Cigarette Prices and Smoking Experimentation in Sierra Leone: An Exploratory Study

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ABSTRACT

This study examines the effect of cigarette prices on the likelihood of experimental smoking among adolescents in Sierra Leone. The study links data from the 2017 Global Youth Tobacco Survey (GYTS) to price data covering 2008–2017 obtained from the World Health Organization (WHO). After employing duration analysis techniques, we find that increases in cigarette prices are associated with a lower probability of smoking experimentation, with an estimated price elasticity of −1.63 (CI: −.24 to −3.02). Other factors affecting an adolescent's decision to experiment with smoking are parental and friends' smoking status, gender, exposure to tobacco advertising, and income. We conclude that higher prices, through excise taxation, are important tools for controlling smoking uptake among the youth of Sierra Leone.

KEYWORDS: cigarette experimentation, elasticity, excise tax, cigarette prices, duration analysis, tobacco use

TYPE: Original Research

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Introduction

Tobacco use is a major cause of morbidity and mortality worldwide. Smoking is a major risk factor for many chronic noncommunicable diseases such as cancer and chronic obstructive pulmonary disease (COPD).[1] This imposes an economic burden on the society,[2,3] making tobacco control a global health priority. Although there has been a considerable decline in worldwide smoking prevalence following the implementation of tobacco-control policies, there are many people who still smoke,[4] and in some countries, especially in Africa and the Eastern Mediterranean, the number of smokers is expected to increase.[5]

Over the past few years, there has been a surge in multinational tobacco companies' activities in developing countries, especially those in Asia and Africa. The aim has been to develop new markets so as to increase sales. In Africa, for instance, cigarette production and consumption increased significantly between 1990 and 2012.[6,7] Aside from the industry's strategy, rising incomes in Africa will contribute to an increased smoking intensity and prevalence.[6] Thus, in the absence of effective tobacco-control measures, the economic burden of tobacco use will be aggravated.

In Sierra Leone, 28% of males and 4.4% of females smoked cigarettes in 2013.[8] It is an outlier in the African context—a country with a relatively high smoking prevalence compared to its neighbors in the region. As of 2016, age-standardized estimates showed that 17% of the population were current users of cigarettes. At the same time, prevalence rose to 31% among males, while prevalence among females declined slightly to 3.5%. It is estimated that smoking prevalence will reach 41.2% by 2025.[9] Since the majority of smokers start the habit in early life, usually before reaching age 18,[10,11] the future smoking prevalence will be driven by experimentation and initiation among young people. In Sierra Leone, 3.7% of students aged 13–15 years reported smoking cigarettes, and 6.0% used smokeless tobacco, in 2017.[12] Overall, smoking prevalence (smoked tobacco) was 7.1% among the youth.[12]

Knowing that young people are a potential source of future revenue, the tobacco industry targets schools and tempts nonsmokers to experiment.[13] This experimentation encourages daily cigarette smoking and creates a pool of future customers for the tobacco industry.[14,15] In Sub-Saharan Africa, about 75% of all young smokers experimented before reaching age 15.[11] Research also shows that smoking at an early age increases the risk of drug use and alcohol abuse,[16,17] which expose smokers to additional health risks. At present, smoking costs Sierra Leone

at least .5% of its gross domestic product (GDP)[2] and this burden will increase if smoking remains unchecked.

Although Sierra Leone has ratified the World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC), implementation has been weak and slow. Sierra Leone ranks lowest among African countries on implementation rates, at 9% of all FCTC articles.[18] Tobacco excise tax was only introduced in 2017.[19] As of 2018, the share of total tax in the retail price of cigarettes was only 18.6%[20]—far below the recommended 75% benchmark.[21] The low tax makes cigarettes cheap and affordable in the presence of rising incomes.[6]

At the same time, there are no restrictions on the sale of tobacco to minors and retailers do not display "No sale to minors" signs.[13] This not only violates Article 16 of the WHO FCTC, but also puts children at risk of smoking experimentation and uptake.

To date, there are no studies examining the link between youth tobacco use and cigarette prices in Sierra Leone except a report on a tax simulation exercise by the World Bank Group.[19] This study explores links between cigarette prices and smoking experimentation in Sierra Leone in order to assist in the design of tobacco-control policies, especially tobacco tax and youth access policies.

