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# To what extent did the government investment in health reduce households' catastrophic out-of-pocket health expenditure in the Millennium Development Goals era? A panel data analysis of 71 low- and middle-income countries

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## Abstract

Purpose: The purpose of this study is to analyze the association between the incidence of catastrophic out-of-pocket health expenditure (CHE) and general government health expenditure (GGHE) as a share of gross domestic product (GDP) and out-of-pocket spending (OOPS) as a share of total health expenditure (THE) in low- and middle-income countries (LMICs) during the Millennium Development Goals (MDGs) era.

Methods: We searched the following databases in June 2016: CENTRAL, MEDLINE, EMBASE, and Web of Science for studies to estimate the incidence of CHE and extracted data from articles meeting our selection criteria. GGHE as a share of GDP and OOPS as a share of THE were extracted from the World Health Organization's Global Health Expenditure Database. We fitted linear mixed effects models to estimate the effects on the incidence of CHE associated with the two exposure variables.

Results: We collected 37 articles estimating 142 incidences of CHE in 71 countries. The median incidence of CHE was 4.3%. After adjustments, the decline in the incidence of CHE was significantly associated with an increase in GGHE as a share of GDP (coefficient: −0.207, *p*-value: 0.049, 95% confidence interval (CI): −0.413 to 0.000), but not with a reduction of OOPS as a share of THE. The adjusted effects were not significant for a subgroup analysis based on income levels.

Conclusion: The decline in the incidence of CHE was associated with an incremental change in GGHE as a share of GDP after adjustment in the MDGs era. Further studies with a more balanced panel dataset of the incidence of CHE are needed in the Sustainable Development Goals era.

**Keywords**：catastrophic out-of-pocket health expenditure, Sustainable Development Goals, universal health coverage, health system strengthening, low- and middle-income countries, panel data analysis

## Ⅰ. Introduction

Universal health coverage (UHC) involves countries providing quality essential health services to their entire population equitably without people incurring financial hardship[1)]. The global trend toward UHC has been gradually increasing since 2010, and the attainment of UHC was listed as a critical element in Goal 3 of the Sustainable Development Goals (SDGs) in the 2030 Agenda for Sustainable Development that was adopted in September 2015[2)].

People without financial protection can become impoverished by massive out-of-pocket spending (OOPS) for health care and might be forced to sell assets such as land or livestock. Alternatively, they might avoid seeking care when they fall ill, which could lead to worse health outcomes[3)]. However, the World Health Organization (WHO) pointed out that OOPS remain the primary source of financing health systems in many low- and middle-income countries (LMICs)[1)]. A prepayment scheme enabling the pooling of funds for the purchase of essential

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health services, such as a social health insurance scheme, could reduce dependence on OOPS[4].

The key measure used to track the extent to which OOPS cause financial hardship for people is catastrophic out-of-pocket health expenditure (CHE)[3]. OOPS for health care are deemed *catastrophic* if they exceed a given proportion of total household expenditure or income[5]. The proportion of households facing CHE in a country should be regularly estimated using nationally representative household surveys to measure progress toward UHC[6]. The incidence of CHE has become more important in the SDGs era because it was officially approved as SDG Indicator 3.8.2 in November 2016[7, 8].

Numerous studies prior to the introduction of the SDGs, during the period of the Millennium Development Goals (MDGs), attempted to identify the determinants of CHE. Saksena et al. identified five factors associated with a lower incidence of CHE: 1) household heads with a higher level of education; 2) urban households; 3) households without children or older people; 4) lower OOPS as a share of total health expenditure (THE); and 5) less income inequality across households[9]. There is conflicting evidence on whether the gender of the household head influences the likelihood of experiencing CHE[10-16]. Conflicting results were also reported in relation to the impact of various community-based health insurance schemes[17-22]. Engelgau et al. claimed that non-communicable diseases contributed to higher incidences of CHE than communicable diseases, while Thuan et al. argued a contrary position[23, 24]. Additionally, specific cost components such as higher indirect costs or in-patient care costs were found to increase the risk of CHE[22, 25, 26]. Ukwaja et al. argued that seeking care at private health facilities was more likely to lead to financial catastrophe[13].

