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RESEARCH PAPER

Does health insurance mitigate the economic impact of negative health outcomes? Evidence from Ghana's National Health Insurance Scheme

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Abstract
In many developing countries, financial risk protection for health is under-developed and negative health outcomes can be impoverishing. In this study, we sought to investigate the impact of negative health outcomes on household welfare and the role of public health insurance in mitigating this impact. We used data from the seventh round of the Ghana Living Standards Survey (GLSS). To address the potentially non-random nature of the health insurance scheme, the Lewbel instrumental variable estimation technique was used. The results suggest that more days of illness lead to fewer hours of labour supply and this result was statistically significant across all specifications. We found evidence of a heterogeneous impact of negative health outcomes through health insurance coverage on hours of labour supply for the full sample. We also find that for rural dwellers and informal sector workers, days of illness reduced labour supply, while the impact was relatively less with health insurance coverage. The findings call for policies that focus on reforming the NHIS to ensure effectiveness and achieve its primary objectives of removing financial barriers to health care in Ghana.

Keywords Health insurance · Health outcomes · Labour supply · Ghana

JEL Classification I13 · I3 · D12

Introduction

There is consistent evidence in the literature that negative health outcomes have significant implications for the affected individual's welfare (Lenhart 2019). Poor health affects income and consumption levels directly, and can also affect them indirectly through labour

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supply decisions and intensity. This is because negative health outcomes are mostly unpredictable and, in some cases, significant proportions of household earnings are used in treatment (Wagstaff et al. 2018). Lindelow and Wagstaff (2005) noted that the devastating impact of illness, for example, on welfare operates through factors such as medical expenditure and loss of income through reduced labour supply. Moreover, the economic burden of negative health outcomes transcends the affected individual and spreads to the entire household, which includes caregivers (Aakvik et al. 2019).

In developing countries, the absence of effective formal health insurance markets exacerbates the economic burden of negative health outcomes. Households are forced to bear the full financial and economic burden of negative health outcomes using diverse coping strategies that may worsen long-term economic well-being. Wagstaff et al. (2018) showed that direct payments for health care may be catastrophic and, in some cases, impoverishing. Their results also suggest that the incidence of impoverishment from direct health payments is profound in developing countries. Other authors have also noted that, within countries, the impact of out-of-pocket (OOP) health payments varies for rural and urban dwellers as well as different demographic groups. For instance, Kadiyala et al. (2011) noted that negative health outcomes can have particularly devastating impacts on rural households. This is because households in rural areas tend to be heavily dependent on labour-intensive agriculture for their livelihoods. Furthermore, negative health outcomes of adult male members of a household, and male household heads are associated with lower non-farm incomes (Beegle 2005; Omar Mahmoud and Thiele 2013).

These negative consequences of OOP have prompted global calls for policies directed towards reducing the economic burden of illness, particularly in resource-constrained settings. For instance, Sustainable Development Goal (SDG) three seeks to achieve universal health coverage (UHC) while ensuring financial risk protection for all.[1] In recent years, the achievement of UHC has been the focus of national and international policymakers alike, with three pillars of equity, quality, and protection against financial risk from the use of health care (WHO 2016). In Ghana, health policy reforms have been implemented to mitigate the financial and economic impact of negative health outcomes while pursuing the UHC agenda. These include the National Health Insurance Scheme (NHIS), Community-based Health Planning and Services (CHPS) and a free maternal healthcare programme. These policies sought to, among others, mitigate the financial impact of ill-health on households.

The NHIS seeks to provide financial protection from the cost of health care by pooling mostly public resources. Established in 2004, the NHIS covers about 95% of disease conditions and the benefits package is the same for all subscribers. The scheme is largely tax-financed and the main revenue source is the National Health Insurance Levy (NHIL), a 2.5% value-added tax (VAT) on goods and services. Other revenue sources include 2.5% deductions from formal sector workers' social security contributions, premiums from informal sector workers, donations and internally generated funds. By design, the scheme attempts to address equity by exempting some population groups from paying premiums and/or processing fees. Pregnant women, beneficiaries of the Livelihood Empowerment Against Poverty (LEAP) programme, persons with mental disorders, and indigents (the extremely poor) are exempted from paying both processing fees and premiums, while

[1] https://www.who.int/topics/sustainable-development-goals/targets/en/#:~:text=The%20goals%20within%20a%20goal%3A%20Health%20targets%20for%20SDG%203&text=3.2%20By%202030%2C%20end%20preventable,25%20per%201000%20live%20births.

children under 18 years, the aged (above 70 years), Social Security and National Insurance Trust (SSNIT) contributors, and SSNIT pensioners are required to pay processing fees but not premiums (NHIA 2012; Nsiah-Boateng and Aikins 2018). The registration and renewal fees (processing fees) for the exempt group are GHS8.00 ($1.36) and GHS5.00 ($0.85),[2] respectively. For non-exempt subscribers, a flat rate of GHS15.00 ($2.54) and GHS22.00 ($3.73) is charged for rural and urban dwellers, respectively. Nsiah-Boateng and Aikins (2018) showed that enrolment and renewal were higher for urban dwellers, people under 18 and informal sector workers. In addition to these, Kwarteng et al. (2020) noted that individuals with higher education and socioeconomic status are relatively more likely to enrol in the scheme. More recently, Novignon et al. (2021) showed evidence of economic inequalities in enrolment even among the exempt population.

The introduction of the NHIS was a major deviation from the then "cash and carry" system where patients were required to pay out-of-pocket for services (Kipo-Sunyehzi et al. 2019). However, not everyone is covered under the scheme even though it was designed as a mandatory scheme. About 40% of the population (about 12 million people) is currently covered.[3] In addition, the scheme covers medical expenses for a vast range of health conditions (over 95% of disease conditions that afflict the population),[4] which means that patients must pay out-of-pocket for treatments that are not covered. Moreover, since benefits only include medical bills, other indirect costs of ill health, such as loss of income and reduction in hours of labour supply due to hospital visits remain a burden to the individual and household at large. This suggests that the gains from enrolling in the scheme may vary across individuals. In this study, we examine how the scheme mitigates the economic impact of suffering a negative health condition.

