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Tuberculosis and its socioeconomic determinants in Nigeria: An empirical investigation using ARDL approach

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ABSTRACT

Purpose: This study was conducted to investigate the socioeconomic determinants of tuberculosis (TB) in Nigeria. The prevalence of TB in Nigeria in recent years has been on thunderous increase, and this has led to poor health outcome and dwindled economic growth. Nigeria government has put different measures to stop the prevalence of TB in Nigeria, but it seems their efforts are fruitless. This situation becomes a great challenge to the people and the government. These facts motivated this study to empirically investigate socioeconomic factors/determinants which may have been related to TB continuous prevalence despite the government efforts to stop its menace in Nigeria.

Design/methodology/approach: This study used auto regressive distributed lag (ARDL) model for its design and methodology. Unit root test was conducted at the initial stage which led to the decision of using the ARDL model. The ARDL bound test, coefficient test, error correction model, and diagnostic test were conducted. The data used in this study is annual secondary data ranging from 1985 to 2018. The data were sourced from a reliable means.

Findings: This study finding shows that there are socioeconomic determinants/factors which related to TB and can control the prevalence of TB in Nigeria. Socioeconomic determinants like income, education, savings, and final consumption expenditure (FCE) were used in this study and they showed a positive relationship with TB. It was only savings and FCE that were significant at 5% and 10%, respectively proving that increase in savings and FCE leads to increase in TB prevalence in Nigeria, which simply implies that people should stop savings in order to fight, control and reduce TB prevalence. Secondly, when FCE is increased meaning no money left to spend to curtail TB, then TB prevalence will increase. Income and education were not significant with TB because savings and FCE are components of income, and they were used in the study. Increase in education may lead to increase in TB prevalence because of the nature of TB transmission from one person, one place to another.

Keywords: ARDL model, socioeconomic determinants, tuberculosis, Nigeria

INTRODUCTION

Economic growth and development have become a vital issue in the world recently. Many countries are striving to improve their economic growth, in order to improve the wellbeing of their citizens, which Nigeria is not exceptional. However, current studies on economic growth have recognized favorable growth effects of human health (Barro, 1991; Mankiw et al., 1992). Ever since health became recognized to the international community, a lot of commitments have been made regarding improvements of health with instigations that one of the causes of health problems are diseases. Diseases deteriorate the health outcome of the people, thereby making the people to be non-active and non-productive in the economy.

Tuberculosis (TB) is one of the infectious diseases which have been disrupting Nigeria economic growth in recent times. Additionally, in affecting health and life of the people directly, TB creates a remarkable impact on the society, political systems, and plans of the country. TB has been classified as one of the most dangerous infectious diseases in Nigeria and in the whole world as well (FMOHN, 2017). The symptoms include less fatigue, chills, night sweats, coughing, chest pain, loss of appetite, and weight loss.

TB spreads through the air, therefore the infected people are kept in isolation from other people. According to communicable diseases statistics, TB has caused about 15.2% of deaths in Nigeria since 2017 (FMOHN, 2017). TB is curable, but the period and process of its medication to the victims are highly inconvenient. The health practitioners who administer

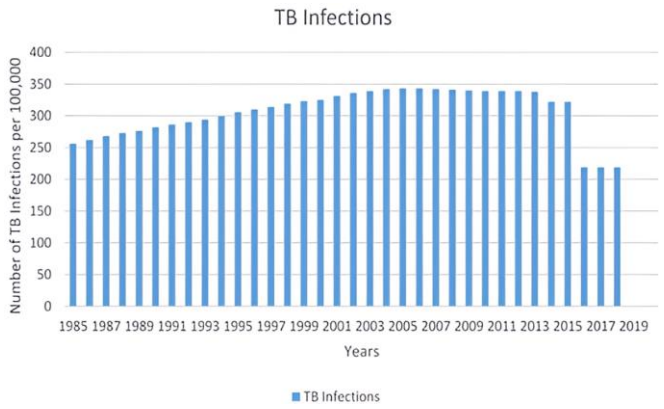

Figure 1. Annual number of TB infections per 100,000 in Nigeria (1985-2018)