United Nations agencies and development partners have been advising LMICs, even more strongly in the SDG era, to channel more government resources into country health systems that enable the entire population to access essential health services. The Abuja Declaration urged member countries in the African Union to allocate at least 15% of their state budget to health systems[27]. Similarly, the World Health Report in 2010 called on LMICs to optimize the share of total government expenditure allocated to health[28]. However, in the MDGs era, it was unknown whether or to what extent increased government spending on health contributed to reducing the incidence of CHE and achieving UHC. Theoretically, it is expected that the incidence of CHE could be reduced if OOPS as a share of THE declines. However, OOPS can be offset by various financing sources, such as voluntary health insurance or general government health expenditure (GGHE). The level of GGHE, particularly its proportion to the size of the country's economy, could be less associated with the incidence of CHE. Thus, there is a need to revisit the questions we identified prior to the SDGs era and obtain additional evidence to inform better policy decisions aimed at achieving UHC, one of the critical SDG targets.

Therefore, the aim of this study is to analyze the association between the incidence of CHE and GGHE as a share of GDP as well as OOPS as a share of THE in LMICs during the MDGs era. Our findings should support policymakers in LMICs in their efforts to protect people from financial catastrophe as a result of accessing essential health care.

## Ⅱ. Methods

### 1. Criteria for selecting studies for this review

The outcome of interest was the proportion of households in a country that incurred CHE in a given year. We included original studies or reviews of original studies that estimated the incidence of CHE in LMICs during the MDGs era between 2000 and 2015. We used the World Bank's classification of income levels to define LMICs[29]. Additionally, we only included studies using nationally representative household surveys or applying appropriate sampling strategies to ensure national-level representativeness[30]. To ensure methodological consistency, we only included studies applying the method

proposed by the WHO in 2005 to estimate the incidence of CHE, which was defined as health-related OOPS that exceed 40% of a household's capacity to pay (i.e., non-subsistence spending) or non-food expenditure[31].

2. Search methods used to identify studies

We searched the following databases: CENTRAL (the Cochrane Library 2016 Issue 11); MEDLINE (1950 to December 2016); EMBASE (1980 to December 2016); Science Citation Index Expanded (1955 to December 2016); Social Sciences Citation Index (1956 to December 2016); Arts & Humanities Citation Index (1975 to December 2016); Current Chemical Reactions (1986 to December 2016); and Index Chemicus (1996 to December 2016). Since there was no medical subject heading (MeSH) term representing CHE, we used two MeSH terms, "Health Expenditures" and "Developing Countries," in conjunction with general terms such as "catastrophic" or "out-of-pocket" when we searched the MEDLINE database. We searched the other databases by entering general terms such as "catastrophic health expenditure" or "catastrophic out-of-pocket health expenditure." The original search was performed in June 2016, and we did not apply any language restrictions. We also attempted to search non-peer-reviewed literature using Google and Google Scholar in December 2016.

3. Data collection and management

We imported all of the retrieved studies using Zotero (version 4.0.29.15, Center for History and New Media, George Mason University) and eliminated duplicates. One author screened all of the references in accordance with our inclusion and exclusion criteria, extracted the incidences of CHE from the included studies, and entered the data into a Microsoft Excel spreadsheet. Since we did not intend to collect data from the respective household surveys and re-calculate the incidence of CHE, we did not contact the authors of the studies. The following variables were entered into the panel dataset: Country name/code; Incidence of CHE; and Year survey conducted. In cases where we observed more than two incidences of CHE in the same country in the same year from different studies, we retained the lowest value to examine the association with the most conservative estimates of the outcome.

4. Identification of exposure and predictors

Our exposures of interest were 1) GGHE as a share of GDP and 2) OOPS as a share of THE. In line with the System of Health Accounts, GGHE was defined as health spending from central to local government budgets and social health insurance funds excluding loans and donations from international agencies and nongovernment organizations. OOPS were defined as direct payments to health-care providers by patients from their primary income or savings at the point of care. We downloaded data from the WHO Global Health Expenditure Database as a Microsoft Excel file in December 2016[32], and then imported the collected data to Stata version 14.2 (StataCorp) and merged them into a single dataset by matching country codes and years. Finally, a longitudinal dataset was created of the incidence of CHE and corresponding covariates in different years for clusters of countries.

