

Social Determinants of Health, Religiosity and Tobacco Use in Sub-saharan Africa: Evidence From the Global Adult Tobacco Survey in Seven Countries.

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Abstract

Background

Tobacco use is projected to increase in sub-Saharan Africa (SSA) over the next century, and delineating the patterns of inequality in tobacco use will facilitate its control within this region.

Methods

Using nationally representative data from Global Adult Tobacco Surveys (GATS) conducted in seven SSA countries (2012–2018), this study explores the association between the social determinants of health and tobacco use among SSA adults. The surveys provided information on 47,246 adults aged 15 years or older in Cameroon, Ethiopia, Kenya, Nigeria, Senegal, Tanzania, and Uganda. Current tobacco use prevalence was estimated in each country overall and across socioeconomic and demographic factors (sex, age, residence, education, wealth, religion, marital status, and tobacco health knowledge). Multiple logistic regression analysis was used to assess the association of these determinants with current tobacco use in each country and for the combined dataset. The pooled data analysis was further stratified by tobacco product category and sex.

Results

We found significant homogenous associations between the social determinants and tobacco use across all countries. For the pooled data, smoking was independently associated with male sex, rural residence, greater age, lower education and health knowledge, and irreligiousness. For smokeless tobacco (SLT) use, the trends were similar and stronger for all determinants except sex. Among women only, the odds of smoking and SLT use respectively increased and decreased with greater wealth.

Conclusions

Tobacco use is significantly associated with socioeconomic deprivation in SSA (stronger for SLT use than for smoking). These findings highlight opportunities for targeted interventions within SSA.

1. Introduction

Socioeconomic factors (education, occupation, income, race, etc.) are important determinants of health, with lower socioeconomic status (SES) consistently associated with poorer health outcomes (Braveman and Gottlieb 2014). One proposed mechanism of this phenomenon is through the modifying effect of the social determinants on health behaviours such as exercise, diet and tobacco use (Solar and Irwin 2007). Multiple studies in developed countries have found higher tobacco smoking prevalence in the lower socioeconomic strata of society, which in turn results in worse health outcomes and higher mortality rates in this deprived group (Mackenbach et al. 2008).

The global burden of tobacco-associated morbidity and mortality is disproportionately greater in low- and middle-income countries (LMICs), as over 80% of the world's current tobacco users live in these countries (World Health Organization, 2020). As with developed countries, studies have generally found tobacco use to be more prevalent among socioeconomically deprived adults in LMICs. Using data from the Global Adult Tobacco Survey (GATS), Palipudi et al. (2012) found a significant but varied role of social determinants on current tobacco use within and across LMICs. However, due to limited data availability at the time, this study did not include any sub-Saharan African (SSA) country in its analysis, even though the region constitutes over 30% of the world's LMICs. As tobacco use prevalence increases rapidly among young adults in sub-Saharan Africa (Blecher and Ross 2013), it becomes pertinent to study the factors influencing tobacco use in the region, with a view to preventing a full-blown epidemic in the near future. This includes not just tobacco smoking, but also smokeless tobacco (SLT) use – an oft neglected category of tobacco products which remain very popular in Africa (Agaku et al. 2014).

In sub-Saharan Africa, national and regional studies among adults in Nigeria (Onoh et al. 2021), Uganda (Basaza et al. 2017), South Africa (Peltzer 2001), Ghana (Yawson et al. 2013), Gambia (Cham et al. 2019), and Ethiopia (Lakew and Haile 2015) have found significantly higher odds of tobacco use among men, the less educated, and rural residents. However, most of these studies did not use nationally representative study samples, and failed to explore socioeconomic patterns of tobacco use in appropriate detail. Nationally representative studies in SSA have mostly used data from the Demographic Health Surveys (DHS). Using DHS data from 14 SSA countries (2000–2006), Pampel (2008) reported higher adjusted odds of cigarette smoking among males, the less educated, urban residents, and low status workers. A subsequent DHS study of 30 SSA countries (2006–2012) found similar results, with the distinction that rural residents now had significantly higher adjusted odds of tobacco smoking, and wealth was associated with tobacco smoking to a lesser extent than smokeless tobacco (SLT) use (Sreeramareddy et al. 2014). Two other studies further reported an inverse association between religiosity and tobacco use, highlighting a potential opportunity for targeted tobacco control initiatives in SSA (Peltzer et al. 2002; Onoh et al. 2021). In general, DHS-based studies are limited by the survey's lack of detailed tobacco use data, which limits their ability to properly study SLT use or control for important factors such as respondents' knowledge of the potential health harms of tobacco use.

The Global Adult Tobacco Survey (GATS) provides the ideal context for investigations into the impact of the social determinants on tobacco use. This is due to its specific design for tobacco use & control research, its rich collection of sociodemographic data, and its standard protocol across all study sites and countries. Introduced as a part of the Global Tobacco Surveillance System (GTSS) in 2007, the GATS is a household survey which enables countries to collect nationally representative data on tobacco use among non-institutionalized adults aged 15 years or more, across sociodemographic strata of society, including sex, age, education, marital status, religion and wealth categories (Palipudi et al. 2016). As the global standard for data collection on tobacco use, its consistent protocol generates data that is readily comparable across countries. Using separate and pooled data from GATS surveys conducted in 7 SSA countries (based on availability), this study explores the association between the social determinants and tobacco use within the SSA context, initially considering all tobacco use collectively, then stratified by tobacco use category (smoked versus smokeless tobacco use). Since tobacco use patterns have been shown to differ markedly between men and women in SSA due to social traditions and patriarchal norms (Pampel 2008; Warner and MacKay 2006), the analysis was further stratified by sex. The study also aims to determine the role of religiosity on tobacco use within the SSA context.