In line with the recent policy focus on UHC, there has been growing literature on the impact of various health insurance schemes. Fortunately, several systematic reviews from Africa and Asia have also attempted to synthesise existing studies. The evidence so far suggests that insured individuals pay relatively less for health care (Okoroh et al. 2018; Habib et al. 2016), are more likely to utilize health care (Wang et al. 2017; Spaan et al. 2012; Abrokwah et al. 2019), and have better health outcomes (Erlangga et al. 2019). While the evidence on health care utilization and outcomes seems strong, the evidence on OOP appears to be moderate, at best (Erlangga et al. 2019; Prinja et al. 2017). It is worth noting that while a number of these more recent pieces of evidence suggest a strong favourable impact of health insurance, this was not the case in the past. An earlier study by Acharya et al. (2013) showed limited impact of health insurance among the insured in low and middle-income countries. This may be because social insurance schemes were at the early stages of implementation and gains may not have been fully realized. However, the scope of these studies is also limited as they mostly focus on direct impacts on health spending, utilization or outcomes. The indirect impact of health insurance on economic outcomes through its effectiveness in mitigating the burden of negative health outcomes is understudied in the literature. Consequently, we sought to understand how public health insurance uptake mitigates the labour supply impact of negative health outcomes in Ghana. We also disaggregate our analysis to explore the location and sex-related nuances.

While the impact pathways are not straightforward, they can be linked to the income and substitution effect of the trade-off between labour supply and leisure (Chou and Staiger

[2] Official exchange rates from the Bank of Ghana as of November, 2021 were used ($1 = GHS5.9).

[3] http://www.nhis.gov.gh/News/nhis-active-membership-soars-5282.

[4] http://www.nhis.gov.gh/benefits.aspx (accessed 26th June, 2019).

2001). An individual who suffers a negative health outcome is expected to have better financial access to healthcare if they have health insurance coverage compared to individuals without insurance. While the individual with insurance coverage is expected to receive early care (in the absence of financial barriers) and, therefore, reduces illness severity, the decision to resume labour supply depends on the substitution and income effect. With the substitution effect, the absence of cost for treatment makes leisure more affordable to the individual with insurance. The insured individual may also choose to supply more labour to earn more income. We refer to this as the income effect. The net effect, however, will depend on several other factors including sex, place of residence and type of employment. We explore these interactions in our analysis.

Theoretical framework

The study follows a theoretical framework developed by Chetty and Looney (2006) to evaluate the marginal welfare gain from insurance following an income shock (such as a negative health condition). The authors argue that where private insurance markets are ineffective and individuals are risk-averse, social insurance arrangements can yield significant welfare gains. This theoretical proposition deviates from previous studies that generally conclude that the welfare gains from smoothening consumption through social insurance arrangements are insignificant if fluctuations in consumption due to a negative shock are small (Townsend 1995).

Chetty and Looney showed that the marginal welfare gains from $1 of insurance (or, conversely, the marginal welfare cost of an income shock) depend on the size of the consumption fluctuation and the utility value of having a smoother consumption path. For risk-averse individuals, welfare fluctuations decrease with the value of utility derived from consumption smoothening. This means that risk averse individuals, when faced with such choices under uncertainty, are likely to make optimal decisions in a way that reduces their welfare loss (negative economic outcome) in the event of a serious negative health shock. One way to reach such optimal decisions to minimize welfare losses is by taking insurance.

The proposition by Chetty and Looney (2006) is relevant to our study as many developing countries, including Ghana, face largely underdeveloped private insurance markets. In this regard, the presence of a public insurance scheme is expected to have an impact on welfare. Ghana's NHIS is a typical example of a social insurance scheme and, in line with this theory, it can be hypothesized that the scheme will be a relief to risk-averse individuals or households that would otherwise resort to alternative coping strategies to mitigate the impact of negative health outcomes.

Research Methodology: Econometric model and data

To examine the role of health insurance in mitigating the labour supply impact of negative health outcomes, we interacted the health insurance variable (I_i) with the health outcomes variable (h_i) as represented by the term $I_i h_i$ in Eq. (1) where y_i is hours of labour supply and u_i is an error term. β_3 is the coefficient for the interaction term. Equation (1) permits us to test whether the labour supply impact of negative health outcomes is different for the insured and uninsured.

$$\ln y_i = \beta_0 + \beta_1 h_i + \beta_2 I + \beta_3 I_i h_i + \beta_4 x_i + \mu_i \tag{1}$$

Health insurance was coded as 1 if a respondent is enrolled in the NHIS scheme and 0 otherwise. Also, the health status variable was measured as the number of days suffered illness. This captures variations in the severity of illness across respondents. The control variables (x_i in Eq. 1) include the level of education, sex of the individual, rural location, household expenditure, age, marital status, sector of employment and household size. The estimation of Eq. (1) was preceded by a test of the difference in means in labour supply by insurance status, sex and location. Table 8 in the appendix presents a detailed description of all variables used in the analysis.

The study relied on cross-sectional data from the seventh round of the Ghana Living Standards Survey (GLSS 7) conducted by the Ghana Statistical Service. The GLSS is a series of living standards data collected on various socio-economic indicators. The seventh round was conducted between October 2016 and October 2017.[5] The data is nationally and regionally representative with comprehensive information on household income, expenditure, labour supply, health insurance coverage as well as health outcomes. A total sample of 24,762 individuals was used in the analysis with 12,006 (48.5%) males and 12,756 (51.5%) females (Ghana Statistical Service 2019). Sampling for the GLSS 7 followed a two-stage stratified sampling design. In the first stage, enumeration areas were selected to form primary sampling units (PSUs). The PSUs were allocated to administrative regions based on population size. In the second stage, 15 households were systematically selected from each PSU[6] (GSS 2019).

Identification strategy

The nature and design of the NHIS in Ghana raise concerns about potential self-selection bias. While the scheme was designed as a mandatory national scheme, this is not the case in practice. Individuals, unless they are fully exempt, are expected to pay some amount to subscribe to the scheme. This also suggests that coverage under the scheme is not random or exogenous. This is likely to lead to an endogeneity problem arising from self-selection bias. The fact that individuals have to self-select themselves into the insurance scheme suggests that there may be several other unobservable factors that influence the decision to participate. The omission of these unobservable factors means that the insurance variable and the error term may be correlated, creating some bias. The health outcome variable is also a potential source of endogeneity. Apart from the fact that the variable is self-reported and may therefore suffer potential bias, there is a strong feedback effect between health status and labour supply (Swaminathan and Lillard 2000).

