

Catastrophic health expenditure: A comparative study between hypertensive patients with and without complication in rural Shandong, China

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Abstract

Background

Some previous studies have assessed catastrophic health expenditure (CHE) in households with hypertensive patients, but few have examined the difference of CHE in hypertensive patients with and without complications. The purpose of this study is to compare the prevalence and determinants of CHE between hypertensive patients with and without complications.

Methods

The data were drawn from a cross-sectional study conducted in four rural counties of Shandong Province in China in 2016, including 3,113 hypertensive patients. CHE was defined as out-of-pocket payments for hypertensive care that equaled or exceeded 40% of the household capacity to pay. We employed Chi-square test to explore associated factors and logistic regression model to identify the determinants of CHE.

Results

The prevalence of CHE is 13.6% among hypertensive patients. The prevalence of CHE with one complication is 25.3% ($P=0.000$, $OR=2.29$) and 47.3% ($P=0.000$, $OR=3.60$) in patients with two or more complications, which are both statistically higher than that in patients without complication (6.1%). Across all types of patients, income levels are inversely related to the prevalence of CHE. Patients who use outpatient or inpatient service are more likely to experience CHE ($P=0.000$). Factors including living arrangements, family size, educational attainment are found to be significantly associated with CHE in some subgroups ($P < 0.05$).

Conclusions

CHE prevalence among hypertensive patients is high in rural China. Patients with hypertensive complication are at higher catastrophic risk than those without complication.

Background

Cardiovascular disease is the world's leading cause of deaths, accounting for one third of the total^[1]. Hypertension is one of the major risk factors for cardiovascular disease,

which plays a major role in the development of cerebrovascular disease, cardiac and renal failure^[2]. About 50% of coronary heart disease and 75% of the burden of cerebrovascular disease are caused by hypertension^[3]. Globally, approximately one billion people suffer from hypertension. It is estimated that the prevalence of hypertension will rise from 26.4% to 29.2% in the world by 2025^[2,4]. Hypertension and its complications are the leading causes of death and disability^[5]. The number of deaths worldwide due to hypertensive complication is 9.4 million, of which 45% die from heart disease, and 51% die from

stroke^[6]. The World Health Organization (WHO) ranks hypertension as one of the top five health risk factors^[5].

In China, the prevalence of hypertension in adults aged 18 years and older was 27.9%, with more than 250 million patients, and the number of new cases per year about 10 million. This prevalence was even higher (32.5%) among the adults aged 35 to 74^[7–9]. It was estimated that 2.5 million Chinese adults died from hypertension and its complications, accounting for 28% of all deaths in 2013^[10]. China's total health expenditure was US\$ 30.57 billion in 2013, of which the direct economic burden of hypertension accounted for 6.61%^[11]. In the past decades, the Chinese government has introduced several social health insurance schemes (i.e., Basic Medical Insurance Scheme for Urban Employees, Medical Insurance for urban and rural residents) to the urban and rural residents, and also medical financial assistance to the poor, so as to reduce economic burden of the households with patients^[12]. However, the households which experiencing hypertension and hypertension complications (i.e., heart attack, stroke and kidney failure) often spend a substantial share of their income on hypertension-related healthcare use^[4]. Previous study in China showed that hypertension and its complications ranked the first of all diseases with heavy economic burden among the rural residents^[13]. In addition, rural residents are found to be of higher economic risk than urban residents^[14–15]. For rural households in China, the emergence of such diseases might lead to severe economic risks and a further induced poverty^[16]. The fundamental role of a healthcare system is not only to facilitate access to health services when needed, but also protect households from financial catastrophe associated with illness^[17].

However, many people still do not have access to the healthcare services they needed owing to economic conditions^[18]. When healthcare expenditure seriously affects household living conditions, or even push the household into poverty, we call it "catastrophic"^[19], which can be quantified by catastrophic health expenditure (CHE). Generally, we define CHE as out-of-pocket payment (OOP) for health care that exceed a specified proportion of household income, with the consequence that the household may sacrifice the consumption of other goods or services necessary for their well-being^[19–20].

