



Secondhand Smoke Exposure Inside the Home Among Adults in Eight Countries in Sub-Saharan Africa: Global Adult Tobacco Survey, 2012–2018

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Abstract

Introduction: Secondhand tobacco smoke (SHS) exposure causes diseases and death in adults and children. Evidence indicates that most SHS exposures occur at home and in the workplace. Therefore, home is a major place where adults and children can be effectively protected from SHS. This study examined the magnitude of SHS exposure at home and associated factors in eight sub-Saharan African countries.

Aims and Methods: We analyzed 2012–2018 Global Adult Tobacco Survey data for Botswana, Cameroon, Ethiopia, Kenya, Nigeria, Senegal, Tanzania, and Uganda. We computed prevalence estimates of self-reported monthly SHS exposure at home reported as anyone smoking inside their home daily, weekly, or monthly. We calculated SHS exposure at home prevalence and applied multivariable logistic regression models to identify related factors.

Results: Overall median prevalence of SHS exposure at home was 13.8% in the eight countries; ranging from 6.6% (95% CI: 5.7%, 7.6%) in Nigeria to 21.6% (95% CI: 19.4%, 24.0%) in Senegal. In multivariable analysis across the countries, SHS exposure at home was associated with living with a smoker, ranging from an adjusted odds ratio (AOR) of 4.6 (95% CI: 3.6, 5.8) in Botswana to 27.6 (95% CI: 20.1, 37.8) in Nigeria. SHS exposure at home was significantly associated with lower education attainment (Kenya and Ethiopia), and lower wealth index (Uganda, Senegal, and Botswana).

Conclusions: SHS exposure in homes was associated with the presence of a smoker in the home and lower socioeconomic status.

What Does Paper add?

- There is the variability of and associated factors of secondhand tobacco smoke (SHS) exposure at home among adults in eight African countries and demonstrates that exposure is strongly associated with living with someone who smokes tobacco.
- SHS exposure at home in some countries is high among those with lower socioeconomic status, suggesting focused intervention for this population group.
- SHS exposure at home is strongly associated with those exposed to SHS in public places in most of the countries assessed, raising the importance of implementing article 8 of the WHO FCTC, which focuses on smoke-free public policies.

Introduction

Secondhand tobacco smoke (SHS) exposure causes disease and premature death among nonsmoking adults, youth, and children. Among adults, SHS exposure is associated with heart disease, lung cancer, and stroke; in children, it causes ear infections, asthma attacks, respiratory symptoms, acute lower respiratory infections, and sudden infant death syndrome.^{1–3} Evidence indicates that most SHS exposure occurs at home

and in workplaces^{1–3}; therefore, the home is a major place where adults, youth, and children can be effectively protected from SHS.

SHS is a mixture of mainstream tobacco smoke exhaled by a person smoking and side-stream smoke from the lighted end of a cigarette, pipe, cigar, or tobacco burning in a hookah.^{1,2,4,5} SHS contains toxic and cancer-causing agents or particulates that are harmful to humans.³ These cancer-causing agents

and toxic particulates, such as particulate matter 2.5, could damage the lungs and the body's cells, causing adverse effects on the human body.^{1,3,4} Consequently, the U.S. Surgeon General concluded that there is no safe level of exposure to SHS.^{2,3} Thus, protection against SHS exposure is a paramount public health issue and a rationale for governmental actions. Yet, in 2018, only 22% of the world population was covered by comprehensive smoke-free policies in public places,⁶ with a higher percentage of those not covered residing in low- and middle-income countries (LMICs), including sub-Saharan Africa (SSA).⁶⁻⁸

Despite evidence of adverse health effects from tobacco use and SHS exposure,^{2,3} tobacco smoking continues to increase in LMICs, with the most rapid increase occurring in SSA.⁹ Indeed, the World Health Organization (WHO) projects that the SSA region will experience the fastest growth in tobacco use by 2025, with some places experiencing up to 40% increase in usage.¹⁰ Significant economic growth and population increase contribute to this trend.¹¹ Additionally, the largest transnational tobacco companies continue to target SSA as they seek new markets because of declining smoking rates in most high-income countries.^{12,13} This situation could increase the uptake of smoking with an additional downstream negative effect of increasing the potential for nonsmokers to be exposed to SHS.¹⁴ This indicates the critical need for research to understand the phenomenon.