Addressing these endogeneity problems requires the use of instrumental variables that are correlated with the endogenous regressors but not with the outcome variable except through the endogenous variables. Finding good instruments is usually difficult, especially when secondary data is used. In the absence of strong external instruments, we relied on the Lewbel instrumental variable technique which is suitable in situations where there are no or weak external instruments (Lewbel 2018). The technique relies on internal instruments and requires that these instruments be correlated with the square of the residuals. Baum et al. (2012) showed that if there is heteroscedasticity in some elements of the

[5] See seventh GLSS report for further details about sampling procedure (Ghana Statistical Service 2019).

[6] Detailed description of the survey design is presented in the survey report (GSS 2019).

Table 1 Descriptive statistics. *Source*: Authors' computation using GLSS 7 Data

Variable	Observations	Mean	Std. Dev.	Min	Max
Total hours worked	24,762	32.0	22.2	0.0	147.0
NHIS coverage (Yes)	24,762	0.5	0.5	0.0	1.0
Number of days ill	24,762	0.8	2.5	0.0	14.0
Sex of individual (Male)	24,762	0.5	0.5	0.0	1.0
In union	23,618	0.5	0.5	0.0	1.0
Age in years	24,762	36.0	16.6	5.0	99.0
Urban location	24,762	0.4	0.5	0.0	1.0
Education					
None	24,762	0.0	0.2	0.0	1.0
Primary	24,762	0.2	0.4	0.0	1.0
Secondary	24,762	0.4	0.5	0.0	1.0
Tertiary	24,762	0.1	0.3	0.0	1.0
Sector of employment (formal)	24,762	0.1	0.3	0.0	1.0
Household size	24,762	5.8	3.7	1.0	31.0
Real total expenditure (per adult equivalent, GHS)	24,762	3686.3	4173.7	48.8	199,643.0

regressors, identification can be achieved. They also confirmed that the higher the scale of heteroscedasticity, the higher the correlation between the generated instruments and the endogenous regressors. In addition to the internal instruments, we included previous NHIS subscription as an external instrument for the NHIS subscription variable. This is justified by the fact that individuals who had ever subscribed to the scheme are likely to be current members. We however tested the validity of all instruments using standard tests including under-identification and weak-identification tests (Stock and Yogo 2005). All test results are reported in the respective regression tables.

Results

Descriptive statistics

Table 1 shows summary statistics of the key variables included in the study. On average, individuals worked for about 32 hours every week. About 50% of the sample had NHIS coverage and the average days of illness was 0.8. The average age in the sample was 36 years with almost equal representation of males and females. A majority of the individuals had completed secondary education (about 40%) and worked in the informal sector (about 90%). Average household size was 5.8 while real household total expenditure per adult equivalent was about GHS3,686 on average.

Table 2 presents mean differences in hours of labour supply across selected variables. The results indicate significant differences in hours of labour supply at the 5% statistical level for all the variables included. Specifically, the results show that individuals with NHIS coverage work less compared to their counterparts without coverage. Individuals who were exposed to illness worked fewer hours compared to those who remained healthy. Male respondents, urban dwellers and formal sector workers worked relatively more hours on average.

Table 2 Test of mean differences in hours of labour supply across selected variables. *Source*: Authors' estimation using GLSS 7 Data

Variable	Mean	Difference (0–1)	N
No NHIS coverage (0)	32.75	1.596*** (0.282)	12,629
	(0.192)		
Covered by NHIS (1)	31.150		12,133
	(0.207)		
Not ill (0)	32.26	1.992*** (0.395)	21,021
	(0.153)		
Ill (1)	30.27		3714
	(0.372)		
Female (0)	29.72	−4.629*** (0.281)	12,756
	(0.190)		
Male (1)	34.35		12,006
	(0.207)		
Rural (0)	29.13	−8.067*** (0.291)	16,047
	(0.171)		
Urban (1)	37.19		8715
	(0.238)		
Informal (0)	31.55	−4.673*** (0.496)	22,574
	(0.150)		
Formal (1)	36.22		2188
	(0.392)		

*** represents significance at the 1% level. Standard errors are reported in parentheses

Effect of negative health outcomes on hours of labour supply

In Tables 3, 4, 5 and 6, we present results on the interactive effect of health insurance and health outcomes on hours of labour supply. Table 3 presents results for the full sample while in Tables 4, 5 and 6, we present disaggregated results by sex, location and sector of employment, respectively. In general, we found that the mitigating effect of health insurance was mixed. While the interaction terms generally showed expected signs, the statistical significance of the coefficients was less widespread and inconsistent.

The findings presented in Table 3 show a negative and statistically significant relationship between negative health outcomes and labour supply. This implies that individuals who experience more days of illness are more likely to work fewer hours. This relationship is consistent in all four estimations, with both the OLS and Lewbel instrumental variable (Lewbel IV) estimators. In the case of NHIS coverage, we found a negative and significant relationship with labour supply. The heterogeneous impact of health insurance observed through the interaction variable shows a positive and statistically significant relationship. Thus, for the full sample, while negative health outcomes reduced hours of labour supplied,

Table 3 Health insurance, health status and labour supply—full sample. *Source*: Authors' estimation using GLSS 7 Data

