



# Estimating Catastrophic Health Expenditures from Household Surveys: Evidence from Living Standard Measurement Surveys (LSMS)-Integrated Surveys on Agriculture (ISA) from Sub-Saharan Africa

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## Abstract

**Background** Out of pocket (OOP) payments for healthcare remain a significant health financing challenge in sub-Saharan Africa (SSA). Understanding the drivers and impacts of this financial health burden is both an economic and a public health priority.

**Objective** This study examines how the burden of OOP health expenditures varies with different thresholds for financial catastrophe.

**Methods** The analysis is based on Livings Standards Measurement Surveys (LSMS)-Integrated Surveys on Agriculture (ISA) for five SSA countries—Ethiopia, Malawi, Nigeria, Tanzania, and Uganda. We estimate the degree by which OOP payments as share of total household non-food expenditures exceed either the 15 or 25% threshold.

**Results** For the countries considered, the severity of OOP payments is substantial—the average positive overshoot (beyond the 25% threshold) is above 10%, except for Nigeria. This reflects a higher percentage of OOP in total household health expenditures—compared to taxes and contributions—especially among the poor in these specific countries. Regarding sensitivity of distribution of catastrophic health expenditures, we find that households with low non-food expenditures are more likely to incur catastrophic payments with the exception for Uganda where catastrophic payments increase with the increase of non-food household expenditures.

**Conclusion** The burden of catastrophic health expenditures remains large. In order to reduce this burden, public health expenditures need to be expanded as an alternative. This calls for renewed attention to expand public revenues as the most sustainable methods of financing health expenditures in Africa.

## Key Points for Decision Makers

The burden of catastrophic health expenditures remains large in sub-Saharan Africa.

To reduce this burden, public health expenditures need to be expanded as an alternative.

Public revenues are the most sustainable option for financing health expenditures in Africa, given the level of deprivation on the sub-region.

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**Table 1** Health spending in selected African countries in 2015. Source: [10]

	Distribution of major expenditure category as a share of total health spending				
	Total health expenditure as share of GDP (%)	Domestic public health (%)	Health insurance (%)	Out of pocket (%)	Development assistance (%)
Ethiopia	4.1	33.2	2.6	37.8	26.4
Malawi	9.3	47.3	3.4	10.9	38.4
Nigeria	3.7	18.2	8.6	72.1	1.1
Tanzania	6.1	40.1	8.8	26.2	24.9
Uganda	7.3	27.9	2.4	40.5	29.2
Sub-Saharan Africa	6.2	41.7	11.1	35.3	11.9
Global	8.3	59.2	17.4	22.8	0.6

*GDP* gross domestic product

## 1 Introduction

Catastrophic health expenditures remain a significant health financing challenge in sub-Saharan Africa (SSA) and understanding the drivers and impacts of this financial health burden is both an economic and a public health priority.<sup>1</sup> Estimates by World Health Organization and World Bank [2] show that globally 179 million people (2.6% of the population) incurred catastrophic payments in 2010 exceeding 25% of total income or consumption. Furthermore, whereas per capita health spending in SSA increased at an annualized rate of 3.2% during 1995–2014 period [3], on average 36% of the health expenditures in the region are made through out of pocket (OOP) compared to only 22% for rest of the world [4]. In addition, catastrophic health expenditures have varied widely within SSA—ranging from a very low 1% in Botswana to a high of 25% in Nigeria [1].

Out of pocket (OOP) health expenditures affect households differently depending on whether savings or consumption is used to finance such expenditures. Reduction in consumption to finance health expenditures can be impoverishing if it leads or pushes households further into poverty [2]. In addition, the potential risk of impoverishment may lead to changes in health seek behaviour. Due to unaffordable services, some vulnerable groups may avoid seeking the required health services [5, 6]. Furthermore, there is evidence to show that financing healthcare using OOP payments disproportionately affects poorer households in Ghana, South Africa and Tanzania [7]. Previous studies also show that the share of households spending more than 5% of income on health varies widely in SSA—ranging from 11% in Ghana [8] to 39% in Nigeria [9]. Given that OOP can lead to inequalities, this study contributes to the literature

by examining how the incidence of catastrophic payments differ in countries with different sources of health spending in SSA. Specifically, we examine the following policy question “How much does the burden of OOP payments exceed the threshold for financial catastrophe?”

