



# Tobacco Control and Public Health in Eastern Europe

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## Tobacco use and the risk of catastrophic healthcare expenditure

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**BACKGROUND:** Tobacco consumption increases the chance that an individual will suffer from ill-health. Financial cost associated with increased demand for medical care can be substantial and catastrophic, especially for households in the lowest income stratum. This paper extends what is known about the poverty impact of tobacco use by estimating the increased risk of incurring higher catastrophic health expenditure because of tobacco consumption.

**METHODS:** The data for the study were drawn from the Harmonized Nigerian Living Standard Survey (HNLSS) conducted in 2009/2010 by the National Bureau of Statistics. Three log-linear models of health expenditures were used to predict the health expenditure attributable to tobacco consumption. The incidence of catastrophic health expenditure (CHE) was estimated using the standard 40-percent threshold of household total non-food expenditure.

**RESULTS:** Based on the three log-linear regression models, smokers had higher health expenditure compared to non-smokers (by 43.91%, 33.23% and 41.51%). Excess average health expenditure attributable to tobacco use was the highest among moderately poor smokers (Nigerian national cur-

rency Naira (NGN) 37,734.90 (USD251)) and the lowest among non-poor smokers (NGN 7,819.78 (USD52)). In addition, extremely poor smokers incurred higher medical expenditure attributable to tobacco use compared to non-poor smokers. Among the non-poor households, 23.87% experienced CHE in the rural areas and 13.62% in the urban ones. Accounting for the predicted excess medical expenditure among smokers, there was a 3.11% increase in the burden of CHE among households living in rural location. Overall, excess medical expenditure associated with tobacco use increased the incidence of CHE among households.

**CONCLUSION:** Essentially, smoking will aggravate the financial hardship of households because of higher burden of CHE in the short and long run. Therefore, healthcare policymakers in Nigeria can reduce the excessive financial burden attributable to smoking by developing policies that curtail tobacco consumption. Evidence provided in this study supports this.

**KEYWORDS:** catastrophic health expenditure; tobacco consumption; excess medical expenditure; out-of-pocket payment; healthcare financing; Nigeria.

## INTRODUCTION

Tobacco consumption precipitates ill-health, and the financial cost of increased demand for medical care can be substantial and catastrophic, especially for households in the lowest income stratum. A study showed that about 8.7 percent of all medical spending in the United States in 2012 was a result of ill-

nesses caused by tobacco use (X. Xu, Bishop, Kennedy, Simpson, & Pechacek, 2015).

Previous research has shown that poor households experience higher rates of mortality and morbidity from most diseases compared to rich households (Bobak, Jha, Nguyen, Jarvis, & Mundial, 2000; Harrison, Feehan, Edwards, & Segovia, 2003). As such, tobacco consumption and its socio-eco-

nomics and health consequences will further contribute to social gradient in health and increase the gap between the poor and the rich. This contradicts the goals of reducing inequality between the two groups as articulated by the Sustainable Development Goals (SDGs).

Burden of catastrophic healthcare expenditure (CHE) has become a major public health concern globally and especially in developing

countries where out-of-pocket (OOP) expenditure is the main source of healthcare financing (Daneshkohan, Karami, Najafi, & Matin, 2011; Gotsadze, Zoidze, & Rukhadze, 2009; K. Xu I, 2003). According to WHO statistics (2009), over 74.9% of total healthcare expenditure in Nigeria in 2009 was through OOPs. These OOP payments for healthcare cause poor households and households on the margin of poverty to incur CHE, which in turn can subject them to perpetual poverty.

Worse still, the experience of CHE will be higher among poor and smoking households both in the short- and long-term as tobacco use is likely to contribute to the increase in demand for healthcare services (Bonu, Rani, Peters, Jha, & Nguyen, 2005; Fishman, Khan, Thompson, & Curry, 2003; Herdman, Hewitt, & Laschober, 1993; Lightwood & Glantz, 1997). A study conducted in South Africa showed that the annual medical expenditure of current smokers in 2010 was 11% higher than that of non-smokers (Sturm, An, Maroba, & Patel, 2013). Invariably, a decline in tobacco use will reduce tobacco-related morbidity and assist in avoiding a cycle of poverty resulting from excessive healthcare expenditure.