	Without interaction		With interaction	
	OLS	Lewbel IV	OLS	Lewbel IV
Number of days ill	−0.009***	−0.009**	−0.011***	−0.018***
	(0.002)	(0.004)	(0.003)	(0.004)
Covered by NHIS	−0.023**	−0.124***	−0.027***	−0.138***
	(0.010)	(0.020)	(0.010)	(0.021)
Sick days*Insurance			0.005	0.017***
			(0.004)	(0.006)
Individual characteristics				
Sex of individual	0.105***	0.086***	0.105***	0.086***
	(0.010)	(0.010)	(0.010)	(0.010)
In union	0.166***	0.171***	0.166***	0.172***
	(0.010)	(0.010)	(0.010)	(0.010)
Age of individual	0.005***	0.005***	0.005***	0.005***
	(0.000)	(0.000)	(0.000)	(0.000)
Urban location	0.137***	0.146***	0.137***	0.145***
	(0.011)	(0.012)	(0.011)	(0.012)
Sector of employment (Formal)	0.003	0.014	0.003	0.014
	(0.017)	(0.020)	(0.017)	(0.020)
Education level of individuals				
Primary	−0.022	−0.021	−0.022	−0.021
	(0.015)	(0.015)	(0.015)	(0.015)
Secondary	0.081***	0.088***	0.081***	0.088***
	(0.013)	(0.013)	(0.013)	(0.013)
Tertiary	0.037*	0.054**	0.037*	0.053**
	(0.021)	(0.023)	(0.021)	(0.023)
Household characteristics				
Household size	−0.003**	−0.003**	−0.003**	−0.003**
	(0.002)	(0.002)	(0.002)	(0.002)
Real total expenditure per adult equivalent (log)	0.071***	0.077***	0.071***	0.077***
	(0.008)	(0.008)	(0.008)	(0.008)
Administrative region				
Central	0.003	0.008	0.003	0.009
	(0.022)	(0.022)	(0.022)	(0.022)
Greater Accra	0.180***	0.178***	0.180***	0.178***
	(0.020)	(0.023)	(0.020)	(0.023)
Volta	0.145***	0.158***	0.145***	0.159***
	(0.021)	(0.021)	(0.021)	(0.021)
Eastern	0.009	0.018	0.009	0.017
	(0.023)	(0.021)	(0.023)	(0.021)
Ashanti	0.242***	0.243***	0.241***	0.242***
	(0.019)	(0.021)	(0.019)	(0.021)
Brong Ahafo	0.098***	0.111***	0.098***	0.110***
	(0.021)	(0.021)	(0.021)	(0.021)
Northern	0.130***	0.144***	0.130***	0.143***
	(0.022)	(0.021)	(0.022)	(0.021)
Upper East	0.153***	0.188***	0.152***	0.187***
	(0.023)	(0.023)	(0.023)	(0.023)

Table 3 (continued)

	Without interaction		With interaction	
	OLS	Lewbel IV	OLS	Lewbel IV
Upper West	0.170*** (0.024)	0.212*** (0.025)	0.170*** (0.024)	0.211*** (0.025)
Constant	2.401*** (0.070)	2.386*** (0.067)	2.403*** (0.070)	2.393*** (0.067)
Observations	20,568	20,432	20,568	20,432
R-squares	0.094	0.090	0.094	0.089
Under-identification p value		0.000		0.000
Weak IV test		174.291		116.129

** and *** indicate significance at 5% and 1% levels respectively ($p<0.05$ and $p<0.01$). Values in parentheses are standard errors

we found that being covered by the NHIS mitigates the negative effects of the health shock. This effect is significant at the 5% level of significance.

The results were further disaggregated across rural and urban samples (see Table 4). The disaggregation was necessitated by the fact that households in these locations face different economic conditions, and rural areas in Ghana tend to have relatively less developed health infrastructure compared to urban areas. The results show that in both samples, a higher number of illness days led to a fall in the number of labour hours supplied. The relationship was significant at 5% for both the OLS and Lewbel IV. With regard to the interactive effect, the results showed a positive and significant (at 5% in the rural sample and 10% in the urban sample) effect on labour supply. The findings suggest that individuals exposed to higher illness days and covered by NHIS were likely to work more hours than those without NHIS coverage in both rural and urban communities. The magnitude of the impact was, however, slightly higher in rural areas.

A further disaggregation of the sample by sex (male and female) of respondents, presented in Table 5, indicates that the days of illness affected labour supply for males and females alike. The results showed a negative effect of the number of days ill on labour supply for both males and females. We found that the health insurance variable only had a negative and significant effect on labour supply in the male sample. With regard to the interactive effect, the results show no statistically significant difference in the mitigation effect of health insurance by sex.

In Table 6, we present disaggregated results by sector of employment. The results show that illness days only have an effect on hours of labour supply in the informal sector for the Lewbel IV and OLS estimations, with no statistical significance in the formal sample. This suggests that days of illness are likely to reduce hours of labour supply only in the informal sector. This result holds for both the models with and without the interaction terms. With respect to health insurance, the results show that insurance increases labour supply in the formal sector but reduces labour supply in the informal sector. These are statistically significant in both the OLS and the Lewbel IV estimations and for the models with and without interactions. The positive and significant interaction term shows that the mitigating effect of health insurance is more effective for informal sector workers with a positive and significant coefficient.

Table 4 Health insurance, health status and labour supply—by location. *Source*: Authors' estimation using GLSS 7 Data

	Without interaction				With interaction			
	Rural: OLS	Rural: IV	Urban: OLS	Urban: IV	Rural: OLS	Rural: IV	Urban: OLS	Urban: IV
Number of days ill	−0.009***	−0.009*	−0.007**	0.002	−0.011***	−0.023***	−0.014***	−0.012
	(0.003)	(0.005)	(0.003)	(0.005)	(0.003)	(0.005)	(0.005)	(0.008)
Covered by NHIS	−0.036***	−0.151***	0.008	−0.069**	−0.040***	−0.174***	0.002	−0.077***
	(0.013)	(0.027)	(0.014)	(0.028)	(0.014)	(0.029)	(0.015)	(0.029)
Sick days*Insurance					0.004	0.025***	0.010	0.017*
					(0.005)	(0.007)	(0.007)	(0.010)
Individual characteristics								
Sex of individual	0.127***	0.105***	0.077***	0.064***	0.127***	0.105***	0.077***	0.064***
	(0.013)	(0.014)	(0.015)	(0.015)	(0.013)	(0.014)	(0.015)	(0.015)
In union	0.195***	0.199***	0.120***	0.128***	0.195***	0.199***	0.121***	0.128***
	(0.013)	(0.014)	(0.014)	(0.015)	(0.013)	(0.014)	(0.014)	(0.015)
Age of individual	0.005***	0.005***	0.004***	0.004***	0.005***	0.006***	0.004***	0.004***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Sector of employment (formal)	0.153***	0.168***	−0.076***	−0.069***	0.154***	0.169***	−0.077***	−0.070***
	(0.030)	(0.034)	(0.019)	(0.022)	(0.030)	(0.035)	(0.019)	(0.022)
Education level of individuals								
Primary	−0.044**	−0.043**	0.074***	0.073***	−0.044**	−0.042**	0.074***	0.073***
	(0.018)	(0.018)	(0.028)	(0.026)	(0.018)	(0.018)	(0.028)	(0.026)
Secondary	0.066***	0.074***	0.132***	0.137***	0.066***	0.074***	0.132***	0.136***
	(0.017)	(0.017)	(0.023)	(0.021)	(0.017)	(0.017)	(0.023)	(0.021)
Tertiary	0.005	0.029	0.092***	0.104***	0.004	0.028	0.092***	0.102***
	(0.037)	(0.039)	(0.029)	(0.029)	(0.037)	(0.039)	(0.029)	(0.029)
Household characteristics								
Household size	−0.002	−0.002	−0.010***	−0.008***	−0.002	−0.002	−0.010***	−0.008***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
log Real total expenditure (per adult equivalent)	0.077***	0.082***	0.068***	0.073***	0.076***	0.081***	0.068***	0.074***
	(0.010)	(0.010)	(0.013)	(0.013)	(0.010)	(0.010)	(0.013)	(0.013)