We focus on tax and price policies because these tools have been found to be the most cost-effective tools to reduce smoking intensity[22] and prevent participation,[23–27] and serves as a win-win policy by reducing consumption and providing revenue to governments to finance other health sector activities.[28] Taxation of harmful products also improves overall population health.[29] Our study and that of the World Bank Group are similar in the sense that the 2 studies focus on the role of tax and price measures as tobacco-control tools in Sierra Leone. The difference between the 2 studies is that the latter uses a simulation approach to model the expected changes in government revenue and cigarette consumption for all ages, while our study uses survey data to estimate the impact of price changes on experimentation among the youth.

Methods

Data

The study uses data from the 2017 Global Youth Tobacco Survey (GYTS) in Sierra Leone[12] and cigarette price data (for the most-sold brand) from the World Health Organization (WHO).[30] The GYTS is a global monitoring survey used to track tobacco use among young people. The Sierra Leonean GYTS is a cross-sectional survey of students in junior secondary schools (grades 7–9) and first-year students at senior secondary schools. Two waves of GYTS have been conducted in Sierra Leone: 2008 and 2017. The survey methodology follows a two-stage cluster sample design similar to GYTS in other countries. The 2008 survey did not cover the entire country but only some provinces. Given that our price data cover the period 2008–2017 at the national level, and the 2017 GYTS was conducted at the national level, using the 2017 dataset is more appropriate. For the purposes of this study, youth and adolescents are used interchangeably.

Figure 1 presents the trends in cigarette prices and income. Real per capita income in Sierra Leone rose from about SLL 1 million in 2008 to about SLL 1.4 million in 2014. From the year 2015, income experienced a downward trend. At the same time, prices of cigarettes declined between 2008 and 2010. The higher price peaked in 2014 and later declined again (Figure 1). In Figure 2, we present the trends in experimentation (percent of youth) in each year against real cigarette prices. The graph shows a negative relationship between cigarette prices and experimentation: a lower percentage of youth experiment cigarette smoking at higher prices, whilst a higher percentage of youth experiment smoking at lower prices.

This suggests that, in addition to non-price measures, policies that increase real prices of cigarettes can be a useful tool to prevent smoking experimentation among young people.

Study Sample and Statistical Analyses

We use descriptive statistics in the form of frequencies and percentages to summarize the data. We then employ duration analysis to examine the effect of cigarette prices and per capita income, as well as other demographic characteristics, on smoking onset among the youth of Sierra Leone. The duration analysis estimates the probability of the occurrence of an event and the time from attaining age 8 to the event. The age-at-risk is selected in line with the existing literature on youth smoking initiation.[24–26] Following earlier studies,[23–25,31,32] we construct a person-period dataset using the GYTS question "How old were you when you first tried a cigarette?" and age at the time of the survey.

A total of 6680 students in Junior Secondary School 2–3 and Senior Secondary School 1 were interviewed in 2017.[12] We excluded students who first tried smoking at age 7 or younger and those who experimented before 2008, as well as those with incomplete information on all variables of interest. In the end, the sample analyzed consisted of 5850 students. This dataset which had 5850 students is expanded using the STATA routine command "expand" and then linked to the annual real price dataset. An event variable, experimentation or tried, is created with at-risk students receiving 1 if they tried smoking within this period and 0 otherwise. Students exit the sample once they have tried their first cigarette, since we are interested in those who experiment with smoking for the first time.[23,25] The person-period dataset is usually referred to as pseudo-longitudinal or retrospective dataset.[23–26]

Similar to Vellios and Van Walbeek [23] and Guindon et al.,[25] we use a discrete-time hazard model, with dummy specification for time at risk measured in years. The approach is flexible to account for duration dependency and does not require a specific functional form. According to Jenkins,[33] discrete-time and