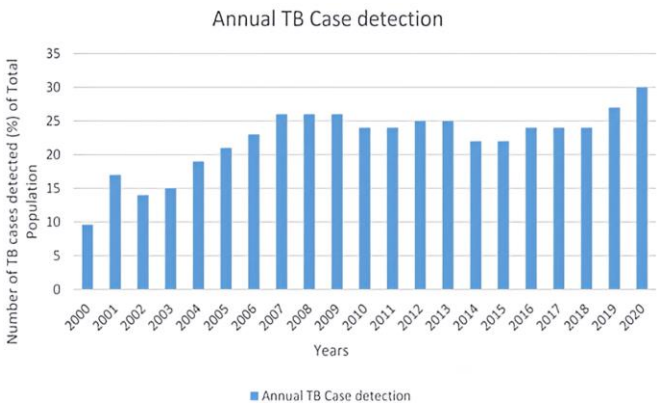

Figure 2. Tuberculosis case detection rate (% all forms) in Nigeria (2000-2020)

the treatment to the victims find it hard because of poor infrastructure, no vehicles, and no protective health materials to avoid them being infected by TB. Most of the time, the isolation places for the TB patients are in the bushes, and difficult to administer their medication in such areas.

TB prevalence increased in Nigeria in 2017 to 2018 from 418,000 to 429,000 incidences respectively. Also, deaths as a result of TB increased in the same period of the years from 155,000 to 157,000, respectively with TB treatment coverage stagnant at 24% (Adepoju, 2020). Also, the prevalence of TB is worsened in Nigeria when there is high prevalence of HIV infections. People with HIV are more vulnerable to active TB. In estimation, 63,000 Nigerians who are HIV/AIDS positive develops TB easily and 39,000 Nigerians died from TB annually (WHO, 2018). TB prevalence becomes worse due to poor economic outcome that has existed among the people to date (**Figure 1**).

Figure 1 is the annual number of TB infections in Nigeria and cases has been in an increase since 1985 to 2015. The control of the disease in Nigeria is coordinated by the national tubeculosis and leprosy control program in line with the 'stop TB partnership' initiatives whose ultimate target is to eliminate TB as a public health problem (less than one case per million population) by the year 2050. TB diseases in general, continue to make costly disruptions to trade and commerce in every region in Nigeria (FMOHN, 2017).

Figure 2 shows that TB detection cases are still at increase in Nigeria in recent years. According to World Health Organization (WHO), Benue has the highest TB prevalence, which is as a result of high HIV prevalence in the state. The age groups commonly affected by TB are the most productive age groups, with the 25-34 age group accounting for 33.6% (15,303) of the smear positive cases registered in 2010 (WHO, 2018).

Figure 2 is all forms of TB cases detection rate by percentage in Nigeria from 2000 to 2020. **Figure 2** proves the fluctuations and increases of TB cases detection. It is noted that in the year 2020 Nigeria experienced the highest TB cases detection.

Socioeconomic Determinants of Tuberculosis in Nigeria

Considering the high rate of TB prevalence in Nigeria, it is important to investigate the socioeconomic determinants of TB in Nigeria, this will help to find a solution to this menace. Therefore, some of the socioeconomic determinants of TB used in this study are explained in the following.

Education

According to United Nation Children Education Fund (UNICEF), primary education is compulsory and free in Nigeria, but about 10.5 million children aged 5-14 years are out from school (UNICEF, 2019). Education is one of the socioeconomic determinants of TB in Nigeria, because it contributes to human capital acquisition and when one is highly educated, he has the chance to acquire good job which will yield high income, thereby making sure the person has enough income and resources to fight against the prevalence of TB, but consistency in education is lacking behind in Nigeria. The lack of education or the situation in which the masses fail to attend schooling poses a serious danger to the health and wellbeing of the people, because when the children are out-of-school, there will be high rate of illiteracy which will help in promoting the existence of TB among Nigerians.

Gross domestic saving

Annual savings of Nigeria is another socioeconomic determinant for TB prevalence in Nigeria. The yearly update of the Nigeria gross domestic savings (SA) from 1981 to 2017 indicates that at an average of 44.4% are saved over the years (World Bank, 2020). Increase in savings as a result of increase in income helps to fight unexpected prevalence of infectious diseases such as TB in Nigeria.