2. Methods

2.1 Setting and Data Source

We used data from the most recent Global Adult Tobacco Surveys (GATS) conducted in sub-Saharan African countries. To enhance comparability, only countries with surveys conducted between 2010 and 2020 were included. These include Cameroon (2013), Ethiopia (2016), Kenya (2014), Nigeria (2012), Senegal (2015), Tanzania (2018), and Uganda (2013). The survey datasets were retrieved from the Global Tobacco Surveillance System (GTSS) database at no cost (CDC 2022). The design of the GATS has been fully described elsewhere (Palipudi et al. 2016). Briefly, the surveys were conducted in each country using multi-stage geographically clustered samples, with households selected at random within concentric sampling units, and a respondent randomly selected from each household to fill the questionnaire (Palipudi et al. 2016). Thus, the GATS produces weighted nationally representative data which is readily comparable across countries. The survey response rates were generally high, with overall response rates of 94.1%, 93.4%, 87.1%, 89.1%, 97%, 91.7% and 86.6% in Cameroon, Ethiopia, Kenya, Nigeria, Senegal, Tanzania and Uganda respectively (CDC 2022). Altogether, the 7 surveys provided data for 47,246 sub-Saharan African adults aged 15 years and above.

2.2 Variables

The primary dependent variable was current tobacco use (“yes” for current daily or less than daily use of any tobacco product, and “no” if otherwise). For the stratified analysis, this variable was split into two dependent variables: current tobacco smoking and current smokeless tobacco (SLT) use. Since this study is focused on *current* tobacco use, former tobacco users were considered non-users. Based on a critical literature review of the social determinants and other sociodemographic factors influencing tobacco use in Africa, the independent variables selected for this study include: sex, age, rural/urban residence, education, religiosity, marital status, employment status, household wealth, and knowledge of potential health harms from tobacco use.

Age was converted into a categorical variable with 6 levels to enable the observation of graded relationships. Since the classification of educational attainment varied slightly across the countries due to different school systems, the *education* variable was uniformly recoded into four levels: No formal education/less than primary education, Completed primary/less than secondary education, Completed secondary/ high school, and Completed University/ college. Marital status included four categories: Single/never married, married/cohabiting, Divorced/separated, and Widowed. Employment status included five categories: Employed, Unemployed, Student, Homemaker and Retired. Since each of these categories is fairly unique, the authors refrained from arbitrarily combining categories and consequently losing information. Religiosity included four categories: Islam, Christianity, Traditional/Others, and None (Senegal and Tanzania did not collect data on religiosity). Religious respondents in Nigeria and Uganda were asked: “as far as you know, does your religion discourage smoking?” An additional variable was created to record their response (Yes, No, or Not Sure).

The GATS does not collect data on personal or familial income. However, questions were asked about the possession of household assets and utilities such as electricity, flush toilet, telephone, radio/television, bicycle/motorcycle/car, etc. Using principal component analysis (Rutstein and Johnson 2004), a household wealth index was created for each country using responses to these questions. Each survey dataset was then divided into wealth quintiles using this index. Similar to methods used by Palipudi et al. (2012), knowledge of

the potential health harms of smoking was measured using responses to three questions about respondents' belief that smoking causes stroke, heart attacks, and lung cancer. Answering all three questions correctly was taken to represent "good knowledge"; answering two correctly represented "some knowledge"; and answering one or no question correctly represented "poor knowledge". GATS uses one question to assess respondents' knowledge of the harms of smokeless tobacco use: "does using smokeless tobacco cause serious illness?" Answering "yes" was taken as good knowledge, while "no", "don't know" or "refused" were taken as poor knowledge.

2.3 Statistical Analysis

Statistical analysis was done using *R* software (version 4.2.0). The sample weights provided with each survey were applied to all analyses to represent each country's entire non-institutionalized adult population aged 15 years or more. A p-value less than 0.05 was taken as statistically significant. Preliminary descriptive analysis was initially done to observe the distribution of each country's adult population across the socio-demographic factors. Then, the prevalence of current any-tobacco use in each country was computed, first overall, and then by socio-demographic factors.

The main analysis proceeded in two phases: separate regression analysis of each country survey, followed by a meta-analysis of the combined dataset of all 7 surveys. In the first phase involving individual surveys, multiple logistic regression analysis was used to model the association between the aforementioned socio-demographic and economic determinants and current any-tobacco use. To keep the results manageable, smoked and smokeless tobacco use were not assessed individually for each country.

In the second phase, all 7 country surveys were combined vertically using the *rbind* command in *R*. Then, the previously described multiple logistic regression analysis was repeated on the large dataset while including a new *country* variable to account for residual inter-country differences, and retaining the original individual sampling weights. Next, the meta-analysis was stratified by tobacco product category (smoked and smokeless tobacco use), and then further stratified by sex. In order to better understand the role of religion, a final subgroup analysis was done for the subset of religious adults who were asked if their religion discouraged smoking. All regression models used cluster-robust standard errors to adjust for intra-cluster correlation (Jayatilake et al. 2011). Tests for linear trends were conducted for age, SES, education and tobacco knowledge. Lastly, tests of model fit were conducted. All *R* codes used for this analysis are provided in a repository at <https://github.com/pharmsteve/GATS.git>.

3. Results

Table 1

Distribution of adults aged 15 & above by socio-demographic characteristics in 7 sub-Saharan African countries
(Global Adult Tobacco Survey, 2012–2018)

Socio-demographic characteristics	Pooled Data	Comoros	Ethiopia	Kenya	Nigeria	Senegal	Tanzania	Uganda
	(n = 47,246)	(n = 5,271)	(n = 10,150)	(n = 4,408)	(n = 9,765)	(n = 4,347)	(n = 4,797)	(n = 8,508)
Sex								
Female	50.7	51.7	50.1	51.2	50.0	51.5	52.1	52.8
Male	49.3	48.3	49.9	48.8	50.0	48.5	47.9	47.2
Age								
15–24	36.8	36.9	42.5	36.1	34.4	33.9	32.0	35.6
25–34	24.9	24.8	23.3	25.6	25.6	24.0	25.9	25.1
35–44	16.8	15.8	15.4	16.1	18.1	17.6	17.6	16.1
45–54	10.1	10.3	9.7	10.6	9.8	10.2	11.6	10.2
55–64	5.9	6.0	4.7	5.5	6.5	8.3	6.7	6.3
65+	5.5	6.1	4.4	6.1	5.6	6.1	6.2	6.7
Place of residence								
Urban	32.9	50.1	24.1	35	37	49.9	33.2	25.8
Rural	67.1	49.9	75.9	65	63	50.1	66.8	74.2
Education								
No formal education or less than primary	42.4	40.4	50.6	38.3	36.2	69.5	29.6	55.6
Completed primary or less than secondary	34.8	48.8	38.6	32.9	25.4	23.8	53.8	28.1
Completed secondary or high school	17.0	7.2	4.8	19.3	32.3	1.3	13.5	10.8
Completed university or college	5.8	3.6	6.0	9.5	6.1	5.3	3.0	5.4
Religion								
Islam	33.6	21.4	34.0	10.4	45.6	NR	NR	12.5
Christian	64.3	68.6	64.4	85.6	53.4	NR	NR	86.1
Traditional/Other	1.0	4.8	0.6	0.4	0.9	NR	NR	0.9