5. Statistical analysis

We applied longitudinal data analysis to predict the magnitude of the association between the proportion of households incurring CHE (*CHE*) and GGHE as a share of GDP (*GGHEGDP*) and OOPS as a share of THE (*OOPSTHE*). We developed a two-level linear mixed model of the form

$$\ln CHE_{ij}=\beta_0+\beta_1\times GGHEGDP_{ij}+\beta_2\times OOPSTHE_{ij}+u_j+\varepsilon_{ij},$$

where $CHE_{ij}$ is the outcome variable in year $i$ in country $j$, $GGHEGDP_{ij}$ and $OOPSTHE_{ij}$ are the predictor variables, $\beta_0$ and $u_j$ are the intercepts of the fixed effect and the random effect for countries, respectively, $\beta_1$ and $\beta_2$ are the fixed

coefficient of $GGHEGDP_{ij}$ and $OOPSTHE_{ij}$ adjusting on, respectively, and $\varepsilon_{ij}$ indicates residuals. The outcome variable, $CHE_{ij}$, was transformed by natural logarithm to satisfy the linearity and normality assumptions. The random coefficient for countries was dropped from the model because it was not statistically significant. The restricted maximum likelihood method was used for log-likelihood calculations and the Kenward–Roger method was used to approximate the degrees of freedom of the denominator, as the dataset was relatively small and unbalanced[33]. An autoregressive (AR1) structure was used for residual correlation.

We decided to include the following two covariates in our final model: GGHE as a share of GDP and OOPS as a share of THE. The former indicates the level of general government spending on the health sector relative to the overall size of the economy, while the latter is a proxy for how effectively a country's health financing system prevents people from incurring OOPS when accessing health services. Due to the limited availability of data of the breakdown of GGHE in LMICs, we did not take into account the difference of health systems architecture, for example, whether countries applied for social health insurance or tax-based models to finance essential health services. None of the interaction terms between exposure variables were statistically significant and there was no significant multicollinearity across the variables in the final model.

6. Subgroup analysis

We conducted a subgroup analysis based on the economic status of the included countries. Regarding the economic status, we used the World Bank income levels, which classify countries into four groups depending on annual gross national income per capita, for the respective years. We downloaded Microsoft Excel files from the World Bank's website in December 2016 and merged them with the main dataset[29]. Then, we fitted the data to the same model as described above using Stata version 14.2 (StataCorp) statistical software.

## Ⅲ. Results

1. Search results

Figure 1 shows the literature review process used to select the articles included in our analysis. The original search of the databases identified 334 articles (duplicates excluded). Of these, we excluded 154 articles that did not meet the eligibility criteria after reading the titles and abstracts, leaving 180 articles, and found 15 additional peer- or non-peer-reviewed articles that met the criteria using Google and Google Scholar. Of these 195 articles, we excluded 158 in accordance with the exclusion criteria. Almost 80% of the excluded articles did not have sufficient national-level representativeness to estimate the proportion of households incurring CHE, while the rest of the excluded articles did not use the WHO method. Thus, 37 articles were retained for further analysis (see Table 1).

2. Descriptive statistics

From the 37 selected articles, we extracted 142 observations of the incidence of CHE in 71 LMICs from 2000 to 2015. Table 2 shows the distributions of the observations and countries (i.e., clusters) classified by the

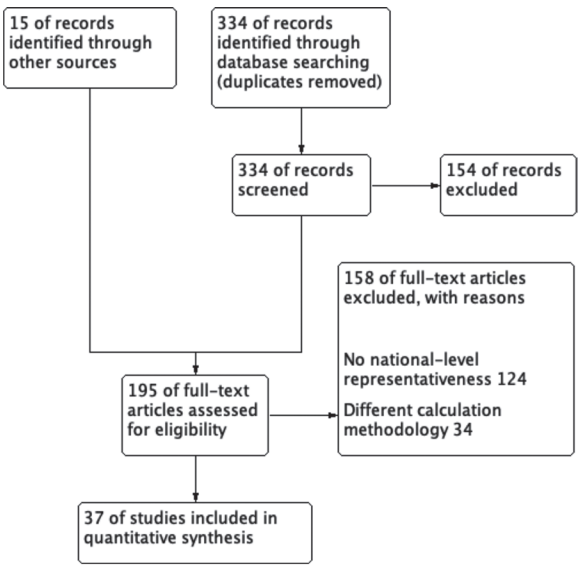


Figure 1　Study flow chart.

