

BMJ Open Catastrophic health expenditure in the Northern midlands and mountainous areas and its determinants, Vietnam from 2014 to 2020: a cross-sectional study

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ABSTRACT

Objectives The study assesses households' catastrophic health expenditure (CHE) by income group, urban versus rural area, and influencing factors in the Northern midlands and mountainous areas of Vietnam.

Design/setting A cross-sectional study with the four waves of data from 2014, 2016, 2018 and 2020 Vietnam household living standards surveys was used.

Participants The number of participants in this study were 1658, 1661, 1659 and 1662 households in 2014, 2016, 2018 and 2020, respectively. We included households residing in the Northern midlands and mountain areas of Vietnam.

Outcomes measure We examined out-of-pocket health payments and capacity to pay by income groups and place of residence, the incidence of CHE and impoverishment. A logistic regression model was used to examine the influence of demographic and socioeconomic characteristics on CHE.

Results The findings showed a remarkable decrease in CHE between 2014 and 2016, followed by a considerable increase between 2016 and 2018. The CHE rates in the region were between 3.5% and 5%, with the highest value observed in 2014. In addition, the differences in household CHE rates according to income and place of residence were observed. The results also indicated that medical impoverishment ranged between 3.4% and 3.9%. Overall, factors such as the burden of disease, rural settlements, increasing use of healthcare services, visiting private health facilities and having an old-aged person in the household were significantly and positively associated with CHE. By contrast, households that were wealthier, participated in health insurance, had a household head employed and female-headed households, were negatively associated with CHE.

Conclusions The findings provide useful information that can guide policy-makers to design policies, and interventions necessary to reduce CHE in the region, narrow the gap between the rich and the poor, the rural and urban settlements, and ensure universal health coverage.

INTRODUCTION

The outcomes of illness have placed a huge burden on individuals, families and households, especially among those with limited financial resources. Medical expenses beyond paying abilities of individuals, families and

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The study used cross-sectional data from the four waves of nationally representative survey to determine the trends of catastrophic health expenditure (CHE), estimate the rates, level of impoverishment, and the determinants of CHE in the North Midlands and mountainous areas of Vietnam between 2014 and 2020.
- ⇒ The study used a cross-sectional design that could not interpret causal effect.
- ⇒ Healthcare payments, consumption expenditure, illness status, and healthcare utilisation were self-reported; therefore, underestimating and overestimating could not be eliminated.

households are called catastrophic health expenditures (CHE), which can cause households to lose income and runs into debt.¹ Universal health coverage ensures financial protection when households and their members are suffered from CHE and impoverishment.^{2,3} Unforeseen health shocks, the abundance of supplier-induced demand for medical services, low household affordability and the absence of prepayment mechanisms such as health insurance are among the factors that can increase households' health payment burdens.³

At the 25% threshold of total household expenditure, the exposure rate of CHE in Vietnam was relatively high at 2.1% in 2014. This rate far exceeds that of other low-income and middle-income countries in Southeast Asia, such as Laos (0.3%), Thailand (0.7%), Indonesia (0.4%), and the Philippines (1.4%), and in Africa, such as Nigeria (0.4%), Ghana (0.9%) and Cote d'Ivoire (0.5%).⁴ If the threshold is taken as 40% of the capacity to pay, the CHE rate of Vietnam increases to 4.2%.⁵

Vietnam's health financing strategy for the 2016–2025 period has emphasised strategic goals, including ensuring access and fair,

effective use of quality health services and enhancing financial protection for citizens.⁶ The strategy is also aimed at reducing the proportion of households incurring CHE to less than 2% by 2025. However, there is no target to reduce CHE for each geographical region or income group in this financial strategy. Nevertheless, in Vietnam, the gap between the rich and the poor is relatively high across regions.⁷

The Northern midland and mountainous areas have a total population of 12 292.7 thousand people, the majority (81.4%) of whom are living in rural areas.⁸ The northwest area is most divided and has the highest and most rugged terrain in Vietnam. In addition, the Northern midland and mountainous areas are one of the most impoverished areas in the country, poverty rate was 18.4% in 2018 which is almost three times higher than the national average (6.8%).⁷ The region's monthly income per capita is 2452.2 thousand VND/month, whereas that for the Southeast region is 5762.2 thousand VND. Farming is the primary source of household income.

Regarding health-related indicators, the infant mortality rate was 21.4‰, and the under-5 mortality rate was 32.5‰, far in excess of the national average (14.2‰ and 21.4‰, respectively). Life expectancy seems to be the lowest at 71 years of age. The most common diseases in the region are acute pharyngitis, acute tonsillitis, pneumonia, complications of pregnancy and delivery, and primary hypertension. The highest mortality rates are recorded from diseases such as pneumonia, cardiovascular disease, respiratory disease, myocardial infarction and stroke.⁸ The region's health insurance coverage rate was the highest at 96.6%.⁷ Although the rate of medical doctors/10 000 people in the area is quite high at 8.9, while that for the whole country is 6.4, the proportion of communes having a medical doctor is the lowest, at 87.4%.⁸

The Vietnamese government has provided free health insurance, eliminated copayments for poor households, and enacted other entitlements for near-poor households.⁵ However, the Northern midlands and mountainous areas have natural and socio-economic conditions that are much more difficult than other regions and that constitute obstacles for both the supply and demand sides to health service access, use, and affordability. Can these regional hardships translate into increased out-of-pocket health spending (OOP), resulting in high CHE rates, impoverishment and risks to people's health? This study accordingly aims to estimate the CHE incidence and its determinants in the Northern midlands and mountainous areas. The findings will provide information on the distribution and determinants of CHE, thereby assisting policy-makers in designing the policies and interventions needed to reduce CHE in the region and protect disadvantaged population group from CHE, moving towards universal health coverage.

METHODS

Samples and data source

The study data were obtained using the four most recent repeated cross-sectional surveys on Vietnam Household

Living Standards (VHLSS) for the years 2014, 2016, 2018 and 2020. The VHLSS is a national survey conducted every 2 years by the General Statistics Office of Vietnam. In the surveys, households were selected based on a two-stage random cluster sampling method, with stratification by urban–rural areas. In the first stage, from clusters at the commune level, urban and rural areas were selected with a probability proportional to size. The survey was conducted in all provinces and cities of Vietnam and representative at national, regional and provincial levels. In all, 50% of the enumeration areas (communes) were reselected from the areas of previous VHLSSs, and another 50% were newly selected from the master sample of the Population and Housing Census. In the second stage, for the newly chosen enumeration areas, households were selected by a systematic random method. The numbers of households in the Northern midland and mountainous areas included in the study were 1658, 1661, 1659, and 1662 in 2014, 2016, 2018 and 2020, respectively. The weighted number of households were 3 076 577, 3 223 836, 3 489 390 and 3 261 783 for 2014, 2016, 2018 and 2020, respectively. The number of households surveyed in each province is provided in [table 1](#).

