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IMPACT OF THE MASS CAMPAIGN FOR THE DISTRIBUTION OF LONG-LASTING INSECTICIDE NETS ON THE STATES AND NATIONAL ECONOMY: EMPIRICAL EVIDENCE FROM NIGERIA.

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Abstract: Mass distribution of long- lasting insecticide nets (LLINs) has led to large increases in its coverage in many sub-Saharan Africa countries. Whereas, it is funded mainly through donor contributions, there is an enormous amount of resources that are deployed during the implementation of the LLIN mass campaigns. This study assesses the impact of LLINs campaign on the States and National Economy of Nigeria with specific reference to how LLINs distribution, administrative coverage and budgets impacts on the health sector contribution to GDP of Nigeria. Within the sampling frame of the 36- states in Nigeria, eight (8) states where nets were distributed for the period 2017- 2019 by Society for Family Health were purposively selected. A panel design was used to analyze the data based on random effect estimation. The study found that LLINs Distribution and LLINs Budgets have a positive and significant impact on the health sector contribution to the GDP of Nigeria. In conclusion, net campaign programmes across the states of Nigeria supported by crucial donors like the Global Fund (as implemented by the NGO- Society for Family Health) impacted on the State Direct Investment (SDI). These improvements are regards to boosting economic activities such as hotel businesses, a boost in petty traders income and tax revenue to the Government. The study recommends the need for policies that will fast track the development of a more vibrant nets market since its levels of distributions among selected States in Nigeria contribute to the GDP. There is a need for a Business Case in encouraging investment in LLIN production. An understanding of the economic impact of the mass campaign will help the advocacy efforts in encouraging states and the Federal Government to contribute necessary counterpart funding for the LLINs mass campaign efforts

Key Words: Economy, Income, Malaria, Nets campaign and Society for Family Health

Introduction

Malaria is hyper-endemic in sub-Saharan Africa, and remains one of the leading causes of morbidity and mortality, especially in pregnant women and children under the age of five (Babalola, Idowu & Omilabu, 2020). In Nigeria and other developing nations of Africa, malaria is still a persistent health and other developmental issues among various age groups. The resultant poor health outcomes impact the Economy on numerous levels. These include: effect on human capital where diseases dramatically reduce the level of educational attainment for children, loss of workdays because of malaria- related sicknesses, decreased productivity, erosion in per capita income of citizenry among others (Sahu, et al, 2020). Although, African governments have tried to limit the effects of these diseases, sub-Saharan Africa is still plagued by high rates of prevalence, with over 500 million people suffering from neglected tropical diseases (Ren, 2019). In response to the high prevalence of diseases, most especially malaria endemic, the Nigerian government and donor agencies such as Global Fund, Presidents USAID, DFID have invested a significant amount of finances and expertise in the healthcare system.

The World Malaria Report (2019) reported that approximately 228 million cases of malaria and nearly 405,000 deaths occurred worldwide in 2018 compared with 251 million cases in 2010. Besides, most malaria cases in 2018 were in the World Health Organization (WHO) African Region (213 million or 93%), followed by the WHO South-East Asian Region with 3.4% of the cases and the WHO Eastern Mediterranean Region with 2.1%. The analysis further revealed that nineteen countries in sub- Saharan Africa and India carried almost 85% of the global malaria burden. Six countries accounted for more than half of all malaria cases worldwide; Nigeria (25%), the Democratic Republic of the Congo (12%), Uganda (5%) and, Cote Ivoire, Mozambique and Niger (4% each). World Health Organization also reported that, the economic costs of malaria are tremendous (WHO, 2019). It estimated that malaria causes a 1.3% loss in GDP growth per year for Africa and more so, results in a total of USD 12 billion in direct losses per year. Around 40% of public health spending in Africa is for malaria and the average household spends greater than 10% of their yearly income on malaria prevention and treatment (WHO, 2018). Accordingly, Neto *et al*, (2016) stated that numerous strategies have been adopted and used to improve access to malaria interventions. Such interventions include: optimizing case management and services in health facilities, improving dispensing practices of drug shop attendants, health education campaigns among others. However, Long-lasting insecticide nets (LLINs) are deemed to have a higher rate of penetration in mostly rural regions. This is an

activity for which the Society for Family Health (SFH) serving as a sub- recipient has engaged in the distribution of mosquito nets in the country's rolling mass campaign efforts in Nigeria. Reports have provided positive analysis of the impact of LLINs on overall childhood mortality and malaria-related morbidity. The LLINs are also reported to have an impact on diseases other than malaria – Leishmaniasis, Japanese encephalitis, Lymphatic filariasis and Chagas Diseases. There is currently no real substitute for LLINs in the market, although Indoor Residual Spraying is often seen as a potential alternative. Insecticide- treated nets have proven efficacious as malaria- control tool in Africa. Despite this evidence of efficacy, the effectiveness of insecticide- treated nets on the Economy of any particular region, country or nation has yet to be shown by previous researches, especially in high- transmission areas within sub- Saharan African (SSA), Nigeria inclusive.