Table 1　List of included articles.

| Authors | Year | | Country | Household sample size | Incidence of CHE (%) |
|---|---|---|---|---|---|
| | Surveyed | Publication | | | |
| Abu-Zaineh et al.[39] | 2006 | 2013 | Tunisia | 5,508 | 4.5 |
| Akinkugbe et al.[10] | 2003 | 2012 | Botswana/ Lesotho | 6,882/6,053 | 7/1.25 |
| Boing et al.[40] | 2003/2009 | 2014 | Brazil | 48,470/ 55,970 | 0.7/1.4 |
| Bonu et al.[41] | 2005 | 2007 | India | 124,644 | 5.1 |
| Bowser and Mahal[42] | 2000/2006 | 2010 | Guatemala | N/A | 19.4/17.9 |
| Bredenkamp and Buisman[43] | 2000−2012 | 2016 | Philippines | 38,400-42,094 | 0.5−2.3 |
| Brinda et al.[44] | 2009 | 2014 | Tanzania | 3,265 | 18 |
| Chuma and Maina[45] | 2007 | 2012 | Kenya | 8,414 | 4.6 |
| Dorjdagva et al.[46] | 2012 | 2016 | Mongolia | 12,811 | 1.1 |
| Gotsadze et al.[47] | 2007 | 2009 | Georgia | 2,859 | 11.7 |
| Hoang et al.[48] | 1992−2012 | 2015 | Viet Nam | N/A | 3.9−5.7 |
| Htet et al.[49] | 2003 | 2015 | Myanmar | 6,045 | 0.41 |
| Kimani and Maina[50] | 2003/2007 | 2015 | Kenya | 8,844 | 10.3/11.1 |
| Li et al.[51] | 2008 | 2014 | China | 38,945 | 14.4 |
| Li et al.[52] | 2008 | 2012 | China | 55,556 | 13 |
| Lu et al.[17] | 2006 | 2012 | Rwanda | 6,264 | 8 |
| Masiye et al.[53] | 2014 | 2016 | Zambia | 6,810 | 9.3 |
| Mchenga et al.[54] | 2011 | 2017 | Malawi | 12,271 | 0.73 |
| Minh et al.[55] | 2002−2010 | 2013 | Viet Nam | 9,188-29,530 | 3.9−5.7 |
| Ministry of Health Kenya[56] | 2013 | 2014 | Kenya | 33,675 | 6.2 |
| Ministry of Health Cambodia[57] | 2010−2013 | 2015 | Cambodia | 3,592−3,840 | 4.0−7.1 |
| Narci et al.[58] | 2004−2010 | 2015 | Turkey | N/A | 0.62−0.92 |
| Raban et al.[38] | 2003−2010 | 2013 | India | 9,626-124,644 | 3.5−33.9 |
| Rashad and Sharaf [59] | 2010 | 2015 | Egypt | 10,550 | 6 |
| Rashad and Sharaf [60] | 2000−2011 | 2015 | 3 countries | 3,757−26,500 | 0.3−7.1 |
| Reddy et al.[36] | 2003 | 2013 | 4 countries | 3,993−10,074 | 4.6−18.6 |
| Saksena et al.[61] | 2006 | 2011 | Rwanda | 6,800 | 5.8 |
| Saksena et al.[9] | 2003 | 2010 | 51 countries | N/A | 1.65−33.48 |
| Shahrawat and Rao[62] | 2005 | 2012 | India | 124,644 | 5.1 |
| Somkotra and Lagrada[63] | 2000−2006 | 2009 | Thailand | 22,547−34,843 | 0.77−1.23 |
| van Doorslaer et al.[64] | 2000−2002 | 2007 | 14 countries | N/A | 0.21−7.13 |
| World Health Organization and Word Bank[65] | 2002−2012 | 2015 | 37 countries | N/A | 0.3−10.1 |
| Xu et al.[66] | 2000/2003 | 2006 | Uganda | 10,691/9,710 | 3.15/2.92 |
| Xu et al.[34] | 1991−2000 | 2003 | 59 countries | 2,015−62,946 | 0.00−10.45 |
| Yardim et al.[67] | 2003−2009 | 2014 | Turkey | 8,558−25,764 | 0.48−0.75 |
| Yardim et al.[68] | 2006 | 2010 | Turkey | 8,558 | 0.6 |
| Zoidze et al.[69] | 2007/2010 | 2013 | Georgia | 3,200 | 6.0−8.5 |