The subjects of the surveys are households and household members. The survey used a face-to-face interview method. The enumerator was responsible for visiting the head of the household and household members directly to interview and write down information on the household interview form. The information collected in surveys included household income and household expenditures (expenses for food, clothing, accommodation, transportation, education, healthcare and other spending). Further information about the household and its members was also included, such as demographic characteristics (age, gender, ethnicity, marital status), education level, illness, disease, use of medical services, employment and occupation.

Measurements

The measurement of CHE is usually through methods such as share of budgets, actual food spending, partial normative food spending, and normative spending on food, housing and utilities. These methods above use OOP payments as the numerator, while the total household income or consumption expenditure, household total expenditure minus actual food spending and household spending minus subsistence food spending as denominators.⁹ For this study, we used the WHO recommended method (partial normative food spending) to calculate CHE. Accordingly, a household incurs CHE when its OOP health spending is equal to or higher than 40% of the household's capacity to pay (non-subsistence expenditure).¹⁰ One of the advantages of this method is the ability to subtract a standard amount of food spending from each household's budget. The method also allows for the categorisation of household spending using the ratio of food expenditure to total household expenditure.

Table 1 Sample size for the study years

Province	2014		2016		2018		2020	
	Sample size	Weighted sample size	Sample size	Weighted sample size	Sample size	Weighted sample size	Sample size	Weighted sample size
Ha Giang	105	183 051	105	194 616	105	192 630	105	192 492
Cao Bang	102	136 704	102	142 491	99	155 640	102	141 513
Bac Kan	99	78 663	101	86 472	102	89 223	102	83 388
Tuyen Quang	114	205 014	114	219 747	114	232 701	114	216 825
Lao Cai	102	164 889	102	181 911	102	209 550	102	177 528
Yen Bai	113	212 690	114	222 975	114	226 392	114	227 247
Thai Nguyen	147	345 492	147	337 422	147	390 456	147	362 634
Lang Son	108	189 777	108	199 602	108	208 644	108	207 645
Bac Giang	168	443 724	168	468 480	168	521 040	168	483 135
Phu Tho	156	428 217	156	406 053	156	423 942	156	400 146
Dien Bien	102	127 155	102	136 269	102	153 267	102	139 551
Lai Chau	102	89 889	102	98 799	102	120 000	102	102 069
Son La	126	257 025	126	302 742	126	334 662	126	304 056
Hoa Binh	114	214 287	114	226 257	114	231 243	114	223 554
Sum	1658	3 076 577	1661	3 223 836	1659	3 489 390	1662	3 261 783

Hence, the food expenditure in a random group of both affluent and poor households can be calculated.⁹

OOP health expenditure (OOP) is defined as the total payments for health-related services such as fees for check-ups, treatment, drugs, laboratory fees, hospital fees, travel, informal payments for doctors, and purchasing medicines and medical supplies without check-ups (prescriptions) for self-treatment. Health insurance reimbursement is subtracted from OOP. Health payment is defined as the annual expenditure on health service utilisation. Health payment is the aggregate expenditure of all household members on healthcare in the 12 months before the survey.

Household consumption expenditure (exp) is the sum of household's purchases and in-kind payment on all goods and services, as well as the money value of items that are produced and consumed at home, and goods received as gifts. Household consumption expenditure includes expenditures on food and drinks, non-food items and other expenditures such as food and drink consumption on festive occasions, regular food and drink consumption, daily consumption of non-food items, education and healthcare expenditures, other consumption included in expenditures, expenditures on durables goods, recurrent expenditures on housing, electricity, water and daily-life waste. Expenditure on items in the 30 days before the survey, such as regular food and drink consumption, and daily consumption of non-food items, is multiplied by 12 to convert into the annual values.

Subsistence spending is the minimum amount of spending necessary to sustain a basic life. Its calculation includes the following steps¹⁰:

Determine the share of food expenditure on the total household's expenditure ($foodexp_h$)

$$foodexp_h = \frac{food_h}{exp_h}$$

where $foodexp_h$ is the food expenditure share of household, $food_h$ is the household's food expenditure, and exp_h is household consumption expenditure.

Calculate equivalised food expenditures ($eqfood_h$):

$$eqfood_h = \frac{food_h}{eqsize_h}$$

Determine the food expenditure share of total household expenditure, which falls between the 45th and 55th percentiles in the entire sample (denoted as $food45$, $food55$), taking into account the sample weights.

Calculate the poverty line (pl):

$$pl = \frac{\sum w_h * eqfood_h}{\sum w_h} \quad \text{where}$$

$$food45 < foodexp_h < food55$$

where w_h is the sampling weight of households.

Generate the subsistence expenditure for each household (se_h):

$$se_h = pl * eqsize_h$$

Determine the household capacity to pay (ctp_h) by subtracting subsistence spending from household consumption expenditure. In cases where household expenditure on food is lower than subsistence expenditure, non-food spending is used as a substitute for non-subsistence spending.¹⁰

$$ctp_h = exp_h - se_h \quad \text{if } se_h \leq food_h$$

$$ctp_h = exp_h - food_h \quad \text{if } se_h > food_h$$

Financial burden ($oopctp_h$) is calculated as follows:

$$oopctp_h = \frac{oop_h}{ctp_h}$$

This is, the OOP health payments are divided by household's capacity to pay. This measure represents the burden of OOP health payments that impose on households.

CHE ($cata$): A household is considered to suffer CHE if $oopctp_h$ is greater than or equal to 0.4. CHE is a dummy variable. CHE equals 1 if a household incurs CHE and 0 otherwise:

$$cata_h = 1 \text{ if } \frac{oop_h}{ctp_h} \geq 0.4$$

$$cata_h = 0 \text{ if } \frac{oop_h}{ctp_h} < 0.4$$

Impoverishment ($impoor$): A household is considered impoverished because of medical expenses if, before paying for health, it is a non-poor household, but it becomes poor after spending on health.¹⁰

$impoor_h = 1$ if $exp_h \geq se_h$ and $exp_h - oop_h$, otherwise

$$impoor_h = 0$$

Dependent and predictor variables

We used a multivariable logistic regression model to determine the factors affecting CHE. The dependent variable (CHE) is binary. CHE equals 1 if the household experiences CHE and 0 otherwise. The independent variables were selected based on a literature review and data available.^{11–15} In Vietnam, the head of the household is the person who manages the family and plays a decisive role in the household. Usually, the household head is the person with the highest income and has information about the other family members' education status, economic and occupational activities. Accordingly, the independent variables included; the age, gender, marital status, educational status, employment status of the head of the household. The composition of a household such as the presence of old age member (60 years and above), presence of child (under 6 years); place of residence; socioeconomic status; the number of household members having health insurance, and households with members suffering severe illness/injury were also chosen. Additionally, the aggregation of all household members' outpatient visits, inpatient admissions, and type of facility visited in the last 12 months was selected as independent variables. The characteristics of households according to CHE status are presented in online supplemental table 1 and 2.

Households and household members are included in the VHLSS. Household members are those who eat and live together in the same household for more than 6 months in the last 12 months before the survey. In addition, they share a common income and expenditure, and the budget, this implies that that all household members use their incomes and contribute to the household's

common budget, and all household expenditures are taken care of from the budget. However, servants, members who have already left the household, and those who died in the last 12 months before the survey, were excluded from the VHLSS.