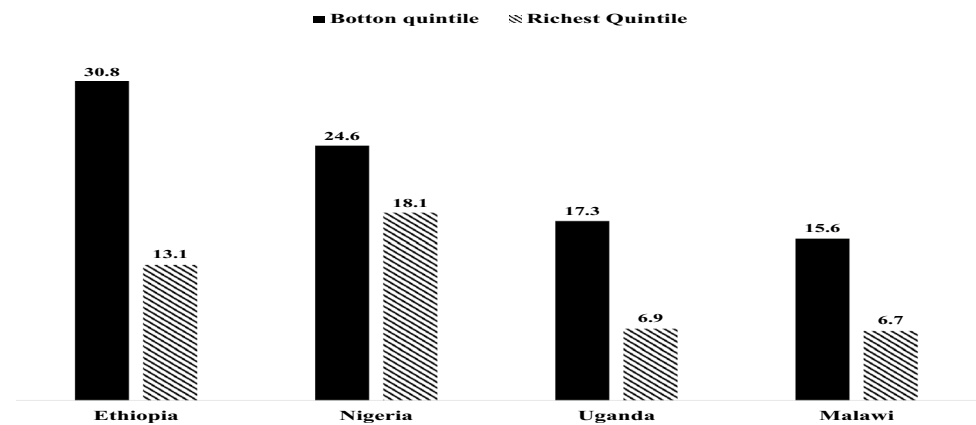
### 1.1 Selected SSA Countries

The study uses the Livings Standards Measurement Surveys (LSMS)-Integrated Surveys on Agriculture (ISA) for five SSA countries—Ethiopia, Malawi, Nigeria, Tanzania, and Uganda. The choice of the five countries is guided both by the availability of comparable data and the variation in the health system financing in the selected countries. Table 1 shows that there are wide variations in the way the 5 selected countries finance their health systems. While Ethiopia’s total health expenditure as share of the gross domestic product (GDP) is only 4.1%, OOP payment accounts for the bulk of health expenditures in the country at 38%. On the other hand, at 9.3% of GDP, Malawi allocates a substantial share of its resources to health—substantially higher than the SSA average of 6.2%. However, a large proportion of the Malawi health resources are contributed by development partners—38%. Furthermore, health insurance coverage in Malawi is extremely low at less than 5%, and those covered by the employer-based insurance are mainly individuals who have attained post-secondary education [11].

Table 1 also shows that Nigeria spends only 3.7% of its GDP on health—the lowest level for all the five countries considered. Indeed, partly due to the lower public spending on health, at least 72% of the total health expenditures in Nigeria are met through OOP payments. As such, the country carries a high risk of catastrophic health expenditures. Since 1999, the country has operated a National Health Insurance Scheme. However, less than 10% of the population is covered by health insurance, predominantly employer-based insurance [12]. Health facilities in Nigeria

<sup>1</sup> According to [1], catastrophic health expenditures are out of pocket payments that exceed a certain threshold e.g. 25% of a household’s non-subsistence income or non-food expenditures.

**Fig. 1** Proportion of individuals who do not seek health care when sick by welfare status (%). Source: Authors calculations from LSMS-ISA surveys for Ethiopia, Nigeria, Uganda and Malawi. No information was collected in Tanzania regarding whether a sick individual did not seek health



charge user fees with a few exemptions for antenatal services piloted in selected states.

At 6.1% of GDP, Tanzania allocates a relatively large share of its resources to healthcare expenditures. Tanzania introduced user fees in public health facilities in 1994 with exemptions for some illnesses and demographic groups (children aged <5 years and adults aged >60 years). Since 2001, the country has operated a National Health Insurance Fund (NHIF), which is funded by mandatory contributions from formal sector employees and voluntary contributions for informal sector workers. At least 9% of adults in Tanzania are covered by health insurance, mainly community-based mutual insurance [13]. On the other hand, most of the health expenditures in Uganda are met privately (Table 1) while <6% of adults are covered by health insurance [14].

Despite the above healthcare expenditures, a substantial proportion of individuals who fall sick may fail to access health services. Estimates based on the LSMS-ISA survey<sup>2</sup> indicate that Ethiopia and Nigeria have the largest proportion of individuals who have not consulted a healthcare provider for illness during the past month – 22% and 21%, respectively. Figure 1 shows that in Ethiopia, individuals from the poorest quintile are disproportionately less likely to seek health services than those in the richest quintile (31 vs 13%). On the other hand, differences between the poorest and richest quintiles in Nigeria are less pronounced.