Table 2　Distributions of observations and countries for estimated incidences of CHE (2000−2015).

| Characteristics | Observation (*N*=142) | Country (*N*=71) |
|---|---|---|
| | *n* (%) | *n* (%) |
| World Bank Income Group | | |
| Low-income country | 55 (38.7) | 28 (39.4)[a] |
| Lower middle-income country | 61 (43.0) | 29 (40.9)[a] |
| Upper middle-income country | 26 (18.3) | 14 (19.7)[a] |
| World Bank Region | | |
| East Asia & Pacific | 34 (23.9) | 10 (14.1) |
| Europe & Central Asia | 32 (22.5) | 16 (22.5) |
| Latin America & Caribbean | 16 11.3) | 11 (15.5) |
| Middle East & North Africa | 14 (9.9) | 5 (7.0) |
| South Asia | 11 (7.8) | 5 (7.0) |
| Sub-Saharan Africa | 35 (24.7) | 24 (33.8) |
| Number of observations within a country | | |
| 8 | 16 (11.3) | 2 (2.8) |
| 7 | 7 (4.9) | 1 (1.4) |
| 6 | 0 (0.0) | 0 (0.0) |
| 5 | 10 (7.0) | 2 (2.8) |
| 4 | 12 (8.5) | 3 (4.2) |
| 3 | 27 (19.0) | 9 (12.7) |
| 2 | 32 (22.5) | 16 (22.5) |
| 1 | 38 (26.8) | 38 (53.5) |

Abbreviation: CHE, catastrophic out-of-pocket health expenditure.

[a] Number of countries by income status of the year when oldest data was collected.

World Bank's income and geographical categories. More than 80% of the incidences of CHE were observed in low-income or lower-middle-income countries, and more than half of the 71 countries included in our study had only one observation of the estimated incidence of CHE over the 15 years of the MDGs era. Conversely, only three countries reported more than seven incidences of CHE during the study period. Consequently, the final dataset was significantly imbalanced.

Table 3 shows the summary statistics for our outcome and exposure variables. The medians of the incidence of CHE, GGHE as a share of GDP, and OOPS as a share of THE were 4.3%, 2.3%, and 42.8%, respectively. Based on the World Bank income classification, low-income countries suffered the highest median incidence of CHE (6.0%) and median OOPS as a share of THE (53.8%), while they had the lowest median GGHE as a share of GDP (1.9%). Regarding the World Bank geographical regions, South Asia had the highest median incidence of CHE (12.3%), followed by Latin America and Caribbean and Sub-Saharan Africa. The median GGHE as a share of GDP was lowest in South Asia at 1.0%, followed by Latin America and

Table 3　Summary statistics of the incidence of CHE, GGHE as a % of GDP, and OOPS as a % of THE (2000−2015).