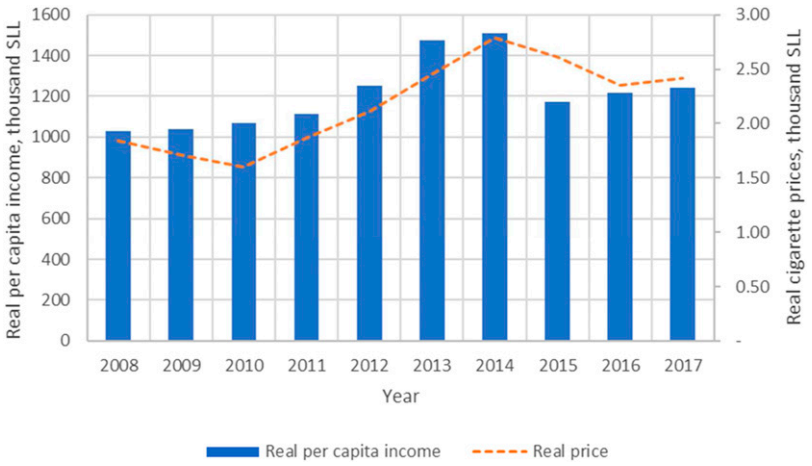

Figure 1. Trends in real cigarette prices and real per capita income, 2008–2017. Source: Authors' compilation.

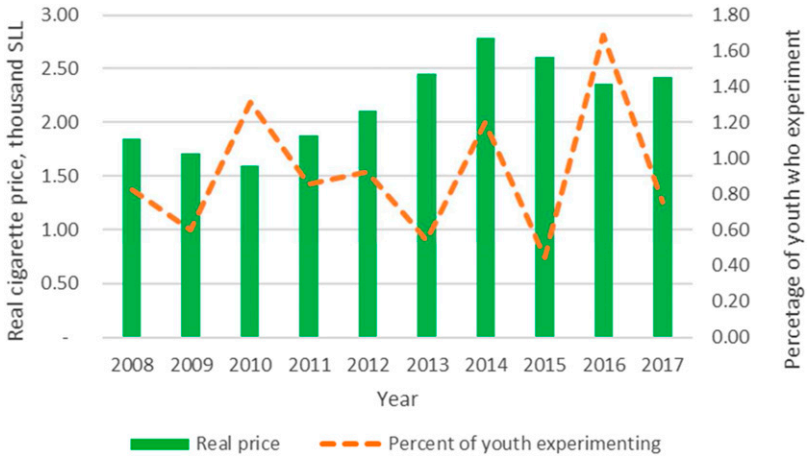

Figure 2. Trends in experimentation and real prices, 2008–2017. Source: Authors' compilation.

continuous-time specifications provide similar results. It must be noted that some individuals will never experiment with smoking, irrespective of price. Therefore, as a robustness check, we estimate a split-population model that accounts for the fact that many young people will never experiment with smoking (i.e., a large number of zeroes).[23,26] Those who had experimented with smoking before age 8 were left-censored, while we right-censored those who never experimented with smoking throughout the study.

The independent variables are average real cigarette prices and real per capita income, age, sex, family/friends' smoking status, and exposure to tobacco advertisements. The categorical variables do not change over time. Prices and income are measured in the Sierra Leone local (SLL) currency unit. Thus, apart from age, prices, and income, all other variables are categorical, hence treated as dummies. The continuous variables are time-variant.

A concern that usually arises in demand analyses is the endogeneity between price and consumption (in this case experimentation), which makes it difficult to disentangle the effect of price. While this is a genuine concern, we rule out the possibility of endogeneity in this study because no (potential) user consumes enough to influence the market price, and because we do not use self-reported prices for analyses.[25] For ease

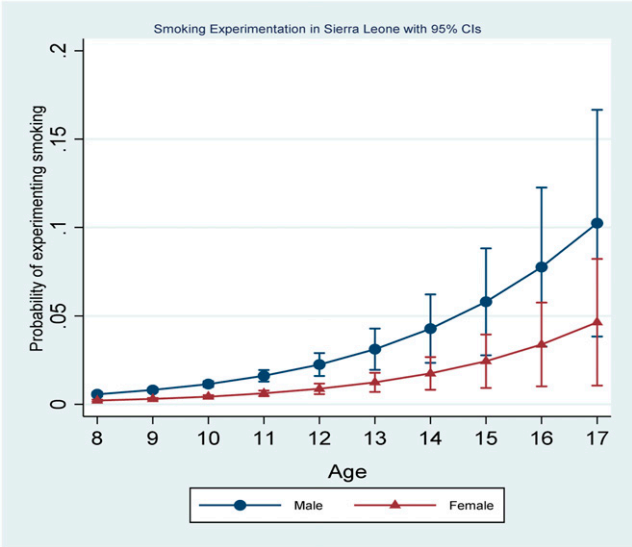

Figure 3. Probability of experimenting cigarette smoking.

