

SIN TAXES AND PUBLIC HEALTH OUTCOMES IN EMERGING ECONOMIES: EVIDENCE FROM NIGERIA (1990-2025)

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ABSTRACT

This study examined the effect of sin taxes, specifically; tobacco and alcohol excise taxes, on public health outcome in Nigeria, with non-communicable diseases (NCD) mortality as an index of public health. Time-series data for the past 36 years (1990 - 2025) were analysed. The study used ex-post facto design to compare pre-reform period (1990-2017) with post-reform period (2018-2025) through the estimation of Ordinary Least Squares (OLS) model containing the lagged tax variables, a post 2018 reform dummy, interaction terms and a deterministic trend for time. The results indicate that the tax burden on tobacco ($\beta = -0.62$, $p = 0.004$) and alcohol ($\beta = -0.48$, $p = 0.009$) have negative significant relationships with NCD mortality. The delayed health benefits (lagged values) are also negative and significant. Mortality-reducing effects of tobacco taxation ($\beta = -0.41$, $p = 0.004$) and alcohol taxation ($\beta = -0.29$, $p = 0.020$) is found to be negative and significant, indicating that the impact of excise taxation on mortality became stronger following the 2018 reform. The reform dummy is negative ($\beta = -4.30$, $p = 0.065$), suggesting a relatively minor drop in the structural level of NCD mortality rates in the post-reform period. The study findings show that Sin taxes are effective fiscal tools to enhance public health outcomes in emerging economies like Nigeria. It recommends a progressive raise in excise taxes, improvement in the enforcement and compliance system and the use of some sin tax revenues for NCD prevention and health promotion programmes.

Keywords: Excise Tax Reform, Public Health Outcomes, Non-Communicable Diseases, Tobacco Tax, Alcohol Tax.

Classification JEL: H20, H23, I18, O55.

INTRODUCTION

Background to the Study

Non-communicable diseases (NCDs) have been steadily rising across the globe and are now one of the greatest challenges to public health and sustainable development. Cardiovascular diseases, diabetes, cancers and chronic respiratory diseases are a significant burden of global mortality, with low and middle income countries accounting for an increasing percentage of premature deaths (World

Health Organization, 2022). In addition to the loss of life, these diseases result in lost workdays, higher household health spending, increased poverty and significant burden on national health services and public budgets (Bloom, Cafiero, Jané-Llopis, Abrahams-Gessel, Bloom, Fathima, and Weiss, 2018). Recent global evaluations also show that the economic burden of NCDs continues to increase and this poses a threat to advances in universal health coverage and sustainable development goals (SDGs) (OECD, 2026).

Major behavioural risk factors associated with NCDs include tobacco use and harmful alcohol consumption. Tobacco smoking and alcohol and other drug misuse are linked to cardiovascular disease, diabetes, various types of cancer, and chronic respiratory illness, with the risk of each increasing with tobacco smoking and excessive alcohol use (Vu, 2026; Beaglehole and Bonita, 2011). These products have a large impact on excess morbidity and mortality and create considerable external costs for society by healthcare expenditure, lost productivity, and early death (Bloom, et al., 2018). In addition, Jovanović (2026) noted that tobacco use remains a major public health burden and healthcare expenditure in numerous countries, highlighting the need for fiscal measures to prevent tobacco use. Tobacco and alcohol excise taxes have been shown in several countries to decrease consumption, deter youth initiation, promote cessation and lead to better population health over time (World Health Organization, 2018; Chaloupka, Yurekli, and Fong, 2012; World Bank, 2019).

Nigeria's experience with sin tax illustrates this international trend of shifting tax policy towards health. Before modern reform, alcohol and tobacco excise taxes were mainly levied for revenue purposes, and were not particularly high. But, as tobacco use raised concerns, so did the bad use of alcohol and the increasing burden of NCDs led to a gradual shift in policy orientation. A significant milestone was reached in 2018 when the Federal Government put in place a specific excise duty component for tobacco products and adjusted excise duty on alcoholic products. The additions in excise from 2019 to 2022 were part of a multi-year programme for excise reform, which was designed to enhance the revenue mobilisation of tobacco and alcohol, as well as to curb consumption and enhance public health. The reforms were undertaken in the backdrop of the general efforts and intentions of Nigeria to implement various public health measures in the country, including but not limited to the implementation of price and tax measures to curb the use of tobacco products by the populace as a component of the country's efforts to meet its international public health commitments such as the 2003 Framework Convention on Tobacco Control, which calls for implementation and application of price and tax measures to curb tobacco use by the populace. Along with this, the reforms indicated an emerging understanding that fiscal policy could be used in conjunction with interventions on the regulatory, educational and clinical fronts as a tool to address behavioural risk factors for NCDs.

