a counterfactual situation.

Before reimbursement, households paid the full costs of medical services and for some the costs were economically catastrophic. Under the NCMS, part of the medical expenses were reimbursed. As out-of-pocket payments were reduced by the reimbursement, some households’ medical payments ceased to be catastrophic; and the severity of catastrophic payments for households remaining in catastrophe after reimbursement was alleviated.

Figure 2 illustrates the impact of the NCMS from two viewpoints: CMP incidence (headcount) and CMP intensity (gap). The *X*-axis shows the cumulative proportion of households, ranked in descending order, according to their medical payments as a percentage of their CTP. The *Y*-axis shows households’ medical payments as a percentage of their CTP above or below the CMP threshold set at 40% of CTP. The dashed curve represents before reimbursement and the solid curve represents after reimbursement.

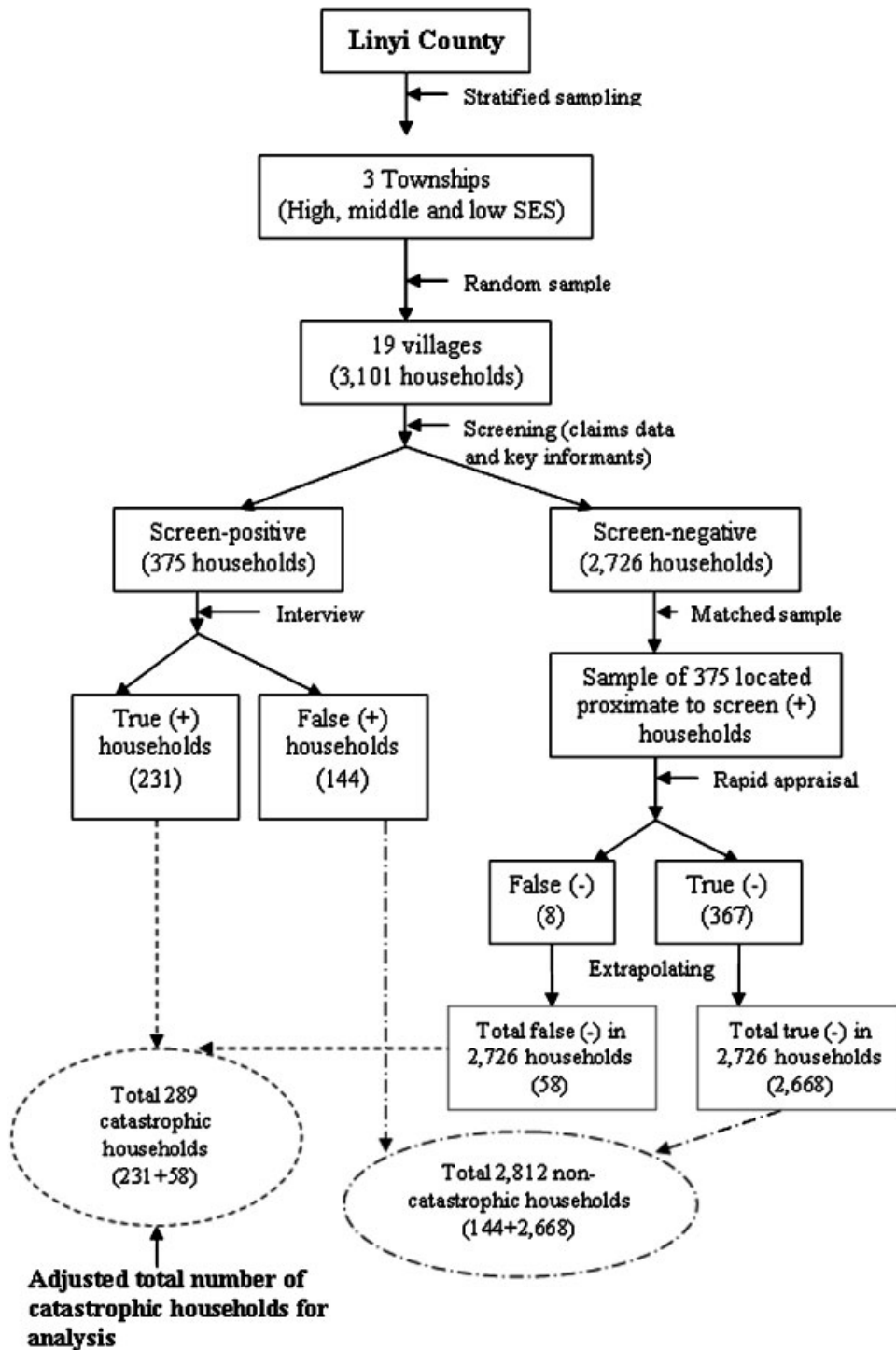


Figure 1. Sampling method and data collection for household survey in Linyi County

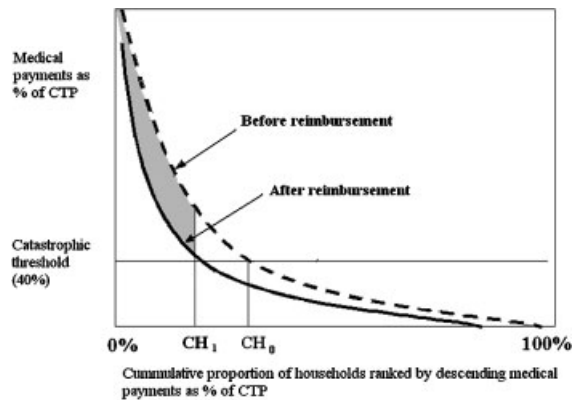


Figure 2. NCMS impact on catastrophic medical payments. *Notes:* CTP, capacity to pay was measured by household's disposable income net of subsistence expenditure; CMP (catastrophic medical payment), household medical payment as a percentage of CTP equalling or exceeding the catastrophic threshold (e.g. 40% of CTP); CH_0 , the proportion of households with CMP in the community, before reimbursement; and CH_1 , the proportion of households with CMP in the community, after reimbursement. *Source:* based on Wagstaff and van Doorslaer (2003)