## 2 Methods

### 2.1 Data

We utilise data from the LSMS-ISA surveys. These are part of a global programme supported by the World Bank to undertake panel surveys and are conducted by national

**Table 2** LSMS-ISA surveys to be used in the analysis. Source: World Bank

	Country	Survey year	Number of households
1	Ethiopia	2015	4954
2	Malawi	2013	4000
3	Nigeria	2013	4536
4	Tanzania	2015	3344
5	Uganda	2015	3285

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statistical agencies.<sup>3</sup> The surveys monitor population, health, and agricultural programmes in developing countries. The surveys are nationally representative and use standardised questionnaires across the different countries. As noted earlier, we use LSMS-ISA surveys from five countries, i.e. Ethiopia, Malawi, Nigeria, Tanzania, and Uganda. All five countries have at least one survey conducted during 2013–2015. The sample size is relatively large, covering more than 3200 households in each survey round. Table 2 shows the coverage of each specific survey used.

All the LSMS-ISA are based on a two-stage cluster sampling design. In the first stage, clusters or enumeration areas (EAs) stratified according to spatial location are the principal sampling unit. The selections of EAs was based on the most recent census as the frame for each country. In the second stage, 10 households are randomly selected from each EA. Each LSMS-ISA survey is composed of at least three questionnaires: the household, agricultural, and community questionnaires. The household questionnaire covers the characteristics of the household, e.g. demographic composition and individual experience of shocks. The household

<sup>2</sup> No information was collected in Tanzania regarding whether a sick individual did not seek health services.

<sup>3</sup> Further details about the conduct of LSMS-ISA surveys can be obtained at <http://surveys.worldbank.org/lsms/programs/integrated-surveys-agriculture-ISA>.

questionnaires have a detailed health module capturing individual experience of illness during the past 30 days prior to the survey. Information captured in the health module includes the nature of illness, type of healthcare provider sought, and the cost of health services if paid for. In addition, the health module captures distance to healthcare provider. Furthermore, ISA surveys capture at the household level, health and medical care expenditures during the past 30 days. This serves as the major indicator of OOP expenditures used in the analysis. Finally, the ISA surveys also contain a detailed community questionnaire with a health facility survey. The facility survey captures services offered at the facility and their corresponding costs.

## 2.2 Estimation Approach

We utilise the framework by Wagstaff and van Doorslaer [15] who examined catastrophic health expenditures in another developing country (Vietnam). In this model, catastrophic expenditures are measured in relation to either total household expenditure or non-discretionary household expenditures (i.e. after accounting for food expenditures). For the present study, we adopt non-food expenditures as our reference for catastrophic health payments.

Healthcare expenditures are considered as catastrophic if they exceed a given threshold. This is formally represented as

$$CTP = \frac{T}{E - F} > z, \quad (1)$$

where CTP is the catastrophic health expenditures,  $T$  is OOP expenditures,  $E$  is total household expenditures,  $F$  are food expenditures and  $Z$  is a set threshold. The incidence of catastrophic health expenditures can be considered within the realm of the standard Foster–Greer–Thorbecke (FGT) class of poverty indexes that incorporate the three most common poverty measures—poverty head count ( $P_0$ ), poverty gap ( $P_1$ ), and the square poverty gap ( $P_2$ ). If we define CTP equal 1 if  $\frac{T_i}{E_i - F_i} > 1$  and zero otherwise, then the head count measure is defined as

$$H = \frac{1}{N} \sum_{i=1}^N CTP_i. \quad (2)$$

The headcount does not reveal the extent to which households exceed a given threshold. To capture the extent to which household exceed the set thresholds, we measure the “catastrophic payment overshoot” and this captures the average degree by which OOP payments as share of total household non-food expenditures exceed the threshold  $Z$ . The overshoot is formally defined as

$$O_i = CTP \left[ \left( \frac{T_i}{E_i - F_i} \right) - Z \right], \quad (3)$$

where  $T_i$  represents the OOP payments of household  $i$ ,  $E_i - F_i$  represents the household non-food consumption expenditure of household  $i$ , and  $Z$  represents the catastrophic threshold selected. The actual estimates of the overshoot are a simple average of the estimate in Eq. (3) defined as