Socio-demographic characteristics	Pooled Data	Came- Roan	Ethiopia	Kenya	Nigeria	Senegal	Tanzania	Uganda
	(n = 47,246)	(n = 5,271)	(n = 10,150)	(n = 4,408)	(n = 9,765)	(n = 4,347)	(n = 4,797)	(n = 8,508)
Sex								
None	1.1	5.3	0.9	3.5	0.1	NR	NR	0.5
Marital status								
Single	33.3	34.9	35.5	32.7	33.7	34.5	28.9	29.9
Married	59.2	55.3	58.3	58.6	60.1	59.4	60.8	58.5
Divorced/Separated	2.9	3.1	2.7	3.0	1.7	1.4	5.7	4.4
Widowed	4.6	6.7	3.6	5.6	4.5	4.7	4.5	7.1
Employment status								
Employed	56.6	48.7	50.4	47.3	60.1	48.4	69.5	64.3
Unemployed	8.4	12.3	4.9	16.5	5.3	7.1	19.2	5.7
Student	18.2	18.7	22.3	18.5	18.7	15.3	8.8	15.8
Homemaker	15.4	18.1	21.6	15.8	14.0	26.6	1.9	13.2
Retired	1.3	2.2	0.7	1.9	1.8	2.5	0.4	1.0
Household wealth index								
Lowest	25.2	22.9	28.1	23.6	25.0	22.8	18.1	31.4
Low	21.4	17.5	18.7	21.1	26.1	21.2	20.0	14.9
Middle	17.9	26.1	19.2	21.4	11.8	17.2	24.9	19.9
High	17.9	15.4	15.8	14.8	21.1	17.5	16.3	19.9
Highest	17.7	18.1	18.2	19.1	16.1	21.2	20.7	13.8
Knowledge								
Poor knowledge	28.2	13.9	29.6	26.8	29.2	23.5	37.6	15.7
Some knowledge	27.6	18.6	34.3	29.1	24.2	15.1	26.1	29.5
Good knowledge	44.2	67.5	36.1	44.0	46.6	61.4	36.3	54.8
Tobacco use								
Current tobacco user	6.6	8.9	4.7	11.6	5.6	5.9	8.6	7.9
Never tobacco user	93.4	86.6	89.4	83.3	90.8	86.3	85.9	85.4

Socio-demographic characteristics	Pooled Data	Came- Roon	Ethiopia	Kenya	Nigeria	Senegal	Tanzania	Uganda
	(n = 47,246)	(n = 5,271)	(n = 10,150)	(n = 4,408)	(n = 9,765)	(n = 4,347)	(n = 4,797)	(n = 8,508)
Sex								
Former tobacco user	3.5	3.9	1.7	4.8	3.1	7.0	4.6	6.2
Note: Estimates are percentages of the total population; n - sample size; NR - Not Reported								

Table 1 shows the distribution of adults aged 15 years or more in the respective sub-Saharan African countries, across sociodemographic characteristics. Since the GATS design in each location was stratified by sex and urban/rural residence, the distribution of these variables represent the population distribution. The age distribution assumes a steep pyramidal structure in all 7 countries, especially in Ethiopia. With the exception of Cameroon and Senegal, all countries have over 60% of their adult populations residing in rural areas. Good knowledge of the health harms of tobacco smoking ranges from 36% in Kenya and Tanzania to 68% in Cameroon. 98.9% of the entire study population identified themselves with a religion. Furthermore, among the religious adults who were asked if their religion disapproves of smoking, 93.9%, 93.5% and 58% of Christians, Muslims and Traditionalists respectively, responded in the affirmative.

Table 2 shows the overall prevalence of current tobacco use in each country and across socio-demographic groups. Current tobacco use prevalence ranges from 4.7% in Ethiopia to 11.6% in Kenya, with an average prevalence of 6.6% across all 7 countries. Although tobacco smoking accounts for most of these estimates, smokeless tobacco (SLT) use is quite prevalent, ranging from 0.6% in Senegal to 3.8% in Kenya. On average, SLT use also accounts for 33% of all tobacco use across the 7 countries. Tobacco use is markedly more prevalent among men than women, with a 5:1 ratio on average, and up to 9:1 as seen in Nigeria. Tobacco use prevalence increases with age and is inversely proportional to educational attainment and health knowledge. It is also more prevalent among rural residents, non-religious persons, non-singles, and the employed/retired in most countries. Only the lowest wealth quintile has a distinctly higher tobacco use prevalence than the other quintiles in most countries. From the pooled data, the prevalence of tobacco smoking is higher among rural (5.1%) than urban (4.3%) residents and among men (8.9%) than women (0.9%). Similarly, SLT use is more prevalent among rural (2.7%) than urban (1.1%) residents and among men (2.7%) than women (1.6%).

Table 2

Prevalence of current tobacco use among adults aged 15 & above by socio-demographic characteristics in 7 sub-Saharan African countries (Global Adult Tobacco Survey, 2012–2018)