Smoking at home puts adults, youth, and children at risk of exposure to SHS and its consequences. A few studies have shown the prevalence of SHS exposure at home in some SSA countries. One study in South Africa found that 26% of adults were exposed to SHS at home.¹⁵ Another previous study estimated that approximately 20%–30% of youth in Africa live in a home with a person who smokes,¹⁶ suggesting

potential exposure to SHS. Other studies using data from the Global Youth Tobacco Survey (GYTS) have also shown that exposure to SHS at home among youth was prevalent.^{17,18} Youth and children are also at risk of exposure to SHS at home because of limited control over their home and social environments.¹⁹

Although existing studies provide an understanding of the magnitude of SHS exposure and facilitate development of intervention, further evidence needs to be generated, particularly from LMICs like those in SSA where data are limited. Additionally, data from these countries are important to understand the magnitude of SHS exposure at home in SSA and inform strategies and interventions to address the problem. This study aims to reduce the knowledge gap by using data from Global Adult Tobacco Survey (GATS).

Our study, therefore, examined the magnitude of SHS exposure inside the home and associated factors among adults in eight SSA countries—Botswana, Cameroon, Ethiopia, Kenya, Nigeria, Senegal, Tanzania, and Uganda—using nationally representative household survey data. These eight countries in SSA implemented GATS between 2012 and 2018, and their data became publicly available. Additionally, these eight countries cover about half of the population in SSA (526 million people, 48.1%),²⁰ which indicates that the findings have broader implications for the region.

Method

Data

We used data collected from GATS between 2012 and 2018, and country-specific sample sizes and overall response rates are provided in [Table 1](#). GATS is a nationally representative household survey of non-institutionalized adults aged 15

Table 1. Global Adult Tobacco Survey Response Rates, and Smoke-free Policy Among Eight Sub-Saharan Africa, 2012–2018 (N = 51 885)

Country	Year	Sample size (n)	Overall response rate (%)	Smoke-free policy status
Botswana	2017	4643	80.0	The law does not provide for 100% smoke free ^a
Cameroon	2013	5271	94.1	The law does not provide for 100% smoke free ^b
Ethiopia	2016	10 150	93.4	The law does not provide for 100% smoke free ^c
Kenya	2014	4404	87.1	The law does not provide for 100% smoke free ^d
Nigeria	2012	9765	89.1	The law does not provide for 100% smoke free ^e
Senegal	2015	4347	97.0	The law does not provide for 100% smoke free ^f
Tanzania	2018	4797	91.7	The law does not provide for 100% smoke free ^g
Uganda	2013	8508	86.6	The law does not provide for 100% smoke free ^h

^aBotswana—Designated smoking rooms are permitted in most indoor public places and indoor workplaces, and on many forms of public transport. Legislation | Tobacco Control Laws.

^bCameroon—Smoking is prohibited in schools, universities, and Ministry buildings. Smoking is not regulated in any other indoor public place, indoor workplace, or on any means of public transportation. Legislation | Tobacco Control Laws.

^cEthiopia Food, Medicine, and Healthcare Administration and Control Authority. Tobacco Control Directive No. 28/2015. March 2015. Ethiopia—Tobacco Ctrl. Dir. No. 28_2015national.pdf (tobaccocontrollaws.org).

^dKenya—Smoking is allowed in designated smoking areas in most public places and workplaces. It is unclear whether smoking is prohibited in most means of public transport, including trains, buses, taxis, and aircraft. Legislation | Tobacco Control Laws.

^eNigeria—Smoking is restricted to designated smoking areas in indoor public places and workplaces. Smoking is prohibited on public transport. Smoking is also prohibited in certain outdoor spaces, including: Restaurants and bars and any place where food or drink is served or consumed, playgrounds, amusement parks, public parks, and other public gathering places; bus stops, vehicle parks, and seaports; among other areas or places. Legislation | Tobacco Control Laws.

^fSenegal—Smoking is prohibited on public transport and in any enclosed workplace or public place except for in hotels, inns, guest houses, restaurants, and airports where designated smoking rooms are allowed. Smoking is also prohibited in religious sites, which may be indoors or outdoors. Legislation | Tobacco Control Laws.

^gTanzania—Designated smoking areas or rooms are allowed in all indoor public places, workplaces, and on public transport. Sub-national jurisdictions may pass more stringent legislation than the national law. Legislation | Tobacco Control Laws.