$$O = \frac{1}{N} \sum_{i=1}^N O_i. \quad (4)$$

Following [15] as well as [16], the intensity of catastrophic expenditures is estimated as the average of the catastrophic overshoot over all households that exceed the selected catastrophic threshold. The estimated average is referred to as the mean positive overshoot. Formally, this is defined as

$$MPO = \frac{O}{H}. \quad (16)$$

It is also important to understand how catastrophic payments affect different households based on the status of the welfare distribution. The distribution of the incidence and intensity of catastrophic payments is assessed by estimating concentration indices (CI) for household overshoot ( $O_i$ ) and CTP. Following [15], the CIs are estimated using the covariance between the fractional rank of the household sorted by socio-economic status (consumption expenditures) and the variable of interest. If the corresponding CIs for the catastrophic payments and overshoot are labelled  $C_E$  and  $C_O$  respectively, they can take on values ranging from  $-1$  to  $+1$ . A positive  $C_E$  indicates a greater tendency for the relatively well-to-do households to exceed the selected threshold while a negative index indicates that it is mainly the worse off that exceed these payments. Similarly, a positive value for  $C_O$  indicates that the overshoots are concentrated among richer households. Following Wagstaff et al. [15], in order to take into account the distribution-sensitive aspects of catastrophic payments, both the headcount and overshoot measures are adjusted by multiplying with the corresponding CI. Formally, this is written as:

$$H^W = H(1 - C_E), H_w \langle H \text{ if } C_e \rangle 0 \quad (6)$$

$$O^W = O(1 - C_o), H_w \langle H \text{ if } C_o \rangle 0 \quad (7)$$

## 2.3 Variables Used in the Analysis

*Household health expenditures* are payments for direct healthcare services, such as medicines, consultation fees, hospital/clinic charges, laboratory diagnostic tests, as well as

fees paid to traditional doctors and medicine. These expenditures are obtained from the consumption module of the survey—in particular the section on non-durable goods and frequently purchased services during the last 30 days.

*Non-food household expenditures* These are total household consumption expenditures less expenditures on food, i.e. housing, durable goods, health, education and transportation. This is derived from the consumption module of the LSMS surveys.

*Threshold of catastrophic health expenditures* In the literature, various thresholds are used to capture the severity of catastrophic health expenses—ranging from 10 [17] to 40% [16]. Following World Health Organization and World Bank [2], we adopted the 15% and 25% threshold and defined catastrophic health expenditures as health expenditures that are either 15% or 25% of a household's ability to pay, where ability to pay is measured by non-food household expenditures.

### 3 Results

#### 3.1 Extent and Intensity of Catastrophic Expenditures

Table 3 shows the incidence of catastrophic health payments based on non-food household expenditures. For each country, the table shows the head count and overshoot as well as the corresponding standard errors in addition to the mean overshoot. The overshoot measure captures the severity of catastrophic payments. As mentioned earlier, we examine how the burden of OOP varies between 15% and our adopted threshold of 25%.

Based on the 25% threshold, Table 3 shows that catastrophic expenditures vary widely—ranging from 0.84% in Nigeria to 20.2% in Tanzania.<sup>4</sup> Indeed, Tanzania (22.2%) and Uganda (8.2%) lead in having the highest share of households spending in excess of 25% of their non-food expenditures on healthcare. On the other hand, apart from Nigeria, Malawi is the other country with the lowest level of catastrophic health expenditures (1.57%). The distribution for the estimates of the overshoot mirror those of the headcount, i.e. ranging from 0.08% in Nigeria to 4.23% in Tanzania.

With respect to the intensity of catastrophic payments, Table 3 shows that the mean positive overshoot is remarkably high for some countries—notably Ethiopia, Tanzania, and Uganda—especially at the 25% threshold of the

**Table 3** Incidence and intensity of catastrophic health payments defined with respect to non-food expenditure, different thresholds. Source: Authors calculations from LSMS-ISA surveys