Furthermore, it has been mooted that malaria burden is relaxed through the adoption of nets and this invariably have a positive impact on households and the community settings at large (Staedke, et al, 2019). However, most studies on the usage of LLINs as one of the techniques for malaria reduction in the world over have neglected the possible impact of LLINs mass campaigns on the Economy as a whole, most especially in sub- Saharan Africa (SSA). It is in this context that this study attempts to ascertain the activities of one of the leading non-governmental organizations [Society for Family Health (SFH)] on nets distribution in Nigeria. Thus, examining the extent to which the levels of LLINs distributed among households, the administrative coverage of LLINs and LLIN budgets impact on health sector contribution to GDP in Nigeria.

Researchers such as Masaninga (2018), Malede *et al.* (2019) has suggested that there should be a communal benefit to individuals using mosquito nets. Such benefits they argued to be known as a 'communal effect'. Finda, *et al,* (2019), among others, found that a community effect on mosquito abundance improves the health of children living near villages and even the urban regions, most especially in African nations. Kilian (2013) and Brown and Rogerson (2016) opined that the reason for the community effect is in three- fold that; mass coverage by LLINs reduces the number of mosquitoes in the community, shortens the lifespan of mosquitoes, thereby decreasing the proportion of mosquitoes and mass coverage which also can divert bites from humans to animals. However, previous researches fall short in examining the impact of LLINs on the overall economy of a nation. This study seeks to examine how LLINs mass campaigns conducted by the Society for Family Health in Nigeria have affected the health sector contribution to the

gross domestic product. More so, Health policies are chosen based on effectiveness, need, and economic reasoning. The use of any measure can only be justified as long as the benefits derived from it outweigh the costs incurred.

This article therefore presents an analysis of the data in the distribution of LLINs in selected States (Osun, Adamawa, Jigawa, Katsina, Delta, Kaduna, Kano and Niger) within Nigeria

Consequently, this study seeks to analyze the impact of LLINs campaigns on the States and the National Economy of Nigeria. Other specific objectives include:

i. To investigate how the levels of LLIN distributed among households impact on health sector contribution to GDP in Nigeria.
ii. To determine how households and administrative coverage of LLINs impact on health sector contribution to GDP in Nigeria.
iii. To assess how the budget for LLIN mass campaign impact on health sector contribution to GDP in Nigeria.

Literature Review

LLINs as a concept

An LLIN is a factory-treated mosquito net made with netting material that has insecticide incorporated within or bound around the fibres. It repels disables and mosquitoes coming into contact with the insecticide on the netting material. The net must retain its effective biological activity without re-treatment for at least 20 standard washes under laboratory conditions and three years of recommended use under field conditions. LLINs are considered the most effective tool of prevention against malaria and, as a result, are a vital pillar in the fight against the disease (WHO, 2015).

Diseases syndrome and the Economy

Many studies have found that diseases (such as malaria, Lassa fever, corona- virus and other viruses) measured by infant and child mortality and maternal mortality is negatively related to the growth of the Economy (WHO Commission on Macroeconomics and Health, 2001., Robalino, *et al,* 2002a., Haacker, 2004., WHO, 2009., McKibbin & Stoeckel, 2018., Levine & McKibbin, 2020., McKibbin & Fernando, 2020).

While measurements of morbidity and mortality are key considerations for estimating the burden of disease in populations, they provide an incomplete picture of the adverse impact of ill-health on human welfare and the Economy at large. Analysis of the economic impact of ill-health addresses a number of policy questions concerning the consequences of diseases. Some of these pertinent issues relate to the microeconomic level of households (individuals), firms or Government- such as the impact of ill-health on a household's income or a firm's profits or including the aggregate impact of a disease on a country's current and future gross domestic products (GDP). Poor levels of health may have adverse impact on educational attainment, consequent levels of future income, businesses and overall economic activities in any region of the world. At the societal level, poor population health is associated with lower savings rates, lower rates of return on capital, and lower levels of domestic and foreign investment: all of these factors can and do contribute to reductions in economic growth (Nonvignon, *et al*, 2016).

