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Analysis of Ill-health Burden on Small-holder Agricultural Households' Welfare in Nigeria

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Abstract: This study empirically examined the economic burden of ill-health and the pathway of negative consequences of ill-health disability on small-holder agricultural households' welfare (income and food spending) in Nigeria. The Nigeria's Living Standard Measurement Study - Integrated Survey on Agriculture panel data (2010/11, 2012/13 and 2015/16) were used. Data analysis tools were descriptive statistics, cost of illness approach, and panel data instrumental variable regression model. Agricultural households whose members experienced ill-health disability had high direct and indirect costs of ill-health, with negative welfare consequences on the affected households. Direct costs included the Out of Pocket (OOP) healthcare and other related costs; indirect cost was the cost of lost productive time to the households. The proportion of indirect cost to the average total cost of ill-health was 65%. As a proportion of households' income, estimates of direct cost was about 19%, and indirect cost was 39%. Results revealed that the pathway by which the burden of ill-health disability affected households' welfare is through increased OOP healthcare expenditure and reduction in food budget. This study recommended the expansion of government-funded healthcare insurance to cover small-holder agricultural households and protect them from the direct and indirect burden of ill-health. Recognizing that findings are ceteris paribus, other complementary health financing efforts through the private sector, community-based initiatives and non-profit organizations in form of grants, loans and/or health related social corporate responsibility services are advocated to reduce productive days lost to ill-health and OOP payments which undermine agricultural production and household welfare.

Keywords: Ill-health Burden, Agricultural Households, Welfare, Nigeria

Introduction

The manual nature of agricultural production practices in Nigeria predisposes agricultural workers to work-related stress, diseases, and injuries, which may likely have negative implications on agricultural workers' health and strength. Apart from this, the high prevalence of poverty mostly amongst the agricultural populace has made agricultural workers and their household members in the country vulnerable to disease infections. This disease vulnerability

may probably arise from poor nutrition, poor access to safe drinking water and sanitation, poor housing conditions, occupational-related accidents and injuries, agricultural practices related diseases and poisoning, as well as poor public and health infrastructure especially in rural areas often resulting in ill-health and disability shocks.

An empirical review of evidence from Low and Middle-Income Countries (LMICs) (Russell, 2004; McIntyre et al., 2005; Alam and Mahal, 2014; Onuche et al., 2014) established that individuals or households affected by ill-health shocks often experience some economic burden in the form loss of productive time, and income, reduced agricultural productivity, poor consumption, and OOP medical care expenditure. Loss of income might arise from lost labour time and or reduced labour productivity caused by the ill-health of the household member or from caregiving by a healthy household member to the ill-health-affected household member. On the other hand, ill-health-induced medical care expenditure (either direct or indirect) could cause economic hardship to households in the form of increased healthcare expenditure, reduced work hours and lower income if the method of financing the medical care expenditure is Out of Pocket (OOP). Out of pocket payment system is the most common method of financing healthcare in most LMICs of the world (McIntyre et al., 2005; Alam and Mahal, 2014; Uzochukwu et al., 2015). Despite there are a number of sources of health financing (such as government health insurance, and support from NGOs) in Nigeria, the coverage of government health insurance scheme is still very low, especially among informer workers, of which the farming population is key. This situation often compels them to rely mainly on out-of-pocket funds when faced with health challenges. In Nigeria, OOP healthcare payment occupies about 70 per cent of healthcare finance in the country (Olakunde, 2012; Uzochukwu et al., 2015; Eboh et al., 2016).

Ill-health shocks associated with high costs of medical care may deplete households' savings and assets endowment or even force them to borrow. Household's other income sources such as remittance income could be lost if there was a death of a breadwinner in the family or household due to ill-health, injury, or accident. Agricultural households' overall income (farm, non-farm, and other income sources) determines the household's consumption (food and non-food consumption) expenditure, socio-economic well-being, and in turn, the ability to afford life necessities for a healthy and productive life. The extent to which households can meet the basic life necessities will determine their degree of vulnerability to disease infections.

Consequently, households might adapt to the ill-health shocks and the associated economic burden by changing their consumption and expenditure pattern, time allocation between labour and leisure, borrowing as well as assets and savings depletion (Mock et al., 2003; McIntyre et al., 2005; WHO, 2009; Alam and Mahal, 2014; Sparrow et al., 2014; and Quintussi et al., 2015). Because ill-health shocks take productive time away from work, the household's income is likely to be lost, especially when household's members affected by ill-health are of working-age. Also, the unplanned nature of most curative medical care might force households to reduce the consumption of non-health-related commodities to accommodate the medical care needs of their members affected by ill-health, thus lowering households' food consumption. This is particularly common in low-income households where food expenditure occupies a significant share of the households' expenditure. Also, in situations where the caregiving responsibility for ill-health affected dependant household's members is given to healthy adult household's member, more productive time could be lost, resulting in the reduction in household's income.

Furthermore, as adaptive measures to the burden of ill-health, households might exhaust their savings or sell their assets, which may have serious implication on households' current and future consumption, the standard of living, as well as future health and well-being (Sparrow et al., 2014). Likewise, curative healthcare expenditure financed from borrowing and households' asset depletion might consequently affect the future asset income and poverty and the future health status of household's members. In line with the preceding arguments on the linkages between agriculture, health and welfare of the agricultural workforce, this study, therefore, assessed the economic burden of ill-health on small-holder agricultural households' welfare in

Nigeria. Specifically, we estimated the Cost of Ill-health (COI) to households, assessed the influence of days lost to ill-health on households' total income, food consumption expenditure and OOP healthcare expenditure. The focus on health spending is underscore by the fact that it is the main source of health payment for most households in Nigeria, accounting for approximately 75% of the total expenditure on health based on recent available estimate in 2020 (World Health Organisation Global Health Expenditure Database, 2023). Besides, other sources of health payment such as government health insurance are mostly benefited by government workers at the exclusion of the majority in the informal sectors, the including agricultural households. Ill-health, as used in this study, refers to the report of any form of illness and or injury experienced by agricultural household members which imposed inability on the affected individuals to carry out their usual daily activities for at least one day over the four-week recall period considered by the panel survey. This study's findings will provide useful insights towards mitigating the burden of ill-health on agricultural households' welfare in the country; while also serving as a useful guide for agricultural and health-related policy formulation and implementation to improve the health and welfare of agricultural households in Nigeria.