Table 1. Descriptive Statistics of the Sample.

VARIABLE	STUDENTS, N = 5850
Females	49.95%
At least one family/parent member smokes	26.43%
At least one friend smokes	21.54%
Exposed to tobacco advertisements	81.61%
Percentage of failures/ever tried	7.84%
Mean age at the time of survey	15.44 (1.37)
Mean age at experimentation	11.76 (.13)
Average real price, 2008–2017	SLL 2176 (128)
Average real GDP per capita	SLL 1 211 909 (53 180)
Incidence rate (both sexes)	.009
Incidence rate: female	.005
Incidence rate: male	.014

Source: Authors. Standard deviation in parenthesis. SLL refers to Sierra Leone local (SLL) currency unit. Average exchange rate: US$1 = SLL 4665.

of interpretation of the results, we report odds ratios and use 100×(Odds Ratio − 1) to convert the odds ratios into percentages. The logistic regression model is as follows:

$$\Pr\left(\text{Experiment} = 1 \middle| X^{'}\right) = \beta_0 + \beta_1 P + \beta_i X^{'} \qquad 1$$

where Experiment is defined as first cigarette puff, P is the real price of cigarette, $X^{'}$ is a vector of other independent variables affecting smoking experimentation among the youth, and β is a vector of the regression coefficients. The predictors, $X^{'}$, represent the independent variables outlined above excluding price. We conduct all analysis using STATA 15 software[34] and estimate the price and income elasticities of smoking experimentation using STATA's routine command "margins."[35,36] The price elasticity is a measure of the responsiveness of demand to a change in the price.[24,25] In this study, price (income) elasticity represents the percentage change in the probability of experimenting smoking in response to a 1% change in price (income). Mathematically, the price elasticity is expressed as follows

$$\frac{dy}{dk} \times \left(\frac{k}{y}\right) \qquad 2$$

where k is the independent variable for which elasticity is needed and y is the dependent variable. The "margins" command produces the standard errors and confidence intervals based on the delta method, a method that treats the covariates at which the response is evaluated as given or fixed. Such standard errors are appropriate when making inferences about samples.[35,36]

Results

Descriptive Statistics

Table 1 presents the descriptive statistics of the variables under study. The study sample (analyzed sample) is 5850 students who satisfied the inclusion criteria.

The mean age of the sample is 15.44 years, with 49.95% female. The mean age at experimentation is about 12 years, suggesting that many young people experiment smoking before reaching age 18. In analyzing the data, 46 317 person-period observations are created to cover the years under study. Among the respondents, 26.43%, 21.54%, and 81.61% are found to have at least one family/parent member smoking, one friend smoking, and to be exposed to tobacco advertising, respectively. These numbers were based on the GYTS question on whether any family member, including parents, or friends smoked and whether they have seen or exposed to any tobacco advert. The incidence rate of experimentation is .009 (CI: .008–.0102). The incidence rate measures the number of new cases among those at risk. An incidence rate of .009 suggests that, on average, about 1% of young people experiment with smoking for the first time every year. Overall, the incidence rate among females is .005 (CI: .005–.006), while that of males is .014 (CI: .012–.016) (Table 1). The average retail price per pack of 20 cigarettes during the period (in 2010 prices) is SLL 2176. At the same time, real per capita income averaged at SLL 1 211 909 during the period.

Figure 3 shows that the average risk of adolescents experimenting with a cigarette increases with age from .003 to .112, and that males have a higher probability of experimenting than females.

Table 2. Effect of Cigarette Prices on Smoking Experimentation in Sierra Leone (2008–2017).