Patient and public involvement

Patients were not involved in this study.

RESULTS

OOP health payments

Table 2 shows a detailed annual OOP expenditure in the households. In purchasing power parity international dollars, the OOP payments shows a slight decrease of about 2% from Int'l.\$437.2 in 2014 to Int'l.\$429.0 in 2016. The reductions were observed in both urban (3.5%) and rural (1.1%) areas and for all quintile groups except Q1 and Q3. However, there was a significant increase of around 74% in OOP expenditure between 2016 (Int'l.\$429.0) and 2018 (Int'l.\$747.4). For the places of residence, the largest increase was seen in an urban area with 117%, from 513.2 to Int'l.\$1115.9 between 2016 and 2018. As for the income quintile, households in the wealthiest quintile group had the highest increase of almost 3.5 times in OOP spending, from Int'l.\$520.4 in 2016 to Int'l.\$1751.2 in 2018. Interestingly, households from the poorest group experienced a significant reduction of approximately 7.3% in OOP payments during the same period. Between 2018 and 2020, OOP payments continued to increase considerably by 18.4%, from Int'l.\$747.4 in 2018 to Int'l.\$885.1 in 2020. Overall, between 2018 and 2020, increases in OOP spending were observed in most households, except for those living in urban areas and those living in the fifth quintile. In addition, there were substantial differences in the yearly average households' OOP payments between urban and rural areas and between quintile groups over the entire study period. In the year 2018, for example, OOP expenditure was about 1.7 times higher in urban households than the households within rural areas. Likewise, the better-off households spent more on healthcare, with the most considerable disparity observed in 2018 (Int'l.\$1506.2).

Financial burden

Table 3 shows the trends in the capacity to pay of the 4-year survey period. OOP expenditures made up around 4.64%–10.25% of the capacity to pay of households. The financial burden decreased greatly by 0.73 percentage points (pp.) from 8.54% in 2014 to 7.81% in 2016, and these reductions were seen in all quintiles and places of residence. However, the share of OOP in households' capacity to pay increased from 7.81% to 9.15% between 2016 and 2018. This trend was attributable to the increases in all areas and quintiles. Between 2018 and 2020, the burden of health payments decreased significantly by 0.95 pp. The OOP payments as a share of the capacity to pay were higher for households from rural areas and

Table 2 Means of OOP per year per household by place of residence and income quintile, 2014–2020

Quintile	2014			2016			2018			2020		
	Current, 000 VND	Constant 2010, 000 VND*	International dollarst	Current VND	Constant 2010, 000 VND*	International dollarst	Current VND	Constant 2010, 000 VND*	International dollarst	Current, 000 VND	Constant 2010, 000 VND*	International dollarst
	Q1	1818.6	1266.0	243.3	2129.7	1435.1	291.1	1829.7	1150.2	245.0	2548.7	1510.0
Q2	3542.8	2466.4	474.1	2690.5	1813.0	367.8	2793.3	1756.0	374.1	4301.5	2548.5	575.6
Q3	3334.1	2321.1	446.1	3770.8	2540.8	515.4	4790.9	3011.8	641.6	6575.5	3895.8	879.8
Q4	4997.2	3478.9	668.7	4507.6	3037.3	616.2	5417.1	3405.5	725.4	6777.5	4015.5	906.8
Q5	4254.4	2961.8	569.3	3806.8	2565.1	520.4	13 076.6	8220.7	1751.2	10 657.6	6314.4	1426.0
Place of residence												
Urban	3974.0	2766.6	531.8	3754.3	2529.7	513.2	8333.2	5238.7	1115.9	6053.1	3586.3	809.9
Rural	3089.4	2150.8	413.4	2989.7	2014.5	408.7	4897.3	3078.7	655.8	4976.8	2948.6	665.9
All	3267.2	2274.5	437.2	3138.1	2114.5	429.0	5581.1	3508.6	747.4	6615.1	3919.3	885.1

*OOP payments were converted to constant 2010 prices using the CPI. The CPI in 2014, 2016, 2018, and 2020 was 143.644, 148.407, 159.07 and 168.784, respectively.

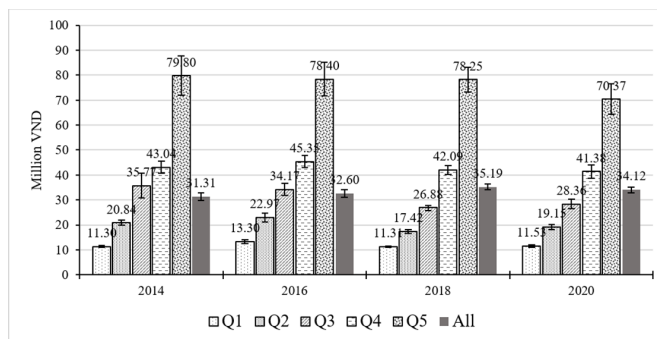
†The purchasing power parity for Vietnam was VND7473.4 per international dollar in 2014, VND7315.6 in 2016, VND7467.4 in 2018 and VND7473.7 in 2020.

CPI, Consumer Price Index; OOP, out-of-pocket.

Table 3 OOP expenditure as share of household's capacity to pay by place of residence and income quintile, 2014–2020

Year	2014		2016		2018		2020		Difference (percentage points)		
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	2014–2016	2016–2018	2018–2020	
Q1 (poorest)	9.86 (8.23 to 11.49)	9.37 (8.13 to 10.61)	10.14 (9.14 to 11.14)	8.70 (7.47 to 9.94)	-0.49*	-0.77*	-1.44*	-0.49*	-0.77*	-1.44*	
Q2	9.77 (7.90 to 11.63)	8.53 (7.19 to 9.87)	9.32 (8.51 to 10.14)	9.23 (7.39 to 11.08)	-1.23*	0.79**	-0.09*	-1.23*	0.79**	-0.09*	
Q3	7.94 (6.09 to 9.79)	7.77 (6.13 to 9.41)	10.25 (9.39 to 11.11)	7.95 (6.15 to 9.74)	-0.17*	2.48**	-2.3*	-0.17*	2.48**	-2.3*	
Q4	7.67 (5.83 to 9.50)	6.38 (5.06 to 7.69)	8.05 (7.33 to 8.76)	7.02 (5.43 to 8.60)	-1.29*	1.67*	-1.03	-1.29*	1.67*	-1.03	
Q5 (richest)	4.89 (3.85 to 5.93)	4.64 (3.54 to 5.75)	7.96 (7.25 to 8.68)	6.63 (4.74 to 8.52)	-0.25	3.32	-1.33*	-0.25	3.32	-1.33*	
Urban	7.02 (5.28 to 8.76)	6.37 (5.13 to 7.60)	8.73 (7.91 to 9.55)	7.12 (5.56 to 8.68)	-0.65*	2.36***	-1.61*	-0.65*	2.36***	-1.61*	
Rural	8.93 (7.93 to 9.92)	8.16 (7.38 to 8.94)	9.25 (8.73 to 9.77)	8.50 (7.62 to 9.39)	-0.76*	1.09**	-0.75*	-0.76*	1.09**	-0.75*	
All	8.54 (7.68 to 9.41)	7.81 (7.14 to 8.49)	9.15 (8.70 to 9.59)	8.20 (7.43 to 8.97)	-0.73**	1.34***	-0.95*	-0.73**	1.34***	-0.95*	