A significant amount of the previous research in the field of public health has focused on the economic impact of diseases. Smith et al, (2019) analyzed the infectious disease and economics considering multi-sectoral impacts. The author suggests that with rapid and extensive international travel and trade, such infectious disease can elicit economic shock waves far beyond the realm of traditional health sectors. Also, private sector organizations are impacted indirectly by these disease events. The study suggested that the economic burden of disease such as malaria will differ across countries. Also, Gallup and Sachs (2001) analyzed the economic impact of malaria across countries throughout 1965-1990. The study used a cross-country empirical growth estimation technique, accounting for factors such as initial income level, overall health, and tropical location. The study showed that countries suffering from severe malaria, which is defined by having a malaria index (the product of the fraction of the population living in areas with high risk in 1965 multiplied by the fraction of malaria cases in 1990 that are due to a specific vector, P. *falciparum*) of greater than 0.5, experienced 1.3% lower growth in GDP per capita. It also concluded that a 10% reduction in malaria would raise GDP per capita by 0.3%.Also, Bloom *et al.* (2005) use the Oxford economic forecasting model to estimate the potential economic impact of a pandemic resulting from the mutation of avian influenza strain. They assume a mild pandemic with a 20% attack rate and a 0.5 percent case- fatality rate, and a consumption shock of 3%. Scenarios include two-quarters of demand contraction only in Asia (combined effect 2.6% Asian GDP or US$113.2 billion), a more prolonged shock with a more massive outbreak and larger shock to consumption and export yields a loss of 6.5% of GDP (US$282.7 billion). Also, global GDP is reduced by 0.6%, the global trade of goods and services contracts by $2.5 trillion.In a study by Ozili (2020) on COVID-19 pandemic and economic crisis in Nigeria. It was observed that Government provided financial assistance to businesses and a small number of households that were affected by the corona virus outbreak. The monetary authority also adopted accommodative policies and offered a targeted 3.5 trillion loan supports to some sectors. The findings reveal that the combination of declining oil

price and spill-over from the COVID-19 outbreak further triggered economic downturn in Nigeria, which not only led to a fall in the demand for oil product but also stopped economic activities from taking place when social distancing policies were enforced

Figure 1: Conceptual framework for identifying the macroeconomic impact of diseases