A review of prevalence-based sub-national studies on tobacco use in Nigeria covering the last three decades revealed rising smoking rates in all age groups, particularly among youth and women (Nwhator, 2012). According to Adeniji, Bamgboye & van Walbeek (2016), the overall smoking prevalence in Nigeria was 4.4% in 2012. This represents about 4.5 million smokers and of these, 78.1% consumed tobacco daily.

In 2005, a study estimated the burden of chronic diseases and related loss of economic output in selected 23 developing countries including Nigeria. The countries selected for the study account for approximately 80% of total mortality burden attributed to chronic diseases in developing countries (Abegunde, Mathers, Adam, Ortegón, & Strong, 2007). These chronic diseases include tobacco-related illnesses such as cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes. The study showed that Nigeria had the third highest burden of chronic diseases in Africa, behind Egypt and the Democratic Republic of Congo. In particular, age-standardized mortality rate from chronic diseases was estimated at over 800 per 100,000 population in Nigeria (Abegunde, Mathers, Adam, Ortegón & Strong, 2007).

Moreover, there is a substantial body of literature linking tobacco consumption to increase in the ill-health and as a direct consequence, increase in the demand for medical care (John, Sung, Max, & Ross, 2011b; Liu, Rao, Hu, Sun, & Mao, 2006; Xin et al., 2009a). This paper extends what is known about the poverty impact of tobacco use by estimating the increased risk of incurring CHE attributable to tobacco consumption with the view that tobacco control will protect households, especially poor households from incurring CHE. This represents a desirable goal of health policy (Bovbjerg, 2001; Filmer, Hammer, & Pritchett, 2002; Kawabata, Xu, & Carrin, 2002; Russell & Gilson, 1997).

## DATA AND METHODS

The data for this study were drawn from the Harmonized Nigerian

Living Standard Survey (HNLSS) conducted in 2009/2010 by the National Bureau of Statistics. The HNLSS survey collected broad information on demography, health and fertility behavior, education and skill training, employment and time use, household income, consumption and expenditure on a broad category of commodities including tobacco products (National Bureau of Statistics, 2012). This survey adopted the Enumerated Areas demarcated by the National Population Commission during 2006 Housing and Population Census. The sampling frame of the survey included all the 774 local government areas in the 36 states in Nigeria and the Federal Capital Territory (FCT). A two-stage sampling design was used to systematically select 100 households in each local government area for part A of the survey; 50 households were systematically selected from each local government area in part B. Part A contained a welfare component while part B elicited information on household consumption and expenditure. Altogether, 77,400 households were enrolled in the study. The B component (the consumption approach) of the survey included 38,700 households that are nationally representative. This section of the survey was used for this study since it provided information on the expenditure of the households in Nigeria. All the expenditures were recorded in Nigerian national currency Naira (NGN) and the average exchange rate during the period of data collection was 1 USD to NGN150.3346.

Household per capita expenditure was used to categorize households into non-poor, moderately poor and extremely poor. Any household with annual per capita expenditure greater or equal to two-thirds of the

weighted mean per capita expenditure (WMPCE) was categorized as non-poor. Any household was categorized as moderately poor if the household's annual per capita expenditure was less than two-third and greater than one-third of WMPCE, while households with annual per capita expenditure less than one-third of the weighted mean per capita expenditure were categorized as extremely poor (National Bureau of Statistics, 2012).

The incidence of CHE was estimated using the 40-percent threshold used by the World Health Organization (Daneshkohan et al., 2011; WHO, 2005; K. Xu et al., 2003), and "capacity to pay" (or non-food expenditure) was used as the denominator with healthcare expenditure as the numerator. Households whose medical expenditure was greater than 40 percent of total non-food expenditure were considered to have incurred CHE. If  $H_e$  represents out-of-pocket expenditure on healthcare,  $E$ , total household expenditure, and  $f(e)$ , total food expenditure or non-discretionary expenditure, then a household incurred CHE when:

$$H_e / (E - f(e)) > z \quad (1)$$

where  $z$  represents a specific threshold (in this case 40%). The value of  $z$  represents the point at which the absorption of household resources by spending on healthcare is considered to cause impoverishment. To predict the health expenditure attributable to tobacco consumption, we estimated three log-linear models (Liu et al., 2006; Xin et al., 2009b). The health expenditure function was specified thus:

$$\ln HE + I = \alpha_0 + \alpha_1 S_h + \alpha_2 Q + \varepsilon \quad (2)$$

where  $\ln HE$  is a logged household health expenditure (1 is added to

health expenditure to ensure that it is a positive number, especially for households that reported zero health expenditure),  $S_h$  is a dummy variable for household smoking status (1 for households with at least one smoker and 0 for households with no smokers), and  $Q$  is a vector of households' socio-demographic characteristics, as it was necessary to control for other household characteristics that were likely to affect household health expenditures. A counter-factual scenario for equation (2) was also estimated (i.e., assuming that smokers never smoked so that the ones in the dummy variables are replaced with zeroes).