***, ** and * indicate the significance at the 1%, 5% and 10% level.
OOP, out-of-pocket.

**Figure 1** Yearly capacity to pay of households (in constant 2010 prices) by income quintile (means; SEs), 2014–2020.

those from lower-income quintile groups. The financial burden of households living in rural areas was greater than that of households in urban areas ranging from 0.52 pp. (in 2018) to 1.91 pp. (in 2014). Similarly, large gaps in the burden of health payments between the poorest and wealthiest households were seen in 2014 (4.97 pp.) and in 2016 (4.73 pp.). Similar patterns were observed in the capacity to pay of households, as shown in figure 1. The capacity to pay of households in the richest quintiles was about six to seven times higher than that of the poorest households. Between 2014 and 2020, the mean household capacity to pay increased from VND31.3 to VND34.1 million (at constant 2010 prices).

CHE and impoverishment

Table 4 provides details about the trends and patterns of CHE, and impoverishment of households in the Northern midlands and mountainous areas of Vietnam. Generally, the exposure rate to CHE and impoverishment among households in the region were higher than at the national level. The incidence of CHE shows a sharp decline from 5.0% in 2014 to 3.5% in 2016, a reduction observed in both urban (1.2 pp) and rural (1.6 pp) areas. However, the CHE exposure rate increased by 1.1 pp from 3.5% to 4.6% between 2016 and 2020. In absolute terms, the estimates showed that the number of households with CHE was 153 771 in 2014. These figures were 111 951 households in 2016, 144 388 households in 2018, and 149 884 households in 2020. The incidence of CHE was higher in rural areas in all the studied years, and a large gap was seen in 2014, with the figures being 5.4% in rural areas and 3.3% in urban areas. However, these gaps narrowed in the next years studied. For example, in 2018, there was no difference in the CHE rates between rural and urban areas. Similar pattern was observed for the incidence of impoverishment, this rate ranged from 3.4% to 3.9% over the entire study period, with the highest rate being observed in 2018 (3.9%). Although the incidence of medical impoverishment slightly declined by 0.2pp from 3.8% in 2014 to 3.6% in 2016, this rate increased to 3.92% in 2018. The numbers of households facing medical impoverishment were 117 409, 116 698, 135 388 and 111 710 in 2014, 2016, 2018 and 2020, respectively.

Table 4 Incidence of catastrophic health expenditure and impoverishment by urban/rural status, 2014–2020

Year	2014			2016			2018			2020			Difference (percentage points)		
	n	%, (95% CI)	n	%, (95% CI)	n	%, (95% CI)	n	%, (95% CI)	n	%, (95% CI)	2014–2016	2016–2018	2018–2020		
Household with catastrophic health expenditures															
Urban	20 599	3.33 (1.00 to 5.66)	13 183	2.11 (0.44 to 3.77)	43 569	4.58 (3.48 to 5.67)	23 593	3.32 (0.84 to 5.81)			-1.22*	2.47**	-1.26*		
Rural	133 172	5.42 (3.80 to 7.04)	98 768	3.80 (2.59 to 5.01)	100 818	4.59 (3.94 to 5.24)	126 291	4.95 (3.56 to 6.34)			-1.61*	0.79*	0.36*		
Region	153 771	5.00 (3.62 to 6.37)	111 951	3.47 (2.44 to 4.50)	144 388	4.58 (4.02 to 5.15)	149 884	4.60 (3.39 to 5.80)			-1.52*	1.11*	0.02*		
Nation	990 564	4.19 (3.73 to 4.56)	1 081 649	4.39 (3.94 to 4.84)	1 144 472	4.54 (4.03 to 4.98)	943 998	3.53 (3.13 to 3.93)			0.2***	0.15**	-1.01**		
Household with medical impoverishment															
Urban	4599	0.74 (-0.29 to 1.78)	5833	0.93 (-0.16 to 2.03)	19 651	1.64 (0.81 to 2.47)	24 504	3.45 (1.04 to 5.86)			0.19*	0.71**	1.81**		
Rural	112 810	4.59 (3.20 to 5.98)	110 865	4.27 (3.02 to 5.51)	115 713	4.49 (3.88 to 5.09)	87 206	3.42 (2.38 to 4.46)			-0.32*	0.22*	-1.07**		
Region	117 409	3.82 (2.67 to 4.96)	116 698	3.62 (2.59 to 4.65)	135 388	3.92 (3.40 to 4.45)	111 710	3.42 (2.46 to 4.39)			-0.2*	0.3**	-0.5*		
Nation	691 581	2.93 (2.53 to 3.33)	683 037	2.77 (2.41 to 3.12)	698 279	2.52 (2.19 to 2.85)	612 636	2.29 (1.98 to 2.60)			-0.16**	-0.25**	-0.23*		

***, **, and * indicate the significance at the 1%, 5% and 10% level.

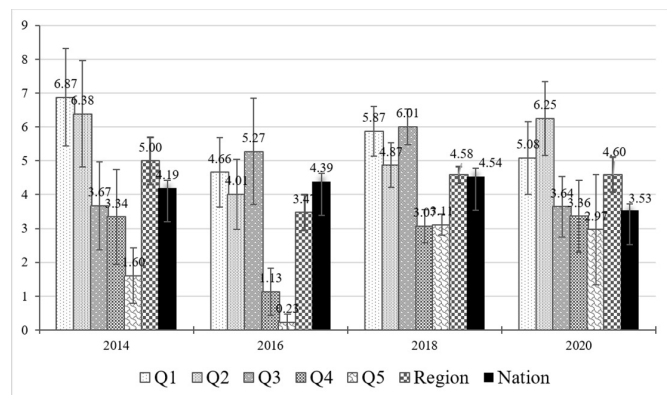


Figure 2 Incidence of catastrophic health expenditure by income quintile (mean, SE bars), 2014–2020.

Figure 2 shows the trend and pattern of CHE incidence according to income quintile. Similar to the tendency for all households, between 2014 and 2016, the CHE incidence decreased for all quintiles, except for Q3. The reductions in CHE rates for Q1, Q2, Q4 and Q5 were 2.2 pp, 2.4 pp, 2.2 pp, and 1.4 pp, respectively. From 2016 to 2018, all households in Q1, Q2, Q3, Q4 and Q5 had a higher likelihood of suffering CHE, with the largest increase of 2.88 pp being observed in households from the wealthiest quintile. Between 2018 and 2020, the incidence of CHE by income quintile followed different patterns. While the CHE exposure rate declined by 0.79 pp, 2.37 pp and 0.14 pp for households from Q1, Q3 and Q5, respectively, those from Q2 and Q4 experienced increases of 1.38 pp and 0.29 pp. In general, better-off households were less likely to incur CHE. Nevertheless, income inequality in the CHE rate tended to shrink over time. As of 2014, the gap in CHE incidence between the households in Q1 and Q5 was 5.3%, which was reduced to 4.33% in 2016, and 2.76% in 2018, and 2.11% in 2020.