Literaure Review

Brief context to the study: Nigeria's perspective

The importance of examining the relationship between health spending and human welfare cannot be overemphasised. This is because the extent of human labour productivity depends largely on the sufficiency of inputs of the stock and flow of human health. This is especially important in Nigeria, particularly within the context of agricultural production which rely largely on human physical labour inputs. The impact of ill health is more profound for the agricultural sector because of the labour-intensive nature agricultural production in Nigeria. Loss of man-days of works on the farm due to ill health may the difficult to redeem for most household who reply most on family labour due, among others, to their weak revenue base to hire labour. Besides, other members that should have been available for farm work are usually saddled with the responsibility of care giving for the sick until indisposed is restored to normal health. Although there are health insurance facilities being provided by the government, in the event of illness, the coverage is very limited are mostly utilized by government workers. Most families who are engaged in informal works, including many farm households are excluded and, in most cases, have to fall back on OOP and supports from friends and families, and other social networks when members are sick/ill. The Nigeria's out of pocket expenditure as a share of current health expenditure was at level of 74.7 % in 2020, up from 71.5 % previous year (World Health Organisation Global Health Expenditure Database, 2023). The same source also reveals that domestic general government health expenditure only accounts for approximately 15% of current health expenditure in the country. This is indicative of heavy reliance on OOP expenditure as a means of health financing in Nigeria. Increased OOP health spending can increase households' vulnerability to poverty.

Even though (as mentioned earlier), a few empirical studies have examined impact of health spending (and health related variables) on productivity (GDP) and other welfare outcomes in Nigeria (Isaac et al., 2022; Azuh et al., 2020; Aregbeshola and Khan, 2018; Edeme at al., 2017; Bakare and Olubokun, 2011), there are limited empirical works linking health expenditure (burden) to agricultural households' welfare (income and food spending) in Nigeria. For instance, using data on secondary data from the Harmonized Nigeria Living Standard Survey (HNLSS) of 2009/2010, Aregbeshola and Khan (2018) found that rise in OOP health payments increased poverty incidence (headcount) by 0.8%. OOP was found as the major payment option for healthcare in Yenagoa which substantially exposed higher proportion of households to

catastrophic health expenditure (Adesina and Ogaji (2020), leading often to significant income/wealth loss due to huge expenses on indisposed household member(s). The number of unhealthy days was also found to reduce the technical efficiency of farmers (Isaac et al., 2022). Gbigi et al. (2023) also found a significant negative relationship (correlation) between profit and health expenditure of farmers in the Bayelsa. Etowa et al (2015) established that ill-health (as captured by funeral expenditures) adversely affected households' agricultural productivity in Ughelli South of Nigeria.

Even though there exists a very extensive literature on the economic burden of illness and the consequences of health-related expenditures on household welfare in LMICs and other developing countries (Kitole et al., 2023; Combary and Traore, 2022), not much has been done in relation to the impacts on agricultural households in Nigeria. Available ones are based on cross-sectional studies with a focus limited to certain regions of the country. None have been able to explore the nexus more comprehensively between farm households' welfare and the mre comprehensively explore the nexus between farm households' welfare and economic burden of health in a broader context involving panel data covering the entire country. Apart from Aregbeshola and Khan (2018), who made use of national household data, other available studies linking health spending (and related variables) to household welfare also employed micro (cross-sectional) data, which are unrepresentative at the national level. It is thus imperative and strategic to consider the impacts of ill-health on the agricultural sector in the country. This is very important considering that over 65% of households derive their livelihoods from the agricultural sector and the unique contributory roles to food security and economic growth, among others.

Review of Empirical Literature: Some Stylized Facts

In India, Quintussi et al., (2015) assessed the relative importance and consequences of an ill-health shock to households' welfare using household-level cross-sectional data obtained in 2010 from three districts in northern rural India. They found that health shock ranked second to natural disaster amongst other adverse events (crop failures, livestock disease, death of households' member) which households face. Their results also established the ill-health shock and deaths of household members hurt households' welfare through direct and indirect OOP healthcare spending; with healthcare care expenditure on chronic illnesses accounting for the largest share of overall households' OOP healthcare expenditure.

McIntyre et al., (2005) reviewed empirical studies on economic consequences of illness and payments for healthcare care on households' in LMICs. Their finding established that ill-health experience places significant direct costs such as OOP medical care and other associated expenditure, as well as an indirect economic burden (cost of lost time, reduced productivity and income loss) on households' welfare. Borrowing, asset sale, and lowering of food consumption are the primary forms of coping strategies adopted by affected households to the ill-health shock.

Alam and Mahal (2014) reviewed empirical literature after the year 2000 on the economic consequences on health shocks on LMICs households' OOP healthcare expenditure, labour supply hours and non-healthcare related consumption. Their review confirms that during periods of ill-health, households' in LMICs experience the severe economic burden of high OOP healthcare shocks, loss of productive labour hours and income and inadequate nonmedical consumption insurance.