Therefore, the predicted healthcare expenditure attributable to tobacco consumption was calculated as follows:

$$H(HE) = H(HE_s) - H(HE_{cf}) \quad (3)$$

where  $H(HE)$  denotes the predicted excess health expenditure attributable to tobacco consumption,  $H(HE_s)$  is the estimated health expenditure for smokers in equation (2) and  $H(HE_{cf})$  is the counter-factual. The risk of incurring CHE (which is also a measure of the poverty impact of tobacco use) was therefore ascertained by subtracting  $H(HE)$  from the denominator, the capacity to pay in equation (1).

The expression becomes:

$$H_e / (E - f(e) + H(HE)) > z \quad (4)$$

The reference group in equations (1) and (4) were households that had no tobacco use in their consumption set. More importantly, in determining the impact of excess medical expenditure on tobacco consuming households, the average excess expenditure was added to the average health expenditure and deducted from the capacity of

smoking households to pay. This approach has been used by Liu et al. (2006) and Xin et al. (2009b).

### Statistical Analysis

Three log-linear models were estimated. In model 1, we assessed unadjusted associations of smoking status and health expenditures. Next, we compared the results of this model to model 2 and 3, where we controlled for household socio-economic variables such as age, education level, household location (rural or urban) and household poverty status (extremely, moderately or non-poor), all merged into three categories. In addition, the budget share of tobacco consumption was included in model 2 in order to improve the explanatory power of the model as well as to capture the effect of varying budget shares of tobacco consumption.

In order to predict the excess health expenditure attributable to tobacco use, model 2 was considered appropriate since the model controlled for all important socio-economic covariates and household smoking status was significant.

All statistical analyses were carried out in R 3.4.1. All results at 10% significance level were considered significant.

## RESULTS

### Effect of tobacco consumption on household health expenditures

Table 1 shows the estimation of the effect of tobacco consumption on household health expenditures. Generally, tobacco use was significantly associated with an increase in health expenditures. Smokers had higher health expenditures (by 43.9%, 33.2% and 41.5%) compared to non-smokers.

**Table 1. Results of the three estimated models with household health expenditures as the outcome of interest**

	Model 1		Model 2		Model 3	
	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
Intercept	4.2376***	0.0258	0.1846	0.1511	4.5545***	0.1550
Smoker	0.4391*	0.2142	0.3323*	0.1884	0.4151*	0.2141
Age 15 - 35			-0.8604***	0.0615		
Age 36 - 55			-0.4688***	0.0548		
Rural dwelling			-0.7324***	0.0540	-0.1872***	0.0595
Moderately poor			0.6166***	0.1690	0.4711**	0.1920
Extremely poor			0.5000***	0.1365	-0.3108**	0.1541
Primary/Secondary			0.4085***	0.0505		
Post-Secondary/College			-0.4411***	0.0760		
Budget share of tobacco consumption			0.1073***	0.0011		
Adj. R <sup>2</sup>	9.21E-05		0.2278		0.001308	
F-Stat	4.203**		1141***		12.38***	
BIC	207,457.4		198,548.4		207,443.5	

Note: 1%, 5% and 10% level of significance are denoted by “\*\*\*”, “\*\*” and “\*”, respectively.

**Predicted average excess health expenditure attributable to tobacco use**

The coefficient on the dummy variable for smoking status helps in predicting the average excess health expenditure incurred by smokers within different poverty categories (shown in Table 2).