Catastrophic payments measures	Threshold budget share (z)	
	15%	25%
Malawi		
Head count (H)	4.97%	1.57%
Standard error	0.60%	0.31%
Overshoot (O)	0.52%	0.21%
Standard error	0.08%	0.05%
Mean positive overshoot (MPO)	11.04%	13.56%
Nigeria		
Head count (H)	3.06%	0.84%
Standard error	0.38%	0.16%
Overshoot (O)	0.25%	0.08%
Standard error	0.04%	0.02%
Mean positive overshoot (MPO)	8.10%	9.65%
Ethiopia		
Head count (H)	11.45%	5.70%
Standard error	0.85%	0.52%
Overshoot (O)	1.75%	0.94%
Standard error	0.16%	0.11%
Mean positive overshoot (MPO)	15.32%	16.44%
Tanzania		
Head count (H)	32.24%	20.22%
Standard error	1.16%	0.96%
Overshoot (O)	6.78%	4.23%
Standard error	0.38%	0.29%
Mean positive overshoot (MPO)	21.02%	20.91%
Uganda		
Head count (H)	15.63%	8.21%
Standard error	0.80%	0.55%
Overshoot (O)	2.40%	1.27%
Standard error	0.17%	0.12%
Mean positive overshoot (MPO)	15.37%	15.46%

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non-food budgets. Specifically, among those spending more than 25% of their non-food expenditure on OOP payments, the average OOP budget share exceeded this by 15 percentage points in Uganda, 21 percentage points in Tanzania, and 16 percentage points in Ethiopia.

#### 3.2 Inequality in Catastrophic Expenditures

Table 4 examines whether the poorest are more likely to fall into catastrophic payments by estimating distribution-sensitive measures of catastrophic payments using concentration indices. The positive indices indicate that the catastrophic expenditures are made mainly by the rich while

<sup>4</sup> Previous research by [18] based on the Kagera region in Northern Tanzania points to the high burden of disease due to chronic illness as a major driver for catastrophic health expenditures in the country.



**Table 4** Are the poorest more likely to fall into catastrophic health payments? (defined with respect to non-food expenditure), different thresholds. Source: Authors calculations from LSMS-ISA surveys

Catastrophic payments measures	Threshold budget share ( $z$ )	
	15%	25%
<b>Malawi</b>		
Concentration index	- 0.1006	- 0.0104
Rank weighted headcount	5.47%	1.59%
Concentration index	- 0.0177	0.0784
Rank weighted overshoot	0.53%	0.20%
<b>Nigeria</b>		
Concentration index	- 0.2884	- 0.3863
Rank weighted headcount	3.94%	1.16%
Concentration index	- 0.3158	- 0.2891
Rank weighted overshoot	0.33%	0.10%
<b>Ethiopia</b>		
Concentration index	- 0.0508	- 0.0496
Rank weighted headcount	12.17%	6.13%
Concentration index	- 0.0198	- 0.0142
Rank weighted overshoot	1.79%	0.95%
<b>Tanzania</b>		
Concentration Index	- 0.0450	- 0.1004
Rank weighted headcount	33.79%	22.36%
Concentration Index	- 0.0811	- 0.0870
Rank weighted overshoot	7.33%	4.59%
Mean positive overshoot (MPO)	21.02%	20.91%
<b>Uganda</b>		
Concentration index	0.0506	0.0612
Rank weighted headcount	14.83%	7.70%
Concentration index	0.0953	0.1335
Rank weighted overshoot	2.17%	1.10%

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negative measures indicate that it is mainly the poor making catastrophic expenditures. Table 4 shows that CIs are predominantly negative, with one exception for Uganda. For Ethiopia, Malawi, Nigeria, and Tanzania, the results indicate that the households with low non-food expenditures are more likely to incur catastrophic payments. Specifically, for Malawi, at lower thresholds, i.e. below 15% it is the poor making the excessive expenditures while for the 25% threshold, it is mainly the rich making the expenditures. For Nigeria, regardless of threshold, it is the poor that make catastrophic expenditures. For Ethiopia, at both the 15% and 25% thresholds, it is the poor making the expenditures. Similarly, in Tanzania, the poor make most payments. On the other hand, Uganda's measures are all positive indicating that the burden of catastrophic expenditures is borne by the rich.

## 4 Discussion and Conclusions

This study analyses the incidence and intensity of catastrophic health payment in five SSA countries. Generally, the results reflect the extent of private payment for healthcare in the respective countries. Although, healthcare payments in Nigeria are predominantly made OOP (i.e. 72%), households in Nigeria face more pressing expenditures other than health.<sup>5</sup> On the other hand, in Malawi, as the threshold is increases from 15 to 25%, the estimate for the incidence of catastrophic payments reduces from 4.9 to 1.6% and the mean overshoot drops from 0.52 to 0.21% of non-food expenditures. These results suggest that fewer households in Malawi make any healthcare expenditures overall. The low levels of catastrophic expenditures for Malawi is consistent with the context that catastrophic health expenditures are generally low in countries where OOP spending is less than 20% of total health expenses (OPP contributes only 11% of health expenses in Malawi (Table 1).