Socio-demographic characteristics	Pooled Data	Cameroon	Ethiopia	Kenya	Nigeria	Senegal	Tanzania	Uganda
Overall	6.6	8.9	4.7	11.6	5.6	5.9	8.6	7.9
Tobacco smoking	4.5	5.9	3.2	7.1	3.6	5.3	6.4	5.6
Smokeless tobacco	1.8	2.9	1.0	3.8	1.7	0.6	1.9	2.1
Both smoked & smokeless	0.4	0.1	0.5	0.7	0.2	0.1	0.4	0.2
Sex								
Female	2.3	4.3	1.7	4.5	1.1	1.2	3.2	4.6
Male	11.1	13.9	7.8	19.1	10.0	10.9	14.6	11.7
Age								
15–24	2.0	2.7	2.0	2.7	1.5	2.8	2.9	1.5
25–34	6.1	9.2	5.9	10.8	4.7	5.4	5.8	5.8
35–44	9.6	12.7	6.8	15.6	8.0	9.2	13.3	12.4
45–54	11.4	11.9	7.8	22.5	9.5	9.3	14.5	13.9
55–64	13.0	20.3	8.4	25.5	11.9	8.9	11.2	18.8
65+	14.9	19.4	7.8	25.5	12.3	6.4	23	19.5
Place of residence								
Urban	5.2	6.2	3.6	9.1	4.0	5.8	7.0	6.0
Rural	7.3	11.6	5.1	12.9	6.5	6.0	9.4	8.6
Education								
No formal education or less than primary	8.4	10.9	6.0	17	6.1	6.1	14.6	11.3
Completed primary or less than secondary	5.7	7.5	3.5	9.6	6.0	5.5	6.9	4.3
Completed secondary or high school	4.8	7.0	4.1	7.4	4.8	0.0	3.5	2.3
Completed university or college	4.2	9.8	2.7	5.3	4.5	6.5	4.5	3.0
Religion								
Islam	5.2	3.3	6.7	9.5	4.1	NR	NR	4.3

Socio-demographic characteristics	Pooled Data	Came- room	Ethiopia	Kenya	Nigeria	Senegal	Tanzania	Uganda
Overall	6.6	8.9	4.7	11.6	5.6	5.9	8.6	7.9
Christianity	6.2	9.8	2.7	10.3	6.4	NR	NR	8.4
Traditional/Other	16.5	14.7	1.6	40.6	26.6	NR	NR	1.1
None	44.2	14.7	75.5	45.2	56.0	NR	NR	24.5
Marriage								
Single	3.8	6.0	2.7	6.4	3.3	4.8	5.5	2.8
Married	7.7	9.1	6.3	13.7	6.6	6.4	9.0	8.8
Divorced/Separated	11.0	20.1	2.3	16.3	11.2	15.7	14.6	13.9
Widowed	9.9	17.5	2.0	17.5	6.0	5.5	16.7	18.7
Employment status								
Employed	9.3	11.7	7.8	15.1	8.0	9.2	10.7	10.3
Unemployed	7.0	13.4	2.7	13.4	4.8	6.3	5.5	7.7
Student	1.0	1.8	1.0	1.2	1.2	0.8	0.2	0.0
Homemaker	2.8	4.7	1.7	10.6	1.0	2.5	3.3	5.7
Retired	11.4	17.6	12.8	19.8	7.0	10.0	17.8	11.4
Household wealth index								
Lowest	7.6	11.5	4.1	15.5	6.2	5.3	12.9	11.4
Low	5.8	7.5	4.0	11.3	4.8	6.9	7.5	8.1
Middle	6.8	7.3	6.8	9.5	5.4	4.7	7.0	6.5
High	6.2	9.3	4.1	9.9	6.3	5.2	7.8	5.8
Highest	6.3	9.1	4.8	10.7	5.0	7.3	8.6	5.0
Knowledge								
Poor knowledge	9.8	15.6	7.7	17.7	8.8	5.7	9.7	16.5
Some knowledge	5.9	8.2	3.9	8.2	5.2	6.8	8.4	10.2
Good knowledge	5.0	7.7	3.1	10.1	3.7	5.8	7.7	4.2
Number of tobacco users (millions)	15.7	1.1	3.2	2.5	4.5	0.5	2.6	1.3
Note: Prevalence estimates are percentages of the specified population; NR – Not Reported								

Table 3

Predictors of current tobacco use among adults aged 15 & above in 7 sub-Saharan African countries (Global Adult Tobacco Survey, 2012–2018)

Socio-demographic characteristics	Pooled Data		Cameroon		Ethiopia		Kenya	
	AOR	95%CI	AOR	95%CI	AOR	95%CI	AOR	95%CI
Sex								
Female (RC)	1.0		1.0		1.0		1.0	
Male	6.8	(5.1, 9.0)***	5.5	(3.9, 7.5)***	6.3	(3.6, 10.8)***	9.7	(6.4, 14.7)***
Age[†]	p < 0.001		p < 0.001		p < 0.001		p < 0.001	
15–24 (RC)	1.0		1.0		1.0		1.0	
25–34	2.9	(2.0, 4.3)***	3.2	(1.8, 5.6)***	3.2	(1.8, 5.4)***	4.3	(2.3, 7.8)***
35–44	4.1	(2.7, 6.3)***	4.6	(2.5, 8.2)***	3.1	(1.4, 6.9)**	7.3	(4.0, 13.5)***
45–54	5.3	(3.4, 8.5)***	4.1	(2.1, 7.8)***	4.9	(1.9, 13.0)**	12.0	(5.5, 26.4)***
55–64	5.6	(3.5, 8.8)***	6.6	(3.3, 13.0)***	4.1	(1.8, 9.2)***	11.4	(5.2, 24.8)***
65+	5.5	(3.4, 8.8)***	5.2	(2.5, 10.9)***	5.2	(1.9, 14.3)**	10.4	(4.8, 22.4)***
Residence								
Urban (RC)	1.0		1.0		1.0		1.0	
Rural	1.2	(1.0, 1.5)*	1.8	(1.3, 2.4)***	1.1	(0.7, 1.7)	1.0	(0.7, 1.5)
Education[‡]	p < 0.001		p < 0.01		p < 0.001		p < 0.001	
Completed university/college (RC)	1.0		1.0		1.0		1.0	
Completed secondary/high school	1.7	(1.2, 2.3)**	1.2	(0.5, 2.9)	2.1	(1.0, 4.6)	2.2	(1.0, 4.6)*
Completed primary/less than secondary	2.0	(1.5, 2.8)***	1.2	(0.6, 2.1)	1.7	(0.9, 3.2)	3.0	(1.6, 5.3)***
No formal education/less than primary	2.0	(1.5, 2.8)***	1.7	(0.8, 3.3)	1.2	(0.6, 2.3)	5.7	(3.0, 10.8)***
Religion								
Muslim (RC)	1.0		1.0		1.0		1.0	