Table 4 (continued)

	Without interaction				With interaction			
	Rural: OLS	Rural: IV	Urban: OLS	Urban: IV	Rural: OLS	Rural: IV	Urban: OLS	Urban: IV
Administrative region								
Central	0.029	0.036	−0.080**	−0.078**	0.029	0.038	−0.080**	−0.077**
	(0.029)	(0.029)	(0.032)	(0.031)	(0.029)	(0.029)	(0.032)	(0.031)
Greater Accra	0.199***	0.207***	0.057**	0.055*	0.199***	0.207***	0.057**	0.055*
	(0.048)	(0.051)	(0.028)	(0.029)	(0.048)	(0.051)	(0.028)	(0.029)
Volta	0.242***	0.258***	−0.063*	−0.060*	0.242***	0.261***	−0.063*	−0.059*
	(0.026)	(0.026)	(0.036)	(0.033)	(0.026)	(0.026)	(0.036)	(0.033)
Eastern	0.093***	0.100***	−0.163***	−0.157***	0.093***	0.099***	−0.164***	−0.156***
	(0.029)	(0.028)	(0.035)	(0.033)	(0.029)	(0.028)	(0.035)	(0.033)
Ashanti	0.254***	0.251***	0.145***	0.152***	0.254***	0.247***	0.145***	0.151***
	(0.028)	(0.031)	(0.027)	(0.030)	(0.028)	(0.031)	(0.027)	(0.030)
Brong Ahafo	0.163***	0.177***	−0.035	−0.024	0.163***	0.175***	−0.035	−0.025
	(0.026)	(0.027)	(0.033)	(0.032)	(0.026)	(0.027)	(0.033)	(0.032)
Northern	0.224***	0.238***	−0.123***	−0.110***	0.224***	0.237***	−0.123***	−0.111***
	(0.027)	(0.027)	(0.039)	(0.036)	(0.027)	(0.027)	(0.039)	(0.036)
Upper East	0.248***	0.287***	−0.091**	−0.069*	0.248***	0.287***	−0.092**	−0.069*
	(0.027)	(0.029)	(0.043)	(0.040)	(0.027)	(0.029)	(0.043)	(0.040)
Upper West	0.234***	0.284***	0.067	0.085*	0.234***	0.284***	0.066	0.084*
	(0.029)	(0.031)	(0.041)	(0.046)	(0.029)	(0.031)	(0.041)	(0.046)
Constant	2.255***	2.253***	2.760***	2.732***	2.257***	2.265***	2.763***	2.735***
	(0.087)	(0.084)	(0.119)	(0.117)	(0.087)	(0.084)	(0.119)	(0.116)
Observations	12,898	12,849	7670	7583	12,898	12,849	7670	7583
R-squares	0.078	0.073	0.078	0.074	0.078	0.071	0.078	0.075
Under-identification p value		0.000		0.000		0.000		0.000
Weak IV test		112.927		73.589		73.138		51.408

*, ** and *** indicate significance at 10%, 5% and 1% levels respectively ($p < 0.1$, $p < 0.05$, $p < 0.01$). Values in parentheses are standard errors

Table 5 Health insurance, health status and labour supply—by gender. *Source*: Authors' estimation using GLSS 7 Data

	Without interaction				With interaction			
	Male: OLS	Male: IV	Female: OLS	Female: IV	Male: OLS	Male: IV	Female: OLS	Female: IV
Number of days ill	−0.012***	−0.019***	−0.006**	−0.002	−0.010***	−0.011***	−0.011**	−0.011**
	(0.003)	(0.005)	(0.003)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)
Covered by NHIS	−0.044***	−0.189***	−0.001	−0.023	−0.042***	−0.139***	−0.008	−0.038
	(0.014)	(0.026)	(0.014)	(0.030)	(0.015)	(0.023)	(0.015)	(0.032)
Sick days*Insurance					−0.004	−0.001	0.008	0.011
					(0.007)	(0.006)	(0.005)	(0.008)
Individual characteristics								
In union	0.202***	0.207***	0.153***	0.156***	0.202***	0.207***	0.153***	0.156***
	(0.015)	(0.016)	(0.014)	(0.014)	(0.015)	(0.016)	(0.014)	(0.014)
Age of individual	0.004***	0.004***	0.006***	0.006***	0.004***	0.004***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)
Urban location	0.119***	0.129***	0.155***	0.158***	0.119***	0.127***	0.155***	0.158***
	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Sector of employment (formal)	−0.042**	−0.027	0.093***	0.097***	−0.042**	−0.031	0.092***	0.097***
	(0.021)	(0.025)	(0.026)	(0.033)	(0.021)	(0.024)	(0.026)	(0.033)
Education level of individuals								
Primary	−0.027	−0.027	−0.018	−0.018	−0.027	−0.028	−0.018	−0.018
	(0.023)	(0.022)	(0.020)	(0.019)	(0.023)	(0.022)	(0.020)	(0.019)
Secondary	0.087***	0.093***	0.077***	0.079***	0.087***	0.090***	0.077***	0.079***
	(0.020)	(0.019)	(0.018)	(0.018)	(0.020)	(0.019)	(0.018)	(0.018)
Tertiary	0.017	0.042	0.066**	0.068*	0.018	0.033	0.066**	0.069*
	(0.029)	(0.030)	(0.031)	(0.037)	(0.029)	(0.030)	(0.031)	(0.037)
Household characteristics								
Household size	−0.006***	−0.005**	−0.000	−0.000	−0.006***	−0.006***	−0.000	−0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
log Real total expenditure (Per adult equivalent)	0.087***	0.096***	0.051***	0.051***	0.088***	0.092***	0.051***	0.052***
	(0.012)	(0.011)	(0.012)	(0.011)	(0.012)	(0.011)	(0.012)	(0.011)

Table 5 (continued)