The impact of the NCMS on the CMP headcount is the reduction from CH_0 to CH_1 . The shaded area, between the two curves above the threshold and left of the line of CH_1 , represents the impact of the NCMS on the severity of catastrophic payment for households still in catastrophe after reimbursement.

RESULTS

Characteristics of 239 catastrophic households

On the basis of the catastrophic threshold of 40% of CTP, we estimated that 289 households were catastrophic among our sample of 3101 households. However, we actually obtained interview-based data from only 239 (231 screen-positive + 8 false-negative) households. Their characteristics are presented as follows.

Demographic profiles. Among the 239 catastrophic household heads, 88.7% were male (Table I). Most (91.2%) were married, but 17 respondents (7.1%) were divorced or widowed and four (1.7%) were unmarried.

Over 70% of household heads had at least primary education, 30.5% had reached junior high school level, 7.1% had attained education at high school or above level and 28.5% had no formal schooling. The majority were farmers (71.1%), followed by casual labourers (17.6%) and self-employed persons (4.6%). Average household size was 3.75 (SD = 1.602, median = 4). Most households (65.7%) had 3–6 people, the remainder (29.7%) mostly having 1–2 people.

Household income and medical care payment. The average economic status of the 239 catastrophic households was below the average for Linyi County. In 2004, their per capita net income averaged 1780 yuan (Table II), compared with 3031 yuan, the average rural income in the county (Bureau of Statistics of Linyi County, 2004). Before health payments in that year, 11.7% of catastrophic households (28/239 households) were below China's national poverty line of 668 yuan per person, and 6.3% (15/239 households) had already been singled out as being in dire poverty by the local government.