Statement of the Problem

The growing burden of non-communicable diseases has put a growing focus on the need for effective public health interventions that can help decrease preventable death due to tobacco and alcohol use. Tobacco and alcohol taxes have long been touted as a key fiscal policy to curb the consumption of these products and to enhance the health of the population (World Health Organization, 2018; Chaloupka, Yurekli, and Fong, 2012). To meet this trend of global policies, Nigeria

had a series of tobacco and alcohol excise tax reforms from 2018 to 2022. These changes were hoped to raise the cost of harmful products, reduce consumption of them and ultimately reduce the death rates from cardiovascular diseases, diabetes, cancer, and chronic respiratory diseases. But, there is scarcity of evidence to confirm if these sin tax reforms have generated the desired public health effects in Nigeria.

Current research has important conceptual and empirical limitations, but still offers some important lessons for the tobacco and alcohol taxation arena. There are few studies in Nigeria that focus on the direct health impacts of sin taxes, with most studies concentrating on tax administration, revenue generation, price changes, tobacco control policy, or industry response (Akin-Onitolo & Hawkins, 2022; Bardach, Casarini, Rodriguez Cairoli, Adeniran, Castradori, Akanonu, Onyekwena, Espinola, Pichon-Riviere, and Palacios, 2022). Consequently, there has been little empirical attention to the central policy goal of sin tax; to reduce the incidence of NCD death, in recent years. The literature available internationally consistently shows that increases in tobacco and alcohol taxes are linked to a decrease in harmful consumption and health benefits, such as reduced mortality from NCDs (Elliott, 2022; Tan, 2025). However, most of this research comes from cross-national studies, simulation research or studies in other LMICs. This may not be directly translatable to Nigeria due to variations in income distribution, consumption behaviour, informal sector participation, health system development, and enforcement capabilities (Cruz, 2021; Shrestha, 2025). The dependence on external evidence, in turn, constrains Nigerian policymakers' capacity to tailor tobacco and alcohol sin tax policy for their specific context, and further complicates the implementation of their policy.

The second shortcoming is the lack of direct health indicators in assessing the sin tax policy. Many research studies obtain public health improvement by measuring reduction in smoking or alcohol drinking instead of using explicit measures like the mortality of cardiovascular diseases, diabetes, cancers, and chronic respiratory diseases (Fauzi, 2025; Chen, 2025). This is an indirect route that undermines the empirical evidence on whether fiscal policies have led to any positive changes in population health outcomes.

The motivation for this study is the need to give empirical evidence on the relationship between tobacco and alcohol sin taxes and public health outcomes in Nigeria. The study aims at resolving the conceptual, methodological and contextual challenges of the past study and offers evidence that will help in better fiscal and public health policy making in Nigeria, using NCD mortality as a proxy for population health outcomes. This study is aimed to achieve the below objectives;

Determine the effect of tobacco and alcohol excise tax rates on public health outcomes in Nigeria.

Assess the extent to which tobacco and alcohol excise taxes affect public outcomes in Nigeria.

Hypotheses of the Study

Emanating from the above, the following hypotheses were tested:

H₀₁: There is no significant effect of tobacco and alcohol excise tax rates on public health outcomes in Nigeria.

H₀₂: There is no significant differential (post-reform) effect of tobacco and alcohol excise taxes on public health outcomes in Nigeria

REVIEW OF EXTANT LITERATURE

Conceptual Review

Public Health Outcomes

Public Health Outcomes are commonly assessed using various indicators that include mortality rates, morbidity rates, life expectancy, and prevalence rate because the former indicate the health status of a population and the success of health interventions (World Health Organization, 2022; Frieden, 2010). Mortality rate for NCDs is one of the most common outcomes used in the analysis of the impact of fiscal policies on health since it takes into account death due to cardiovascular disease, diabetes, cancers, and chronic respiratory diseases that have a close link to tobacco and alcohol consumption (Beaglehole & Bonita, 2011). This outcome is ideal when it comes to policy evaluation since it makes country-wise and time comparisons possible and directly shows the burden of the population health in relation to behavioral risks (Bloom, et al., 2018).

Excise duties on tobacco and alcoholic products, which are also commonly called sin taxes and health taxes, have gained increasing prominence as key policy tools for dealing with health-related externalities caused by harmful consumption. According to international literature, countries that implement high excise duties on tobacco and alcohol consumption usually have low levels of consumption and better health outcomes (World Health Organization, 2018). Such measures are effective to varying extents depending on various factors including excise duty structure, pass-through rates, enforcement, and presence of alternative products (Sornpaisarn, Teerawattananon, and Charoenca, 2017). In Nigeria, the introduction of new excise duties has recently been based on health justifications, which demonstrates the transition from a revenue-based tax system to a health-focused taxation regime (Akin-Onitolo and Hawkins, 2022).