Households with members suffering from chronic diseases have a greater possibility of experiencing catastrophic health expenditure than than their counterparts, which is consistent in both developed countries and developing countries^[21–22]. Under a rapid increasing trend in prevalence of hypertension, to identify the prevalence and determinants of CHE for hypertension patients in rural areas, and evaluate the effect of hypertension complications on the prevalence, intensity of CHE are of high priority for protecting households with hypertension from financial catastrophe in rural China. However, to date, there are only very few studies have explored the CHE in hypertensive patients, and no studies have assessed the effect of complications on the prevalence, intensity of CHE in China. The overall objective of this study is to compare CHE between hypertensive patients with and without complications. To do so, we have several specific objectives. Firstly, we would compare CHE between hypertensive patients with complications and without complications. Secondly, we will identify the determinants for CHE in the hypertensive patients in rural China. Like China, growing incidence of hypertension and co-payment for its health expenditure are

also issues in other low and middle income countries (LMICs), the findings from this study is also of high significance to other LMICs.

Methods

Study participants

Data for the current analysis came from cross-sectional surveys in Shandong Province, which was the second largest province in China, the prevalence of hypertension in Shandong residents aged 18–69 in 2013 was 27.9%, significantly higher than the national average level ^[23]. An expected prevalence of 10% of CHE and also a tolerance error of 0.15 were used to estimate the sample size, and at least 1,600 hypertensive patients should be investigated. A 3-stage cluster sampling was employed to select participants in this survey. Firstly, according to Gross Domestic Product (GDP) per capita in Shandong in 2015, we stratified all counties into three groups. We selected one county from high level, two from middle level, and one from low level as study sites, and four counties were included. Secondly, likewise, we stratified all townships into three groups, from each group we chose one township. Similarly, we then chose two villages among each selected township on the ground of GDP per capita. More details about data collection methods were described in our previous studies ^[24].

According to the Chinese guideline for the management of hypertension, the criterion for hypertension was systolic blood pressure (SBP) ≥ 140 mm HG (1 mm HG ≈ 0.133 k Pa) and diastolic blood pressure (DBP) ≥ 90 mm HG ^[25]. In this study, the status of hypertension and also its complications were diagnosed by medical professionals and registered in the sample village chronic case management system. We selected all of the hypertensive patients from village management system. In total, 3,113 rural hypertensive patients were included in current study.

Data collection

All the subjects were interviewed face-to-face using a standard structured questionnaire by trained postgraduate students from Shandong University School of Public Health. In order to ensure a high response rate, about one week before the normal survey, the sampling hypertensive patients were informed of the purpose and time of the interview by the local healthcare practitioners, and signed the willingness for the participation in the survey. To achieve the purposes of this study, completed questionnaires were subject to stringent quality assurance in each day. The questionnaire included the patients' basic information (gender, age, marital status, education attainment, household composition), household income, total household expenditure, food expenditure, OOP payments for hypertension-related healthcare, health insurance status, and out-patient service and in-patient service. When conducting the interview, the main information of the interviewed hypertensive patients in the case management system would be also reviewed by the interviewers to validate the response of the interviewees.

Variables And Definitions

Outcome and measurement

In our study, we define CHE as OOP (out-of-pocket healthcare payments) that equal or exceed 40% of the household capacity to pay^[26], of which, the household capacity to pay means that household total expenditure minus food expenditure^[27-28]. OOP expense for hypertension and its complications refers to the direct expenses paid to the medical service provider of the whole household, excluding indirect costs such as loss of working time, transportation and accommodation fees incurred at the time of medical treatment^[29-30]. We usually use incidence and intensity indicators to assess CHE^[31-32]. The incidence of CHE can be expressed by head count (HC) and intensity indicators can be evaluated by mean gap(MG) and mean positive gap (MPG). HC is estimated as follows:

$$HC = \frac{1}{N} \sum_{i=1}^N E$$

Where N is the sample size, E is an indicator equal to 1 if OOP of a household *i* as a proportion of its capacity to pay is greater than the threshold *Z* and zero otherwise. MG is the average amount by which payments, as a proportion of income, equals or exceeds 40% of their capacity to pay. It is estimated as follows:

$$MG = \frac{1}{N} \sum_{i=1}^N G$$

Where N is the sample size, G is an indication of how much OOP exceed the threshold, equal to $T_i / X_i Z$ if $T_i / X_i > Z$ and zero otherwise. Here, T_i is the OOP payments of household *i*, X_i is the household capacity to pay and *Z* is the threshold share. MPG is defined as the head count being a fraction of the MG. The specific calculating methods of CHE prevalence and intensity are described in detail by Wagstaff and colleagues *elsewhere*^[20].

Independent variables and covariates

Hypertensive complication

A question of “Have you ever been diagnosed with hypertension complication (including stroke, coronary heart disease, hypertension and kidney disease, heart disease etc.)?” was used to measure hypertension complication in this study. If the answer was ‘yes’, we will record the specific disease(s) in details. We categorized the types of hypertensive complications into 0(no), 1(single), and 2(multiple complications).

Hypertension-related variables

Hypertension-related variables included duration of hypertension (≤ 5 , 5-, 10-, ≥ 15 years), hospitalization due to hypertension and its complication in the past year (yes vs. no), and out-patient service (yes vs. no).

Social demographic characteristics

The social demographic characteristics of the participants included age, gender, marital status, educational attainment, health insurance status, head of household, gender of household head, family size, and household living arrangements.

Economic status

Economic status included household income (Q1, Q2, Q3, Q4, and Q1 was the poorest, and Q4 was the richest), Dibao (yes vs. no), debt (yes vs. no). We used a question of “How much was the total income of your household in the past year (urban households were disposable income, rural households were net income)?” to measure the yearly household income.

Data analysis

The data is double entered and checked using EPI Data 3.1. The statistical package SPSS 22.0 is used to analyze the data. Household total expenditure, food expenditure, capacity to pay and OOP payments are presented as means and medians. Logistic regression analysis is used to compare the prevalence of CHE between hypertensive patients with and without complications, Chi-square test is used to explore which factors are associated with CHE. Multivariate logistic regression analysis is employed to assess the determinants for CHE in each type of subgroups. Statistical significance is set at the 5% level. Sampling weights were included in all analyses to deal with potential cluster effects.

Results

Demographic characteristics

We present the descriptive statistics of the study participants in Table1. Of the 3294 hypertensive patients in the list of chronic patients’ management system in the sampling villages, 3113 hypertensive patients participated in this study, with a response rate of 94.5%. Of the respondents, 2009(64.5%) have no complication, 1013(32.5%) have one complication, and 91(3%) have two or more complications. Majority of the study participants are women (63.3%), with an education level of elementary school and below (78.7%). As for the living arrangements, empty-nest couples account for 65.2%, while empty-nest single

account for 14.1%. During the 12 months prior to survey, 414(13.3%) patients used in-patient service, 410(13.2) patients used out-patient service.

Patients' household income/expenditure, capacity to pay and OOP payments for hypertension

The mean annual household income is US\$2260 (a currency exchange rate of Chinese RMB 689 Yuan to US\$100 dollar, the same below), with a highest mean income of US\$2427 in patients with no complication, and a lowest mean income of US\$1451 in hypertensive patients with two or more complications. Mean annual household expenditure is US\$2487(with a median of US\$1836), and the mean household food expenditure is US\$720(median value US\$610). Mean OOP payment for hypertension-related healthcare is US\$272 (with a median of US\$53), which accounts for 15.4% of the mean household capacity to pay, and 12.1% of the mean household income. Hypertensive patients with two or more complications have highest share of household income (78.1%) and capacity to pay (53.6%), while patients with no complication have the lowest share of household income (4.3%) and capacity to pay (6.2%) (See the table 2).