These 239 catastrophic households had incurred large medical payments in 2004. Total medical payment (before reimbursement) averaged 5521 yuan, 3.1 times the average per capita net income of 1780 yuan. Average reimbursement from the NCMS was 924 yuan or 17.8% of total medical payments, and thus households paid out-of-pocket at an average of 4597 yuan. Our results showed a high degree of variation in the rural households' total medical payments, with the implication that financial risks are extremely unpredictable for the rural population.

Measuring the impact of the NCMS using the CMP headcount (incidence)

To calculate the CMP headcount (incidence) we first defined catastrophic payments at the threshold of 40% of CTP (Section CMP headcount at threshold 40% of CTP) and then performed a sensitivity analysis by recalculating the headcount after defining catastrophic payments at thresholds of 20, 30, 50 and 60% of CTP (Section Sensitivity analysis using other catastrophic thresholds related to CTP). As mentioned in the Methods (Section Data collection), the adjusted total number of catastrophic households in our sample (3101 households) was 289. It should be noted that 289 catastrophic households were the basis of our calculations for CMP headcount and CMP gap.

CMP headcount at threshold 40% of CTP. At the 40% threshold of CTP, CMP frequency was 289 catastrophic households. Thus, the CMP headcount was 9.32% of the sample (3101 households) before reimbursement, 8.98% estimated for Linyi population. After reimbursement, frequency was reduced by 24 (8.3%) to 265 catastrophic households.³ CMP headcount was 8.55% of the sample, 8.25% estimated for Linyi population.

Sensitivity analysis using other catastrophic thresholds related to CTP. Table III presents the results of our sensitivity analysis on the CMP headcount estimated for Linyi at thresholds of 20, 30, 50 and 60% of CTP. The higher the threshold level, the lower the CMP headcount. At 20% of CTP, the CMP headcount was 11.33% before reimbursement and fell to 10.64% after reimbursement. At 60% of CTP, the CMP headcount was 7.39% before reimbursement and 6.47% after reimbursement.

The difference in CMP headcounts before and after reimbursement at different thresholds varied between 0.69 and 0.92 percentage points. We note that the impact of NCMS reimbursement was greatest at the threshold of 60% of CTP, reaching the highest reduction in CMP headcount of 12.41% (Table III).

Measuring the impact of the NCMS using the mean CMP gap

The CMP gap captures by how much a household's CMP exceeds the 40% threshold of its CTP. The impact of the NCMS was measured by the reduction in the mean CMP gap before and after NCMS reimbursement for households remaining in catastrophe after reimbursement.⁴

For the 265 households remaining in catastrophe after reimbursement, the mean CMP gap declined from 8.06 times their CTP before reimbursement to 6.34 times their CTP after reimbursement, a reduction of 21.3% of the original (before reimbursement) mean CMP gap (Table IV); for Linyi population, the reduction was estimated at 18.7%.

³ On evidence of the data, we calculated that NCMS reimbursements had reduced the 231 screen-positive catastrophic households to 207. However, as catastrophe was not eliminated for any of the eight false-negative households, we assumed the same for the extrapolated 58 false-negative catastrophic households. Thus, 265 (207 + 58) was the CMP headcount after NCMS reimbursement.

⁴ Using data collected from interviews, we calculated the CMP gap of each of the 207 households remaining in catastrophe after reimbursement, and of each of the eight false-negative households. Results for the eight households were then extrapolated to the estimated 58 false-negative households. Thus, we obtained the mean CMP gap for 265 (207 + 58) households in catastrophe.

Table III. Catastrophic headcount (incidence) as % of Linyi population before and after reimbursement, at selected thresholds of CTP, 2004

% of CTP	CMP headcount before NCMS reimbursement (%) (a)	CMP headcount after NCMS reimbursement (%) (b)	Reduction by the NCMS (%) ($\frac{a-b}{a} \times 100$)
60	7.39	6.47	12.41
50	8.32	7.55	9.18
40	8.98	8.25	8.15
30	9.91	9.16	7.58
20	11.33	10.64	6.10

Note: CTP (capacity to pay) is defined as total household disposal income minus total subsistence expenditure. *Source:* 2005 Screen-positive Household Survey and 2005 Screen-negative Household Rapid Appraisal Test.