Socio-demographic characteristics	Pooled Data		Cameroon		Ethiopia		Kenya	
Christian	1.4	(1.1, 1.8)*	3.9	(2.5, 6.1)***	0.4	(0.2, 0.7)**	2.0	(0.7, 5.7)
Traditional/Other	3.1	(1.9, 5.0)***	5.2	(2.7, 9.7)***	0.3	(0.1, 1.2).	4.1	(1.0, 16.9).
None	15.5	(4.8, 50.3)***	4.0	(2.1, 7.6)***	154.4	(66.1, 360.6)***	6.8	(2.2, 21.4)**
Marital Status								
Married/Cohabiting (RC)	1.0		1.0		1.0		1.0	
Single	1.4	(1.1, 1.9)*	1.6	(1.1, 2.4)*	1.1	(0.6, 2.2)	2.9	(1.9, 4.5)***
Divorced /Separated	1.7	(1.3, 2.3)***	3.4	(2.0, 5.7)***	0.7	(0.4, 1.4)	1.7	(0.9, 3.1)
Widowed	1.9	(1.4, 2.5)***	2.9	(1.9, 4.5)***	0.6	(0.2, 1.9)	1.7	(1.2, 2.6)**
Employment Status								
Employed (RC)	1.0		1.0		1.0		1.0	
Unemployed	1.2	(0.9, 1.6)	1.3	(0.8, 2.0)	0.7	(0.3, 1.2)	1.0	(0.7, 1.6)
Student	0.3	(0.2, 0.4)***	0.3	(0.1, 0.8)**	0.2	(0.1, 0.4)***	0.1	(0.0, 0.5)**
Homemaker	0.9	(0.6, 1.3)	0.9	(0.6, 1.4)	0.8	(0.4, 1.7)	1.4	(0.8, 2.6)
Retired	0.7	(0.5, 1.1)	0.9	(0.5, 1.9)	2.3	(0.7, 7.8)	0.9	(0.3, 2.1)
Household wealth index[‡]	p < 0.001		p < 0.05		p = 0.822		p < 0.05	
Highest (RC)	1.0		1.0		1.0		1.0	
High	1.1	(0.8, 1.4)	1.1	(0.7, 1.7)	1.0	(0.5, 1.9)	0.7	(0.4, 1.3)
Middle	1.2	(0.9, 1.5)	0.9	(0.6, 1.2)	1.5	(0.8, 2.6)	0.8	(0.5, 1.3)
Low	1.0	(0.8, 1.3)	0.8	(0.5, 1.2)	0.7	(0.4, 1.4)	1.0	(0.6, 1.7)
Lowest	1.2	(0.9, 1.5)	1.1	(0.8, 1.7)	1.0	(0.6, 1.5)	1.1	(0.7, 1.7)
<i>Continuous wealth variable^T</i>	<i>0.995</i>	<i>(.991, .999)*</i>	<i>1.0</i>	<i>(0.9, 1.1)</i>	<i>1.0</i>	<i>(1.0, 1.1)</i>	<i>0.96</i>	<i>(0.9, 1.0)</i>

Socio-demographic characteristics	Pooled Data		Cameroon		Ethiopia		Kenya	
Knowledge of tobacco harms [‡]	p < 0.001		p < 0.001		p = 0.224		p < 0.001	
Good knowledge (RC)	1.0		1.0		1.0		1.0	
Some knowledge	1.4	(1.1, 1.7)**	1.1	(0.8, 1.5)	1.4	(0.8, 2.3)	1.0	(0.6, 1.5)
Poor knowledge	2.4	(1.9, 2.9)***	2.2	(1.7, 2.9)***	2.2	(1.2, 3.9)**	2.2	(1.6, 3.0)***
<p>Note: AOR - Adjusted Odds Ratio (mutually adjusted for all other variables in the model); 95% CI - 95% Confidence Interval;</p> <p>RC - Reference Category; NA - Not Applicable; ***p < 0.001, **p < 0.01, *p < 0.05, .p < 0.1, ‡p-value shown for test of linear trend, [†]Replaced wealth quintiles in a separate model.</p>								

Table 4

Predictors of current tobacco use among adults aged 15 & above in 7 sub-Saharan African countries (Global Adult Tobacco Survey, 2012–2018) cont'd

Socio-demographic characteristics	Nigeria		Senegal		Tanzania		Uganda	
	AOR	95%CI	AOR	95%CI	AOR	95%CI	AOR	95%CI
Sex								
Female (RC)	1.0		1.0		1.0		1.0	
Male	12.0	(8.0, 18.0)***	18.5	(10.2, 33.5)***	8.4	(6.2, 11.5)***	5.1	(3.6, 7.4)***
Age[‡]	p < 0.001		p < 0.001		p < 0.001		p < 0.001	
15–24 (RC)	1.0		1.0		1.0		1.0	
25–34	3.0	(1.7, 5.3)***	1.5	(0.9, 2.8)	2.9	(1.6, 5.3)***	3.1	(1.8, 5.3)***
35–44	4.8	(2.5, 9.2)***	2.5	(1.2, 5.1)*	7.5	(4.2, 13.5)***	6.0	(3.5, 10.3)***
45–54	5.6	(2.8, 11.1)***	2.6	(1.2, 5.8)*	8.8	(4.3, 18.1)***	5.7	(3.2, 10.1)***
55–64	6.1	(3.1, 12.1)***	2.1	(0.9, 4.8).	5.1	(2.5, 10.5)***	9.1	(4.5, 18.3)***
65+	5.9	(2.7, 12.6)***	1.1	(0.4, 3.0)	10.5	(5.5, 20.4)***	7.1	(3.8, 13.3)***
Residence								
Urban (RC)	1.0		1.0		1.0		1.0	
Rural	1.5	(1.1, 2.0)**	1.1	(0.7, 1.5)	1.0	(0.7, 1.3)	0.9	(0.7, 1.2)
Education[‡]	p < 0.01		p = 0.966		p < 0.001		p < 0.001	
Completed university/ college (RC)	1.0		1.0		1.0		1.0	
Completed secondary/ high school	1.6	(0.9, 2.6).	0.0	(0.0, 0.0)	1.1	(0.4, 3.3)	1.1	(0.5, 2.6)
Completed primary/less than secondary	2.1	(1.2, 3.7)**	1.3	(0.7, 2.8)	2.2	(0.8, 5.9)	2.1	(1.1, 4.2)*
No formal education/less than primary	2.1	(1.2, 3.7)*	1.0	(0.5, 2.0)	5.4	(1.9, 14.9)**	4.3	(2.2, 8.3)***
Religion								
Muslim (RC)	1.0		NA		NA		1.0	