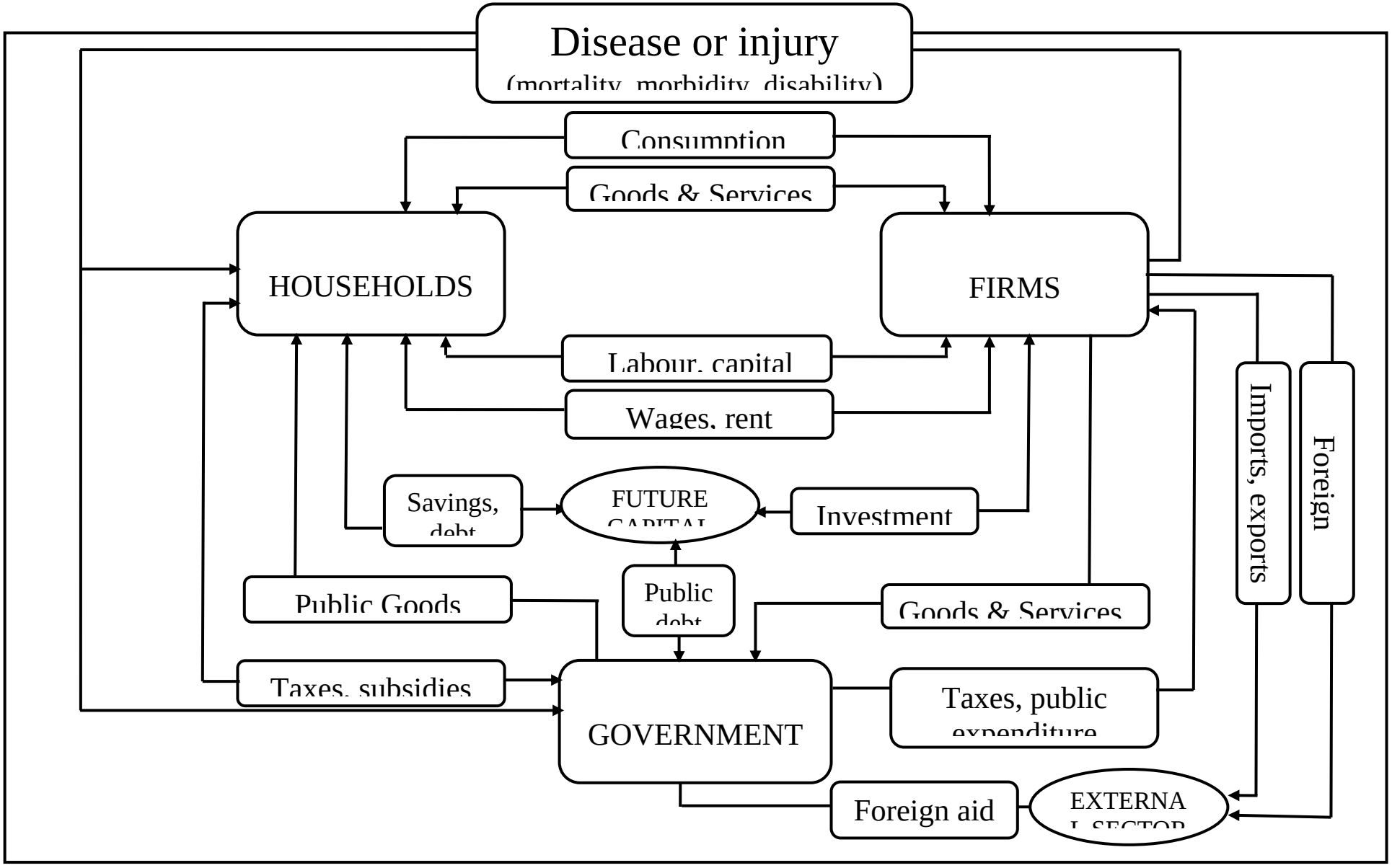

Figure 1 above depicts how the macroeconomics agents align together using a “flow of income” to show the main channels of transmission of the economic impact of the disease on households, firms and the Government. Households provide labour and capital for firms, which employ these inputs to produce goods and services. In return, firms pay wages and rents to households for their productive inputs, and households use this income to consume the outputs of production and to invest in order to finance future consumption. The households also provide labour to the Government for the production of public goods.

In addition to providing inputs to production and consumed goods and services with the income earned from these inputs, the diagram also illustrates their economic functions or activities such as payment of direct and indirect taxes, transfer of disposable income. Disease such as malaria, corona virus and other endemics may challenge the household economic capacity to such an extent that it is forced to resort to loans and debt. Governments might also run surpluses and deficits; firms might be net borrowers or net lenders.

Government on the other hand generates revenue through the collection of direct and indirect taxes, loans and any foreign aid (such as Global Fund, President Malaria Initiative) made available by the external sector. The Government uses this income to purchase goods and services from the firms for the production of public goods. Closing the circular flow of income is the external sector, which in addition to foreign aid also make direct transactions with the private sector and selected non-governmental organizations such as Society for Family Health.

In addition to the numerous channels discussed above, there are other ways through which diseases such as malaria, corona virus can impact the Economy. These include: the wider economic impact of disease resulting from epidemiological and economic factors. For instance, the outbreak of rapidly spreading infectious diseases (Malaria, Lassa Fever, Ebola and Corona virus) and the public perception of the risk of becoming infected can lead to dramatic changes of social and economic interaction. During the outbreak of Corona virus (COVID-19) in China and international community’s between 2019 and 2020, this has been shown to reduce the level of social contact, which in turn reduced the volume of economic transactions and by extension affected the world Economy.

Methods

The Society for Family Health (SFH) gave permission for the data used by this study. Eight states (Osun, Adamawa, Jigawa, Katsina, Delta, Kaduna, Kano and Niger States**)** were selected because of the availability of data within the study scope. The data spanned over the period from 2017 to 2019 in states where the SFH has served as sub-recipient to the Global Fund grant for net distribution. The research design is panel design. The reason for this choice was that the panel research strategy allows for repeated observations of some quantities about the same entities of study over time (Kothari & Garg, 2014). Similarly, according to Gujarati (2004), panel design has the advantage of more degrees of freedom, more efficiency and less collinearity. STATA Version 13 was used to analyze the data showing the relationship between the response and predictive variables. To enhance the meaningfulness of this study and to better understand the context of LLIN mass distribution and its impact on Nigeria's Economy, we conducted series of post estimation regression diagnostic tests were conducted to ascertain the validity of the statistical inferences for the study - multi collinearity, correlation matrix and descriptive statistics.