Furthermore, our empirical results show that the share of the population facing catastrophic health expenditures, based on the 25% threshold, varies from an extremely low 0.84% in Nigeria to higher rates of 22.2% in Tanzania. The counter-intuitive results for Nigeria may be partly explained by dominance of non-health expenditures in the household's non-food budgets and the higher tendency to self-medicate using pharmacies and chemists. Our results also indicate that it is mainly the relatively poor individuals that make catastrophic payments. This suggests that it is primarily the poor that are excluded from the available safety nets such as accessing publicly subsidised health insurance or receiving exclusions from making co-payments. These results have implications for the ability of African countries to achieve SDG 3, especially targets relating to universal health coverage (UHC), including financial risk protection.

The high share of catastrophic expenditures found for Tanzania and Uganda are not unprecedented. Indeed, Brinda et al. [19] find similarly high rates for Tanzania based on 2008/9 survey while Ataguba [20] shows that 17% of households in Nigeria exceed the 40% threshold based on a 2003/4 survey. Also, higher estimates have been registered in other African countries, e.g. Lu et al. [21] for Rwanda and Masiye et al. [22] for Zambia. The high share of OOP payments suggests that even in countries like Tanzania with relatively high health insurance coverage, a substantial proportion of the population is not protected from catastrophic expenses. The higher rates in Tanzania may be partly explained by the fact that public

<sup>5</sup> Specifically, items such as rent, utilities, transportation and education account for a much larger share of Nigerian household budgets compared to health.

health facilities in the country charge user fees. Furthermore, the fact that the country with the highest health insurance coverage rate (Tanzania) also has the highest rate of catastrophic payments, highlights the challenges of reaching the majority who are informal sector workers, especially those with incredibly low education attainment. This, coupled with the fact that user fees exist for certain demographic groups, implies that countries with no universal health insurance coverage but charging user fees do not offer adequate financial protection. As earlier noted, other countries such as Namibia and Liberia show that health insurance is associated with higher OPP expenses [23].

Relatedly, Uganda is the country with the second highest rate of catastrophic expenditures despite abolishing user fees in 2001. For Uganda, the estimated rate of catastrophic payment of 8.2%, based on 2016 data, is higher than rate recorded based on 2003 data of 2.9% [6]. This suggests that abolition of user fees only may not be enough to protect citizens from catastrophic expenses. The results for the distribution-sensitive measures are in line with previous studies such as Mills et al. [7] that show that the poor bear the heaviest burden of catastrophic payments.

Overall, in the current setting characterised by low health insurance coverage, the burden of catastrophic health expenditures remains large. In order to reduce this burden, public health expenditures need to be expanded as an alternative. This calls for renewed attention to expand public revenues as the most sustainable methods of financing health expenditures in Africa.

#### 4.1 Limitations

The study is not without limitations. The datasets used were for the period 2013–2015. Indeed, the study does not consider the recent changes in the health financing landscape in Africa due to 2014–2016 Ebola outbreak and the 2020 COVID-19 pandemic. It is possible that the health financing situation in the considered countries may have changed significantly by 2020. Second, the five countries considered may not be representative of sub-Saharan Africa, but nonetheless these countries capture the diversity in sources of healthcare financing on the continent.

**Author contributions** Sarah Ssewanyana and Ibrahim Kasirye conceived the presented idea. Both authors developed the theoretical framework and performed the computations together, discussed the results, and contributed equally to the final version of the manuscript.

**Data Availability Statement** The datasets used in this study are publicly available from the Living Standards Measurement (LSMS) web site: <http://microdata.worldbank.org/index.php/catalog/lsm>.

## Declarations

**Conflict of interest** The funders were not involved in the study design, data collection or analysis. The decision to publish and the preparation of the manuscript were only the authors' own will. All authors (Sarah Ssewanyana and Ibrahim Kasirye) report no conflicts of interest relevant to this article.

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**Ethics approval, Consent to participate, Consent for publication, Code availability** Not applicable.

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