| Characteristics | Incidence of CHE (% of population) | | | GGHE (% of GDP) | | | OOPS (% of THE) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Median | Q3 | Q1 | Median | Q3 | Q1 | Median | Q3 |
| Total | 1.7 | 4.3 | 11.1 | 1.6 | 2.3 | 3.7 | 29.8 | 42.8 | 57.6 |
| World Bank Income Group | | | | | | | | | |
| Low-income countries | 3.1 | 6.0 | 13.4 | 1.3 | 1.9 | 2.5 | 31.9 | 53.8 | 62.3 |
| Lower middle-income countries | 1.1 | 3.8 | 12.2 | 1.8 | 2.3 | 3.7 | 34.8 | 43.0 | 57.2 |
| Upper middle-income countries | 0.7 | 1.8 | 7.4 | 3.0 | 3.9 | 4.7 | 17.4 | 23.3 | 33.3 |
| World Bank Region | | | | | | | | | |
| East Asia & Pacific | 1.8 | 4.3 | 5.7 | 1.4 | 1.6 | 2.3 | 40.4 | 55.2 | 62.3 |
| Europe & Central Asia | 0.8 | 2.7 | 10.5 | 2.8 | 3.9 | 4.8 | 19.8 | 33.1 | 45.7 |
| Latin America & Caribbean | 2.4 | 7.5 | 18.3 | 1.9 | 2.6 | 4.0 | 30.8 | 49.1 | 56.6 |
| Middle East & North Africa | 0.7 | 1.8 | 3.2 | 2.0 | 2.8 | 4.5 | 37.8 | 40.2 | 58.1 |
| South Asia | 3.5 | 12.3 | 23.9 | 1.0 | 1.0 | 1.2 | 58.9 | 63.4 | 65.9 |
| Sub-Sahara Africa | 2.9 | 7.4 | 12.2 | 2.1 | 2.6 | 3.3 | 22.3 | 31.9 | 49.1 |

Abbreviations: CHE, catastrophic health expenditure; GDP, gross domestic product; GGHE, general government health expenditure; OOPS, out-of-pocket spending; Q, quartile; THE, total health expenditure.

Caribbean and Sub-Saharan Africa. The median OOPS as a share of THE was also highest in South Asia at 63.4%.

3. Results of the statistical analysis

Table 4 shows the results of our analysis aimed at estimating the association between the incidence of CHE and GGHE as a share of GDP and OOPS as a share of THE. For GGHE as a share of GDP, the crude effect model (coefficient: −0.333, *p*-value: <0.001, 95% confidence interval (CI): −0.484 to −0.182) and adjusted effect model (coefficient: −0.207, *p*-value: 0.049, 95% CI: −0.413 to 0.000) showed significant declines in the proportion of households incurring CHE associated with an increase in GGHE as a share of GDP. For OOPS as a share of THE, the crude effect model demonstrated a significant increase in the incidence of CHE associated with increased OOPS as a share of THE (coefficient: 0.025, *p*-value: <0.001, 95% CI: 0.013 to 0.037), whereas the adjusted effect model did not show a significant association between the two variables (coefficient: 0.014, *p*-value: 0.083, 95% CI: −0.002 to 0.030).

4. Results of the subgroup analysis

Table 5 shows the results of subgroup analysis wherein we created subsets of the original dataset using the World Bank's income categories and fitted the data to the same models as described above. For GGHE as a share of GDP, only low-income countries (coefficient: −0.412, *p*-value: 0.002, 95% CI: −0.651 to −0.172) showed a significant drop in the incidence of CHE associated with increased GGHE as a share of GDP in the crude effect model. However, the effect in low-income countries (coefficient: −0.185, *p*-value: 0.309, 95%CI: −0.548 to 0.178) was not statistically significant after adjustment. For OOPS as a share of THE, two subgroups, low-income countries (coefficient: 0.026, *p*-value: 0.002, 95% CI: 0.011 to 0.042) and upper-middle-income countries (coefficient: 0.054, *p*-value: 0.033, 95% CI: 0.005 to 0.104), showed a significant increase in the incidence of CHE associated with an increase in OOPS as a share of THE. However, none of the subgroup results were significant after the adjustment.

## Ⅳ. Discussion

We found 37 articles with 142 point estimates of the incidence of CHE from 2000 to 2015 in 71 LMICs. More than 80% of the data were collected in low-income or lower-middle-income countries. The median incidence of CHE was 4.3%. There was a significant decline in the proportion of households experiencing CHE associated with the incremental increase of GGHE as a share of GDP after adjusting for OOPS as a share of THE. Conversely, the association between the incidence of CHE and OOPS as a share of THE became insignificant after adjusting for GGHE as a share of GDP. We could not find any significant associations after adjustment in

Table 4　Crude and adjusted effects of the incidence of CHE associated with GGHE as a % of GDP and OOPS as a % of THE[a].