VARIABLES	LOGIT ODDS RATIO	SPLIT POPULATION: HAZARD RATE
Real price	.999**	.999**
	(.000)	(.000)
Real GDP per capita	1.0002***	1.0002***
	(.000)	(.000)
Sex		
Ref = Male		
Female	.533***	.531***
	(.057)	(.059)
At least one parent smokes		
Ref = No		
Yes	2.832***	2.875***
	(.288)	(.345)
At least one friend smokes		
Ref = No		
Yes	3.482***	3.534***
	(.361)	(.432)
Exposed to tobacco advertising		
Ref = No		
Yes	1.516***	1.519***
	(.237)	(.241)
Age	1.651	1.594
	(1.056)	(1.016)
Constant	.000***	.000**
	(.000)	(.000)
Cure_p Constant		.250 (.573)
Person-period observations	46 317	46 317
Number of people	5850	5850
Pseudo R-squared	.10	
Chi squared	459.4***	459.1***
Price elasticity of experimentation	−1.63**	
	(.709)	
Income elasticity of experimentation	2.29*** (.740)	

Standard errors in parentheses
***P < .01, **P < .05, *P < 0.1.

Regression Analysis

To find the association between cigarette prices and the decision to experiment with smoking, we estimate a discrete-time survival model using a logit specification (Table 2).

The results show a significant negative relationship between cigarette prices and smoking experimentation among the youth (OR = .999, P < .05). This implies that a unit increase in the cigarette price is associated with .1% lower probability of experimenting with smoking. Similarly, a unit increase in income is associated with .02% higher probability of smoking experimentation (OR = 1.0002, P < .01).

Other variables significantly associated with a higher probability of smoking experimentation are friends' smoking status (OR = 3.482, P < .01), parental smoking (OR = 2.832, P < .01),

and exposure to tobacco advertisements (OR = 1.516, $P < .01$). Compared to males, females are less likely to experiment with smoking (OR = .533, $P < .01$). The effect of age is positive, but statistically insignificant.

Table 2 also presents the results from the robustness check using the split-population model. The split-population regression result accounts for the fact that not all students will experiment with smoking even if cigarettes are free. All models provide qualitatively similar estimates and confirm that there is a statistically significant negative relationship between cigarette prices and smoking experimentation among the youth.

The price elasticity is −1.63 (CI: −.24 to −3.02) and is statistically significant at the 5% level. This means that a percentage increase in the price of cigarettes is associated with a 1.63% lower probability of experimenting smoking. The income elasticity of smoking experimentation is 2.29 (CI: .84–3.74). If income increases by 1%, the likelihood of smoking experimentation increases by 2.29%.

Sensitivity Analysis

The World Bank (Marquez et al.[19]) advises the government of Sierra Leone to peg specific excise taxes to the US$ to account for inflation and currency depreciation while adjusting the tax level for income growth to reduce the affordability of cigarettes. In this regard, we use data from Euromonitor to obtain the price per pack of 20 cigarettes in US dollars for the period. These data show that real (2010 = 100) price fell from US$0.87 in 2008 to US$0.26 in 2017. At the same time, real GDP per capita grew from US$ 385 in 2008 to US$463 in 2017, or by about 20%. During this period, aggregate cigarette consumption increased by about 24%.

With the new price information, we re-estimate the initial model and obtain the price elasticity of smoking experimentation as −.71 (−1.24 to −.8) (results not reported). The estimates from this new regression are within the range estimated using local currency (SLL) above. Thus, the decision to experiment with cigarette smoking is sensitive to price changes. The odds ratios for other explanatory variables (not reported) are similar to those obtained using the local currency unit.

Discussion

To prevent the expected increase in the number of smokers and the associated economic burden, effective tobacco-control measures must be instituted. Price increments through excise taxes have been found to be one of the most cost-effective tobacco-control tools.[28] Such measures prevent (young) people from initiating smoking and encourage current smokers to quit.[24,26] Indeed, a simulation study done by the World Bank Group showed a fall in total cigarette consumption and an increase in government revenue following the changes in tax policy.[19] This finding is similar to that obtained from our study: tax changes that significantly raise cigarette prices reduces consumption through reduced experimentation. It has been estimated that a 10% increase in cigarette prices is associated with a 2–6% lower probability of smoking initiation,[23–25] although some studies find higher elasticities.[26] The effectiveness of price interventions is even higher in low- and middle-income countries.[28]