Figure 3 displays the trends and patterns of medical impoverishment by income quintile. Similar to the trend for CHE incidence of households, from 2014 to 2016, the incidence of impoverishment decreased by 1.0 pp, 0.3 pp and 0.2 pp, respectively, for Q1, Q2 and Q5, compared with rises of 1.0 pp and 0.8 pp for Q3 and Q4, respectively.

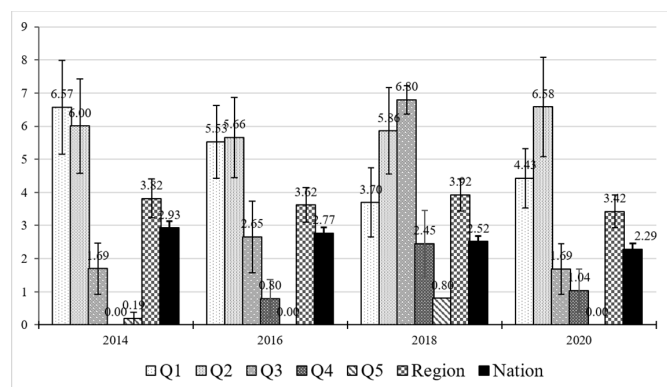


Figure 3 Incidence of medical impoverishment by income quintile (mean, SE bars), 2014–2020.

Between 2016 and 2018, only the households from the poorest quintile experienced a significant decrease of 1.83 pp, whereas there were increases of 0.2 pp, 4.15 pp, 1.65 pp and 0.80 pp for those from Q2, Q3, Q4 and Q5, respectively. However, between 2018 and 2020, the region witnessed a decrease in healthcare-related impoverishment of households from quintiles Q3, Q4 and Q5, and a sharp decrease was observed in Q3 with 5.11 pp. Overall, wealthier households were better protected from medical impoverishment, and the disparity in the impoverishment rate between the worst-off and better-off households narrowed.

Figure 4 represents the percentage of households incurring CHE and impoverishment by province over the study period. The results show that provinces with the highest CHE incidence were Phu Tho, Tuyen Quang, Bac Giang and Hoa Binh, while those with the lowest CHE incidence were Lao Cai, Dien Bien, Lai Chau and Ha Giang. In 2014 and 2016, Phu Tho and Tuyen Quang had the most households experiencing impoverishment, and in 2018 and 2020, Hoa Binh had the most. On average, Lao Cai, Lai Chau and Dien Bien had the least impoverishment.

Determinants of CHE

Table 5 shows the results of a multivariable logistic regression model of the factors affecting CHE in the northern midlands and mountainous region of Vietnam. The results revealed that in most of the study years, certain variables caused increasing risk of household's CHE, variables such as illness status of household members, households living in rural areas, frequency of using outpatient and inpatient services, use of private health services, age of the household head and presence of older people in the household. However, the wealthier households, number of household members enrolled in health insurance, the employment status of the household head and female-headed households displayed a reduced risk of CHE.

DISCUSSION

This study measured the CHE incidence and medical impoverishment of households in the northern midland and mountainous region of Vietnam from 2014 to 2020, the period after the implementation of the universal health insurance coverage policy in 2014. We found that OOP health spending increased by about 1.7 times from 2014 to 2020. Meanwhile, during the same study period, the capacity to pay of households increased about 1.1 times. Although there were significant differences in OOP expenditure between income groups, place of residence (urban and rural areas), these differences gradually narrowed. In addition, the estimated results show a sharp decrease in the CHE exposure rate of the households from 2014 to 2016, followed by a gradual increase in the subsequent years. The CHE rates ranged from 3.5% to 5%, with the highest rate observed in 2014. The falls in financial burden and CHE between 2014 and 2016

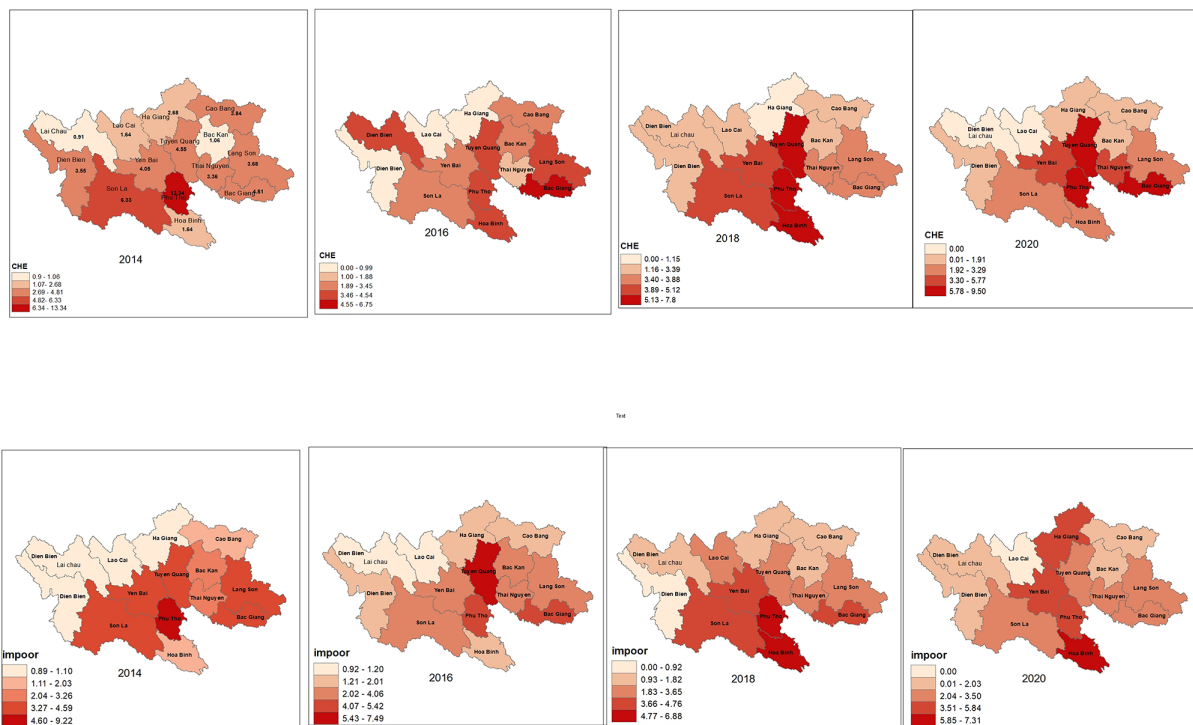


Figure 4 Incidence of catastrophic health expenditure (CHE) and impoverishment (impoor) (%) by province between 2014 and 2020.

were because of decreases in OOP from Int'l.\$437.2 to Int'l.\$429.0. By contrast, the increases in financial burden and CHE in the next year were related to increasing households' OOP. Furthermore, the rise in OOP moved in a speed faster than that of increase in capacity to pay. Another reason for this pattern is that the average health-care expenditure per person having treatment in the region declined by 8.7% between 2014 and 2016, while this figure almost tripled between 2016 and 2018.⁷ Most increase was contributed by the rise in the expenditure on inpatient visits (nearly 3.27 times). In particular, the inpatient services utilisation in the region increased considerably by 0.8 pp. between 2016 and 2018, this figure for the national level was just 0.1 pp.⁷