Socio-demographic characteristics	Nigeria		Senegal		Tanzania		Uganda	
Christian	2.1	(1.5, 3.1)***	NA		NA		1.6	(1.1, 2.4)*
Traditional/Other	6.2	(2.8, 13.7)***	NA		NA		0.1	(0.0, 0.4)**
None	19.3	(2.6, 143.5)**	NA		NA		2.6	(0.6, 12.0)
Marital Status								
Married/Cohabiting (RC)	1.0		1.0		1.0		1.0	
Single	1.2	(0.7, 2.2)	1.1	(0.7, 2.0)	2.8	(1.8, 4.6)***	1.5	(1.0, 2.2)*
Divorced /Separated	2.1	(1.2, 3.6)*	4.7	(2.5, 9.1)***	2.4	(1.6, 3.6)***	1.8	(1.2, 2.8)**
Widowed	1.4	(0.8, 2.6)	4.1	(1.9, 9.1)***	2.7	(1.8, 4.0)***	2.9	(2.0, 4.2)***
Employment Status								
Employed (RC)	1.0		1.0		1.0		1.0	
Unemployed	1.3	(0.7, 2.3)	1.1	(0.7, 1.8)	0.6	(0.4, 0.8)**	0.6	(0.4, 0.8)**
Student	0.4	(0.2, 0.7)**	0.1	(0.0, 0.4)***	0.0	(0.0, 0.2)***	0.0	(0.0, 0.0)***
Homemaker	0.7	(0.4, 1.5)	1.6	(0.9, 2.8)	0.8	(0.2, 3.6)	0.8	(0.5, 1.1)
Retired	0.4	(0.2, 0.8)*	1.1	(0.5, 2.5)	2.0	(0.8, 5.2)	0.4	(0.2, 1.2).
Household wealth index[‡]	p = 0.987		p = 0.363		p < 0.05		p < 0.001	
Highest (RC)	1.0		1.0		1.0		1.0	
High	1.5	(1.0, 2.3).	0.5	(0.3, 0.9)*	1.1	(0.7, 1.6)	1.1	(0.8, 1.6)
Middle	1.3	(0.9, 2.0)	0.6	(0.3, 0.9)*	0.9	(0.6, 1.4)	1.1	(0.8, 1.7)
Low	1.1	(0.8, 1.6)	0.7	(0.4, 1.2)	0.9	(0.6, 1.4)	1.5	(1.0, 2.3)*
Lowest	1.3	(0.9, 1.8)	0.9	(0.5, 1.5)	1.5	(1.0, 2.4)*	1.9	(1.2, 2.9)**
<i>Continuous wealth variable[†]</i>	<i>1.0</i>	<i>(1.0, 1.0)</i>	<i>1.0</i>	<i>(1.0, 1.0)</i>	<i>0.95</i>	<i>(0.9, 1.0)*</i>	<i>0.90</i>	<i>(0.8, 0.95)**</i>

Socio-demographic characteristics	Nigeria	Senegal	Tanzania	Uganda
Knowledge of tobacco harms [‡]	p < 0.001	p = 0.692	p = 0.613	p < 0.001
Good knowledge (RC)	1.0	1.0	1.0	1.0
Some knowledge	1.6 (1.2, 2.2)**	1.2 (0.8, 2.0)	1.3 (0.9, 1.8)	2.7 (2.1, 3.6)***
Poor knowledge	3.1 (2.3, 4.2)***	1.0 (0.7, 1.4)	1.4 (1.0, 1.9)*	4.2 (3.2, 5.5)***
Note: AOR - Adjusted Odds Ratio (mutually adjusted for all other variables in the model); 95% CI – 95% Confidence Interval; RC - Reference Category; NA - Not Applicable; ***p < 0.001, **p < 0.01, *p < 0.05, .p < 0.1, ‡p-value shown for test of linear trend, [†] Replaced wealth quintiles in a separate model.				

Tables 3 and 4 show the results of multiple logistic regression models exploring the association between the social determinants and current any-tobacco use in each country and for the pooled data. In general, current tobacco use is significantly associated with male sex, greater age, rural residence, lower educational attainment, irreligiousness or non-Muslim religions, not being married/not cohabiting, lower household wealth, and poor tobacco health knowledge. However, these relationships differ slightly for smoked and smokeless tobacco use. These distinctions are represented in Fig. 1, a visualization of the regression estimates from the pooled data analysis stratified by tobacco use category (see actual estimates in supplementary table 1).

Figure 1 shows that the higher odds of tobacco use among men relative to women is greater for tobacco smoking (AOR = 12.0) than for SLT use (AOR = 2.4). Also, while the odds of SLT use increases consistently up the age categories, the odds of tobacco smoking peaks at 45–54yrs and begins to descend. Rural residents are 20% more likely to smoke (p < 0.001) and 60% more likely to use SLT (p < 0.001), than urban residents. Furthermore, while education is inversely associated with the odds of being a current user of both types of tobacco products, this association is stronger for SLT use than for smoking – adults in the lowest education group have greater odds of smoking (AOR = 1.7) and using SLT (AOR = 3.6) than university/college graduates.

Knowledge of the potential harms of tobacco use influences both categories of tobacco users similarly – adults with poor knowledge are significantly more likely to use both smoked (AOR = 2.6) and smokeless (AOR = 2.9) tobacco products than those with good knowledge. Compared to Muslims, Christians have significantly greater odds of SLT use (AOR = 1.6), followed by traditionalists (AOR = 4.8) and irreligious persons (AOR = 16.1). In contrast, the odds of tobacco smoking does not differ significantly between the religions, but is five times greater among irreligious adults compared to Muslims. Furthermore, religious adults who did not believe that their religion discourages smoking were more likely to smoke (AOR = 2.5) or use SLT (AOR = 2.7) than those who did (supplementary table 2).