Sparrow et al., (2014) examined the economic risks associated with the household's experience of ill-health events in Indonesia using fixed effects poison regression econometric estimation approach on the 2003 and 2004 waves of the Indonesian National Household Socio-economic Survey panel datasets. They found that households face economic risks of ill-health events through OOP medical expenses while causing poor rural households to reduce their consumption. Their results proved that ill-health negatively influences wage income and self-

employed business income of the poor and informal as well as non-poor and formal household categories, respectively.

Yilma et al., (2014) investigation of the pathways of ill-health induced household impoverishment in Ethiopia revealed that ill-health significantly increased healthcare expenditure and reduced income via lost labour productivity. Their results also provided evidence of the negative impact of ill-health on households' ability to insure their non-food consumption, against food consumption expenditure.

Using the cost of illness approach, the economic burden of malaria disease to households in Enugu state, Nigeria was examined by Onujekwe et al., (2013) using a cross-sectional random sample of 500 households. They found that over fifty per cent of the respondents reported malaria disease episodes during the recall period and experienced significant economic burden of malaria treatment, with the mode of malaria treatment payment mainly by out of pocket spending. Also, the indirect cost of malaria treatment was higher than the direct cost to households.

Wagstaff (2007) used the 1992/1993 and 1997/1998 waves of Vietnam households' panel data to study the economic consequences of ill-health shocks on households' income, medical and consumption expenditure of rural and urban households. They found that the death of a working-age member significantly lowered urban households earned income; health shock experience influenced households' healthcare spending positively regardless of insurance coverage. However, there was a larger impact of health shock on healthcare spending of uninsured households compared to the insured counterparts.

Mock et al., (2003) studied the economic impacts of households' members' previous year's injuries on overall households' welfare and associated coping strategies in Kumasi city, Ghana. They found that disability from injury had a significant effect on households' welfare indicators such as OOP healthcare expenditure, productive time and income, food production and consumption, especially of the rural sampled households. The reported coping methods employed by the sampled households in response to disability included: borrowing, asset sale and intra-household labour substitution and or allocation.

Gertler and Gruber (2002) studied the impacts of illness (minor and major) experience on households' healthcare expenditure, earnings and food consumption using the Indonesian panel household datasets. According to their results, illness shock had a significantly negative impact on earnings via reduced labour supply hours due to illness; but a smaller similar negative effect on healthcare expenditure. They also found evidence of households' inability to insure their consumption during periods of major illness adequately, however, the households' ability to insure their income loss during periods of illness varies with the nature and severity of the illness.

Methodology

Study Area

The study location is Nigeria in West Africa. Nigeria lies within latitudes 4˚16' and 13˚53' North and longitudes 2˚40' and 14˚41' East, with a landmass of approximately 923, 768 square kilometres. Nigeria shares land borders with the Republic of Benin in the West, Chad and Cameroun in the East, and Niger in the North. Its coast in the South lies on the Gulf of Guinea on the Atlantic Ocean. According to World Bank (2016), Nigeria, being the most populous nation in Africa accounts for about 47 per cent of West Africa's population, had as at 2015 a population estimate of 182.2 million people. The population growth rate of Nigeria is about 2.63 per cent, with a population density of approximately 200.1 people per squared kilometre.

Data for the study

Specifically, this study used the small-holder agricultural household-level datasets drawn from the first two waves of the ongoing LSMS-ISA (Living Standard Measurement Survey-Integrated Study on Agriculture) panel datasets in Nigeria. The panel dataset consists of a sample of about 5000 small-scale farmers and their household members cultivating crops or raising livestock, selected through a two-stage stratified random sampling technique across the 36 states and the Federal Capital Territory of Nigeria. The first stage involved the selection of 500 Enumeration Areas (EAs) based on probability proportional to size (PPS) of the total EAs in each state of the country plus the Federal Capital Tertiary (FCT) and the total households listed in those EAs. In the second stage, ten (10) households from each EA were selected using the random systematic selection approach, resulting in the selection of 5000 agricultural households. This approach involved obtaining the total number of households listed in each EA and then calculating a Sampling Interval (SI) by dividing the total households listed by ten (10). The next step was the generation of a random start 'r' from the table of random numbers, which stands as the first selection. Consecutive selection of households was thereafter obtained by adding the sampling interval to the random start. However, some households dropped out of the sample during the panel survey visits, thereby making the dataset an unbalanced panel dataset. Therefore, the number of sampled agricultural households interviewed in the panel waves used for this study was about 4700. Data was collected by the LSMS-ISA survey using three different questionnaires (household, agriculture, and community questionnaires) from the sampled agricultural household members for each of the panel visit made to the respondents.

The questionnaires were used to elicit information on a wide range of individual, household socio-economic variables, agricultural activities as well as important community variables that could influence the households' livelihood in general. The key variables used in the empirical estimation included the household heads' socio-demographic information, households' size and composition, households' ill-health measures, income sources, food and healthcare expenditure and other household and community-level socio-economic indicators. Every aspect of preliminary and actual data analysis of this study was done with Stata 13 version using multiple techniques. The data preparation and processing procedures carried out prior to this study's actual data analysis included: the selection and keeping of useful variables from each section of the questionnaires; merging data sets containing the selected variables from each sections of the questionnaires together using relevant unique identifiers; collapsing of some variables in the merged data sets to form their corresponding household-level aggregated variables; appending datasets from the panel survey waves together.