The supply-side and demand-side factors can explain the increase in health expenditure in the areas. From the supply-side perspective, the improvements in health system might be responsible for increasing healthcare utilisation in the region. There was an increase in public health budget per capita (from 699 in 2015 to 817.7 thousand VND in 2018), the number of doctors per 100 000 population (from 7.05 to 8.91), and the number of hospital beds per 1000 population (from 1.15 to 1.35), the remarkable expansion of social health insurance with significant changes in the benefit packages.¹⁶ However, the supply-induced demand problem which is related to the fee-for-service payment method could explain the increase in OOP. In the demand-side factors such as the increase in health expenditure might be explained by the population old-age and ageing-related health problems in the region, the increasing percentage of population aged above 60 (from 9.5% in 2014 to 10.7% in 2018), the

increasing non-communicable diseases, and the increase in monthly income per capita (from VND1.6 million in 2014 to VND2.5 million in 2018).

Similarly, there were disparities in household CHE rates by income group and place of residence. However, these gaps show a narrowing pattern over time. The results of healthcare-related impoverishment, however, show no considerable differences in medical impoverishment between years, ranging from 3.4% to 3.9%. In accordance with the present results, about 2.4% of households in Ghana and 2.7% of Swazi households spent more than 40% of their non-food expenditure on healthcare.^{17 18} A study in Cambodia estimated that the national incidence of CHE declined from 5.2% in 2009 to 4.9% in 2014.¹⁹ Another study in Thailand also demonstrated that between 2002 and 2015, the CHE rate decreased significantly by 50% from 4.1% to 2.0%.²⁰ However, a study estimating CHE incidence among elderly households in China reported that the CHE incidence increased from 20.86% in 2011 to 31.00% in 2015.¹ The differences in study results are attributable to differences in the characteristics of the samples, socioeconomic conditions, health systems and health policies of the countries.

In addition, the study examined the factors affecting CHE in the region. The results showed that the determinants of CHE included illness status of the household, income status, health insurance coverage, location, use of inpatient and outpatient services, use of healthcare services at public and private health facilities, and other factors such as employment status, age and gender.

Disease burden is one factor that has the greatest influence on CHE in the Northern midlands and mountainous

Table 5 Determinants of catastrophic health expenditure in northern Midlands and mountainous region of Vietnam, 2014–2020

Variable	Year/adjusted OR (95% CI)			
	2014	2016	2018	2020
Age of HH	1.122 (1.108 to 1.446)	1.119*** (1.108 to 1.446)	1.016*** (1.004 to 1.029)	1.033*** (1.009 to 1.058)
Gender of HH				
Female	Referent	Referent	Referent	Referent
Male	0.567 (0.182 to 1.760)	0.318*** (0.138 to 0.735)	0.772 (0.547 to 1.091)	0.332*** (0.148 to 0.744)
Marital status				
Others (Single, widowed, divorced...)	Referent	Referent	Referent	Referent
Married	2.546 (0.719 to 9.012)	3.681** (1.221 to 11.102)	0.707** (0.502 to 0.994)	1.786 (0.737 to 4.329)
Employment status of HH head				
Currently not employed	Referent	Referent	Referent	Referent
Currently employed	0.424 (0.126 to 1.419)	0.710 (0.188 to 2.679)	0.579** (0.405 to 0.828)	0.455* (0.185 to 1.121)
Household with children (under 6 years)				
No	Referent	Referent	Referent	Referent
Yes	0.731 (0.371 to 1.443)	0.579 (0.277 to 1.211)	0.835 (0.609 to 1.145)	0.819 (0.397 to 1.688)
Household with old age member (60 years and above)				
No	Referent	Referent	Referent	Referent
Yes	1.832* (0.993 to 3.381)	1.14 (0.587 to 2.237)	1.471** (1.043 to 2.074)	1.809* (0.974 to 3.360)
Settlement				
Rural	Referent	Referent	Referent	Referent
Urban	0.589* (0.222 to 0.930)	0.693** (0.151 to 0.810)	1.241 (0.625 to 2.464)	0.423* (0.168 to 1.067)
Social economic status				
Q1 (poorest)	Referent	Referent	Referent	Referent
Q2	0.566 (0.265 to 1.211)	0.829 (0.362 to 1.897)	1.217 (0.900 to 1.645)	1.008 (0.480 to 2.118)
Q3	0.235** (0.075 to 0.739)	1.023 (0.427 to 2.450)	0.717* (0.489 to 1.050)	0.283** (0.096 to 0.833)
Q4	0.106*** (0.025 to 0.445)	0.244* (0.048 to 1.231)	0.462*** (0.284 to 0.754)	0.252** (0.065 to 0.975)
Q5 (richest)	0.101*** (0.021 to 0.493)	0.037*** (0.005 to 0.270)	1.019 (0.639 to 1.623)	0.113*** (0.028 to 0.463)

Continued

Table 5 Continued

Variable	Year/adjusted OR (95% CI)			
The no of household members having health insurance	0.736*** (0.605 to 0.896)	0.778*** (0.643 to 0.941)	0.708*** (0.645 to 0.777)	0.801** (0.646 to 0.994)
Households with members suffering severe illness/injury				
No	Referent	Referent	Referent	Referent
Yes	4.982*** (2.381 to 10.424)	4.699*** (2.327 to 9.491)	6.122*** (4.684 to 8.002)	4.940*** (2.534 to 9.628)
No of outpatient visits in the last 12 months	0.949 (0.878 to 1.027)	1.008 (0.960 to 1.057)	1.027*** (1.011 to 1.044)	1.119*** (1.058 to 1.183)
No of impatiant admissions in the last 12 months	1.704*** (1.406 to 2.064)	1.325*** (1.154 to 1.520)	1.259*** (1.193 to 1.328)	1.648*** (1.369 to 1.985)
Type of facility visited				
Public health facility	Referent	Referent	Referent	Referent
Private health facility	2.476** (1.006 to 6.095)	2.231* (0.867 to 5.740)	0.947 (0.658 to 1.364)	2.072* (0.930 to 4.618)
Traditional healers and individual medical services	0.785 (0.245 to 2.521)	1.496 (0.361 to 6.197)	0.828 (0.405 to 1.693)	2.221 (0.345 to 14.281)
No of observations	1658	1661	1659	1662
** , * and † denote the significance at the 1% , 5% , and 10% level , respectively . HH , household head .				

areas of Vietnam. Households with at least one person that is seriously sick or injured are approximately five times more likely to incur CHE than households with no sick person. Severe illness requires regular medical examination and treatment, leading to medical expenses that may exceed the household's capacity to pay, especially in poor households. This finding was also reported by Ghimire *et al*,²¹ Kumara and Samaratunge,²² Thu Thuong *et al*,¹⁵ and Barasa *et al*.¹²