Prevalence of CHE among patients with different numbers of complications

Table 3 presents the prevalence of CHE for different types of patients, of which the overall prevalence of CHE is 13.6%. In order to better compare the prevalence of CHE across different types of patients, we firstly use a univariate logistic regression model. The results show that, CHE prevalence is highest among the hypertensive patients with two or more complications (47.3%), and is lowest among the patients with no complication (6.1%). The difference is statistically significant ($P = 0.000$). Then, we included the factors of age, gender, marital status, education, household income, health insurance, duration of disease, in-patient, out-patient, dibao, be in debt, head of household, head of household's gender, family size, and living arrangement into the model to control the effect of potential confounders, and difference in CHE prevalence across different types of patients is statistically significant($P = 0.000$).

CHE for hypertensive patients with different numbers of complications

In Table 4, we can observe an inverse association between CHE prevalence and household income. Over 21% of patients in the poorest quartile (Q1) compared to 6.9% of those in the richest households (Q4). Similar trends are observed among all of three types of hypertensive patients. In each income level, CHE prevalence is highest in the patients with two or more complications.

In addition, we also use the overshoot and mean positive overshoot indicators to describe the intensity of catastrophic health expenditure. With the increase of income level, the overshoot and mean positive overshoot of CHE gradually decrease, showing a negative correlation trend. On average, health care payments for hypertension are 8.3% higher than the 40% threshold. For those experienced CHE, the MPO was found to increase to 61%.

CHE distribution

For hypertensive patients, out-patient (13.2%) and in-patient (13.3%) are at high risk of experiencing CHE, no matter whether there is complication or not. Among the patients with no or only one kind of complication, those who are older, who with lower household income, and those with less than four family members are more likely to experience CHE. We also find that in patients with two or more complications, female and patients with lower education are inclined to suffer CHE (Table5).

Determinants of CHE in patients with different numbers of complications

For better understanding of the determinants of CHE in each subgroup, we use a logistic regression model to examine the related factors of CHE for each of the three subgroups separately in Table 6. Two factors are found to be statistically significant ($P < 0.05$) in all three types of patients, including outpatient service use in the past 6 months, and inpatient service use in the 12 months. Among the patients with no complication, those empty-nest singles and with lower education level are more likely to experience CHE ($P < 0.05$). Likewise, those who have lower household income are more likely to experience CHE in patients with one complication ($P < 0.05$).

Discussion

The participants in this study were selected from the chronic patients' management system in the sampling villages, which were randomly chose from those selected counties based on GDP per capita. This sampling process enables its representativeness of the rural Shandong, China. This survey based on villages offers an insight into the economic burden shouldered by the hypertensive patients and their households in rural Shandong, China.

In this study, the prevalence of CHE is 13.6%. In order to better understand the prevalence of CHE, we try to compare the CHE in this study to some others in China which used the same measuring method of CHE as ours. It is higher than the reported 6.7%, 11.19% and 5.4% in general households in rural Sichuan, rural Yunnan and rural Shaanxi respectively^[33-35]. A study by Zhao et al. estimated an prevalence of 6.3% and 5.4% in general households in rural Gansu and Heilongjiang, which were both lower than the prevalence in this study^[36]. Another study conducted in the same province as this study indicated that 4.5% and 4.3% of the rural general households experienced CHE in 2006 and 2008, which were also lower than the prevalence of CHE in this study^[37]. Even though the prevalence of CHE in this study is lower the reported 23.48% in hypertensive patients' households in rural Shaanxi in 2013^[38], the results both from Shandong and Shaanxi indicate that hypertension might exert a significant effect to incur CHE on the patients and their households in rural China. In addition, the Chinese government has taken several measures to promote essential public health service (including hypertension case management) and also universal health coverage in the past five years. The gap in CHE among hypertensive patients between Shandong and Shaanxi province, might imply a progress in such measures.

Not surprisingly, the results of this study reveal that the hypertensive patients with complication are more likely to experience CHE compared with those without complication. In addition, with the increase in the

types of hypertensive complications, the intensity and prevalence of CHE also increase significantly. Some previous studies indicate that the treatment and healthcare costs for hypertensive complications (i.e., coronary heart disease, stroke) are particularly expensive^[39]. The high economic burden for hypertension patients and their households mainly comes from hypertensive complications^[39]. This finding implies a need for the community health providers to monitor the blood pressure regularly for the rural hypertensive patients, so as to prevent the progression of the hypertension and the occurrence of its complications.