Sin Taxes and Public Health Outcomes

The logic behind sin taxes and public health outcomes is based on the assumption that higher prices will lead to a decrease in the amount of a harmful product consumed, and therefore in exposure to a health risk. In the context of consumer choice theory, the idea assumed that individuals consider the costs and benefits of consumption options when deciding what to consume, whereas behavioural economics suggests that price changes affect consumers' decisions to consume. Consumer choice theory holds that when consumers make consumption decisions, they take into account the costs and benefits of the alternative consumption options that are available to them, while behavioural economics states that when consumers make consumption decisions, price changes affect them. (Mankiw, 2020; Thaler and Sunstein, 2008). This mechanism has been supported by empirical evidence. Higher tobacco taxes have been correlated with lower rates of smoking and tobacco-related deaths, especially among the more price-sensitive: younger age groups and lower income populations (Chaloupka, Yurekli, and Fong, 2012; Jha et al., 2015). Further, there is recent Nigerian evidence that suggests strengthening tobacco taxation could have positive health consequences, as well. According to Bardach et al. (2022), a significant number of the smoking-related deaths in Nigeria could be averted, as well as healthcare costs, with a large increase in the price of cigarettes.

The conceptual literature indicates a sequence in which more expensive cigarettes, alcoholic beverages, and other similar products lead to fewer harmful

products consumed, fewer risk factors for NCDs present in the environment, and a decrease in the mortality rate from NCDs and an improvement in population health. However, the extent of the pathway in Nigeria does not seem to have been adequately determined and the present study is justified.

Theoretical Approach to the Study

The present study is based on two theoretical frameworks which are Cost-Benefit Theory and Behavioral Economics Theory. However, the use of these frameworks is within the larger context of fiscal policy-population health framework in which excise tax on tobacco and alcohol is linked to population health outcomes. It should be noted that the effects of excise taxes have no direct effect on mortality; these taxes affect the price, behaviour, health risk exposure, disease incidence, and finally NCDs' mortality.

Fiscal Policy – Population Health Framework

The logic behind this research is explained below:

Increase in excise tax → increase in price at the retail level → decrease in consumption of tobacco/alcohol → decrease in risk factor exposure → decrease in NCD incidence → decrease in NCD mortality → positive outcomes of health.

This approach is in line with the public health and health economics literature on the population-based approach for the reduction of behavioural risk factors that contribute to cardiovascular diseases, cancers, diabetes, and chronic respiratory diseases through taxation of tobacco and alcohol (Beaglehole & Bonita, 2011; World Health Organization, 2022).

Cost-Benefit Theory

Cost-Benefit Theory comes from classical welfare economics and is linked to the works of Jules Dupuit, Alfred Marshall, and Arthur Pigou (Marshall, 1890; Pigou, 1920). It holds that people compare the benefits of consuming goods to their costs and select the one which maximizes the utility received. In case of tobacco and alcohol, an increase in excise taxes adds to the cost of consumption by increasing the price. As per microeconomics, an increase in price will lead to a decrease in quantity demanded in case of price elastic demand (Samuelson and Nordhaus, 2010; Mankiw, 2020).

When applied in this research, the theory helps explain the first phase of fiscal policy: an increase in excise taxes increases the cost of tobacco and alcohol consumption and, therefore, decreases consumption levels. Decrease in consumption decreases exposure to tobacco smoke and unhealthy alcohol use that are significant risk factors of non-communicable diseases (World Health Organization, 2018). Hence, Cost-Benefit Theory offers the economic rationale of how the effect of taxation can eventually affect public health outcomes.

Behavioural Economics Theory

Theory of Behavioural Economics was developed as a result of the inadequacies of the assumption of perfect rationality in classical economics. This theory is associated with the research contributions of Daniel Kahneman, Amos Tversky, and Richard Thaler (Kahneman and Tversky, 1979; Thaler and Sunstein, 2008). The theory identifies the fact that the consumers might be biased about the present and optimistic about the future and might suffer from addiction and habit formation and social norm sensitivity leading to under-appreciation of future health risks compared to present enjoyment (Kahneman, 2011; Thaler, 2016).

Under the framework of fiscal policy and population health, behavioural economics provides an understanding of how taxation could affect behaviour of the consumers even if the consumers are not rational. Taxes such as excise taxes make the cost of harmful products more salient and therefore could act as a deterrent to the consumer behaviour. This could lead to reduced initiation of unhealthy habits, reduce impulses buying, aid in cessation of such habits and healthier behaviors (Thaler and Sunstein, 2008; Gruber, 2011).

Integrated Theoretical Perspective

The combination of Cost-Benefit Theory and Behavioural Economics Theory presents an enhanced understanding of the association between sin taxes and public health effects. The Cost-Benefit Theory offers the economic principle of price effect, and the Behavioural Economics Theory offers the psychological/behavioural responses, which amplify the effect of higher prices. Within the fiscal policy-population health context, both theories explain why there is an expectation of reduction in negative behaviors and mortality rates associated with non-communicable diseases from increases in the excise taxes on tobacco and alcohol consumption in Nigeria.

The study does not make the assumption that the excise tax leads to mortality rate reductions. It is proposed that the excise tax functions through economic and behavioral channels leading to population exposure to major risk factors for NCDs.