Final consumption expenditure

This is an expenditure made by all the components (government, households, and enterprises) in the economy, having their economic interest focusing within the country territory. According to the Keynesian aggregate expenditure model, people either consume or save their income. Therefore, income is equals to consumption plus savings. If income increases, then consumption and savings will increase. When income remains constant over the years, then increase in final consumption expenditure (FCE) decreases savings which leads to decrease in investment because savings is equals to investment. Decrease in investment against TB prevalence results to increase in the prevalence of TB because there is lack of capital saved against the rainy day or invested to combat any emergency prevalence of TB. Therefore, FCE has an important

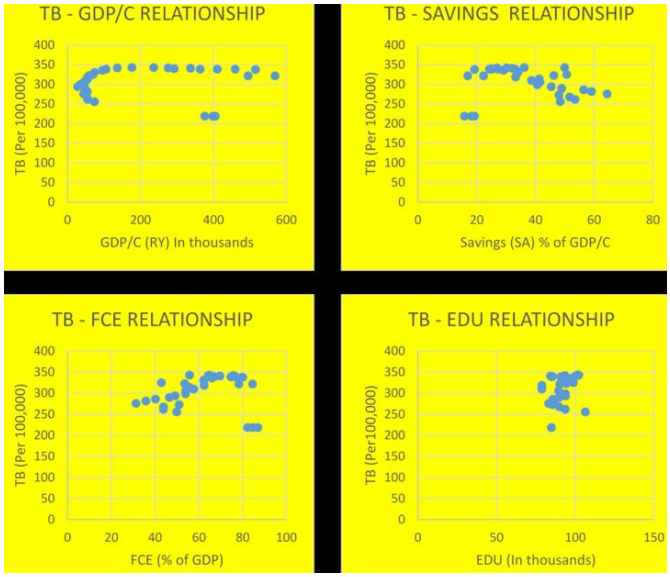

Figure 3. Scatter plots linking determinants with TB (1985-2018)

relationship with CDs via level of income since expenditure is a component of income.

Gross domestic product per capita

Gross domestic product per capita (GDP/C) is a good measure of a country's standard of living. It explains how prosperous a country feels to its citizen. In Nigeria, the GDP/C was recorded at 2396.30 United States dollars in 2018. Nigeria has a low standard of living despite it is classified as low middle income country. Poor standard of living is a ticket to increase rate of the existence of TB in the country, hence the income of the people is a good socioeconomic determinant to the existence and prevalence of TB in Nigeria.

In addition, **Figure 3** is the scatter plot relating TB and its determinants in Nigeria. The relationship was plotted with each of the determinants to see how TB links with each of them. The first panel is the relationship between TB and GDP/C, it is depicting a positive linear relationship in the short run but a negative linear relationship in the long run. This implies that, the continues prevalence of TB will decrease GDP/C in the long run but not in the short run. The second panel is the relationship between TB and SA, which is percentage of GDP/C, the scatter plot indicates a negative relationship between TB and savings, implying that decrease in TB leads to increase in savings. The third panel is the scatter plot between TB and FCE, which is also a percentage of GDP/C. The panel depicts a positive linear relationship between TB and FCE within the period of observation. This means increase in TB leads to increase in FCE.

The fourth and last panel is the relationship between TB and EDU. It shows a positive relationship between TB and education. This means improvement in education and awareness of TB may not reduce TB prevalence. This may be as a result of its mode of infections which is by air.

However, there are many other socioeconomic determinants of TB in Nigeria but the mentioned are few as used in this study. This study examines the socioeconomic determinants of TB in Nigeria by answering the question "What are the socioeconomic determinants of TB and why is TB in an increasing prevalence in Nigeria"? This study is organized in five sections starting with introduction, and then literature review, methodology and data, result estimation and analysis, and finally conclusion, policy implication, and study limitation.

LITERATURE REVIEW

Empirical Review

Houéto (2019), the social determinants of emerging infectious diseases in Africa, using primary data from national health interview survey, concludes that social inequalities, poverty, socio-cultural and religious belief are good social determinants that caused the prevalence of ebola (infectious diseases) in Africa. Duarte et al. (2021), in their study on different disease, same challenges; social determinants of TB and COVID-19, using a conceptual and empirical analyses, proves that inadequate finance and lack of human resource availability are great contributors to the prevalence of TB and COVID-19. Bishwajit et al. (2014) also studied the social determinants of infectious diseases in Southeast Asia using conceptual and empirical analyses as a method and their results proves that poverty, food insecurity, illiteracy, poor sanitation, and social stigma are creating formidable challenges to prevention of further spread of HIV/AIDS & TB. Additionally, WHO CSDH in 2007, examined the determinants of communicable diseases, using a conceptual framework in their analysis, and ascertained that people who are less well-off and people who are socially excluded have a bad link with their health status and the social determinants.