Excess average health expenditures were the highest among smokers that are moderately poor and lowest among non-poor smokers. Also, extremely poor smokers incurred higher medical cost due to tobacco use compared to non-poor smokers. This revealed that poor households demand more

**Table 2. Annual excess average health expenditure**

Poverty Status	N	Predicted average excess health expenditure incurred by smokers, in Nigerian Naira
Extremely poor	466	13,168.30
Moderately poor	28	37,734.90
Non-poor	11	7,819.78

**Table 3. Annual average health expenditure before and after accounting for excess health expenditure**

	N	Average Health Expenditure				
		Non-Smokers		Smokers		
		Mean	Standard Error	N	Mean	Standard Error
<b>Before accounting for excess health expenditure</b>						
Extremely poor	31,711	28,583.08	485.29	466	39,627.75	5,010.15
Moderately poor	1,542	68,104.20	4,929.48	28	113,557.00	37,894.48
Non-poor	1,011	54,326.50	5,070.35	11	23,532.30	15,830.13
<b>After accounting for excess health expenditure</b>						
Extremely poor	31,711	28,583.08	485.29	466	52,796.05	3,345.28
Moderately poor	1,542	68,104.20	4,929.48	28	151,291.90	25,302.15
Non-poor	1,011	54,326.50	5,070.35	11	31,352.08	10,569.78



medical services, and tobacco use may subject these households to higher medical expenditure, which could increase the chance of economically less viable households getting poorer. Table 3 shows the average health expenditure before and after accounting for predicted increase in health expenditure because of tobacco use. Overall, tobacco use increased average health expenditure for all smoking households, whether extremely poor, moderately poor, or non-poor.

#### **Risk of catastrophic health expenditure before and after deduction of excess health expenditure attributable to tobacco use**

Table 4 shows frequency and percentages of CHE cases by household poverty status, sector and smoking status. The results revealed that 21.78% of extremely poor households residing in rural setting and 15.45% in urban areas experienced CHE. Moderately poor households residing in rural loca-

tion had the highest percentage of CHE (29.12%) compared to other households. Likewise, non-poor households experienced CHE, 23.87% for households in rural settings and 13.62% for non-poor urban residents. Excess medical spending attributable to tobacco use increased the risk of CHE among non-poor rural residents by 0.32% and slightly increased the experience of CHE for majority of the households. However, this increase in CHE can be substantial

**Table 4. CHE Experience of Households by Poverty Status, Sector and Smoking Status**

	Sector	CHE (Pre-deduction of health expenditure attributable to tobacco consumption)		CHE (Post-deduction of health expenditure attributable to tobacco consumption)		Total
		No	Yes	No	Yes	
<i>Poverty Status</i>						
Extremely poor	Rural	19,146 (78.22%)	5,330 (21.78%)	19,136 (78.18%)	5,340 (21.82%)	24,476
	Urban	6,511 (84.55%)	1,190 (15.45%)	6,511 (84.55%)	1,190 (15.45%)	7,701
Moderately poor	Rural	465 (70.88%)	191 (29.12%)	463 (70.58%)	193 (29.42%)	656
	Urban	776 (84.90%)	138 (15.10%)	776 (84.90%)	138 (15.10%)	914
Non -poor	Rural	236 (76.13%)	74 (23.87%)	235 (75.81%)	75 (24.19%)	310
	Urban	615 (86.38%)	97 (13.62%)	615 (86.38%)	97 (13.62%)	712
<i>Smoking Status</i>						
Non-smoker	Rural	19,519 (78.00%)	5,505 (22.00%)	19,519 (78.00%)	5,505 (22.00%)	25,024
	Urban	7,834 (84.78%)	1,406 (15.22%)	7,834 (84.78%)	1,406 (15.22%)	9,240
Smoker	Rural	328 (78.47%)	90 (21.53%)	315 (75.36%)	103 (24.64%)	418
	Urban	68 (78.16%)	19 (21.84%)	68 (78.16%)	19 (21.84%)	87
		Percentage of Smokers with CHE (Pre-deduction)		Percentage of Smokers with CHE (Post-deduction)		Difference
All		21.58		24.16		2.57
Rural		21.53		24.64		3.11
Urban		21.84		21.84		0.00
Extremely poor		21.03		23.18		2.15
Moderately poor		35.71		42.86		7.14
Non-poor		9.09		18.18		9.09

for households in the lowest income stratum and could cause further impoverishment for these households. Excess average medical expenditure attributable to tobacco use increased the risk of CHE by 3.11% among households living in rural location. For all smoking households, health expenditure attributable to tobacco use increased the risk of CHE by 2.57%, with the highest effect occurring among non-poor households. Overall, smoking increased the incidence of CHE among all households irrespective of their poverty status.