	Without interaction				With interaction			
	Male: OLS	Male: IV	Female: OLS	Female: IV	Male: OLS	Male: IV	Female: OLS	Female: IV
Administrative region								
Central	−0.039	−0.029	0.045	0.046	−0.039	−0.033	0.044	0.047
	(0.031)	(0.031)	(0.030)	(0.030)	(0.031)	(0.030)	(0.030)	(0.030)
Greater Accra	0.123***	0.117***	0.240***	0.245***	0.123***	0.123***	0.240***	0.242***
	(0.029)	(0.032)	(0.029)	(0.032)	(0.029)	(0.032)	(0.029)	(0.032)
Volta	0.163***	0.183***	0.131***	0.131***	0.163***	0.174***	0.130***	0.133***
	(0.030)	(0.029)	(0.030)	(0.029)	(0.030)	(0.029)	(0.030)	(0.029)
Eastern	−0.009	0.002	0.032	0.035	−0.009	−0.002	0.032	0.035
	(0.032)	(0.030)	(0.032)	(0.030)	(0.032)	(0.030)	(0.032)	(0.030)
Ashanti	0.201***	0.201***	0.286***	0.289***	0.201***	0.203***	0.285***	0.288***
	(0.027)	(0.030)	(0.028)	(0.030)	(0.027)	(0.030)	(0.028)	(0.030)
Brong Ahafo	0.115***	0.129***	0.084***	0.089***	0.116***	0.126***	0.083***	0.088***
	(0.028)	(0.029)	(0.030)	(0.030)	(0.028)	(0.029)	(0.030)	(0.030)
Northern	0.177***	0.192***	0.079**	0.085***	0.178***	0.187***	0.079**	0.086***
	(0.030)	(0.030)	(0.032)	(0.031)	(0.030)	(0.029)	(0.032)	(0.031)
Upper East	0.148***	0.201***	0.154***	0.161***	0.149***	0.183***	0.153***	0.162***
	(0.033)	(0.033)	(0.031)	(0.032)	(0.033)	(0.033)	(0.031)	(0.032)
Upper West	0.189***	0.245***	0.148***	0.162***	0.189***	0.226***	0.148***	0.163***
	(0.033)	(0.034)	(0.034)	(0.036)	(0.033)	(0.034)	(0.034)	(0.036)
Constant	2.450***	2.401***	2.482***	2.485***	2.448***	2.422***	2.486***	2.486***
	(0.100)	(0.093)	(0.099)	(0.095)	(0.100)	(0.093)	(0.098)	(0.095)
Observations	10,112	10,028	10,456	10,404	10,112	10,028	10,456	10,404
R-squares	0.094	0.084	0.089	0.088	0.094	0.090	0.089	0.089
Under-identification p value		0.000		0.000		0.000		0.000
Weak IV test		113.461		75.244		161.652		49.998

** and *** indicate significance at 5% and 1% levels respectively ($p < 0.05$ and $p < 0.01$). Values in parentheses are standard errors

Table 6 Health insurance, health status and labour supply—by sector of employment. *Source*: Authors' estimation using GLSS 7 Data

	Without interaction				With interaction			
	Formal: OLS	Formal: IV	Informal: OLS	Informal: IV	Formal: OLS	Formal: IV	Informal: OLS	Informal: IV
Number of days ill	−0.003	−0.014	−0.009***	−0.008**	0.006	−0.005	−0.012***	−0.019***
	(0.006)	(0.009)	(0.002)	(0.004)	(0.014)	(0.014)	(0.003)	(0.005)
Covered by NHIS	0.081***	0.083*	−0.034***	−0.136***	0.087***	0.082*	−0.038***	−0.152***
	(0.024)	(0.045)	(0.011)	(0.021)	(0.025)	(0.046)	(0.011)	(0.022)
Sick days*Insurance					−0.011	−0.004	0.005	0.018***
					(0.015)	(0.016)	(0.004)	(0.006)
Individual characteristics								
Sex of individual	0.015	0.011	0.118***	0.098***	0.014	0.012	0.118***	0.097***
	(0.023)	(0.025)	(0.011)	(0.011)	(0.023)	(0.025)	(0.011)	(0.011)
In union	0.041	0.037	0.182***	0.187***	0.040	0.037	0.182***	0.187***
	(0.026)	(0.026)	(0.011)	(0.011)	(0.026)	(0.026)	(0.011)	(0.011)
Age of individual	−0.001	−0.001	0.005***	0.005***	−0.001	−0.001	0.005***	0.005***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Urban location	−0.003	−0.006	0.152***	0.162***	−0.002	−0.005	0.152***	0.161***
	(0.025)	(0.025)	(0.012)	(0.013)	(0.025)	(0.025)	(0.012)	(0.013)
Education level of individuals								
Primary	0.090	0.081	−0.015	−0.015	0.092	0.088	−0.015	−0.015
	(0.120)	(0.088)	(0.015)	(0.015)	(0.120)	(0.088)	(0.015)	(0.015)
Secondary	−0.038	−0.044	0.083***	0.090***	−0.036	−0.039	0.083***	0.090***
	(0.067)	(0.058)	(0.014)	(0.014)	(0.067)	(0.058)	(0.014)	(0.014)
Tertiary	−0.090	−0.096	0.078***	0.089***	−0.087	−0.090	0.078***	0.087***
	(0.065)	(0.059)	(0.027)	(0.029)	(0.065)	(0.058)	(0.027)	(0.029)
Household characteristics								
Household size	0.012***	0.013***	−0.004**	−0.004**	0.012***	0.013***	−0.004**	−0.004**
	(0.004)	(0.005)	(0.002)	(0.002)	(0.004)	(0.005)	(0.002)	(0.002)
log Real total expenditure (Per adult equivalent)	0.064***	0.063***	0.074***	0.079***	0.064***	0.064***	0.074***	0.079***
	(0.018)	(0.018)	(0.009)	(0.008)	(0.018)	(0.018)	(0.009)	(0.008)

Table 6 (continued)