Income status is another important factor that determine household's CHE in the Northern midland and mountainous areas of Vietnam. Households from the fourth and the fifth quintiles were less likely to suffer from CHE than those from the lower-income quintiles. This could be because healthcare is a necessary service, and spending on healthcare is inelastic with income. In a study of the determinants of CHE in Vietnam, Nguyen *et al* pointed out that poor households have a higher number of sick days than better-off households (15 days vs 10 days), thereby increasing their burden of spending on health. These results corroborate the findings of a great deal of previous work in China¹⁴, Iran,²³ Nigeria¹³ and Peru.²⁴

Health insurance was found to be a protective factor for households from CHE. Increasing the numbers of members with health insurance coverage in the household reduced the odds of experiencing CHE in the region. This can be explained by the policy of universal insurance coverage in Vietnam that was implemented since 2014, with some essential adjustments in the beneficiaries' entitlements. For example, it reduced copayments for near-poor households and eliminated copayments for poor households. Moreover, patients with health insurance can visit any medical facility at the district level without a referral. In addition, a study by Tungu *et al*²⁵ showed that households with health insurance were less likely to delay medical examinations and treatment than households without health insurance. Timely diagnosis and treatment can reduce the healthcare costs for households. Our findings are consistent with those of Thu Thuong *et al*, who found that households more than two-thirds of whose members had health insurance were 0.53 times less likely to suffer CHE than those without health insurance.¹⁵ In addition, the results are in line with those of previous studies by Li *et al*,¹⁴ Falconi and Falconi,²⁴ and Yardim *et al*.²⁶ This finding has signify the important of continuing

the policy of expanding and covering universal health insurance.

The study found that living in rural areas increased the odds of incurring CHE. This can be explained by the fact that rural areas often have higher poverty rates, households with lower affordability and limited access to comprehensive health services. Tran *et al.*²⁷ showed that 20% of the respondents in the mountainous areas of Vietnam are not patronising health facilities care when sick rather go for the option of self-treatment. This may cause a worsened disease condition, while the medical examinations and treatment capacities of rural health facilities are still limited. As a result, patients often have to rely on provincial or central hospitals in urban areas which have higher costs for treatment (direct and indirect). This study supports the findings of previous studies (eg, Yazdi-Feyzabadi *et al.*,²³ Van Minh *et al.*¹¹ and Jacobs *et al.*)²⁸

Another risk factor for CHE found by the study is the frequency of using outpatient or inpatient services. Health insurance coverage in areas was very high. However, in the absence of a referral, health insurance enrollees still pay 40% of the inpatient's examination and treatment costs at a provincial hospital and 60% at the central hospital. Payment can be at 100% if outpatient care was used. There are other additional costs such as expenses for travel, meals, expenses associated with a relative to accompany and provide care, opportunity costs related to the number of days not working, and informal costs. These results reflect those of Ahmed *et al.*,²⁹ who also found that households in the Mekong Delta region of Vietnam with hospitalised members, were about 1.24 times more likely to incur CHE than their counterparts. In addition, our results are in agreement with those obtained by Ir *et al.*³⁰ and Yazdi-Feyzabadi *et al.*²³

Using health services at private health facilities has a higher risk of CHE than using services at public health facilities. This may be due to the limited number of private health facilities that are covered by health insurance in Vietnam. Public health facilities often receive great support from the state budget, while private health facilities often operate on capital contributed by shareholders with the goal of maximising profits. Hence, the patient's OOP costs are usually higher. Beogo's study in Africa showed that the cost of drugs when visiting a private health facility was 50% higher, consultation fees were 100% higher and the total medical expenditure was about 1.7 times higher than in public health facilities.³¹ Similarly, Thuan's study in Vietnam shows that the average cost of healthcare in private health facilities is 4.1 times higher than that in public health facilities.³² Our findings are in line with those of previous studies by Thu Thuong *et al.*¹⁵ and Ahmed *et al.*²⁹

In addition, the study results show a direct relationship between the employment status of the head of the household and CHE, such that employed heads of the households are less likely to suffer CHE than unemployed household heads. This result may be explained by the fact that employed

household heads have higher incomes, which translate into the increased in the household capacity to pay. This result is consistent with the findings of Thu Thuong *et al.*¹⁵ and Proaño Falconi and Bernabé.²⁴ In addition, the higher age of the household head and the presence of older people in a household increased the odds of suffering CHE. A possible explanation for this is that the elderly is more likely to suffer from chronic diseases and have more healthcare needs. A study by Jacobs *et al.*²⁸ showed that the incidence of illness in the elderly was 34.7%, while that in people under 60 years old was 13%. Our findings match those of earlier studies by Barasa *et al.*¹² and Khan *et al.*³³ In addition, the study findings reveals that household head by male were less likely to suffer CHE than female-headed households. A study by Tran *et al.*²⁷ in the mountainous areas of Vietnam showed that women often experience mental health problems and have lower perceived health-related quality of life than men. Vietnamese women are often responsible for taking care of children and families, while those in mountainous areas have to work even harder.

The findings of this study suggest that to achieve Sustainable Development Goals 3.8.2 (financial risk protection) and 3.8.1 (health service coverage), policy-makers should expand social health insurance coverage, especially among voluntary groups such as farmers, fishermen and the near-poor. In addition, increasing inpatient reimbursement, introducing a critical illness insurance programme and different poverty alleviation programmes diminishing the gap between the wealthy and the poor, should be taken into account to decrease CHE.

Since the study was limited to secondary data, it was impossible to control factors associated with the supply side of healthcare services and health risk behaviour. Other limitation of this study include; self-reported conditions, income and healthcare payments. The study also did not consider some informal costs ('under-the-table payment') and implicit costs (loss in wages). Another issue that was not addressed in this study was sensitivity analysis of CHE and impoverishment rate at different thresholds, such as 10% and 25% of the total expenditure, 40% of non-food household expenditure. Additionally, health expenditure can be determined by both services utilisation frequency and unit price. However, detailed information about unit price was not available, we could not separate direct cost (treatment fees, medical and drug costs) and indirect cost (bonus for doctors, service charge for additional drug requirement, medical supplies, transportation costs). Finally, the study failed to stratify CHE and impoverishment incidence among households seeking different levels of healthcare providers and those seeking formal and informal facilities.

CONCLUSIONS

This study measured the prevalence of CHE and impoverishment in the Northern midlands and mountainous areas of Vietnam. The estimation results showed a significant decrease in CHE in 2014–2016, followed by slight increase during 2016–2020. Similar results were observed

when we measured the medical impoverishment rates in the region. The study demonstrated that poor households and households living in rural areas were more vulnerable to CHE than the wealthy and urban households. We found a decrease in the disparities related to the burden of CHE between income groups and geographical locations after the implementation of universal health insurance policy. Health insurance was found to be protective against households from CHE. However, illness status, income, frequency of health service use, age and location were still risk factors for CHE. Therefore, universal health coverage can be achieved through maintaining health insurance coverage, other stronger protective mechanism such as formulating policy that ensure improving the financial status for patients with serious illnesses, strengthening primary healthcare systems with special focus on the prevention of noncommunicable diseases particularly for those residing in a deprived area, developing strategic purchasing services, designing interventions and improving the quality of medical examinations and treatment in disadvantaged areas through mobile health services, retaining health workers that show interest and the capacity to work in rural areas. In addition, strengthened control of non-essential medical services and controlling the revenue balance should be prioritised in the region. Finally, maintaining a culture of effective management and monitoring CHE rates in the region is necessary to enhance the health financing system's ability to protect households from the burden of CHE and impoverishment.