The model for this study is given as follows:

$Yit = \beta_{i\,t} + \beta_1 X_{it} + \varepsilon_t$ …… (1)

This is further stated as:

$HS/GDP = f(LLIND, LLINAC, LLINB$…… *(2)*

This functional model is transformed into an econometric form as:

$HS/GDP_{it} = \alpha_0 + \beta_1 LLIND_{it} + \beta_2 LLINAC_{it} + \beta_3 LLINB_{it} + e$…… *(3)*

$F_{ij} = \beta_1 LLIND_{ij} + \beta_2 LLINAC_{ij} + \beta_3 LLINB_{ij}$…… *(4)*

$R_j = \beta_1 LLIND_{ij} + \beta_2 LLINAC_{ij} + \beta_3 LLINB_{ij}$…… *(5)*

Where:

HS/GDP = Health Sector Contribution to Gross Domestic Products

α_0 = constant, representing value of HS/GDP when all explanatory variables are held constant

LLIND = Levels of Long-Lasting Insecticide Nets Distributed within the scope of study

LLINAC =Long-Lasting Insecticide Nets Administrative Coverage within the scope of study

LLINB =Long-Lasting Insecticide Nets Budgets within the scope of study.

β_{1-} β_3 = Coefficients of the explanatory variables
e = Error term

The equation Fij represents fixed effects while the equation Rj represents random effects. Usually, random- slope models are used, in which variables have both a fixed mean component to their slope as well as a random variable around the mean for different States where LLIN mass campaigns are conducted. Hausman test was conducted in order to choose the most appropriate panel estimation between fixed effect and random effect (Hausman, 1978). The test provides two estimates and compares the slope of their coefficients. The threshold is based on 5% level of significance, therefore if the P-value is greater than 5%, then the random effect model prevails otherwise fixed effect.

In view of the above, this paper outlined the following hypotheses:

H_{O1}: There is no significant relationship between LLIND and HSGDP in Nigeria.
H_{O2}: There is no significant relationship between LLINAC and HSGDP in Nigeria.
H_{O3}: There is no significant relationship between LLINB and HSGDP in Nigeria.

Analysis and Discussion

The objective of this article is to examine the relationship of LLINs mass campaigns to the Economy of Nigeria. Thus, the results of the analysis with the help of STATA (13) statistical software package are presented as follows:

Descriptive statistics of the data

Descriptive statistics enable the transformation of raw data into more meaningful information (Sekaran, 2010). Descriptive statistics such as mean, standard deviation, minimum and maximum were presented in Table 1 below.

Table 1: Descriptive Table (N = 8)

Variable	OBS	Mean	Std. Dev.	Min	Max
HSGDP	8	8.851097	.3673284	7.976768	9.771366
LLIND	8	3.729027	.035503	3.62349	3.764101
LLINAC	8	1.805126	.1872122	1	1.996512
LLINB	8	.9073165	.1255363	.6720979	1.108903

Source: STATA (13) output, 2020.

The descriptive statistics table shows the mean score of HSGDP is 8.85 for the sampled States where LLIN mass campaigns was conducted during the study period. This implies that for every one naira invested in the mass campaign, 8.85 percent is added to health sector contribution to gross domestic product in Nigeria. The minimum HSGDP value recorded during this period was 7.97 whereas 9.77 was its corresponding maximum value. Similarly, the standard deviation from the value of HSGDP was 0.367. This shows that there exist significant variations of HSGDP among selected States where LLIN mass campaign is conducted. Looking at the independent variable of mass campaign measured by LLIND, LLINAC and LLINB having mean values of 3.72, 1.81 and 0.91 respectively. The maximum values of 3.76, 1.99 and 1.11 and minimum values of 0.03, 0.18 and 0.12 respectively were also found.

Correlation matrix

To determine the association between the entire variables of the study, correlation matrix is obtained as presented in Table 2. Similarly, correlation is used to determine the presence of multicollinearity among the independent variables.