	Without interaction				With interaction			
	Formal: OLS	Formal: IV	Informal: OLS	Informal: IV	Formal: OLS	Formal: IV	Informal: OLS	Informal: IV
Administrative region								
Central	−0.136***	−0.123***	0.019	0.023	−0.136***	−0.125***	0.019	0.024
	(0.050)	(0.048)	(0.023)	(0.023)	(0.050)	(0.048)	(0.023)	(0.023)
Greater Accra	0.010	0.006	0.214***	0.211***	0.009	0.006	0.214***	0.210***
	(0.047)	(0.044)	(0.022)	(0.025)	(0.047)	(0.044)	(0.022)	(0.025)
Volta	0.067	0.078	0.162***	0.174***	0.066	0.074	0.162***	0.176***
	(0.049)	(0.050)	(0.023)	(0.022)	(0.049)	(0.050)	(0.023)	(0.022)
Eastern	−0.026	−0.023	0.019	0.027	−0.027	−0.024	0.018	0.026
	(0.048)	(0.050)	(0.024)	(0.023)	(0.048)	(0.050)	(0.024)	(0.023)
Ashanti	0.059	0.057	0.268***	0.268***	0.058	0.057	0.267***	0.266***
	(0.043)	(0.046)	(0.021)	(0.023)	(0.043)	(0.046)	(0.021)	(0.023)
Brong Ahafo	−0.020	−0.015	0.116***	0.129***	−0.021	−0.015	0.116***	0.127***
	(0.049)	(0.052)	(0.022)	(0.023)	(0.049)	(0.052)	(0.022)	(0.023)
Northern	−0.215***	−0.211***	0.166***	0.179***	−0.216***	−0.212***	0.166***	0.179***
	(0.074)	(0.056)	(0.023)	(0.023)	(0.074)	(0.056)	(0.023)	(0.023)
Upper East	−0.080	−0.072	0.181***	0.216***	−0.079	−0.074	0.181***	0.215***
	(0.052)	(0.057)	(0.024)	(0.025)	(0.052)	(0.057)	(0.024)	(0.025)
Upper West	−0.021	−0.020	0.201***	0.244***	−0.022	−0.018	0.200***	0.243***
	(0.048)	(0.055)	(0.026)	(0.027)	(0.048)	(0.055)	(0.026)	(0.027)
Constant	3.028***	3.045***	2.328***	2.317***	3.021***	3.033***	2.331***	2.325***
	(0.172)	(0.175)	(0.076)	(0.071)	(0.171)	(0.175)	(0.076)	(0.071)
Observations	1991	1936	18,577	18,496	1991	1936	18,577	18,496
R-squares	0.041	0.038	0.101	0.096	0.041	0.040	0.101	0.096
Under-identification *p* value		0.000		0.000		0.000		0.000
Weak IV test		20.581		166.337		13.873		109.797

** and *** indicate significance at 5% and 1% levels respectively ($p < 0.05$, $p < 0.01$). Values in parentheses are standard errors

Discussion of results

In general, our results suggest that experiencing a negative health outcome is likely to reduce the number of hours worked. This finding is also consistent with similar findings from previous studies. For example, Nwosu and Woolard (2017) found a negative and significant impact of negative health outcomes on labour force participation in South Africa. Similarly, Jones et al. (2020) found evidence that the incidence of a negative health outcome was associated with a significant reduction in income and labour supply. This relationship meets a priori expectations and is also intuitively appealing. Healthier individuals are generally expected to have better economic outcomes for several reasons, including their relatively greater capacity to engage in productive activities (Cai et al. 2014). As noted by Grossman's (1972) theoretical model on health capital, improved health stock has investment benefits where healthier individuals can work relatively more than their counterparts who suffer a decline in health status and thus can improve their economic outcomes.

The results on the mitigating effect of health insurance suggest that the effect is positive for the full sample, the rural/urban sample and informal sector workers. For males/females and the formal sector, health insurance coverage did not make any difference in mitigating the extent of the reduction in labour supply resulting from ill health. Most rural households in Ghana depend on labour-intensive agriculture for their livelihoods. This is in contrast to urban areas where there are a lot more workers in some form of formal employment where illness-induced absence from work does not necessarily result in loss of income. Formal employees may be granted a day off work or reduced work hours without a commensurate reduction in wages. For a typical farmworker in a rural location, any time lost to illness would likely not be compensated. This finding is consistent with Sparrow et al. (2014), who find that rural dwellers are more likely to face a reduction in consumption in the event of ill health. Concerning the effect for males, the findings of this study that illness days have a stronger effect on labour supply for males are in line with Lenhart (2019) as well as Nwosu and Woolard (2017), who found that the impact of ill health on labour supply and income tends to be greater for males since they usually account for a larger portion of household earnings.

We also found evidence that the NHIS provides some protection for people exposed to relatively higher illness days, even though their statistical significance was limited to the full sample, informal sector workers and rural dwellers. For these groups, health insurance mitigated the impact of the negative health shocks. Indeed, the evidence in the literature is not consistent. While some studies, particularly in sub-Saharan Africa, found statistical significance, others found no impact (Liu 2016; Atake 2018). Evidence from Rwanda suggests that the direct benefits of the community-based health insurance scheme (CBHIS) include a significant reduction in out-of-pocket health payments (Woldemichael et al. 2016). This is expected to indirectly improve welfare as resources can be channelled to other welfare-improving expenditure items and reduce financial pressure. Other researchers have argued that financial protection for health care insulates households when they experience negative health outcomes. Evidence from Ethiopia's CBHIS showed that the scheme reduced the likelihood of borrowing to smoothen consumption in the event of a negative health outcome (Yilma et al. 2015). The statistical significance observed for rural areas may be attributed to the fact that rural workers mostly engage in non-mechanised agriculture which requires more intensive labour. As a result, small changes in health care costs could have a significant mitigating impact on labour supply. Furthermore, while the formal sector has structures that allow employees to work less when ill, the same cannot be said of the informal sector. The lack of alternative support systems in the informal sector means the mitigating effect of NHIS is likely to be significant.

Conversely, evidence from other parts of the world showed that public health insurance may have no significant impact on economic outcomes. For example, Liu (2016) found that household income and consumption were largely unaffected by health shocks, even in the absence of health insurance in China. They did however acknowledge that health insurance helped to maintain households' ability to invest in the education of their children, suggesting that it may be important for reducing reliance on costly smoothing mechanisms in the event of a shock. Indeed, these findings from Liu (2016) are not completely unfounded as our results also indicate that the mitigation effect of health insurance is limited to specific population subgroups.

The findings of our study, therefore, provide indications for the need to improve implementation effectiveness, sustain, and scale up the NHIS. While the NHIS is considered one of the most important reforms in the history of Ghana's health system, its implementation has faced several challenges. Apart from ensuring its effectiveness, policymakers should extend the membership of the scheme, especially to vulnerable populations. It is also important to note that while NHIS coverage provides financial risk protection for healthcare access, it does not provide solutions to challenges regarding physical access. Indeed, this may explain the limited impact on labour supply. Improving healthcare infrastructure to ensure proximity, especially to deprived communities, will help improve the impact of the scheme.