Theoretical Review

Social determinants of health (SDH) theory (WHO, 2018), believe that the existence of communicable diseases on health is determined by the conditions in which people are born, grow, live, work and age. Societal elements and economic characteristics have made emphasis as powerful determinants of peoples' health status (prevalence of TB) and they have important relevance to policy formulations if the goal is to improve health by stopping the prevalence of TB. It has been empirically established that income and health status are directly related since income changes in the same direction with life expectancy (Deaton, 2001). Deaton (2001) maintains that increase in income improves health outcome and decreases vulnerability of diseases. When one is educated, he will be cautious on the type of food he eats, the water he drinks, the place he lives and so on and all these factors are attributes to the SDH. However, this study adopts the Cobb-Douglas production function in which the factors of production are considered as the determinants of levels of output in the production process, depending on the combination levels of the determinants/factors of production. Cobb-Douglas production function is stated mathematically, as follows:

$$Q=f(K, L), \quad (1)$$

which simply expresses the relationship between output (Q) and the combinations of determinants/factors or inputs of production known as labor (L) and capital (K), which is widely

used in economics. This theory was emulated for the empirical model of this study analysis, where TB is used as the dependent variable while real income (RY), savings (SA), FCE, and education (EDU) are used as the independent variables, which are the determinants/factors indicating the level of TB prevalence in consideration to the combination of the independent variables. Empirical model for TB and their determinants is mathematically stated, as follows:

$$TB=f(RY, SA, FCE, EDU). \quad (2)$$

Eq. (2) is the mathematical statement of empirical model relating TB, the dependent variable and RY, SA, FCE, and EDU, the independent variables. Statistically, the empirical model for Eq. (2) is written, as follows:

$$TB=ARY^{b1}SA^{b2}FCE^{b3}EDU^{b4}. \quad (3)$$

The reduction of Eq. (3) after taking the natural logarithm is stated, as follows:

$$InTB_t=A+b_1InRY_t+b_2InSA_t+b_3InFCE_t+b_4InEDU_t+\varepsilon_t, \quad (4)$$

where EDU represents education, RY represents GDP/C, SA represents savings, and ε represents the error term. *A* represents the intercept, In is the natural logarithm, while b_1, b_2, b_3, and b_4 are coefficients of the independent variables, for b_1, b_2, b_3, and b_4 are fractions between 0 and 1 because they are the output elasticity of the independent variables respectively which explains the percentage change of the dependent variable (output) as a result of the percentage change of the independent variable (input).

METHODOLOGY AND DATA

Methodology

The unit root test was the first test conducted in this study to find the stationary outcome of the variables in the series, and the result shows that the variables exhibit a mix mode stationary. Therefore, this study adopts the auto regressive distributed lag (ARDL) model approach in its analysis. The analysis starts with the ARDL bound test to find the cointegration existing among the variables within the study period with the help of the F-statistics computation to find the significant level of the variables. The upper bound and lower bound critical value as well the value of the F-statistics helps to know if the variables are cointegrated. Meanwhile the ARDL bound test for the determinants of TB model can be written, as follows:

$$\Delta InTB_t=A+b_1InTB_{t-1}+b_2InRY_{t-1}+b_3InSA_{t-1}+b_4InFCE_{t-1}+b_5InEDU_{t-1}+\sum_{i=1}^{P}\mu_1\Delta InTB_{t-i}+\sum_{i=0}^{q}\mu_2\Delta InRY_{t-i}+\sum_{i=0}^{r}\mu_3\Delta InSA_{t-i}+\sum_{i=0}^{s}\mu_4\Delta InFCE_{t-i}+\sum_{i=0}^{t}\mu_5\Delta InEDU_{t-i}+\varepsilon_t. \quad (5)$$

The hypothesis for the ARDL bound test is stated, as follows:

H_0: $b_1=b_2=b_3=b_4=b_5=0$ (There is no long run cointegration among the variables).

H_1: $b_1\neq b_2\neq b_3\neq b_4\neq b_5\neq 0$ (There is long run cointegration among the variables).