Household wealth index does not appear to influence the odds of tobacco smoking as it does SLT use. Adults in the lowest wealth quintile are significantly more likely to be current SLT users than those in the highest quintile (AOR = 1.4), although this relationship is not graded across the quintiles. When the continuous wealth index was used in lieu of the categorical variable, each 10 percentage point increase in wealth index was associated with a

5% decrease in the odds of SLT use ($p < 0.001$). Employed adults are as likely to use both smoked and smokeless tobacco as unemployed adults. Being married is associated with lower odds of smoking than being single (AOR = 1.6) or divorced (AOR = 2.3). The results from the analysis stratified by sex (supplementary table 3) are consistent with those above, with the distinction that wealth index significantly influences tobacco use among women and not men – greater household wealth is associated with lower odds of SLT use and higher odds of smoking among women only. The tests for model fit showed no significant violations of the linear model assumptions.

Discussion

Understanding the relationship between the social determinants of health and tobacco use in sub-Saharan Africa will facilitate the design of effective tobacco control policies in this region of increasing global interest with regards to tobacco use. This study provides the most recent evidence of this relationship in seven sub-Saharan African (SSA) countries, both for tobacco smoking and SLT use. Smoking was independently associated with male sex, greater age, rural residence, lower education and health knowledge, and irreligiousness. Similar associations were found for SLT use, although the trends were stronger for all determinants except sex. Wealth index was a significant factor only among women, where the odds of smoking and SLT use respectively increased and decreased with greater wealth. Also, while the odds of SLT use increased consistently with age, the odds of tobacco smoking peaked at 45–54yrs and began to descend. This age disparity is probably explained by a stronger *healthy survivor effect* for smoking – older living adults are generally less likely to be smokers due to a higher mortality associated with smoking, compared to SLT use (Baillargeon and Wilkinson 1999).

These findings are mostly consistent with those of previous representative studies in SSA, although the socioeconomic gradients in tobacco use appear to have shrunk in this population. Using DHS data from 30 SSA countries (2006–2013), Sreeramareddy et al. (2014) found that smoking was weakly associated, but SLT use was strongly associated, with education and wealth index. Our study similarly found stronger education and wealth associations with SLT use than with smoking. Sreeramareddy et al. (2014) further reported that smoking was significantly more likely among rural-residing adults and among employed men. We similarly found significantly higher odds of both smoking and SLT use among rural residents, but no significant associations with employment status. In essence, our study suggests a recent bridging of the SES gaps in tobacco smoking across wealth, employment and rural/urban groups in SSA countries, although these gradients persist for SLT use. This verdict is corroborated by a recent time-trend study which reported a consistent decrease in the magnitude of socioeconomic inequalities in tobacco use across SSA countries between 2003 and 2019 (Sreeramareddy and Acharya 2021).

Residential location is an important determinant of health, as it is related to neighbourhood deprivation, which has been shown to influence tobacco use and health outcomes in developed countries (Chuang et al. 2005). The relationship between rural/urban residence and tobacco smoking in SSA has been historically elusive. A systematic review of tobacco use literature among SSA adults found no clear urban/rural differences, although this may have been due to its failure to consider smoked and smokeless tobacco use separately (Townsend et al. 2006). In a DHS study of 14 SSA countries, Pampel (2008) found higher AOR for cigarette smoking, but lower AOR for other tobacco smoking, among urban residents. In contrast, a more recent DHS study of 30 SSA

countries found higher AOR for tobacco smoking among rural residents (Sreeramareddy et al. 2014), consistent with our results. However, this contrasts with data from other non-SSA LMICs showing higher odds of smoking among urban residents (Palipudi et al. 2012; Jha and Chaloupka 2000). For SLT, we found higher odds of current use among rural residents, consistent with reports from other SSA studies (Sreeramareddy et al. 2014; Pampel 2005) and in other LMICs (Somatunga et al. 2012; Sabnis et al. 2016).

Sex is another important determinant of tobacco use identified in this study, with a stronger association observed for smoking than for SLT use. In the sub-Saharan African context, this phenomenon of markedly higher prevalence of tobacco smoking among men, but equivalent prevalence of SLT use between men and women, is well documented (Rudatsikira et al. 2010; Kaplan et al. 1990). While seeking an explanation for this phenomenon in Kenya, Kaplan et al (1990) found that SLT use was socially acceptable for both men and women, but smoking was acceptable only for men. They attributed this social prohibition of female tobacco smoking to locally held beliefs that tobacco smoking harms children, smoking represents the infiltration of Western culture which threatens customary controls over women, and smoking signals sexual promiscuity among women. In public health practice, while tobacco smoking interventions in SSA countries may focus more on men, interventions for SLT use should be aimed equally at men and women.

Education displayed one of the strongest associations with tobacco use in this study, with a graded inverse relationship observed for both tobacco smoking and SLT use. As such, amongst other benefits of population literacy, governments may achieve a reduction in tobacco use prevalence by making basic education accessible to their populaces. Tobacco use was also significantly inversely associated with respondents' knowledge of the health harms of tobacco use, independently of educational attainment. Consequently, tobacco health warning forms an integral part of the World Health Organization's MPOWER tobacco control package (WHO 2008). Unfortunately, most sub-Saharan African countries continue to fall short of the WHO-recommended cigarette pack labelling specifications, aimed at improving public knowledge of the potential harms of tobacco smoking (Egbe et al. 2019). Knowledge of SLT harms was even lower in this study, likely due to the general neglect of this category of tobacco products by regulatory authorities. These public knowledge deficits highlight important areas for potentially effective public health intervention.

This study also aimed to examine the relationship between religiosity and tobacco use in sub-Saharan Africa. We found five times greater odds of smoking and 16 times higher odds of SLT use among irreligious adults, compared to Muslims. Furthermore, among religious adults, those who believed that their religion condemns smoking were only half as likely to smoke or use SLT as those who did not. Similar findings have been reported in other studies from Nigeria (Onoh et al. 2021) and South Africa (Peltzer et al. 2002). Furthermore, divorced or separated *men* in this study were significantly more likely to use tobacco than married/cohabiting men. With further research, interventions may be designed to target these highly susceptible groups of irreligious and divorced/separated adults in SSA.

The landscape of tobacco use in Sub-Saharan Africa is unravelling in a different context than it did in developed countries, and this warrants special considerations for effective tobacco control. SSA countries are generally purported to be in the first stage of the Lopez four-stage model of the global tobacco epidemic, characterized by generally low but rapidly increasing prevalence of cigarette smoking, especially among men (Lopez et al. 1994). While this model still holds true in terms of the relatively high smoking prevalence among SSA men, its validity is brought in question by the reported decrease in tobacco use across SSA countries between 2003 and 2019

(Sreeramareddy and Acharya 2021). This suggests that tobacco use in SSA is likely to follow a different blueprint than was anticipated, and as such, public health agencies in the region should be willing to adapt existing policies as required.