Table IV. Mean CMP gap at the 40% of CTP threshold in Linyi County, 2004

	Mean CMP gap of the 265 catastrophic households	Estimated mean CMP gap of catastrophic households in Linyi
Before reimbursement (a) (number of times household CTP)	8.06	8.95
After reimbursement (b) (number of times household CTP)	6.34	7.28
Reduction by the NCMS (a-b)	1.72	1.67
Reduction in original payment	21.3%	18.7%

Note: CMP is catastrophic medical payment. The 265 households analysed are those that remained in catastrophe after reimbursement. CTP is capacity to pay, defined as total household disposal income minus total subsistence expenditure. Estimates for catastrophic households in Linyi are based on weighted means that adjust for the SES-stratified sample. *Source:* 2005 Screen-positive Household Survey and 2005 Screen-negative Household Rapid Appraisal Test.

Modelling projected impact of the NCMS on CMP headcount using selected reimbursement rates (at 40% of CTP)

In practice, the NCMS in Linyi County offered a variety of reimbursement rates for different circumstances; the 17.8% reimbursement rate was the average observed in this study (Table II, last column). This section explores what the NCMS could achieve at different reimbursement rates, other factors assumed to be constant (including 40% of CTP catastrophic threshold). Figure 3 shows the impact of NCMS on Linyi County at various reimbursement rates: without NCMS (zero reimbursement) the CMP headcount would be 8.98% of Linyi's population, at full (100%) reimbursement there would be 0% (no catastrophe).

We estimated that the current reimbursement rate, averaging 17.8%, reduced CMP headcount in Linyi County by 8.1%. Our modelling yielded the following results: a reimbursement rate of 40% could reduce the catastrophic headcount by 15.0%, 50% by 22.5%, 60% by 28.0%, 70% by 48.8%, 80% by 64.9% and 90% by 80.1%.

DISCUSSION

After 25 years of economic reforms, Chinese farmers now pay out-of-pocket for treatment of illness and injury, and many are at risk of facing CMP. This study is one of the few empirical studies on China to quantify the incidence and severity of CMP among rural households. Also it is probably the first to attempt to measure the impact of the NCMS, China's most recent implementation of health insurance for rural families.

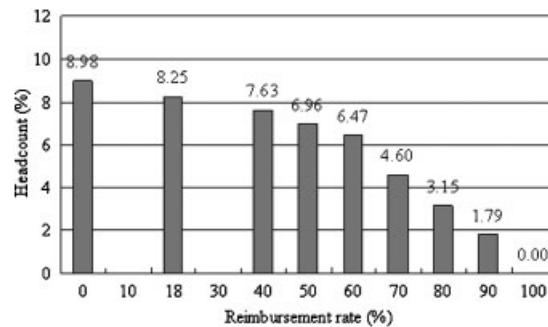


Figure 3. CMP headcount in Linyi County at selected reimbursement rates, 2004. *Note:* calculation of CMP (catastrophic medical payment) headcount has been adjusted according to results of the Screen-negative Household Rapid Appraisal Test (see Methods). Estimates for CMP in Linyi are based on weighted means that adjust for the SES-stratified sample. *Source:* 2005 Screen-positive Household Survey and 2005 Screen-negative Household Rapid Appraisal Test

Impact of NCMS—catastrophic incidence and severity in relation to medical expenditure for rural households

We measured both the incidence and severity of CMP and provide strong evidence to show that medical expenditure is a financial burden for many rural households. In Linyi County, 8.98% of rural households in 2004 fell into a catastrophe because of out-of-pocket medical payments, and NCMS reimbursements only reduced this incidence to 8.25%, which was still high. Yet Linyi County ranks economically in the middle among all counties of Shandong Province, and Shandong is above average economically among the provinces of China. This implies that the harsh economic effects of illness and injury in the less well-off parts of China would be worse. Moreover, many households could incur catastrophic payments several years in a row, especially those with chronic illnesses.