The estimation analysis continued with long-run coefficient relationship test, to find out the equilibrium relationship existing between the dependent and independent variables. The formula for this long-run coefficient relationship test is presented, as follows:

$$InTB_t=A+\sum_{i=1}^{P}b_1\ InTB_{t-i}+\sum_{i=0}^{q}b_2\ InRY_{t-i}+\sum_{i=0}^{r}b_3\ InSA_{t-i}+\sum_{i=0}^{s}b_4InFCE_{t-i}+\sum_{i=0}^{t}b_5InEDU_{t-i}+\varepsilon_t. \quad (6)$$

The error correction model (ECM) is the next estimation after the coefficient relationship estimation. It is conducted to measure the speed of adjustment of the variables in restoring equilibrium in the dynamic model. The formula for this test is, as follows:

$$\Delta InTB_t=\delta_0+\varphi ECT_{t-1}+\sum_{i=1}^{P}\mu_1\Delta InTB_{t-i}+\sum_{i=0}^{q}\mu_2\Delta InRY_{t-i}+\sum_{i=0}^{r}\mu_3\Delta InSA_{t-i}+\sum_{i=0}^{s}\mu_4\Delta InFCE_{t-i}+\sum_{i=0}^{t}\mu_5\Delta InEDU_{t-i}+\varepsilon_t. \quad (7)$$

From Eq. (7), φ is the error correction term (ECT) used to measure the speed of adjustment parameter among the variables in the model. According to Pahlavani et al. (2005), a stable ECM should be statistically significant and possess a negative sign. The final test to run is the diagnostic test. It is conducted in order to identify and examine if problems exist in the model. The selected tests are the cusum and cusum of square test to diagnose the stability of the model, autocorrelation test to identify the correlation between the series members of observation, and heteroscedasticity test conducted to check if there is existence of non-constant variance in the model.

Data

This study used secondary data which were collected from reliable sources. Most of the data were collected from World Bank, WHO, United Nations (UN). The data collected are annual time series data ranging from 1985 to 2018 with 34 years' observations. The dependent variable is TB, and its source are from WHO. The independent variables are EDU, which is the percentage number of gross primary school enrolment (gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown) which the source is from world bank, also another independent variable is GDP/C (RY), which the source was from World Bank. SA is another independent variable in objective one which its source was from World Bank. FCE is a share of payments/expenditures of total income, they are payments made on goods and services and which its source was from World Bank.

RESULT ESTIMATIONS AND ANALYSIS

Descriptive Statistics and Covariance Matrix

The descriptive statistics of the variables are shown in **Table 1**. It contains the mean, maximum, minimum and standard deviation of the variables.

Also, the covariance matrix is shown in **Table 2**, it shows the correlation among the variables used in the model.

The covariance between the dependent variable TB and the independent variables are positive for RY, negative for SA, positive for FCE and positive for EDU. It means only savings have a negative relationship with TB, increase in TB leads to decrease in savings. This is because the masses will spend all their money trying to have medical treatment when they are infected with TB.

Table 1. Descriptive statistics

Variable	Obs	Mean	SD	Max	Min
TB	34	305.764	38.148	343.000	219.000
RY	34	192.282	174.123	568.499	27.752
SA	34	36.842	13.389	64.355	15.846
FCE	34	61.350	15.208	86.920	31.192
EDU	34	90.662	7.069	106.283	78.663

Table 2. Covariance matrix of coefficient of TB model

E(V)	TB	RY	SA	FCE	EDU
TB	1,412.533				
RY	652.039	29,427.160			
SA	-67.375	-1,741.654	173.994		
FCE	63.879	2,128.274	-194.243	224.501	
EDU	77.313	-90.050	6.938	-8.349	48.509

Table 3. Unit root test result

	ADF test		PP test	
Level				
	Constant	**C&T**	**Constant**	**C&T**
LTB	-0.768	4.288**	-1.022	0.173
LRY	0.036	-2.572	-0.149	-2.557
LSA	1.115	-4.613***	-1.077	-4.609***
LFCE	-1.214	-3.643**	-1.534	-5.406***
LEDU	-3.127**	-3.058	-3.014**	-2.980
First difference				
LTB	2.543	-6.296***	-5.380***	-6.321***
LRY	-4.741***	-4.646***	-4.736***	-4.643***
LSA	-6.363***	-6.552***	-19.767***	-23.337***
LFCE	-7.950***	-3.728**	-15.458***	-14.954***
LEDU	-4.351***	-4.264**	-5.279***	-5.327***

Note. Source: Eview 10, 2021; ***, **, & * denotes significant at 1%, 5%, & 10%, respectively; C&T: Constant & trend

Unit root test

The next result is the unit root test. The result is shown in **Table 3**. The variables are stationary in mix mode; hence, ARDL model was used for the result estimations.