Conclusion

The study set out to examine how health insurance mitigates the impact of negative health outcomes on labour supply. To answer this question, we used data from the seventh round of the GLSS. The Lewbel instrumental variable technique was used to correct for endogeneity problems. The results suggest that illness days had a statistically significant impact on labour supply. However, for individuals with health insurance coverage, hours of work were higher in the face of an illness, relative to individuals without insurance coverage. This relationship was, however, only statistically significant for the full, rural and informal employment samples. The findings support the need for policymakers to consider efforts to sustain and scale up the NHIS in Ghana by addressing the various challenges of the scheme. While we used cross-section data to answer these questions, the study would have benefited from data that randomizes NHIS coverage to account for potential endogeneity in the models. The absence of such data for Ghana limited the scope of analysis. Another limitation of the study was our inability to determine the sequence of events (occurrence of health shock and NHIS subscription). If individuals subscribe to the NHIS because they experience a negative health outcome, this may limit the validity of our interaction analysis. Unfortunately, we are unable to determine this sequence from the data used. Future studies may leverage these limitations to provide further evidence. It will also be interesting to understand how private health insurance mitigates the impacts of negative health outcomes in Ghana. We recommend that future studies consider these dynamics to inform policy on not only the NHIS but also the impact of private health insurance in the Ghanaian economy. These could not be factored in the current study due to limited information on the coverage of private health insurance in the data used.

Appendix

See Tables 7 and 8.

Table 7 First stage results (full sample). *Source*: Authors' estimation using GLSS 7

	Without interaction		With interaction	
	NHIS	Sick days	NHIS	Sick days/NHIS
Ever insured	0.591***	0.116***	0.582***	0.360***
	(0.007)	(0.035)	(0.007)	(0.024)
Individual characteristics				
Sex of individual	−0.077***	−0.169***	−0.076***	−0.146***
	(0.006)	(0.030)	(0.005)	(0.020)
In union	0.017***	−0.094***	0.017***	−0.048**
	(0.006)	(0.031)	(0.006)	(0.021)
Age of individual	0.001***	0.019***	0.001***	0.009***
	(0.000)	(0.001)	(0.000)	(0.001)
Urban location	0.061***	−0.240***	0.058***	−0.055***
	(0.007)	(0.035)	(0.007)	(0.023)
Sector of employment (Formal)	0.057***	−0.043	0.056***	0.004
	(0.012)	(0.059)	(0.012)	(0.039)
Education level of individuals				
Primary	−0.001	−0.001	−0.002	−0.016
	(0.009)	(0.044)	(0.009)	(0.029)
Secondary	0.028***	−0.037	0.028***	0.010
	(0.008)	(0.040)	(0.008)	(0.026)
Tertiary	0.093***	−0.166**	0.092***	0.003
	(0.014)	(0.069)	(0.014)	(0.046)
Household characteristics				
Household size	−0.002*	−0.005	−0.002*	0.002
	(0.001)	(0.005)	(0.001)	(0.003)
log Real total expenditure (Per adult equivalent)	0.024***	0.132***	0.025***	0.087***
	(0.005)	(0.023)	(0.005)	(0.016)
Administrative region				
Central	0.075***	0.133**	0.074***	0.095**
	(0.013)	(0.065)	(0.013)	(0.043)
Greater Accra	−0.027*	−0.292***	−0.027**	−0.178***
	(0.014)	(0.069)	(0.014)	(0.046)
Volta	0.053***	0.517***	0.053***	0.225***
	(0.013)	(0.062)	(0.021)	(0.041)
Eastern	0.033***	0.055	0.032***	0.086**
	(0.013)	(0.064)	(0.013)	(0.043)
Ashanti	−0.043***	−0.378***	−0.041***	−0.166***
	(0.013)	(0.064)	(0.013)	(0.043)
Brong Ahafo	0.009	−0.242***	0.010	−0.066
	(0.012)	(0.064)	(0.013)	(0.042)
Northern	0.067***	0.128**	0.067***	0.137***
	(0.013)	(0.064)	(0.013)	(0.043)
Upper East	0.193***	0.240***	0.191***	0.288***
	(0.014)	(0.067)	(0.014)	(0.045)
Upper West	0.238***	−0.132*	0.236***	0.115***
	(0.015)	(0.072)	(0.014)	(0.048)
Constant	−0.272***	−0.773***	−0.269***	−0.843***
	(0.041)	(0.201)	(0.040)	(0.133)
Observations	20,432	20,432	20,432	20,432

** and *** indicate significance at 5% and 1% level respectively ($p<0.05$ and $p<0.01$). Values in parentheses are standard errors

Table 8 Variable definitions

Variable name	Definition
Hours of work	Total number of hours worked in a month (log)
Sex of individual	Binary (1 = male, 0 = female)
Age of individual	Measured in years
Location	Binary (0 = rural, 1 = urban)
In union	Marital status of the individual (1 = in union, 0 = not in union)
Education	Highest educational attainment of the individual (0 = no education, 1 = primary, 2 = secondary, 3 = tertiary)
Region	Region of residence

Table 9 VIF matrix

	VIF	1/VIF
Number of days ill	1.041	0.960
NHIS coverage	1.123	0.891
Sex	1.094	0.914
In union	1.211	0.826
Age	1.289	0.776
Urban location	1.419	0.705
Formal sector employment	1.528	0.654
Primary education	1.467	0.682
Secondary education	1.925	0.520
Tertiary education	1.974	0.507
Household size	1.407	0.711
Real total expenditure	2.084	0.480
Central region	1.823	0.549
Greater Accra region	1.954	0.512
Volta region	2.007	0.498
Eastern region	1.845	0.542
Ashanti region	1.905	0.525
Brong Ahafo region	1.888	0.530
Northern region	2.37	0.422
Upper East region	1.934	0.517
Upper West region	1.861	0.537
Mean VIF	1.674	

Table 9 presents a VIF matrix of the variables included in the study. Results from the VIF matrix (and a pairwise correlation matrix—not presented here) suggest no multicollinearity since the VIF for each variable is less than 10.

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Declarations

Conflict of interest The authors have no conflicts of interest to declare.

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