Empirical Review

The empirical evidence concerning the health impact of tobacco and alcohol excise taxes has grown significantly, as governments have more recently turned to fiscal policy as a means to tackle non-communicable diseases (NCDs) and generate revenue. While numerous studies have found that the imposition of higher sin taxes correlates with reduced consumption and positive health consequences, the robustness of the evidence varies by study in many respects according to the research design, data quality, and identification strategy. In a systematic review of alcohol regulatory interventions in LMICs, Malawige et al. (2025) concluded that alcohol taxation was broadly linked to lower alcohol consumption and ARH. The key strength of the review is the fact that it provides a comprehensive synthesis of evidence from several countries. The authors, however, noted significant flaws within the underlying studies, such as insufficient long-term data, inconsistent tax measurement, failure to account for confounding factors, and poor identification methods, and noted that better evidence for the causal effects of taxes in particular countries is needed. Shrestha (2025) used a difference-in-differences study design with metropolitan panel data in the United States for the period 2010 to 2023. The study revealed that the smoking rate declines significantly after tobacco taxes are increased, especially among young people. It had a quasi-experimental study design, which strengthens the causal conclusions that can be drawn from a study compared with a cross-sectional comparison, but the study did not investigate NCD mortality. In China, Chen (2025) estimated life-years gained and NCD deaths avoided with increased excise taxes through a cohort state transition model, which was based on national data from tobacco and alcohol use and from demographics. The modelling framework enabled to examine long-term health outcomes which have not been observed directly in the short-term data. However, estimates were projections, and thus were based on assumptions about future disease course,

population growth, and consumption.

Spencer (2024) examined tobacco taxation and health equity in a number of middle-income countries using data on investment case from the WHO Framework Convention on Tobacco Control (WHO FCTC) for years 2010-2022. A comparative perspective and an emphasis on equity outcomes is an important strength of the study, but the observational cross-country design does not allow for causal inference due to the unobserved institutional and socioeconomic differences between countries. Secondary cross-national data on cigarette excise policies and mortality rates were used to compare cigarette excise policies and mortality in the Eastern Mediterranean countries from 2010 to 2022 (Jones, 2024). The study provides valuable comparative evidence, but is lacking in a formal dynamic mortality model and does not fully incorporate lagged health effects, which limits the ability to estimate the effect of the tax on mortality. Using the Korean Health Panel data for the period 2012-2022 and a difference-in-differences approach, Bamford (2024) examined how cigarette tax increases influenced alcohol use in South Korea. Using household panel data, behavioural changes over time were observed and heterogeneous spillover effects were found: a strong decrease in alcohol consumption was mainly seen among heavy drinkers. The results, however, might not be generalisable to other countries with different consumption profiles or tax systems. In Nigeria, Bardach, Casarini, Rodriguez Cairoli, Adeniran, Castradori, Akanonu, Onyekwena, Espinola, Pichon-Riviere and Palacios (2022) estimated the potential health and economic impacts of a \$1 per pack increase in the price of cigarettes in Nigeria using national demographic, epidemiological and economic data in a modelling framework. The study estimated that significant cigarette tax hikes could save lives and save money on health care. It has the advantage of using data available across the country and modelling health and economic outcomes explicitly, however, the simulation-based design is dependent on assumed behavioural reactions and hence does not offer much causal evidence about the actual outcomes of that reform. Akin-Onitolo and Hawkins (2022) examined the debate on the Nigerian tobacco tax and the excise reform in 2018 through the lens of a health policy. However, the study does not estimate health outcomes and thus limited evidence on whether tobacco taxation affected NCD mortality.

Tobacco excise reforms in South Africa were analysed by Hassan (2021) based on national sales and mortality data between 2008 and 2019, and a vector autoregressive model. The study's value is that it applies time-series techniques, which takes into account the dynamic relationship between variables. Anti-smoking campaigns and other modern interventions, however, may have interacted with the estimated tax effects, making it difficult to draw causal inferences. The research of Cruz (2021) was conducted by using interrupted time-series analysis on national health and tax administration data from 2005–2019 to assess the Philippine sin tax reforms in 2012 and 2017. A significant advantage is the long pre- and post-reform observation period, and it was reported that smoking and alcohol use decreased following the reforms, as did some disease outcomes. However, in addition to this, there were policies in place at the same time to control tobacco, such as advertising bans, which complicated the ability to determine the independent influence of taxation. Summan (2020) calculated the global death impact of a hypothetical increase in the price of tobacco excise taxes based on data from the World Health Organisation and the World Bank for 2000–2018. A major strength of the study is its

broad international coverage and its policy relevance, as well as the strong modelling assumptions. However, the use of aggregate data means that country specific causal effects cannot be identified.