## DISCUSSION

The association between tobacco use and increased medical expenditures is already well established in published research. This study examined the risk of elevated burden of CHE as a result of tobacco use in Nigeria. Consistent with previous research (Xin et al., 2009a; X. Xu et al., 2015), the results in this study revealed that excess medical expenditure attributable to tobacco use resulted in higher risk of CHE and, as expected, this impact was more profound on poor households. Smokers had higher health expenditure compared to non-smokers in the three estimated models. This presupposes that poor households with at least one smoker demand more medical services and as a result, expend more on healthcare, which could also have spill-over or cascading effects on the consumption of other social goods. Excessive medical spending poses enormous financial burden on households, regardless of whether they are poor or not, and can quickly drive households into poverty. A similar result is found in a study conducted on the healthcare use and expenditures at-

tributable to smokeless tobacco consumption among adults in the United States, where smoking resulted in total annual excess expenditures of \$3.4 billion after accounting for the costs of hospitalizations, emergency room visits, and doctor visits (Wang et al., 2017). Similarly, in another study, smoking was revealed to cause higher medical spending, which resulted in increase in household poverty (Xin et al., 2009a, 2009b).

Estimates in this study indicated that excess average expenditure for smoking households was higher among extremely and moderately poor households compared to non-poor households, with these households having average excess medical spending of NGN 13,168.30, NGN 37,734.90, NGN 7,819.78, respectively. Also, average expenditure in poor and smoking households already higher than what it was in poor households without smokers, had a further increase after accounting for excess average expenditure attributable to tobacco use. This finding reiterates the possible adverse effects of tobacco use on health outcomes such as patients' average length of hospital stay and overall clinical outcomes during and after treatment. Smoking has also been associated with higher risk of postoperative complications (Terry-McElrath, O'Malley, & Johnston, 2017). A study carried out on the effect of smoking status on the long-term outcome after successful percutaneous coronary revascularization revealed that patients who continue to smoke after successful percutaneous interventions have a higher risk of death from any cause than those who stopped smoking (Hasdai, Garratt, Grill, Lerman, & Holmes Jr, 1997). In addition, a study conducted in

China found that indirect medical care and costs associated with tobacco use was higher among smokers than non-smokers (Xin et al., 2009a).

Prior to ascertaining the effect of tobacco use on increase in household burden of CHE, our results showed that some households, irrespective of their poverty classifications, experienced CHE. This is not surprising given that OOP, in most cases in the form of fee-for-service, remains the major source of health care financing in Nigeria and because of this, medical spending poses high financial burden on household budgets. In rural locations, the baseline burden of CHE was the highest among moderately poor households, 29.12%, versus 21.78% among extremely poor households. The experience of CHE was generally higher among households living in rural areas compared to those residing in urban centers. This could be due to the general level of poverty in rural settings and the fact that poor households experience higher rates of ill-health from most diseases compared to rich households (Bobak et al., 2000; Harrison et al., 2003). Accordingly, tobacco use will further increase the risks of ill-health and CHE among households in the low and lowest income strata, especially in rural settings. Accounting for the effect of excessive medical spending on the burden of CHE, non-poor rural residents experienced 0.32% increase in the risk of CHE. Excess medical expenditure attributable to tobacco use had a slight, however, considerable effect on the CHE experienced by majority of the households. Moreover, tobacco use increased the burden of CHE by 3.11% among households living in rural location. For all smoking house-

holds, excess health expenditure attributable to tobacco use increased the risk of CHE by 2.57%. Overall, smoking increased the risk of CHE among all households irrespective of their poverty classification.

A limitation of this study was a likely underestimation of the effect of higher medical costs attributable to tobacco consumption since the health expenditure data collected in the survey did not account for indirect costs such as productivity loss, time spent seeking health care services, caregiver cost, the transportation costs from patient homes to the hospital and intangible costs (the costs of pain).

## CONCLUSION AND POLICY IMPLICATION

This study found that excess medical costs attributable to tobacco use increased the risk of incurring CHE, especially for less economically viable households residing in rural locations. Essentially, due to the sub-optimal nature of health financing infrastructure in Nigeria, smoking will aggravate the financial hardship of households due to the increase in OOP for healthcare services in the short and long run. Therefore, with the healthcare policymakers seeking to increase the coverage of social healthcare financing, policies that further curtail tobacco consumption as well as encourage cessation is highly supported by the evidence provided in this study.

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