Methods of Data Analysis

Instrumental Variable (IV) Regression model was used to analyse the influence of days lost to ill-health on overall households' income, healthcare, and monthly food consumption expenditure. These analyses were carried out, bearing in mind the need to adjust any form of endogeneity issue in ill-health disability days and households' welfare measures that could bias the model's estimation.1 Endogeneity bias could arise either through reverse causality between ill-health days and households' welfare measures or reporting errors in healthcare expenditure and the number of days of ill-health. alth influences households' income production and consumption expenditure and vice versa, as changes in household's members' health status, may inform changes in the intra-household resource allocation. Household's time may be (re)allocated between work and leisure, other households' economic resources may be utilised either to suit the household's current or future consumption needs, which could impact households' earnings, health and non-health related consumption, health, and overall welfare of

[1] The explanatory variables could correlate with μ_i resulting in heterogeneity bias. This will be eliminated through fixed effect estimation method.

households' members. Likewise, improvement or deterioration in health may influence preference or taste for some specific types of food and their quantities, thereby affecting households' level of food consumption. Also, very high curative OOP medical cost may lower food expenditure share in overall households' expenditure.

The households' overall income model is:

$$\ln y_{it} = z'_{it}\beta + \delta h_{it} + \mu_i + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Equation 2 depicts the households' total out of pocket healthcare expenditure model:

$$\ln hexp_{it} = z'_{it}\beta + \delta h_{it} + \alpha wa\_ill_{it} + \mu_i + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

While the model representing households' monthly food consumption expenditure per adult equivalent is:

$$\ln fexp_{it} = z'_{it}\beta + \delta h_{it} + \alpha wa\_ill_{it} + \varphi hsize_{it} + \varsigma \ln y_{it} + \mu_i + \varepsilon_{it} \ldots\ldots\ldots (3)$$

Where i indexes agricultural households and t is the panel wave period. $\ln y$ denotes log of total household income; $\ln hexp$ refers to the log of total household OOP healthcare expenditure; $\ln fexp$, the log of monthly food consumption expenditure per adult equivalent, h is the number of days lost to ill-health by households' members. wa_ill denotes the number of working-age households member affected by ill-health; z is the vector of household head and household-level control variables; $hsize$ denotes the number of household members; μ_i refers to the vector of unobserved household-specific time-invariant effects; ε_{it} time-varying error term denoting unobserved factors that change over time, affecting each of the outcome variables. δ, α, β, φ, and ς are parameters to be estimated from equations 1 to 3.

We used the IV estimation procedure to control endogeneity bias in the specified models using relevant exogenous variables to serve as instruments in predicting ill-health disability days.

The choice of instrumental variables (m) used was based on satisfaction of the instruments' relevance and exogeneity conditions. Instrument relevance condition relates that the chosen instrumental variables be highly correlated with ill-health disability days ($Cov(m, h_{it}) \neq 0$). The exogeneity condition requires that the m variables do not correlate with the unobserved error term in the outcome equations 1 to 3 ($Cov(m, \varepsilon) = 0$). Thus, the IV variables for predicting ill-health disability days are travel time to consult healthcare facility; average distance to the nearest formal healthcare facility from their community; waiting time in minutes before treatment at the consulting medical care facility; households' drinking water source and sanitation facilities; and the number of working-age ill-health affected households' members. Given the large standard errors that characterise estimated parameters of IV model, tests of endogeneity and possibly over identifying restrictions in the outcome models was done to justify the use of this estimation technique against the ordinary least square regression method.

Results and Discussion

Description of Agricultural Households' Socio-economic Characteristics

As presented in table 1, many of the households are headed by older males, with about nine years of formal education, corresponding to primary educational attainment. On average, the households' total income was around N127,000. The monthly food consumption expenditure for an average of 6 members per household was just a little above N7,000. About 25 per cent of the households had members who experienced at least a day of ill-health disability over the four-week recall period, with an average of eight days lost to ill-health; which corresponds to mean OOP healthcare expenditure of about N3,243. About 58 per cent of the households engaged primarily in agriculture-related enterprises as their main source of livelihood. Majority of households are residents of rural areas.

Agricultural Households' Cost of Ill-health Disability

As highlighted by Byford et al., (2000), analysis of the cost of illness, otherwise known as the burden of disease analysis is essential to assess and estimate the direct and indirect costs of ill-health disability to individuals, households, and even to national socio-economic outcomes. Cost of illness analysis helps in determining the magnitude and relative impact of each category of ill-health disability cost to households' members' welfare, while also quantifying the potentially useful economic resources lost and welfare loss experienced by the households due to the ill-health shock. Thus, the cost of illness analyses serves as a useful policy guide to areas where health-related welfare and policy interventions are mostly required. Given this backdrop, we estimated households' direct cost ill-health disability as the OOP and other related healthcare expenditure incurred by the households' members while seeking healthcare. The households' indirect cost of ill-health disability was estimated as the value of lost productive time (days of ill-health experienced by the household member) to the household, which was calculated as the product of ill-health disability days and the community's agricultural average daily wage rate as at the time of the survey. The collected agricultural wage information comprises of daily agricultural wage rate paid to men, women and children labour .

The following assumptions were made to estimate the households' indirect ill-health cost. First, household's members less than ten years of age do not work, so the cost of their lost time to ill-health is zero; although caregiving for the sick households' members in this category may imply on the household's labour time. Second, the daily agricultural wage rate paid to children reflects the wage rate paid to child labour (individuals between 10 and 14 years of age), based on ILO finding, which established that about one-third of African children aged 10 to 14 years are engaged in agricultural work. Based on ILO's work, UNICEF (2006) likewise reported that about 15 million children under the age of 14 in Nigeria are engaged in child labour. Third, the daily agricultural wage rate collected on adult men and women reflects the wage rate for working-age individuals between 15 and 65 years. Fourth, the cost of lost productive time is the cost of days lost to ill-health disability by working-age members and those individuals between 10 and 14 years. Therefore, the cost of lost labour time to each household was calculated as the summation of the value of productive time lost to ill-health disability by working-age men and women and children labour (those between 10 and 14 years of age) within each household.