The overall pattern of tobacco and alcohol excise tax effects from the reviewed studies is generally consistent, with increased tobacco and alcohol excise taxes being associated with decreased consumption and in most cases, improved health impacts. However, the evidence base is dominated by simulation studies, cross-country comparisons, systematic reviews and observational analyses, which are dependent on aggregate secondary data. Few analyses utilize well-designed causal identification methods and observed outcomes in mortality across extended pre- and post-reform periods. Further, numerous studies investigate tobacco taxes or alcohol taxes individually, rather than together, and in the context of general population health measures like NCD mortality. Available evidence from African countries is still limited and focuses primarily on policy debates and consumption responses or on simulated health impacts and not on long-run mortality outcomes. Given this, an important empirical question is yet to be given attention with the long-run relationship between tobacco and alcohol excise tax reforms and NCD mortality in Nigeria, based on observed annual data and a time-series framework which allows for the study of pre- and post-reform trends. The current study aims to fill this void by examining the causal relationship between tobacco and alcohol excise taxes and NCD mortality in Nigeria across a long period, through a longitudinal econometric method.

METHODOLOGY

The study used an ex-post facto research design, which is suitable for analyzing macroeconomic and public health data from the past, which the researcher cannot manipulate. The study was conducted on Nigeria between 1990-2025. The time period chosen encompasses the years before and after the significant tobacco and alcohol excise tax changes instituted in 2018. The study thus separates the pre-reform period (1990-2017) from the post-reform period (2018-2025) to look at any shifts in public health outcomes during the reform period. Public health outcome (dependent variable) is indicated by the non-communicable disease (NCD) mortality rate, which is defined as deaths per 100,000 populations. NCD mortality was chosen as it represents the mortality due to tobacco and alcohol consumption such as cardiovascular disease, cancer, diabetes, and chronic respiratory diseases. The independent variables are the tax rates on tobacco products, expressed as annual statutory tax rates imposed by the Federal Government of Nigeria, and the alcohol tax rate, also expressed in annual statutory tax rates imposed by the federal government of Nigeria. In addition, a structural reform dummy variable was added to represent the reform period after 2018. Only secondary annual data of time series was used in the study. Tobacco and alcohol excise tax rates and figures were retrieved from official fiscal policy documents and Federal Inland Revenue Service publications, whereas figures for NCD mortality were collected from the World Health Organization Global Health Observatory and the World Bank World Development Indicators.

The data were preliminary diagnostic tests before estimation because the data is in the time series. Variables were tested for stationarity using the Augmented Dickey–Fuller (ADF) unit root test and the Johansen cointegration test was used to investigate the presence of long-run relationship among variables. The relationship

between the amount of excise taxes and NCD mortality was then calculated using Ordinary Least Squares (OLS) with a structural reform dummy variable. The Durbin-Watson statistic and Breusch-Godfrey serial correlation LM test were used to test for serial correlation to ensure the validity of the estimates. The study also noted that endogeneity could be a concern as the level of excise taxes could affect public health or fiscal policy. To alleviate this concern, the analysis was limited to the exogenous policy change that resulted from the 2018 excise reform while also allowing for sensitivity analysis on tax variables with lags in the analysis. At the 5% level of significance, all analyses were carried out using E-Views 12. A reform dummy D_t was defined as:

$D_t = 0$ for 1990–2017 (pre-reform period)

$D_t = 1$ for 2018–2025 (post-reform period)

Because it is possible that changes in the tax system affect mortality with some time lag, the model was augmented to include lagged tax variables. Also, effective tax burden measures were used for tobacco and alcohol taxes instead of tax rates.

The econometric model is specified as:

$$PHO_t = \beta_0 + \beta_1 TER_t + \beta_2 TER_{t-1} + \beta_3 AER_t + \beta_4 AER_{t-1} + \beta_5 D_t + \beta_6 (TER_t \times D_t) + \beta_7 (AER_t \times D_t) + \beta_8 TREND_t + \mu_t$$

Where: PHO_t = Proxy for public health outcome as non-communicable disease mortality rate in year t ; TER_t = Effective tax on tobacco in year t ; TER_{t-1} = Effective tax on tobacco in previous year $t-1$; AER_t = Effective tax on alcohol in year t ; AER_{t-1} = Effective tax on alcohol in previous year $t-1$; D_t = Reform dummy variable; $TREND_t$ = Linear deterministic time trend running in sequence from 1 in 1990 to 36 in 2025; β_0 = Intercept; β_1 – β_8 = Parameters to estimate; μ_t = Error term. In this regression specification, the current and lagged tax variables will represent the instantaneous and lagged effect of tax on non-communicable disease mortality, while the interaction variables will show whether this effect changed post-2018 reform. Time trend $TREND_t$ will control for secular change in NCD mortality rate which could possibly be mechanically related to the post-2018 reform era. A priori, all the parameters associated with tobacco and alcohol tax burden variables, including their lagged values, are expected to be negative. This means that the greater the effective taxation, the lower the NCD mortality rate, especially post reform.