All the variables are estimated in log form. LTB=log of TB, LFCE=Log of FCE as a percentage of GDP, LRY=log of real GDP per capita, LSA=log of gross savings per capita as a percentage of GDP per capita, and LEDU=log of education. All these are the log of all the dependent and independent variables used in the study.

ARDL bound test

The ARDL bound test was computed to find the cointegration that existed among the variables in the model. The comparison between the computed F-statistics and critical value bound are used to predict the result of the cointegration (**Table 4**).

The condition for this test is that if the value of the computed F-statistics is lesser to the lower bound critical value, then there is no cointegration and if it is higher than the upper bound critical value, then there is cointegration among the variables and when the value of the computed F-statistics falls between the lower and upper bound of the critical vales, the test result is inconclusive. The value of the F-statistics is 5.094. This is above the upper bound value of 4.22 at 5% significant level. It proves that the null hypothesis is rejected at 5% significant level, hence there is cointegration among TB (dependent variable) and the independent variables at 5% significant level.

Table 4. ARDL bound test for cointegration

Model	TB=f(RY, SA, FCE, EDU)	
K=4; n=30	Computed F-statistics: 5.094	
Critical values	**Lower bound-I(0)**	**Upper bound-I(1)**
1%	4.28	5.84
5%	3.05	4.22
10%	2.52	3.56

Note. Significant level at the *10%, **5%, & ***1%

Table 5. Coefficient estimation (Dependent variable: LTB)

Variables	Coefficient	Probability
LRY	0.006	0.924
LSA	0.899**	0.041
LFCE	1. 020*	0.072
LEDU	0.051	0.920
Constant	1.936	0.621

Note. Significant at *10%, **5%, & ***1%

ARDL estimated coefficient test

The result of the ARDL coefficient test is presented in **Table 5**. The estimation of the model is based on the ARDL lag (1, 2, 1, 1, 1) for TB, RY, SA, FCE, and EDU, respectively.

The ARDL coefficient test is done to achieve the objective of this study which is to investigate the socioeconomic determinants of TB in Nigeria. In a summary, there is a long run relationship between TB and all the independent (determinants) variables. The result shows that there is a positive relationship between TB and all the independent variables (determinants) which are income (RY), savings (SA), FCE (FCE) and education (EDU). Only savings (SA) and FCE (FCE) are significant at 5% and 10%, respectively. It simply implies that increase in savings and FCE increases TB while income and education is insignificant.

The coefficients b_2, and $b3$, which recorded a positive relationship and also significant indicates that any 5% increase in savings, and 10% increase in FCE will lead to 0.89%, and 1.02% increase of TB, respectively. This may simply mean that when people have increased their savings or have spent all their income, these will lead to increase in TB, hence as a result of TB prevalence, people are expected not to save money but will spend all their income trying to stop the menace. Also, income and education have no significance on TB because even at increase in income and education, TB prevalence can still be in increase, but it depends on the channel of expenditure of the part of income, whether it is focused on TB cure and cases. Therefore, it is the expenditure and savings done from income towards TB can determine the prevalence of TB, hence increase in savings leads to increase of TB prevalence and increase in FCE is as a result of increase in TB prevalence.

The error correction model test

The ECM test is the next test after the coefficient test. The ECM test is done to identify the speed of adjustment that causes the dependent variable to return to equilibrium after some changes in the independent variables (**Table 6**).

Table 6. ECM result (Dependent variable: DTB)

Variables	Coefficient	Probability
D(LRY)	0.128	0.028
CointEq(-1)*	-0.3412***	0.000