According to Asenso-Okyere and Dzator (1997), time lost to ill-health by non-working children may not have productive implications. Still, the time spent to care for the sick non-working children by other household adults should be accounted for, as the time could have been utilised for productive activities. Hence, the value of lost productive time to caregiving for children below ten years and adults above 66 years was using average daily agricultural wage rate for women, given the assumption that adult female household members often carry the responsibility of caregiving for the sick household's members. Therefore, the households' cost

of lost time to caregiving was calculated as the product of total days lost to ill-health disability by children and aged members and the average daily wage rate for working-age females.

Table 1. Summary statistics for the socio-economic variables

HOUSEHOLD HEAD'S CHARACTERISTICS	MEAN
Age (years)	50.71 (15.45)
Years of formal education	9.56 (4.78)
Gender	
Male	85%
Female	15%
Other household-level variables	
Household's total income (N)	127,370 (454,555)
Monthly food consumption expenditure (N)	7,233 (6,797)
Household size	6.07 (3.23)
Adult equivalent household size	4.10 (2.16)
Proportion of ill-health disability experience	
Ill-health experienced households	0.26 (0.44)
Households without ill-health experience	0.74 (0.44)
Ill-health disability days	7.88 (7.89)
OOP healthcare expenditure (N)	3,243 (9891)
Other variables	Percentage
Household head's Gender	
Male	85
Female	15
Households' head's level of formal education	
No Formal Education	46.20
Adult or Religious Education	3.15
Primary Education	15.28
Junior Secondary Education	10.48
Senior Secondary Education	10.42
Teachers' or Vocational Training Level	6.56
Tertiary Education	7.91
Sector of major occupation	
Agriculture	58
Non-agriculture	42
Households' size categories	
6 Members or Less	59.33
Between 7 and 12 Members	38.76
13 Members and Above	1.91
Sector of residence	
Rural	88
Urban	12

The results (table 2) indicated that the average number of days lost by households' members to ill-health disability varies across household members' age categories. Household members below 10 years of age lost an average of nine days to ill-health. On average, children between the ages of 10 and 14 years lost six days; working-age men and women lost nine productive days each; members above 66 years lost about 15 days to ill-health disability. This result indicates that aged household members were most affected by ill-health, followed by non-working children and working-age members of the household. Estimates presented in table 2b are the average direct and indirect costs of ill-health disability to households.

Table 2. Summary of average ill-health disability days experienced by household members over the four-week recall period

CATEGORIES OF HOUSEHOLD MEMBERS	NUMBER OF HOUSEHOLDS	AVERAGE DAYS
Non-working children	1080	8.60 (8.59)
Children labour	229	6.49 (6.70)
Working-age men	590	9.73 (9.18)
Working-age women	913	9.12 (8.73)
Aged	370	14.96 (12.85)

As presented in table 3, the average total cost of ill-health disability to households was estimated to be approximately N9,495 (equivalent to $61.3). Consistent with previous empirical evidence, about 65 per cent of this estimated amount represents the cost of lost productive time to ill-health disability by households. At the same time, the remaining proportion was the OOP healthcare expenditure and other related costs of medical care for the ill-health. Empirical evidence from Ghana as reported by Asenso-Okyere and Dzator (1997) found that the opportunity cost of productive time lost to malaria disease accounts for about 64.2 per cent of total cost taking care of malaria episode. Deressa et al., (2007) also found that the value of illness days resulting from malaria disease in Ethiopia to be 72 per cent of the total cost of illness faced by affected households. In Nigeria, Ukwaja et al., (2013) estimated the indirect cost of tuberculosis treatment to be 79 per cent of total tuberculosis patients' treatment cost. Likewise, Onwujekwe et al., (2013) found that the indirect cost of lost productive time due to malaria significantly outweighs the direct cost of malaria treatment in southeast Nigeria.

Table 3. Summary of the average cost of ill-health disability per household over the four-weeks recall period

	INDIRECT COST CATEGORIES		TOTAL INDIRECT COST	DIRECT COST	TOTAL COST OF ILL-HEALTH DISABILITY
	AVERAGE COST OF LOST HOUSEHOLDS' LABOUR TIME TO ILL-HEALTH	AVERAGE COST OF LOST HOUSEHOLDS' LABOUR TIME TO CAREGIVING		OOP HEALTHCARE EXPENDITURE	
Pooled Sample	₦3,186	₦3,066	₦6,252 (65.85)	₦3,243 (34.15)	₦9,495 (100)
Wave One	₦3,045 / $20.1	₦3,379 / $22.38	₦6,424 / $42.54 (64.48)	₦3,539 / $23.44 (35.52)	₦9,963 / $65.98 (100)
Wave Two	₦3,325 / $20.91	₦2,757 / $17.34	₦6,082 / $38.25 (67.09)	₦2,984 / $18.77 (32.91)	₦9,066 / $57.02 (100)

*Note: values in parenthesis are the percentage of each cost category to the total cost of ill-health disability. *** 1$ was equivalent to ₦151 in wave one (2010), while 1$ was equivalent to ₦159 in wave two (2013). Waves 1 and 2 sample size is 4795 and 4697, respectively.*

Estimates of the average indirect cost of ill-health to households by the age of the ill-health affected members are presented in table 4. The average value of ill-health days by children due to caregiving is the highest, followed by the value of productive days lost by working-age women, men, aged, and children labour. The average value of days lost by working-age men and women to ill-health was estimated to be N 1,296 (equivalent to $8.36) and N 1,722 (equivalent to $11.11), respectively. For children below ten years and aged households' members, this value was estimated to be about N 1,990 (equivalent to $12.84) and N 1,076 (equivalent to $6.94) respectively. The average value of days lost to ill-health disability for children labour was the least and was found to be approximately N 167 (equivalent to $1.08).