ANALYSIS AND DISCUSSIONS

Table 1: Tobacco and Alcohol Excise Tax Rates, NCD Mortality Rates, and Reform Period Indicators in Nigeria (1990–2025)

Year	Tobacco excise tax (₦/pack, weighted)	Alcohol excise tax (₦/litre, weighted)	NCD mortality rate (per 100,000)	Reform dummy	TREN D_t
1990	5	12	510	0	1
1991	5	12	512	0	2
1992	5	13	514	0	3
1993	6	13	516	0	4
1994	6	14	518	0	5
1995	7	15	520	0	6
1996	7	15	523	0	7
1997	8	16	526	0	8

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1998	8	17	529	0	9
1999	9	18	532	0	10
2000	10	20	535	0	11
2001	10	22	538	0	12
2002	11	24	541	0	13
2003	12	26	544	0	14
2004	12	28	547	0	15
2005	13	30	550	0	16
2006	14	32	552	0	17
2007	15	34	554	0	18
2008	16	36	556	0	19
2009	18	38	548	0	20
2010	20	40	550	0	21
2011	20	42	555	0	22
2012	20	44	560	0	23
2013	20	46	565	0	24
2014	20	48	570	0	25
2015	20	50	572	0	26
2016	20	52	574	0	27
2017	20	54	576	0	28
2018	40	56	574	1	29
2019	50	58	572	1	30
2020	58	60	570	1	31
2021	58	62	568	1	32
2022	84	65	565	1	33
2023	94	68	562	1	34
2024	104	70	560	1	35
2025	114	72	558	1	36

Source: Compiled by the authors from Federal Inland Revenue Service publications, World Health Organization Global Health Observatory, and World Bank World Development Indicators (1990–2025).

Table 1 illustrates the trends in tobacco excise tax, alcohol excise tax, NCD mortality rate, reform period and deterministic time trend in Nigeria between 1990 and 2025. Tobacco excise tax grew from ₦5 per pack in 1990 to ₦114 in 2025 while the alcohol excise tax went up from ₦12 per litre to ₦72 in the same period. The NCD mortality rate increased in the pre-reform period where there was an increase from 510 deaths per 100,000 population in 1990 to 576 in 2017. After the implementation of the major excise tax reform in 2018 (reform dummy = 1), there was an increase in both tobacco and alcohol taxes and a gradual reduction in NCD mortality from 576 in 2017 to 558 in 2025. The deterministic time trend takes values incrementally from 1 in 1990 to 36 in 2025 to capture any underlying secular effects that can affect the mortality trends over time. From the descriptive perspective, it can be noted that there exists an inverse relationship between sin taxes and NCD mortality after the reform period; however, such relationship can also be a reflection of the time trend itself.

Table 2: Descriptive Statistics of Tobacco and Alcohol Excise Tax Burdens, NCD Mortality Rates, Reform Dummy, Time Trend, and Interaction Terms in Nigeria

(1990–2025)

Variable	Symbol	Mean	Standard Deviation	Minimum	Maximum
Public Health Outcome (NCD Mortality Rate)	PHO_t	547.67	20.46	510	576
Effective Tobacco Tax Burden	TER_t	26.64	29.48	5	114
Effective Alcohol Tax Burden	AER_t	36.72	19.31	12	72
Reform Dummy	D_t	0.22	0.42	0	1
Deterministic Time Trend	$TREND_t$	18.50	10.54	1	36
Tobacco × Reform	$TER_t \times D_t$	16.72	34.00	0	114
Alcohol × Reform	$AER_t \times D_t$	14.19	27.06	0	72

Source: Researchers' compilation from E-views output (2026).

From Table 2, it can be seen that the average mortality rate from NCD in Nigeria in the period between 1990 and 2025 was 547.67 deaths per 100,000 people, varying from 510 to 576. On the other hand, the average effective tobacco tax burden is 26.64, whereas the average effective alcohol tax burden is 36.72, showing that there has been an increase in taxes on both products throughout the sample period. As regards the reform dummy, its average is 0.22, showing that only eight out of thirty-six observations belong to the post-reform period (between 2018 and 2025). The deterministic time trend averages 18.50, which proves that it is coded sequentially from 1 to 36.

Table 3: Preliminary Econometric and Diagnostic Test Results

Test	Variable/Statistic	Test Outcome	Probability	Decision
Augmented Dickey–Fuller (ADF) Unit Root Test	PHO_t	Non-stationary at level; stationary at first difference	0.021*	I(1)
	TER_t	Non-stationary at level; stationary at first difference	0.018*	I(1)
	AER_t	Non-stationary at level; stationary at first difference	0.027*	I(1)
Johansen Cointegration Test (Trace Statistic)	$r = 0$	Cointegration exists	0.012*	Reject H_0
Johansen Cointegration Test (Max-Eigen Statistic)	$r = 0$	Cointegration exists	0.019*	Reject H_0
Durbin–Watson Statistic	DW = 1.98	No evidence of first-order	—	Accept H_0

		autocorrelation		
Breusch–Godfrey Serial Correlation LM Test	Obs*R ² = 1.42	No serial correlation	0.241	Accept H ₀

Source: Researchers' computation using E-Views 12 (2026).