4.2 Study Strengths and Limitations

An important strength of this study is the custom design of GATS surveys for tobacco research, enabling the inclusion of relevant information unavailable from other national and sub-national surveys. As the first GATS-based study from SSA, this study constitutes a vital supplementation to the available evidence from DHS-based studies. Also, the pooling of data from 7 countries lent this study sufficient power to explore determinants of SLT use and tobacco use among women in general.

However, the study has important limitations. Firstly, that current tobacco use was self-reported and not objectively measured using biochemical assays, making it susceptible to social desirability bias. Secondly, the household possessions used to assess wealth may not truly represent wealth distribution in all countries. Thirdly, considering that the pooled data represents only 7 countries in SSA where GATS survey data were available within the indicated timeframe (2010 to 2020), generalization of its results to the entire region should be done with caution. Lastly, due to its cross-sectional design, this study can only identify associations and not causal relationships.

Conclusions

As the first GATS-based study using the most recent representative data on the tobacco use in sub-Saharan Africa, this paper makes an essential contribution to the limited literature on the relationship between the social determinants of health and tobacco use in the region, as well as the role of religiosity. We found a fairly homogenous and significant role of the social determinants on tobacco use across the 7 countries, although this role is more pronounced for SLT use than for smoking. The following recommendations are made for public health practice in SSA: greater effort should be made to improve people's knowledge of the harms of tobacco smoking and SLT use; the infiltration of cigarettes to rural areas should be followed by a similar infiltration of adequate control measures; and lastly, due to the popularity of religion in SSA and the observed deterrent effect of religious condemnation of smoking, public health authorities may consider involving religious leaders in anti-tobacco public health education.

Declarations

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Figures

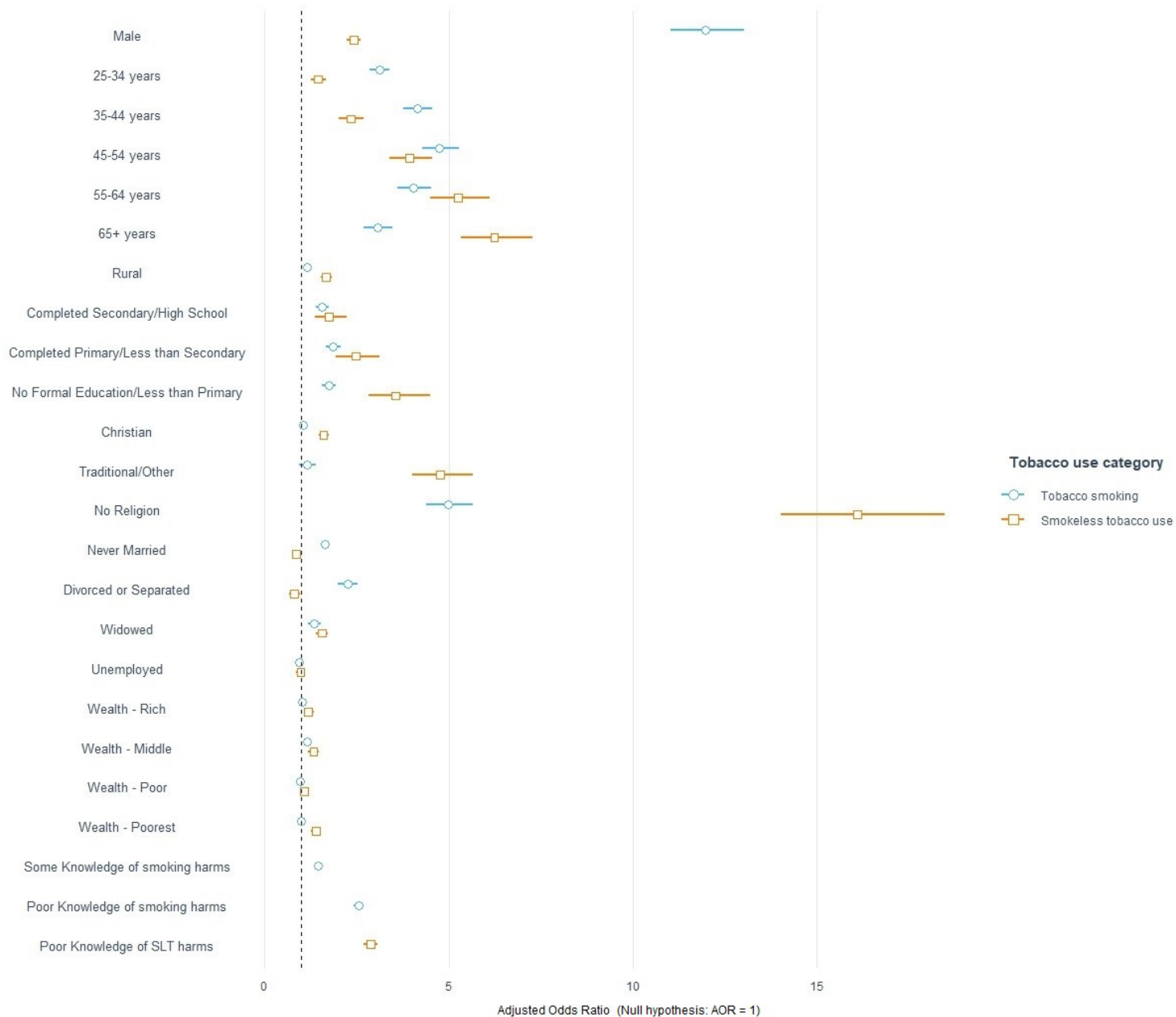


Figure 1

Visualization of regression output (adjusted odds ratios and 95% confidence intervals) from separate multiple logistic regression models for smoked and smokeless tobacco use (using pooled GATS data from 7 sub-Saharan African countries). Reference categories are: Female, 15-24 years, Urban Residence, No formal education/less than primary, Muslim, Married, Employed, Wealth - Richest, Good knowledge of smoking harms, and Good knowledge of SLT harms. All estimates are adjusted for all other variables in the model.

Supplementary Files

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