Note. Significant level at *10%, **5%, & ***1%. D: First difference operator

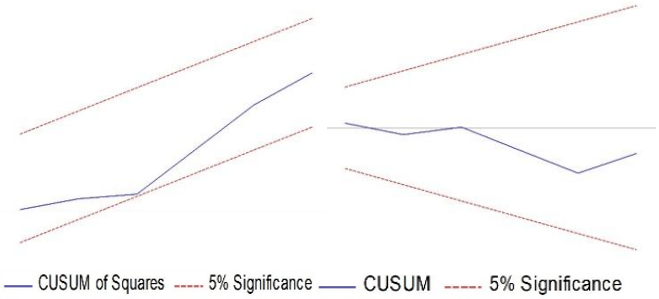

Figure 4. Stability check–CUSUM & CUSUM of square test

The speed of adjustment in this model is significant at 1% which indicates that there is a long run causality in the model. Also the coefficient of ECMt-1 (cointEq(-1)*) is -0.3412 indicating that the model will be adjusting within the frame of 34% annually towards the long run equilibrium and this means the adjustment speed is normal. Therefore, based on the level of significance, the model is significant and concludes that the independent variables are social determinants of TB.

Stability of the Models

The CUSUM and CUSUMSQ are used to test the stability of the model. This is done to make sure that the robustness of the model in long and short run has stable coefficient (**Figure 4**).

The stability test result shows that the model is stable because the test lines fall within the boundary of the 5% level of significance. Therefore, there is a long run relationship and stability of coefficient among the variables over the period of study.

Diagnostic Test

The diagnostic test is the next test after the stability test. The auto correlation and heteroscedasticity test are the diagnostic test. These tests are to check if there is existence of correlation and variance problem in the model (**Table 7**).

Table 7 shows the serial correlation test, Obs*R-squared recorded 2.7089, which is also higher than the chi square probability value of 0.2581, indicating nonexistence of serial correlation in the model, which implies that the probability value is 25.8%, which is above the 10% significance level. For heteroscedasticity, the Obs*R-squared recorded to be 24.59 and it is above the probability value of 0.3717. Also, the model has no residual heteroscedasticity because the probability value is 37.1% which is above the 10% significant level. In conclusion the model used in this study is free from heteroscedasticity and serial correlation problem.

Table 7. Serial correlation and heteroscedastic test result

	Model	
Test statistics	**Obs*R-square**	**Prob. Chi-square**
Serial correlation	2.708	0.258
Heteroscedasticity	24.591	0.371

CONCLUSIONS

This study discussed the socioeconomic determinants of TB. The motivation accrued for this study is as a result of the increasing prevalence of TB in Nigeria. It is important to understand that the objective of this study is geared up by the failure of Nigeria to achieving the millennium development goals (MDGs) health targets. However, the result of this study significantly proves that there is great relationship between TB and its determinants as indicated in the model. The result proved that all the independent variables (determinants) in the model had a positive relationship with TB, which implies that increase of the determinants can lead to increase in TB. However, real income and education were not significant on the relationship outcome. It was only savings and FCE that were significant at 5% and 10% respectively. In conclusion based on the findings, the study provides evidence in support of the social determinant of health theory. Therefore, all the dependent variables are good determinants of TB in Nigeria.

Policy Implications

The result of the study proves that real income is a good determinant of TB in Nigeria because savings and expenditure which were significant in this study are components of income. The income level of people or income per capita of Nigerians is very low when compared to other countries of the world which are categorized as developing countries like Nigeria, low income will lead to poor health expenditure which will allow the prevalence of TB to escalate. Low income will lead to no savings because people don't have enough to spend rather than to save. When there is no savings, the era of a rainy day becomes disastrous.

Nigeria government should as a matter of fact and urgency improves their economic policy with equity in order to improve the real income of the people. This will help to curtail the prevalence of TB among the populace in Nigeria. Also since there are other determinants of TB like education, the government of Nigeria should improve the provision of education to the masses, mostly those in the Northern part of Nigeria which had the believe that western education is a sin and they only absconded to Islamic education, which has a minimal impact of knowledge as regards to the society we are in today. Improvement on the determinants of TB is a road to the reduction of TB prevalence in Nigeria.

Limitations and Recommendation

It is observable that this study is not exceptional from some limitations. One of the limitations of this study is the up-to-date data. The annual data used in this study is from 1985 to 2018. This study intended to use data up to the year 2020 but some of the data to some variables were not available. So, there is need for further study using data from 2019, and there may be need for a cross sectional data from states to find the actual state which has the highest prevalence of TB in Nigeria. There are some variables that can play a major role as the determinants of TB. Such variables like poverty, out-of-pocket health expenditure and others should be included in further research to see their impacts on the TB prevalence in Nigeria.

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Availability of data and materials: All data generated or analyzed during this study are available for sharing when appropriate request is directed to corresponding author.

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