| Characteristics | Crude | | | | | Adjusted | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. of Obs (No. of countries) | Coefficient | *p*-value | 95% CI | | No. of Obs (No. of countries) | Coefficient | *p*-value | 95% CI | |
| GGHE as a % of GDP | 138 (69) | −0.333 | ＜0.001 | −0.484 | −0.182 | 138 (69) | −0.207 | 0.049 | −0.413 | 0.000 |
| OOPS as a % of THE | 139 (70) | 0.025 | ＜0.001 | 0.013 | 0.037 | | 0.014 | 0.083 | −0.002 | 0.030 |

Abbreviation: CHE, catastrophic health expenditure; CI, confidence interval; GDP, gross domestic product; GGHE, general government health expenditure; OOPS, out-of-pocket spending; THE, total health expenditure.

[a] The log-transformed incidence of CHE was regressed by accounting countries for a random effect. [b] The covariates included in the model were GGHE as a % of GDP and OOPS as a % of THE.

sub-group analyses by income status.

This study is unique because, based on our literature search, no previous study has attempted a panel data analysis of the incidence of CHE across LMICs over time. Previous studies such as that by Xu et al. used a linear regression model with ordinary least squares without taking into account CHE data collected in different years[34]. A strength of our study is the use of a mixed effects model that should provide more robust variance estimates.

Our findings have policy implications for LMICs trying to reduce the incidence of CHE and move toward UHC. First, the degree of association between the incidence of CHE and GGHE as a share of GDP fell significantly after adjustment by OOPS as a share of THE (see Table 4). As described earlier, OOPS as a share of THE indicates to what extent health financing schemes allow people to access essential health services without incurring OOPS. The decline in the size of the adjusted effect suggests that increasing health spending without strengthening the health financing system will have less impact in terms of reducing the incidence of CHE in LMICs.

Conversely, the association between the incidence of CHE and OOPS as a share of THE became insignificant after adjustment by GGHE as a share of GDP (see Table 4). One limitation in our study was the imbalanced dataset, which could have resulted in inaccurate variance estimations. The majority of LMICs could not calculate incidences of CHE regularly due to the lack of their capacities. Additionally, the co-existence of multiple methods of calculating CHE that were not comparable reduced the number of observations included in our study[35]. Moreover, the number of observations further reduced to 138 for regression analysis since either or both exposure variables were not obtainable and missing in 4 observations in 2 countries. Thus, we believed that it was not conclusive whether health financing reform without increasing funding will reduce the incidence of CHE in LMICs.

Regarding the subgroup analysis, the reduced incidence of CHE was significantly associated with both OOPS as a share of THE and GGHE as a share of GDP in the low-income subgroup but not in other subgroups (see Table 5). This finding suggests that the reduction in the incidence of CHE as a result of increased resource allocation for health care could be more pronounced in low-income countries than in

Table 5　Crude and adjusted effects of the incidence of CHE associated with GGHE as a % of GDP and OOPS as a % of THE by the World Bank Income Group.

| Characteristics | No of Obs (No of countries)[a] | Crude effect[b] | | | | Adjusted effect[b, c] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Coefficient | *p*-value | 95% CI | | Coefficient | *p*-value | 95% CI | |
| Low-income countries | | | | | | | | | |
| GGHE as a % of GDP | 54 (29) | −0.412 | 0.002 | −0.651 | −0.172 | −0.185 | 0.309 | −0.548 | 0.178 |
| OOPS as a % of THE | | 0.026 | 0.002 | 0.011 | 0.042 | 0.019 | 0.107 | −0.004 | 0.042 |
| Lower middle-income countries | | | | | | | | | |
| GGHE as a % of GDP | 58 (32) | −0.173 | 0.269 | −0.486 | 0.141 | −0.150 | 0.44 | −0.542 | 0.242 |
| OOPS as a % of THE | | 0.010 | 0.424 | −0.014 | 0.034 | 0.003 | 0.844 | −0.027 | 0.033 |
| Upper middle-income countries | | | | | | | | | |
| GGHE as a % of GDP | 26 (17) | −0.356 | 0.11 | −0.799 | 0.087 | −0.110 | 0.678 | −0.658 | 0.437 |
| OOPS as a % of THE | | 0.054 | 0.033 | 0.005 | 0.104 | 0.046 | 0.142 | −0.017 | 0.109 |

Abbreviations: CHE, catastrophic health expenditure; CI, confidence interval; GDP, gross domestic product; GGHE, general government health expenditure; NA, not available; OOPS, out-of-pocket spending; THE, total health expenditure.