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Collaborators NA.

Contributors NTTT designed the study, extracted, processed and analysed the data, interpreted the results and wrote and approved the final drafts. TQH designed the study and discussed the results. DNTH discussed the research results and critically reviewed the manuscript. All authors engaged in the writing of this paper and have read and approved the final manuscript. All authors approved the final draft. NTTT is the guarantor of the work.

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REFERENCES

- Liu S, Coyte PC, Fu M, *et al*. Measurement and determinants of catastrophic health expenditure among elderly households in China using longitudinal data from the CHARLS. *Int J Equity Health* 2021;20:1–9.
- McIntyre D, Kutzin J. *Health financing country diagnostic: a foundation for national strategy development*. World Health Organization, 2016.
- Xu K, Evans DB, Carrin G, *et al*. *Designing health financing systems to reduce catastrophic health expenditure*. World Health Organization, 2005.
- Wagstaff A, Flores G, Hsu J, *et al*. Progress on catastrophic health spending in 133 countries: a retrospective observational study. *Lancet Glob Health* 2018;6:e169–79.
- Japan International Cooperation Agency (JICA), KRI International Corp. *Basic information survey for basic health service package and provider payment mechanism in Viet Nam*. JICA, 2017.
- World Health Organization and Vietnam Ministry of Health. *Health financing strategy of Vietnam (2016–2025)*. *Who, Moh* 2016.
- General Statistics Office of Viet Nam. *Result of the Vietnam household living standards survey 2018*. Vietnam: Statistical Publishing House, 2019.
- Son NT, Lien NN, Hang PLT. *Health statistic Yearbook*. Ministry of health, 2018.
- Cylus J, Thomson S, Evetovits T. Catastrophic health spending in Europe: equity and policy implications of different calculation methods. *Bull World Health Organ* 2018;96:599–609.
- Xu K. *Distribution of Health Payments and Catastrophic Expenditures. Methodology*. Geneva: WHO, 2005.
- Van Minh H, Kim Phuong NT, Saksena P, *et al*. Financial burden of household out-of-pocket health expenditure in Viet Nam: findings from the National living standard survey 2002–2010. *Soc Sci Med* 2013;96:258–63.
- Barasa EW, Maina T, Ravishankar N. Assessing the impoverishing effects, and factors associated with the incidence of catastrophic health care payments in Kenya. *Int J Equity Health* 2017;16:31.
- Aregbeshola BS, Khan SM. Determinants of catastrophic health expenditure in Nigeria. *Eur J Health Econ* 2018;19:521–32.
- Li Y, Wu Q, Xu L, *et al*. Factors affecting catastrophic health expenditure and impoverishment from medical expenses in China: policy implications of universal health insurance. *Bull World Health Organ* 2012;90:664–71.
- Thu Thuong NT, Van Den Berg Y, Huy TQ, *et al*. Determinants of catastrophic health expenditure in Vietnam. *Int J Health Plann Manage* 2021;36:316–33.
- Thuong NTT. Impact of health insurance on healthcare utilisation patterns in Vietnam: a survey-based analysis with propensity score matching method. *BMJ Open* 2020;10:e040062.
- Akazili J, McIntyre D, Kanmiki EW, *et al*. Assessing the catastrophic effects of out-of-pocket healthcare payments prior to the uptake of a nationwide health insurance scheme in Ghana. *Glob Health Action* 2017;10:1289735.
- Ngcamphalala C, Ataguba JE. An assessment of financial catastrophe and impoverishment from out-of-pocket health care payments in Swaziland. *Glob Health Action* 2018;11:1428473.
- Fernandes Antunes A, Jacobs B, de Groot R, *et al*. Equality in financial access to healthcare in Cambodia from 2004 to 2014. *Health Policy Plan* 2018;33:906–19.
- Tangcharoensathien V, Tisayaitom K, Suphanchaimat R, *et al*. Financial risk protection of Thailand's universal health coverage: results from series of national household surveys between 1996 and 2015. *Int J Equity Health* 2020;19:163.
- Ghimire M, Ayer R, Kondo M. Cumulative incidence, distribution, and determinants of catastrophic health expenditure in Nepal: results from the living standards survey. *Int J Equity Health* 2018;17:1–12.



- 22 Kumara AS, Samaratunge R. Patterns and determinants of out-of-pocket health care expenditure in Sri Lanka: evidence from household surveys. *Health Policy Plan* 2016;31:970–83.
- 23 Yazdi-Feyzabadi V, Bahrampour M, Rashidian A, *et al.* Prevalence and intensity of catastrophic health care expenditures in Iran from 2008 to 2015: a study on Iranian household income and expenditure survey. *Int J Equity Health* 2018;17:44.
- 24 Falconi DP, Bernabé E. Determinants of catastrophic healthcare expenditure in Peru. *Int J Health Econ Manag* 2018;18:425–36.
- 25 Tungu M, Amani PJ, Hurtig A-K, *et al.* Does health insurance contribute to improved utilization of health care services for the elderly in rural Tanzania? A cross-sectional study. *Glob Health Action* 2020;13:1841962.
- 26 Yardim MS, Cilingiroglu N, Yardim N. Catastrophic health expenditure and impoverishment in turkey. *Health Policy* 2010;94:26–33.
- 27 Tran BX, Nguyen LH, Nong VM, *et al.* Health status and health service utilization in remote and mountainous areas in Vietnam. *Health Qual Life Outcomes* 2016;14:85.
- 28 Jacobs B, de Groot R, Fernandes Antunes A. Financial access to health care for older people in Cambodia: 10-year trends (2004–14) and determinants of catastrophic health expenses. *Int J Equity Health* 2016;15:94.
- 29 Ahmed S, Szabo S, Nilsen K. Catastrophic healthcare expenditure and impoverishment in tropical deltas: evidence from the Mekong delta region. *Int J Equity Health* 2018;17:1–13.
- 30 Ir P, Jacobs B, Asante AD, *et al.* Exploring the determinants of distress health financing in Cambodia. *Health Policy Plan* 2019;34:i26–37.
- 31 Beogo I, Huang N, Gagnon M-P, *et al.* Out-Of-Pocket expenditure and its determinants in the context of private healthcare sector expansion in sub-Saharan Africa urban cities: evidence from household survey in Ouagadougou, Burkina Faso. *BMC Res Notes* 2016;9:34.
- 32 Thuan NTB, Lofgren C, Lindholm L, *et al.* Choice of healthcare provider following reform in Vietnam. *BMC Health Serv Res* 2008;8:162.
- 33 Khan JAM, Ahmed S, Evans TG. Catastrophic healthcare expenditure and poverty related to out-of-pocket payments for healthcare in Bangladesh—an estimation of financial risk protection of universal health coverage. *Health Policy Plan* 2017;32:1102–10.