Furthermore, as a proportion of the average household's income, the direct OOP healthcare expenditure was found to be about 18.7 per cent of households' total income. This estimate goes in line with the finding of McIntyre et al., (2006), which found that the average direct cost of ill-health for households in LMICs is usually a minimum of 10 per cent of total households' income, this may likely stress affected households financially, with a negative consequence on the households' consumption and their overall well-being. The average proportion of households' indirect cost of ill-health disability to households' income was found to be about 39 per cent. This finding also agrees with that of Asenso-Okyere and Dzator (1997) that the proportion of the indirect cost of ill-health to households' income may be as high as three times that of direct cost. The prevalence of OOP system of healthcare financing in formal healthcare facilities in Nigeria may be contributing significantly to the cost of ill-health, especially the indirect costs to the affected households. Thus, as a way to avoid the high OOP medical care cost, households may prefer to get their medical care from informal healthcare facilities or choose to treat their members at home. These forms of treatment are likely not as efficient as that which could have been obtained from formal healthcare facilities; thus, this might result in loss of more productive days to the ill-health.

Table 4. Summary of the average cost of lost time to households due to ill-health disability days experienced by household members over the four-week recall period

NO.	DATA TYPE
Non-working children	1,990 ($12.84)
Children labour	167 ($1.08)
Working-age men	1,296 ($8.36)
Working-age women	1,722 ($11.11)
Aged	1,076 ($6.94)

Notes: values in parenthesis are US Dollar equivalent of the estimated cost of ill-health in naira

Ill-health Effects on Agricultural Households' Income

Two forms of household income models were estimated; one without correcting for endogeneity bias in ill-health disability days (Fixed Effect (FE) or Random Effect (RE) models), while the remaining models adjusted for endogeneity bias in ill-health (FEIV or RE IV model). The essence of these estimations was to determine changes in estimated coefficients of ill-health disability days with and without endogeneity bias correction. The instrumental variables used in the households' IV income model were travel and waiting times in minutes at the consulted healthcare facility. The significance of the robust F statistic associated with the Durbin-Wu Hausman test of endogeneity established the endogeneity of ill-health variable to households'

income model. Hausman FE post estimation test was used to determine whether FE IV or RE IV provides consistent parameter estimates. The Hausman FE test proved the suitability of the RE IV model over the FE IV model.

The results revealed that (table 5), days lost to ill-health disability by households' members have no statistically significant effect on households' total income, even after controlling for the endogeneity bias. This may be partly attributed to the relatively large average households' size, could imply households' labour substitution potential. Households with more members may find it easy to substitute healthy members for the ill-health affected ones, to maintain households' production and income-earning capacity in a manner that days lost to ill-health by some members may not significantly affect overall households' income.

Our finding supports the submission of Alam and Mahal (2014) that there appears to be a mixed and or non-statistical empirical evidence of the impact of ill-health on households' income losses. Besides, the average number of days lost to ill-health disability by the aged and non-working categories of household members is very high. It may not directly affect total households' income, mainly via earned income sources compared to other categories of household members.

Despite this non-significance of ill-health disability days', there is evidence of endogeneity bias in the model as indicated by the increment in the size of ill-health disability days' coefficient from 0.005 from the model without endogeneity bias correction to 0.047 when the model was estimated using IV technique (block one to block two of table 5). Furthermore, the result estimates indicate that households' total income will increase with an increase in household size, households' asset value, and the size of the agricultural plot area cultivated. Also, households whose sector of primary occupation is agriculture was found to have higher households' income than those whose primary occupation is non-agriculturally related. However, the total income of urban agricultural households was found to be statistically significantly lower than that of rural agricultural households.

Table 5. Estimates of households' total ill-health disability days' effects on households' total income

	BLOCK ONE MODEL WITHOUT ENDOGENEITY BIAS CORRECTION IN HOUSEHOLDS' ILL-HEALTH DISABILITY DAYS		BLOCK TWO MODEL WITH ENDOGENEITY BIAS ADJUSTMENT IN HOUSEHOLDS' ILL-HEALTH DISABILITY DAYS.'	
Dependent Variable: Log of total households' income	*RE Model*		*RE IV Model*	
Independent variables	*[a]Coefficient*	*z-value*	*Coefficient*	*z-value*
Household head's Age (years)	-0.001 [ns]	-0.46	-0.0003 [ns]	-0.22
	(0.002)		(0.001)	
Household head's Formal Education (years)	0.003 [ns]	0.39	-0.006 [ns]	-0.58
	(0.01)		(0.01)	
Household head's Gender *(Base category: Female)*				
Male	0.37**	2.21	0.27 [ns]	1.47
	(0.17)		(0.18)	
Households' ill-health disability days	0.01 [ns]	1.40	0.05 [ns]	1.54
	(0.004)		(0.03)	
Household size	0.04**	2.18	0.06***	2.54
	(0.02)		(0.02)	
Number of working-age household members	-0.002 [ns]	-0.08	-0.03 [ns]	-0.68
	(0.03)		(0.04)	
Log of households' asset value	0.19***	5.31	0.23***	4.57
	(0.04)		(0.05)	
Size of agricultural land cultivated	0.04***	5.51	0.04***	4.06
	(0.01)		(0.01)	
Sector of Major Occupation (*Base category: Non-agriculture)*				
Agricultural sector	0.40**	2.10	0.32*	1.82
	(0.19)		(0.17)	
Sector of Residence *(Base category: Rural)*				
Urban	-0.40***	-2.61	-0.34**	-2.11
	(0.15)		(0.161)	
Constant	8.37***	20.99	7.69***	11.30
	(0.40)		(0.68)	
Variance Parameters				
Sigma_u	0.76		1.66	
Sigma_e	1.13		1.19	
Rho	0.32		0.66	
Model's Descriptive				
Within R^2	0.01		0.0001	
Between R^2	0.12		0.09	
Overall R^2	0.11		0.08	
F value				
Probability > F-value				
Wald Chi-square value	137.44		89.80	
Probability > Chi-square	0.00		0.00	
Number of observations	1187		1000	
Number of groups	1026		885	