^hUganda—The Tobacco Control Act, 2015 is the primary law in Uganda regulating tobacco products and tobacco use and regulates restrictions on smoking in public places, advertising, promotion and sponsorship of tobacco products, production and sale of tobacco products, measures to protect against tobacco industry interference, and tobacco packaging and labeling measures, among others. Full-page photo (tobaccocontrollaws.org).

years and older designed to measure tobacco use and other key tobacco control indicators, including SHS exposure at home. GATS is conducted separately in each country using a standard protocol for sampling, data collection, data management, and weighting. This systematic collection of data allows policy makers, researchers, and tobacco control practitioners to monitor adult tobacco use and track key tobacco control indicators.²¹ Details of GATS methods have been published elsewhere.²²

Measures

Dependent Variable

SHS exposure at home was the dependent variable in the study, and a detailed definition has been described in a previous study.²³ Briefly, two questions were used to assess SHS exposure in the home. First, each respondent was asked, "Which of the following best describes the rules about smoking inside your home?" and the responses include: (1) "smoking is allowed inside of your home," (2) "smoking is generally not allowed inside your home but there are exceptions," (3) "smoking is never allowed inside your home," and (4) "there are no rules about smoking in your home." Respondents who indicated that smoking was "never allowed" inside their homes were considered to live in a smoke-free home. Those who indicated that smoking was allowed inside their home or allowed with exceptions, or no rules were then asked, "How often does anyone smoke inside your home?" Responses were categorized as "none" (those who responded "never") or "some" (those who responded "daily," "weekly," or "monthly"). Those who responded "never" were also considered to live in a smoke-free home and therefore not exposed to SHS at home. Those who indicated "daily," "weekly," or "monthly" were considered to have been exposed to SHS at home at least monthly.

The questions used to define the dependent variable measure have been included in the United States Bureau of Labor Statistics Tobacco Use Supplement to the Current Population Survey (CPS). These questions or even whole supplements in CPS are approved by the Bureau of Labor Statistics and Census Bureau. In addition, the Bureau of Labor Statistics and Census Bureau in consultation with U.S. federal government agencies obtained Office of Management and Budget (OMB) early in the development process for any questions about the appropriateness and validity of the proposed questions.²⁴ Other studies have also evaluated this measure and found it to be a valid and reliable measure of SHS exposure at home.²⁵⁻²⁷

Independent Variables

The variables examined include sociodemographic factors (age, sex, place of residence, education, and wealth index), presence of a person who smokes in a home, knowledge about the dangers of smoking, and SHS exposure in at least one public place. These variables were selected based on the risk factors for SHS exposure at home as reported in the literature.^{28,29} Sex was recorded as "Male" or "Female" from observation and asked only when necessary. Respondents were asked to provide their date of birth, which was computed into age and categorized as 15-24, 25-34, 35-44, 45-54, 55-64, and 65 years and older. Place of residence was determined as urban or rural. Education was grouped into four categories: (1) No formal education/less than primary complete, (2) less than high school complete, (3) high school completion, and

(4) above high school. The wealth index is based on household assets such as electricity, flush toilet, fixed telephone, cell telephone, television, radio, refrigerator, car, moped/scooter/motorcycle, and washing machine. Similar to previous studies,³⁰ responses were divided into wealth quintiles ranking from 1 (lowest) to 5 (highest).

Living With Someone Who Smokes

was defined using two questions that asked about the number of people in the household: "In total, how many persons live in this household?" and "How many of these household members are 15 years of age or older?" A roster is generated by asking the following questions about adults 15 years or older in a home: "What is the oldest/next oldest person's first name?"; "What is this person's age?"; "Does this person currently smoke tobacco, including cigarettes, cigars, pipes?" Based on these questions, we computed the variable that a household had someone 15 years and older who smoked.

Exposure to SHS in Public Places

was defined as a combination of responses on SHS exposure in any of the following public places: government buildings, health care facilities, public transportation, and restaurants. Respondents were first asked whether they had visited each location in the past 30 days, and among those who indicated "yes," exposure to SHS was assessed using the following question, "Did anyone smoke inside of any (government buildings or government offices/health care facilities/public transportation/restaurants) that you (visited/used) during the past 30 days?" Respondents who visited or used any of the four public places and indicated that someone smoked there were assumed to be exposed to SHS in a public place.

Belief About Whether SHS Causes Serious Illness in Nonsmokers

was defined using the questions "Based on what you know or believe, does breathing other people's smoke causes serious illness in non-smokers?" with responses (1) yes and (2) no.

Analysis

Descriptive statistics, including weighted point estimates and 95% confidence intervals (CIs) were computed for SHS exposure inside the home by selected sociodemographic characteristics.

We applied multivariable logistic regression with complex survey design to assess factors associated with SHS exposure at home for each country separately; therefore, we used eight country-specific models in the analyses. All models were adjusted for sociodemographic characteristics (age, sex, residence education, and wealth index) and environmental factors (smoke-free home rules, living with a person who smokes, and SHS exposure in public places). We checked for collinearity among the independent variables in the model and found no association (tolerance scores >0.05 and variance inflation factors <5). An analysis using pooled countries data controlling for sociodemographic characteristics including country as well to assess the independent factors consistent across countries results are provided in [Table 2](#).