[a] The total number of countries exceeded 71 since some countries transitioned income statuses, which observations were split into more than two subgroups. [b] The log-transformed incidence of CHE was regressed by accounting countries for a random effect. [c] The covariates included in the model were GGHE as a % of GDP and OOPS as a % of THE.

affluent countries. However, none of the estimates were significant after adjustment, suggesting the need for more research with a balanced panel dataset, as noted earlier. Similarly, more research is required to clarify whether an increased allocation of funding for health care or health financing reform could reduce the incidence of CHE in middle-income countries.

Regarding the descriptive statistics, the highest median incidence of CHE in conjunction with the median OOPS as a share of THE and the lowest median GGHE as a share of GDP was observed in low-income countries in South Asia (see Table 3). These findings are consistent because at the time when the incidences of CHE were originally estimated, most countries in this region were in the low-income group. These results confirmed that low-income countries suffered from the highest incidence of financial catastrophe as a result of inadequate health spending and systems to protect people from CHE.

There are some further limitations regarding the internal validity of the dataset we used. First, we were unable to obtain the household surveys used in these studies to recalculate the incidence of CHE. We sometimes found multiple articles presenting slightly different values of the incidence of CHE for the same countries and years, even though they used the same surveys and calculation methodology[9, 36]. This may imply some inconsistency between the original researchers' methods. Although we made every effort to check for methodological consistency across studies, we had no choice but to accept the analyses performed by the original researchers.

In addition, the design of the survey instruments may have affected the estimates of the incidence of CHE. Lu et al. found that fewer questions in a household survey resulted in a lower estimate of average health expenditure, while a shorter recall period yielded a higher estimate[37]. One study from India reported multiple values of the incidence of CHE estimated using different surveys conducted in the same year[38]. However, there was no consensus on the appropriate number of survey items and recall period, and thus we are unable to determine which survey design elicited the most unbiased estimate of health expenditure. Our study included all of the original studies regardless of which household surveys were used to enable us to obtain an adequate number of observations and avoid random errors.

## Ⅴ. Conclusion

The decline in the incidence of CHE was associated with an incremental change in GGHE as a share of GDP but not in OOPS as a share of THE after adjustment in the MDGs era. Further studies are needed in relation to the SDGs era to re-examine the association between independent and dependent variables with a more balanced panel dataset relating to the incidence of CHE.

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# 破滅的な自己負担保健医療支出を被った家計の頻度と保健医療支出の関係に関する71の低・中所得国を対象としたパネルデータ分析

田中　豪人　　和田　耕治

## 抄　録

目的：ミレニアム開発目標の時代に，低・中所得国における破滅的医療支出を被った家計の割合と保健医療支出についての関係を明らかにする．

方法：混合効果モデルを用いて，文献レビューより抽出した各国の同割合と，公的医療支出（対GDP比）および自己負担医療支出（総医療支出に占める割合）の間で回帰分析を行った．

結果：37の文献から71カ国より142個の観測値を抽出した．破滅的医療支出を被った家計の割合の中央値は4.3%だった．調整後も同割合は公的医療支出（対GDP比）の増加に伴い有意に低下していたが（係数−0.207，*p*値0.049, 95%信頼区間−0.413−0.000），自己負担医療支出（総医療支出に占める割合）との相関は有意ではなかった．サブグループ解析でも，有意な相関関係は認めなかった．

考察：破滅的医療支出を被った家計の割合と公的保健医療支出（対GDP比）は有意に相関していた．今後はよりバランスしたパネルデータに基づく，破滅的医療支出に関する研究が行われることが期待される．

**キーワード**：破滅的な自己負担医療支出，持続可能な開発目標，ユニバーサル・ヘルス・カバレッジ，保健システム強化，低・中所得国，パネルデータ分析