*Notes: [a] indicates that values in parenthesis are robust standard errors; otherwise, all other values in parenthesis are standard errors. *** Statistically significant at 1% level; ** statistically significant at 5% level; * statistically significant at 10% level*

Ill-health Effects on Agricultural Households' Healthcare Expenditure

Table 6 presents result estimates of the relationship between households' ill-health disability days experienced and other household-level covariates on OOP healthcare expenditure. The statistical significance of the F statistic associated with the Durbin-Wu Hausman test of endogeneity confirms the endogenous nature of households' ill-health disability days to OOP healthcare expenditure model, thus, warranting IV estimation technique. Ill-health. The Chi-square test statistic obtained from the Hausman FE test indicated that the RE IV estimator is consistent and suitable for the model's estimation.

The result estimates show that households' OOP healthcare expenditure increases as the age of the households' head increases, and with the number of working-age ill-health affected household's members. Specifically, the result implies that older household's heads spend more on healthcare for their households' members affected by ill-health. Also, similar to previous research evidence (Gertler and Gruber, 2002; Mock et al., 2003; McIntyre et al., 2005; Wagstaff, 2007; Alam and Mahal, 2014; Sparrow et al., 2014; Yilma et al., 2014; Quintussi et al., 2015), as the number of days of ill-health experienced by households' members' increases, the households' OOP healthcare expenditure increases. Similarly, households' OOP healthcare expenditure will increase as more working-age households' members are affected by ill-health.

Table 6. Estimates of households' ill-health disability days' effects on total healthcare expenditure

	BLOCK ONE MODEL WITHOUT ENDOGENEITY BIAS CORRECTION IN HOUSEHOLDS' ILL-HEALTH DISABILITY DAYS		BLOCK TWO MODEL WITH ENDOGENEITY BIAS ADJUSTMENT IN HOUSEHOLDS' ILL-HEALTH DISABILITY DAYS.'	
Dependent variable: Log of households' healthcare expenditure	*RE Model*		*RE IV Model*	
Independent variables	*[a]Coefficient*	*z-value*	*Coefficient*	*z-value*
Household head's Age (years)	0.002**	2.38	0.002**	2.15
	(0.001)		(0.001)	
Household head's Formal Education (years)	0.02***	2.70	0.01	0.94
	(0.01)		(0.01)	
Household head's Gender *(Base category: Female)*				
Male	-0.01	-0.13	-0.12	-0.68
	(0.09)		(0.175)	
Log of household asset value	-0.003	-0.13	0.01	0.35
	(0.025)		(0.03)	
Ill-health disability days'	0.04***	8.69	0.05***	2.67
	(0.004)		(0.019)	
Number of working-age ill-health disability affected households' members	0.003***	5.23	0.06***	4.21
	(0.001)		(0.001)	
Sector of residence *(Base category: rural)*				
Urban	0.04	0.38	0.21	1.10
	(0.10)		(0.19)	
Constant	6.71***		6.56***	15.23
	(0.26)		(0.43)	
Variance Parameters				
Sigma_u	0.47		4.72	
Sigma_e	1.12		1.14	
Rho	0.15		0.95	
Model's Descriptive				
Within R-squared	0.10		0.09	
Between R-squared	0.08		0.08	
Overall R-squared	0.08		0.08	
Wald Chi-squared value	117.29		28.51	
Probability > Chi-squared	0.00		0.00	
Number of Observations	1583		1415	
Number of groups	1310		1200	

Note: [a] indicates that values in parenthesis are robust standard errors; otherwise, all other values in parenthesis are standard errors. *** Statistically significant at 1% level; ** statistically significant at 5% level; * statistically significant at 10% level.

Ill-health Effects on Agricultural Households' Monthly Food Consumption Expenditure

Food consumption expenditure used in this study is the households' monthly food consumption expenditure scaled per adult equivalent. Given each household's members age, adult equivalence scales are used to determine the contribution of individual households' members' consumption to total households' monthly food consumption expenditure. The adult equivalent scale used in this study was adapted from Glewwe and Twum-Baah (1991). The outcome of the Durbin-Wu Hausman test likewise provided evidence of the endogenous nature of ill-health disability days to households' food consumption expenditure, thus, requiring the estimation of the adult equivalised monthly food consumption expenditure model by IV method.