The primary goal of health insurance scheme is to prevent patients from falling into poverty trap due to healthcare expenditures worldwide. However, in this study, we found that health insurance has no significant effect on the prevention of CHE, which is similar with some previous studies^[40–43]. This finding indicates that the healthcare expenditure for hypertension after reimbursement still poses a high financial burden on the patients' households. In other words, the protection effect of the health insurance scheme on the hypertension and its complications is very limited. Therefore, to upgrade the height of coverage of the health insurance schemes targeting the hypertensive patients, especially for those patients with complications, is essential to decrease the possibility of CHE in the hypertensive patients' households.

Similarly, our results find that the outpatient and hospitalization service use are the determinants of CHE in hypertensive patients^[44–45]. A study in Yichang, China found that average expense for each hypertension-related outpatient and inpatient visit was US\$ 36.1 and US\$ 1877.0 respectively^[46]. Hypertensive patients need to use outpatient visit for about eight times per year^[47]. The health service utilization posed a high direct economic burden on the patients and their households. This was also demonstrated to be true in some other countries^[48–49]. In addition, some other indirect costs, such as transportation and accommodation expenses for health service use, and formal care expenses for those need care, also bring dramatic burden to the patients and their households. This finding suggests for the policy makers to develop interventions of healthcare cost control, especially for those inpatient services, to reduce healthcare expenditure for the hypertensive patients and their households. Simultaneously, practitioners in community health centers should carry out hypertensive patients targeting health education, especially in patients with poor education, to improve their understanding of hypertension and its consequences so as to prevent the progression of the hypertension and its complications.

Consistent with the studies in some other diseases, this study also reveals that the prevalence and intensity of CHE among hypertensive patients is negatively correlated with the economic status, patients in lower income quartiles are at higher risk of experiencing CHE. In the same income quartile, the prevalence and intensity of CHE increased with the increase in the number of hypertension complications. China began to implement a strategy of Targeted-Poverty-Alleviation in 2014, and the disease-caused poverty is the most common target in this strategy. This finding is meaningful to develop anti-poverty policy of pro-patients with chronic diseases (e.g., hypertension), especially for those with complications, so as to effectively achieve the goal of the Targeted-Poverty-Alleviation strategy.

Several limitations are involved in this study. First, the number of patients with two or more complications is only 91(3.0%). Of the participants, 63.3% were women. These might result in possible bias. Second, when we collect the expenditure and income of the patient's household (such as OOP, food expenditure), even though we have tried to, it is hard to exclude recall bias.. Third, this is a cross-sectional study, which makes it impossible for us to evaluate some potential interventions to prevent CHE. This will be remedied in the follow-up study.

Conclusion

This study reveals that the prevalence and intensity of CHE are relatively high in hypertensive patients in rural China. Patients with complications are at higher risk of experiencing CHE than those with no complications. Our findings also show that patients who use outpatient or inpatient services are more likely to suffer from CHE. In addition, some other at-risk factors, including living arrangements, family size and education level, are also identified in some subgroups. The results imply a need of regular monitoring for blood pressure in rural hypertensive patients. Some measures to enhance adherence to anti-hypertension treatment as well as lifestyle changes to lower BP (blood pressure), are also of significance to prevent the progression of the hypertension and its complications, so as to reduce the risk of potential CHE.

Declarations

Ethics approval and consent to participate

The study protocol was approved by The Ethical Committee of Shandong University School of Public Health. The investigation was performed after the acquisition of written informed consents of all participants.

Consent to publish

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare there are no competing interests.

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Authors' contributions

CZ, XZ, and QX conceived the idea. CZ, XZ, XG, ZJ, QX, LS, and JL participated in the statistical analysis and interpretation of the results. XZ and QX drafted the manuscript. CZ gave many valuable comments on the draft and also polished it. All authors read and approved the final manuscript.

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Tables

Due to technical limitations, Tables 1 - 6 are only available for download from the Supplementary Files section.

Supplementary Files

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