Table 2 Correlation Matrix (N= 8)

	HSGDP	*LLIND*	*LLINAC*	*LLINB*
HSGDP	*1.0000*			
LLIND	*0.7952*	*1.0000*		
LLINAC	*-0.0938*	*0.1575*	*1.0000*	
LLINB	*0.6435*	*-0.2585*	*0.1338*	*1.0000*

Source: STATA (13) output, 2020.

To determine the association among the variables of the study, correlation coefficients were obtained as presented in the correlation matrix table. The coefficient values revealed different levels of associations among the variables. For instance, HSGDP exhibits a strong and significant association of O.79 with levels of long- lasting nets distributed (LLIND) across the selected States of the federation, insignificant negative correlation of -0.09 with long-lasting insecticide nets administrative coverage (LLINAC) and a significant positive association of 0.64 between HSGDP and LLINB.

Regression Result

As indicated in the methodology, the model was analyzed using random effect techniques with an option of robust standard error. The result presents R- squared value of 0.6707 for the model; indicating that Long- Lasting Insecticide Nets (LLINs) mass campaigns indicators combined explained 67.07% of the variability of the Nigerian Economy measured by Health sector contribution to the GDP. The Wald test value of 19781.05 for the model is significant at 5% and this provides an indication that this model is statistically fit to explain the contribution of health sector to GDP through nets distribution across Nigeria's States.

Table 3: Random Effect Estimation Results

HSGDP	Coeff.	Robust Std. Er	Z	P > Z	Significance
LLIND	0.0477	0.0173	2.76	0.004	*
LLINAC	-0.0063	0.0155	-0.41	0.684	
LLINB	0.1336	0.0268	4.99	0.000	*
CONS	-0.0507	0.0298	-1.70	0.089	
Observations		8			
R^2		0.6707			
Wald X^2		19781.05	0.000		*
Hausman ($X^2 > 5\%$)		1.87	0.9316		

Source: STATA (13) output, 2020.
Note: * Significant at 5% level of Significance

Concerning the influence of each of the Long- lasting insecticide nets (LLINs) indicator with the Health sector contribution to GDP, the result found both LLIND and LLINB have positive and significant relationship of (Coeff= 0.0477; P>Z = 0.004) and (Coeff= 0.1336; P>Z = 0.000) respectively. Going by the findings, the null hypotheses (H_{O1} and H_{O3}) are rejected. This implies that an increase in LLIND or LLINB has significant relationship with an increase in HSGDP of Nigeria and vice versa. The remaining metric LLINAC is however found to have negative non significant relationship of (Coeff= -0.0063; P>Z = 0.684) with HSGDP respectively. With this result, null hypothesis (H_{O2}) is accepted. This means that an increase in LLINAC has no significant relationship with a

decrease in HSGDP in Nigeria. The findings have not been established by prior studies on the Long-lasting nets campaigns and its impact on the Economy.

Conclusion and Recommendations

This study assessed the impact of long-lasting insecticide nets (LLINs) mass campaigns on the Nigerian Economy. In view of this , it is observed that variability in the Economy is 67% influenced by the Society for Family Health mass campaigns. The study found that LLINs indicators are good predictors of both States and national at large as evidence by the significant wald test value of less than 5 percent. This study in conclusion views that, in the course of the net campaign programme across the states of Nigeria, the infusion of huge amount of resources by activities of the NGO- Society for Family Health have invariably affect the State Direct Investment (SDI) significantly in terms of improvement in economic activities such as hotel businesses, boost in petty traders income and government participation. Based on the findings obtained, the following recommendations are hereby offered:

1. There is need for the Government in conjunction with relevant stakeholders to formulate policies that will fast track the development of a more vibrant nets market since its levels of distributions among selected States in Nigeria impacts on the GDP. This will enable easy access to nets among households most especially in rural areas.

2. The Government should develop a comprehensive national strategies for long-lasting insecticide nets. These strategies should include large-scale mass community distribution campaigns and continuous distribution approaches. A Business Case scenario should be adopted in encouraging investment in LLIN production.

3. LLIN budget is observed as a significant indicator in determining health sector contribution to GDP, thus funding streams for non-governmental organizations such as the Society for Family Health should be simple and accessible. With this at hand, it will allows the organization to extend their activities penetration to various States of the federation evenly rather than conducting nets campaigns in less than four States per year. Furthermore, Government should ensure a planned and coordinated implementation of a sustainable funding system for nets campaigns in the country.

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