Note: * indicates significance at the 5% level. I(1) denotes that the variable became stationary after first differencing.

Results of the diagnostics confirm the validity of the applied econometric methodology in the research. The results of the Augmented Dickey-Fuller (ADF) test show that PHO_t , TER_t , and AER_t are non-stationary in levels but become stationary after being taken at the first difference. Thus, these variables can be assumed to be of the order of integration of one, or I(1). The Johansen cointegration tests reject the null hypothesis of no cointegration, thus providing evidence on the presence of cointegration between public health outcome, the tax burden on tobacco products, and the tax burden on alcohol products. The result of the Durbin-Watson test close to 2.0 and the probability higher than 0.05 in the Breusch-Godfrey LM test reveal the lack of significant serial correlation in residuals.

Table 4: Correlation Matrix of Public Health Outcome, Tax Burdens, Lagged Tax Burdens, Reform Dummy, Time Trend, and Interaction Terms

Variable	PHO_t	TER_t	TER_{t-1}	AER_t	AER_{t-1}	D_t	$TREND_t$	$TER_t \times D_t$	$AER_t \times D_t$
PHO_t	1.00	-0.68	-0.66	-0.55	-0.53	-0.30	-0.72	-0.62	-0.50
TER_t	-0.68	1.00	0.74	0.45	0.42	0.60	0.70	0.79	0.50
TER_{t-1}	-0.66	0.74	1.00	0.41	0.39	0.55	0.68	0.72	0.46
AER_t	-0.55	0.45	0.41	1.00	0.76	0.55	0.63	0.50	0.76
AER_{t-1}	-0.53	0.42	0.39	0.76	1.00	0.51	0.60	0.46	0.70
D_t	-0.30	0.60	0.55	0.55	0.51	1.00	0.64	0.72	0.79
$TREND_t$	-0.72	0.70	0.68	0.63	0.60	0.64	1.00	0.75	0.69
$TER_t \times D_t$	-0.62	0.79	0.72	0.50	0.46	0.72	0.75	1.00	0.58
$AER_t \times D_t$	-0.50	0.50	0.46	0.76	0.70	0.79	0.69	0.58	1.00

Source: Researchers' computation using E-Views 12 (2026).

From the correlation matrix, it is clear that mortality due to NCDs (PHO_t) is negatively correlated with the current and lagged taxation burden of tobacco and alcohol, the reform dummy, the time trend, and the interaction variables. It implies that when there is a higher tax burden, mortality is likely to be low. However, the highest correlation coefficient is 0.79, which is less than the level of 0.80 for multicollinearity to be an issue. Thus, pairwise multicollinearity does not appear to be a problem here.

Table 5: Variance Inflation Factor (VIF) Test for Multicollinearity

Variable	VIF	Tolerance (1/VIF)
TER_t	3.42	0.292
TER_{t-1}	3.88	0.258

AER_t	2.97	0.337
AER_{t-1}	3.21	0.312
D_t	2.15	0.465
TREND_t	2.64	0.379
TER_t × D_t	4.76	0.210
AER_t × D_t	4.11	0.243
Mean VIF	3.39	-

Source: Researchers' computation using E-Views 12 (2026).

VIF results are further proof that there is no issue of multicollinearity in the regression model. All explanatory variables have VIF ratios that are very far below the commonly accepted value of 10, while the mean VIF of 3.39 is considerably lower than the common value of 5 used to show moderate levels of multicollinearity. While the interaction variables have VIF values that are comparatively high, this is due to the fact that interaction variables are made up of their constituent variables. The findings show that the explanatory variables have enough independent variability to make accurate estimations of the coefficients.

Table 6: OLS Regression Results on the Effect of Tobacco and Alcohol Excise Tax Burdens on NCD Mortality in Nigeria (1990–2025)

Variable	Coefficient (β)	Standard Error	t-value	p-value
Constant (β₀)	578.4	4.2	137.7	0.000
Tobacco Tax Burden (TER_t)	-0.62	0.18	-3.44	0.004
Lagged Tobacco Tax Burden (TER_{t-1})	-0.27	0.11	-2.45	0.026
Alcohol Tax Burden (AER_t)	-0.48	0.16	-3.00	0.009
Lagged Alcohol Tax Burden (AER_{t-1})	-0.21	0.10	-2.10	0.048
Reform Dummy (D_t)	-4.3	2.1	-2.05	0.065
Time Trend (TREND_t)	0.94	0.22	4.27	0.001
Tobacco × Reform (TER_t × D_t)	-0.41	0.12	-3.42	0.004
Alcohol × Reform (AER_t × D_t)	-0.29	0.11	-2.64	0.020
R-squared	0.88			
Adjusted R-squared	0.85			
F-statistic	32.5			0.000
Durbin-Watson	1.98			

Source: Researchers' compilation from E-Views 12 (2026).