In this study, rising cigarette prices are found to be significantly associated with a lower probability of smoking experimentation among adolescents in Sierra Leone. Holding all other things constant, a percentage increase in the price is associated with a 1.63% reduction in the probability of experimenting smoking. In Ghana and Nigeria, for instance, price elasticities of smoking experimentation have been estimated to range from −1.04 to −3.7.[26] Given that young people have lower incomes, rising prices can put cigarettes out of reach of many young people, thus lowering the probability of experimentation. Our findings are consistent with previous studies[23,25,26] and in line with tax simulations done in Sierra Leone.[19] Higher tobacco tax, that translates to higher cigarette prices, not only reduces consumption but also provides additional domestic revenue that can finance other health sector activities.[37] In line with the literature[23,26,28] and economic theory, income is a significant and positive determinant of smoking experimentation in Sierra Leone. Economic theory predicts a positive relationship between income and demand. In Sierra Leone, a percentage increase in income is associated with a 2.29% higher probability of experimenting smoking among adolescents.

Our results also show that parental and friends' smoking status are significant determinants of smoking experimentation among the youth of Sierra Leone. Adolescents whose parents smoke are much more likely to experiment with smoking. Research shows that parental smoking is an important determinant of intergenerational transmission of smoking behavior, and that adolescents in these households are susceptible to even more intense smoking patterns.[38–40] Children whose parents smoke may see it as socially acceptable behavior and are more likely to experiment. Consistent with the literature,[39] the odds of smoking experimentation are also higher for those whose friends smoke. Adolescents whose friends smoke have a 248% higher chance of experimenting with smoking, suggesting the influence of peers on the lifestyles of adolescents.

Similar to studies in Ghana, Nigeria, and the US,[26,41] we found that the exposure to tobacco advertisements increases the likelihood of smoking experimentation. Knowing that young people are the key to future profitability, the industry targets this population group in its marketing. In Sierra Leone, for example, tobacco companies are advertising and selling their products aggressively around schools.[13]

Females in Sierra Leone have a lower probability of experimenting with smoking relative to males, a result similar to other countries in the region.[26] This could be due to males being more risk-seeking than females. It is socially acceptable for adult

men to smoke than for adult women.[22,42] This may explain gender differences in smoking experimentation found in Sierra Leone.

Conclusion

This study examines the effect of cigarette prices on the likelihood of experimenting with smoking among adolescents in Sierra Leone. We find that young people are sensitive to cigarette price changes: a 1% increase in cigarette prices is associated with a 1.63% lower probability of smoking experimentation. Our findings support the use of tax and price measures to control tobacco use among adolescents in Sierra Leone. Given that higher income is associated with more smoking experimentation, the excise tax policy needs to account for income growth in order to discourage young people from experimenting.

Aside from tax and price measures, our findings also point to a positive association between exposure to tobacco advertising and smoking experimentation. For this reason, Sierra Leone must ban any form of tobacco advertising, especially around schools. This is particularly important given the current advertising strategies of the tobacco industry in Sierra Leone.[13] Further, smoking cessation interventions targeting parents and friends who smoke would help to reduce the risk of experimentation among adolescents. Sierra Leone should continue to implement tax and price, as well as non-price, policies to prevent potential smokers from experimenting and possibly becoming regular smokers. The introduction of the excise tax in 2017 is a step in the right direction. Nevertheless, the design and administration of the tax should give no room for the tobacco industry to manipulate the system.

Even though we are confident in our results, they are subject to some limitations. First, we were able to obtain price data for only certain years, which reduced the number of person-period observations. The GYTS data used by this study come from a self-reporting survey, which means that the responses are prone to recall errors. Many adolescents may not remember their exact age at experimentation, which determines their inclusion in or exclusion from the study. Another issue relates to social desirability bias when self-reporting social behaviors like smoking and alcohol use, especially among females. To conform to societal norms, people may choose to under-report in such surveys. Factors such as community norms with respect to smoking, enforcement of laws on the sale of tobacco to minors, and changes in the social image of smoking may influence smoking experimentation but are not captured in our models due to lack of data. Other limitations include the use of time-invariant characteristics like sex, and non-inclusion of parental educational level due to data paucity. Future studies may address these limitations when examining the factors influencing smoking experimentation among the youth. Notwithstanding these shortfalls, our exploratory study provides a general picture of the link between smoking experimentation and price and non-price factors in Sierra Leone.

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