The CMP headcount in our Shandong study appears to be relatively high when compared with the results of a WHO multi-country (non-China) study of household catastrophic health expenditures (Xu *et al.*, 2003b), also based on the threshold of 40% of CTP. Although lower than Vietnam at 10.45% and Brazil at 10.27%, our Shandong CMP headcount was higher than those for all the other countries in this WHO study; for example, Azerbaijan at 7.15%, Colombia at 6.26%, Argentina at 5.77% and Cambodia at 5.02%.

There was a study on China in 2000 by van Doorslaer *et al.* (2005), also based on the 40% of CTP threshold. The catastrophic incidence of 4.81% in a sample covering 10 provinces was lower than in our Shandong study. However, their study covered both rural and urban areas, and urban residents are normally protected by some kind of health insurance, unlike their rural counterparts. Indeed out-of-pocket payment averaged 60.4% of the household's total health expenditure in their sampled population, compared with 82% in our study, which covered only rural residents.

The severity of catastrophic payments in rural households is noteworthy. Our study found that for the 265 households, out-of-pocket payments before NCMS reimbursement averaged 8.06 times the household's CTP. After reimbursement it was 6.34 times, which was still too harsh for the rural households and a disaster in the context of their meagre lives.

Both indicators of catastrophe were reduced after households received NCMS reimbursements. However, the majority of catastrophic households remained catastrophic; only the severity of their situation was alleviated slightly. Two main factors may explain the modest relief from the NCMS.

The first is the low premiums. NCMS's ability to reduce the financial burden of illness depends on the amount of funds that can be raised and pooled. Raising the funding level is fundamental to improving NCMS capacity to shield more households from CMP. The relationship between the reimbursement

rate and NCMS impact on CMPs has been illustrated by our simulation analysis. The funding levels of NCMS in Shandong's pilot counties were too low, as farmers still paid relatively large sums out-of-pocket.

The second factor relates to the benefit package of the scheme, which was determined by its funding level and premiums. In Linyi County the NCMS insured for both outpatient and inpatient care and was supposed to increase reimbursements in proportion to medical expenditure. In practice, the reimbursement rates did not vary significantly between low-paying and high-paying households. Households with ≥ 3000 yuan in total medical payments received reimbursement of 18.7%, compared with 16.9% for households with total payments of < 3000 yuan. With reimbursement rates averaging at 17.8%, co-payments were still high. Thus, the scheme in Linyi County could not alter the predicaments of many households.

Problems of measuring the impact of the NCMS on financial protection

This study quantified the impact of the NCMS on financial protection by measuring the reduction in the level of CMP among rural households. The strength of our methodology is that we have two indicators of catastrophe – CMP headcount and CMP gap – to inform on whether NCMS reimbursements have achieved their goal of providing financial protection. The indicators, however, are subject to several factors that could influence the results. Three important ones are discussed below – the definitions of CMPs and thresholds, the types of costs used in the study and the methodology issue of counterfactual analysis.

Definitions of CMP and thresholds. There are two main definitions of CMP used in contemporary studies. The first is CMP related to CTP, which was adopted in this study. The second is CMP in relation to absolute income level or absolute fixed amount of medical expenses (deemed to be catastrophic if too high). Some studies have adopted the income-related CMP definition (Wyszewianski, 1986a,b; Waters *et al.*, 2004; Su *et al.*, 2006); for example, Russell (2004) considers total health payment to be catastrophic if it is 10% of household income. The definition of CMP based on CTP has been adopted in several WHO studies (Murray *et al.*, 2003b; Xu *et al.*, 2003a,b).