All GATS data are weighted to each country's population with adjustments for non-response. We determined the statistical significance level of the adjusted odds ratios (AOR) with a cutoff point of p -value < .05. We used SAS-callable

Table 2. Pooled Analysis of Predictors of Exposure to Secondhand Smoke at Home Among Adults Aged 15 Years and Older in Eight Sub-Saharan African countries, GATS 2012–2018

Demographic characteristics	AOR (95% CI)
<i>Age</i>	
15–24 y	REF
25–44 y	1.13 (0.97, 1.32)
45–64 y	1.19 (0.98, 1.45)
≥65 y	1.08, (0.81, 1.44)
<i>Sex</i>	
Male	1.20 (1.04, 1.38)*
Female	REF
<i>Residence</i>	
Urban	REF
Rural	1.25 (1.00, 1.56)*
<i>Education</i>	
No formal/ less than primary complete	1.82 (1.30, 2.55)*
Below high school	1.45 (1.04, 2.01)*
High school	1.41 (1.01, 1.95)*
Above high school	REF
<i>Wealth index</i>	
Lowest	1.24 (0.90, 1.69)
Low	1.36 (1.02, 1.83)*
Middle	1.30 (0.98, 1.72)
High	1.06 (0.81, 1.38)
Highest	REF
Believe SHS cause serious illness in nonsmokers	
Yes	0.79 (0.62, 1.02)
No	REF
SHS exposure in at least 1 public place	
Yes	1.76 (1.50, 2.08)*
No	REF
Person who smokes at home	
Yes	20.44 (17.18, 24.32)*
No	
<i>Country</i>	
1–Cameroon	2.68 (2.02, 3.54)*
2–Kenya	1.92 (1.48, 2.51)*
3–Uganda	2.30 (1.85, 2.86)*
4–Nigeria	REF
5–Senegal	3.99 (3.13, 5.10)*
6–Ethiopia	2.80 (2.05, 3.82)*
7–Botswana	1.31 (1.03, 1.67)*
8–Tanzania	1.94 (1.54, 2.45)*

Abbreviations: *n* = sample size, AOR = adjusted odds ratio, REF = reference, SHS = secondhand smoke, CI = confidence interval, GATS = Global Adult Tobacco Survey. AOR calculated in logistic regression adjusting for age, sex, residence, education, wealth index, person who smokes at home, believe SHS causes serious illness, SHS exposure in at least one public place, country.
*Statistically significant at $p < .05$.

SUDAAN (SAS Version 9.4, SAS Institute Inc., Cary NC, USA; SUDAAN [Ver. 11.0], Research Triangle Institute, Research Triangle Park, NC, USA) for all the analysis. GATS data for all eight countries were adjusted for survey design, clustering, and sample weights.

Results

Prevalence of SHS Exposure in the Home

Table 3 shows the distribution of prevalence of SHS exposure at home among adults in eight SSA countries. Of the total participants across the eight SSA countries, and extrapolating from sampling weights, an estimated 26.6 million adults (median = 13.8%) were exposed to SHS smoke at home between 2012 and 2018. The overall prevalence of SHS exposure at home ranged from 6.6% (95% CI: 5.7, 7.6) in Nigeria to 21.6% (95% CI: 19.4, 24.0) in Senegal. Among females, the prevalence ranged from 7.7% (95% CI: 6.5, 9.0) in Nigeria to 24.5% (95% CI: 21.5, 27.8) in Senegal; among males, it ranged from 5.6% (95% CI: 4.4, 7.0) in Nigeria to 19.0% (95% CI: 16.8, 21.4) in Senegal. By place of residence, SHS exposure at home among urban residents ranged from 4.2% (95% CI: 3.1, 5.8) in Nigeria to 20.8% (95% CI: 18.4, 23.5) in Senegal, and among rural residents from 8.0% (95% CI: 6.8, 9.4) in Nigeria to 22.8% (95% CI: 19.4, 26.6) in Cameroon. Detailed information is available in Table 3 on SHS exposure at home by other different sociodemographic variables across the eight countries.

The prevalence of daily SHS exposure at home among adults in the eight SSA countries is presented in Supplementary Table 2. This shows that Supplementary Table 1 shows the current cigarette smoking prevalence among the eight countries which, ranged from 2.9% in Ethiopia to 12.9% in Botswana. Prevalence among men ranged from 5.5% in Ethiopia to 23.9% in Botswana while prevalence among women ranged from 0.3% in Senegal to 2.8% in Botswana.