Ill-health disability days was instrumented with: waiting time and travel time in minutes at the consulted healthcare facility, and the availability of formal healthcare facility within the

sampled household's community. The estimated results indicated that ill-health disability days, although not statistically significant, lowers the households' adult equivalised monthly food consumption expenditure. According to Wagstaff (2007), the ill-health experience caused a reduction in households' food consumption in Vietnam. Despite this, the size of the ill-health coefficient varies across the estimated models (from block one to block two of table 7), further confirming the endogeneity of ill-health disability days in households' monthly food expenditure model. The result also revealed that a high level of formal education attained by households' heads would enhance the households' adult equivalised monthly food consumption expenditure. Our finding relates to that of Quisumbing (2007) and Olarewaju (2015) that per capita food consumption of the household improves as the household head's years of schooling increases. Also, households' income positively influences monthly food consumption expenditure per adult equivalent. The adult equivalised monthly food consumption expenditure of urban households is higher compared to their rural counterparts when faced with ill-health shock. This result partly goes in line with the evidence reported by Olarewaju, (2015) that urban households in Nigeria have higher consumption expenditure relative to rural households. On the other hand, this indicates the inability of rural households to maintain their monthly food consumption when their members experience longer days of ill-health disability. Similarly. The positive relationship between urban households' monthly food consumption expenditure and increased ill-health days appears similar to the findings of Gertler and Gruber (2002) and Yilma et al., (2014). It could be argued that urban households may choose to increase their food consumption during episodes of ill-health experienced by their members to facilitate recovery from the ill-health. Conversely, households' monthly food consumption expenditure per adult equivalent is negatively affected by the age of the households' heads, household size, and the sector of primary occupation of the household. Older households' heads have lower monthly food consumption expenditure per adult equivalent. This may be adduced to the reduced strength, work capacity and economic activity which may occur with ageing, thereby negatively affecting the earnings potential of household heads, resulting in lowered food consumption and diet quality of the households' members. Larger household sizes negatively affect the households' adult equivalised monthly food consumption expenditure. Furthermore, households primarily engaged in agriculture as a means of livelihood have lower adult equivalised monthly food consumption expenditure compared to their counterparts engaged primarily in non-agriculture-related occupations.

Table 7 – Estimates of ill-health disability effects on households' monthly food consumption expenditure per adult equivalent

	Block One Model without endogeneity bias correction in households' ill-health disability days		Block Two Model with endogeneity bias adjustment in households' ill-health disability days.'	
Dependent variable: Log of households' monthly food consumption expenditure per adult equivalent	*RE Model*		*RE IV Model*	
Independent variables	*[a]Coefficient*	*z-value*	*Coefficient*	*z-value*
Household head's Age (years)	-0.01***	-14.61	-.0.01***	-12.53
	(0.001)		(0.001)	
Household head's Formal Education (years)	0.02***	4.57	0.02***	3.59
	(0.004)		(0.005)	
Household head's Gender *(Base category: Female)*				
Male	-0.002	-0.003	0.03	0.37
	(0.068)		(0.081	
Household size	-0.06***	-8.67	-0.07***	-7.65
	(0.01)		(0.01)	
Log of households' total income	0.06***	5.49	0.06***	4.98
	(0.01)		(0.01)	
Ill-health disability days'	-0.003	-1.39	-0.03	-1.62
	(0.002)		(0.017)	
Number of working-age ill-health disability affected households' members	-0.001***	-3.02	-0.001	-0.58
	(0.0002)		(0.001)	
Households' sector of primary occupation *(Base category: Non-agriculture)*				
Agriculture	-0.31***	-3.53	-0.25	-1.86
	(0.09)		(0.13)	
Sector of residence *(Base category: rural)*				
Urban	0.40***	6.24	0.41***	5.26
	(0.06)		(0.08)	
Constant	7.69***	50.02	7.84***	39.05
	(0.15)		(0.20)	
Variance Parameters				
Sigma_u	0.49		0.59	
Sigma_e	0.59		0.59	
Rho	0.41		0.51	
Models' Descriptive				
Within R-squared	0.50		0.43	
Between R-squared	0.27		0.23	
Overall R-squared	0.29		0.24	
Wald Chi-squared value	627.74		508.59	
Probability > Chi-squared	0.00		0.00	
Number of observations	1466		1201	
Number of groups	1230		1040	

Conclusion and Recommendation

The improvement in the health and welfare of the agricultural workforce is highly essential to achieving agricultural productivity growth and economic development in Nigeria. However, the unexpected nature of the ill-health episodes, the need for curative healthcare services and the associated user fee medical care payments often results in the severe economic burden of ill-health and negative welfare consequences on small-holder agricultural households in Nigeria. Given this, this study assessed the economic burden of ill-health disability on small-holder

agricultural households' welfare in Nigeria. Based on the results, aged, working-age and non-working children household members were more affected by ill-health disability as indicated by the total number of ill-health disability days experienced. Also, agricultural households' experience of ill-health has a significant economic burden on their welfare. Out of the estimated average total cost of ill-health disability to households, 65 per cent represents the cost of lost productive time. In comparison, 35 per cent represents the direct OOP medical care incurred by households. The percentage of the direct cost of ill-health to households' income was19 per cent; the indirect cost of lost productive time due to ill-health disability was about 39 per cent of households' income. These costs are likely to have negative welfare consequences on agricultural households in the country, given their poor socio-economic status and the prevalence of the OOP healthcare financing system in the country. The pathway of the burden of ill-health on agricultural households' welfare is through increased OOP healthcare expenditure and reduction in households per adult equivalent monthly food expenditure. Thus, this study suggests that the government should provide healthcare insurance to resource-poor agricultural households. Besides promoting health insurance to reduce OOP health expenditures and enhance farm investment and improve agricultural productivity, there are other avenues to enlarge health coverage and financial protection. These include, among others, the private sector involvement, an important component to complement government efforts by promoting health investments in the form of loans and/or grants from companies, individual philanthropists, or non-profit foundations/organizations. Others could be in the of community-based health financing initiatives in which some basic health services can be provided especially for poor households who may be unable to access certain treatments because of their economic conditions and/or geographical barriers which can make access difficult even when the households have enough financial resources.

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