The catastrophic thresholds used in different studies are not uniform. Comparison of results between different studies is difficult when the threshold levels are not the same. However, some studies have adopted a range of cut-off points to generate corresponding ranges of catastrophic incidence and catastrophic severity measures under different thresholds. We have undertaken a sensitivity analysis to show how the impact of the NCMS varied according to different thresholds relative to CTP.

Specifically, it is necessary in China to compare the performance and impact of the different existing versions of NCMS, so that the one with the best ability to reduce CMPs could be chosen by policymakers for nationwide implementation. To evaluate the impact of NCMSs, the use of a threshold to define catastrophic payments should be consistent. The catastrophic threshold should represent an approximate point at which the household is forced to sacrifice other basic needs. However, the appropriate threshold is still somewhat arbitrary, as the share of household resources satisfying this principle can vary in different social and cultural situations.

Limitation of medical costs in measurement of CMP incidence and CMP severity. Generally, the cost of illness and injury comprises direct and indirect costs. Direct costs arise from treatment seeking (including medical expenses and non-medical expenses such as for transport or food) and indirect costs result from loss of the productive labour of patients and caregivers (Jackson *et al.*, 2002, 2005, 2006a,b; Russell, 2004). McIntyre *et al.* (2006) reviewed the literature on the economic effects of direct and indirect costs of illness in low and middle-income countries and noted that in a majority of studies indirect costs exceeded direct costs by 2.0–3.6 times.

In our study, only medical costs (part of the direct costs) were used to measure catastrophes, which would be bigger if non-medical costs and indirect costs were also taken into account. We are aware that only considering medical costs underestimates the CMP headcount (incidence) and CMP gap (severity), but our main interest is the NCMS. We took this approach because only out-of-pocket medical expenses can be ameliorated directly by the NCMS. Only changes in medical expenses before and after reimbursement reflect the impact of the NCMS on financial protection.

Methodology issue of counterfactual analysis. A counterfactual approach assumes that the population's health-care-seeking behaviour did not change after introduction of NCMS. In theory, health-care-seeking behaviour and health-care providers' behaviour might change after the implementation of a health insurance scheme (moral hazard effects). People in an NCMS county may spend more on health care because they were covered, and providers may charge insured patients more or offer more services. This would alter health payments measured in the catastrophe effects. This insurance effect, however, was not taken into account in the financial protection.

The 'ideal' method by which to measure the impact of the NCMS on financial protection is a controlled study, which compares indicators between populations covered by the scheme and not covered by the scheme. However, it is not easy to find two populations with exactly the same conditions. It is also difficult to use a 'before' and 'after' design due to problems of recall of medical events, income and expenditures during the year before the intervention if the research is done the year after the intervention (as was the case with this study). As an alternative method, counterfactual analysis, which has been widely used in population health (Murray *et al.*, 2000, 2003a; Hofler, 2005), was adopted.

Even with the limitations, counterfactual analysis is meaningful because it provides a comparison of the actual situation regarding catastrophic health payments under the NCMS system before and after reimbursement. It is informative for scheme evaluation and for policy formulation.

CONCLUSIONS

Financial protection against the cost of illness in rural China is an urgent issue, as catastrophic payments affect nearly 10% of the population each year. The NCMS is a viable risk-sharing mechanism for rural residents who are excluded from financial protection in respect of illness and injury. Implementation of the NCMS is a great leap forward towards fairer health financing and could prevent catastrophes. However, at the current NCMS funding level, financial protection is limited because premiums are relatively low and benefits ungenerous.

Scheme design could be improved. One possibility is to reduce co-payments by providing higher reimbursements through increasing government subsidies, increasing the premiums of individual participants or both. A less costly option is to target those impoverished households with high risks of incurring CMP, perhaps exempting them totally from medical costs. This requires better understanding of what kind of households are at high risk of catastrophic payments, and further research is necessary to this end. If vulnerable households could be effectively helped, the scheme could then achieve its fundamental goal of financial protection for the needy.

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IMPACT OF CHINA'S NCMS ON CATASTROPHIC MEDICAL PAYMENTS

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