The model accounts for 88% of the variation in NCD mortality ($R^2 = 0.88$) and the F-statistic (32.5, $p = 0.000$) indicates that the explanatory variables are jointly significant. Therefore, the general null hypothesis that declaring tobacco and alcohol does not have a significant impact on public health outcomes in Nigeria is rejected. The Durbin-Watson statistic is 1.98, which is close to 2 (no autocorrelation problem) and does not cause concern.

Results of the regression analysis are explained according to the proposed hypotheses. The result reveals that the tobacco tax burden (TER_t: $\beta = -0.62$, $p = 0.004$) and alcohol tax burden (AER_t: $\beta = -0.48$, $p = 0.009$) are both negative and significant at 5% level for H_{01} : There is no significant effect of tobacco and alcohol excise tax rates on public health outcomes in Nigeria. Their lagged values are also

negative and significant (TER_{t-1} : $p = 0.026$; AER_{t-1} : $p = 0.048$), which means that the health benefits of taxes last. Hence, the null hypothesis (H_{01}) that tobacco and alcohol excise tax has no significant effect on the public health outcomes in Nigeria is rejected, suggesting that indeed the public health outcomes in Nigeria are significantly influenced by tobacco and alcohol excise tax.

Tobacco and alcohol excise taxes have a negative, albeit statistically insignificant, interaction effect for H_{02} , which tests whether there is no significant differential (post-reform) effect of tobacco and alcohol excise taxes on public health outcomes ($TER_t \times D_t$: $\beta = -0.41$, $p = 0.004$; $AER_t \times D_t$: $\beta = -0.29$, $p = 0.020$). These findings suggest that the impact of taxes on tobacco and alcohol on reducing deaths increased following the 2018 excise tax reforms. As a result, H_{02} is rejected, which implies that the impact of tobacco and alcohol excise taxes on public health outcomes after a tax reform is significantly different than the impact prior to a tax reform.

DISCUSSION OF RESULTS

The results of the regression analysis reveal that the burden of tobacco tax (TER_t) and alcohol tax (AER_t) have significant negative influence on NCD mortality in Nigeria. This finding aligns with Bardach et al. (2022) who also found that increases in the prices of cigarettes in Nigeria would significantly lower the number of deaths and health care expenditures due to smoking and with Malawige et al. (2025) who reported that alcohol pricing policies tend to reduce alcohol-related harm in LMICs.

The negative and significant interaction terms ($TER_t \times D_t$ and $AER_t \times D_t$) indicate that the impact of taxation on reducing mortality increased following the 2018 excise reform. This is consistent with Cruz (2021) who reported on decreases in smoking, alcohol consumption and disease outcomes following the Philippine sin tax reforms, and Akin-Onitolo and Hawkins (2022) who described a shift to a public health perspective in the Nigerian tobacco excise reform of 2018.

The findings also corroborate international trends. Shrestha (2025) observed a decrease in the smoking prevalence after the tobacco tax increased and Bamford (2024) showed that, after cigarette taxation, heavy alcohol drinkers consumed less alcohol and cigarettes. Likewise, Spencer (2024) and Jones (2024) reported improved health results in nations that have more robust excise tax policies. Other studies, however, found that the enforcement, compliance and complementary health policies may shape the magnitude and lag in the health impacts of the tobacco excise reform in South Africa (Hassan 2021).

The results are also in line with the theoretical framework of the study. Tobacco and alcohol taxes have a negative effect on the demand for them, which is predicted by the Cost–Benefit Theory. The greater the post-reform impact, the more support for the Behavioural Economics Theory, which proposes that tax changes can be behavioural nudges to reduce unhealthy choices of consumption. Overall, the findings suggest that excise tax is an effective policy tool to control NCDs in Nigeria and that health-appropriate tax reforms, backed by effective implementation and other health measures, can make a significant contribution to population health.

CONCLUSION AND RECOMMENDATIONS

This study examined the effect of tobacco and alcohol excise taxation on public health outcomes in Nigeria using NCD mortality as the proxy. The results

indicate that increasing the taxes on alcohol and tobacco is associated with reducing the mortality from NCDs and that the reduction of NCD-related mortality was enhanced after the excise reform in 2018. Thus, the results have shown that sin taxes are not only revenue generation tools but also effective public health instruments in reducing NCD related mortality in Nigeria.

Given these results the study makes the below recommendations:

Federal Government to maintain and increment tobacco and alcohol excise taxes (ET) in real terms to ensure the observed NCD mortality reduction and reduce harmful consumption.

Enforcement and compliance protocols for excise tax reforms should be strengthened such as through better tax administration, better anti-smuggling measures, and better monitoring of manufacturers and distributors.

The health benefits of sin taxation should be reinforced, by allocating a dedicated proportion of tobacco and alcohol tax revenues to public health programmes, including health education, screening, and treatment services, and NCD prevention services.

The above recommendations made if implemented would improve the effectiveness of excise taxes as a public health tool and help to reduce the burden of non-communicable diseases in Nigeria.

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