Factors Associated With SHS Exposure Among Adults in SSA

The pooled analysis of data for all eight countries is presented in Table 2. The results showed that SHS exposure at home was associated with no formal education or less primary completion than high school completion, and above high school. In addition, SHS exposure at home was found to be associated with low wealth index compared to highest wealth index, living with a person who smokes, and exposure to SHS in public places.

Table 4 presents country-specific multivariable logistic regression results. Across all the eight SSA countries, living with a person who smokes was significantly associated with increased SHS exposure at home, after adjusting for other factors. The AOR for SHS exposure at home among adults living with a person who smokes ranged from 4.56 (95% CI: 3.60, 5.79) in Botswana to 26.41 (95% CI: 18.96, 36.80) in Tanzania. SHS exposure in public places was significantly associated with SHS exposure at home in Cameroon (AOR = 1.48; 95% CI: 1.10, 2.01), Ethiopia (AOR = 1.67; 95% CI: 1.13, 2.48), Nigeria (AOR = 2.44; 95% CI: 1.79, 3.33), Senegal (AOR = 1.48; 95% CI: 1.10, 2.00), Tanzania (AOR = 1.72; 95% CI: 1.21, 2.46), and Uganda (AOR = 1.56; 95% CI: 1.13, 2.14).

In Cameroon, compared to the 15–24 age-group, SHS exposure at home was associated with 45–64 age groups (AOR = 1.51; 95% CI: 1.06, 2.14), and 65 and older (AOR = 2.06; 95% CI: 1.06, 3.78). Compared to the 15–24 age-group, the adjusted odds of SHS exposure at home were high among the 65 and older age groups in Nigeria (AOR = 1.86; 95% CI: 1.01, 3.43). The odds of SHS exposure at home were significantly higher among males than females in Botswana (AOR

Table 3. Prevalence of Exposure to Secondhand Smoke at Home by Demographic Characteristics Among Adults in Eight Sub-Saharan African Countries, GATS 2012–2018

Variable	Cameroon	Kenya	Uganda	Nigeria	Senegal	Ethiopia	Botswana	Tanzania
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Overall	15.5 (13.5, 17.7)	14.3 (12.3, 16.6)	13.1 (11.8, 14.5)	6.6 (5.7, 7.6)	21.6 (19.4, 24.0)	12.6 (9.7, 16.2)	13.8 (12.1, 15.6)	13.8 (12.2, 15.7)
Age								
15–24 y	13.9 (10.8, 17.7)	13.6 (10.1, 18.0)	11.2 (9.4, 13.2)	6.3 (4.8, 8.3)	19.2 (16.5, 22.4)	11.0 (7.8, 15.2)	13.6 (10.5, 17.4)	13.7 (11.4, 16.3)
25–44 y	15.5 (13.0, 18.4)	13.1 (11.0, 15.5)	12.5 (10.9, 14.4)	6.3 (5.2, 7.6)	23.4 (20.5, 26.5)	13.5 (10.2, 17.7)	13.7 (11.5, 16.1)	12.5 (10.4, 15.0)
45–64 y	17.5 (14.0, 21.7)	17.9 (14.3, 22.3)	16.6 (13.8, 19.9)	7.0 (5.5, 8.9)	23.2 (19.8, 27.1)	16.1 (11.4, 22.4)	11.3 (8.9, 14.2)	17.3 (14.0, 21.1)
≥65 y	20.0 (13.7, 28.2)	17.5 (11.9, 25.0)	17.2 (13.2, 22.3)	9.5 (5.9, 14.8)	18.4 (13.0, 25.4)	10.2 (5.5, 18.2)	21.0 (15.8, 27.4)	13.7 (10.3, 18.0)
Sex								
Female	16.8 (13.8, 20.2)	16.8 (14.1, 19.9)	14.3 (12.6, 16.1)	7.7 (6.5, 9.0)	24.5 (21.6, 27.7)	12.7 (9.8, 16.4)	17.1 (14.4, 20.1)	15.9 (13.7, 18.5)
Male	14.3 (11.9, 17.0)	12.0 (9.5, 14.9)	12.0 (10.5, 13.6)	5.6 (4.4, 7.0)	19.0 (16.8, 21.4)	12.5 (9.1, 16.8)	10.7 (9.1, 12.5)	11.9 (10.0, 14.1)
Residence								
Urban	8.2 (6.8, 9.8)	13.0 (9.1, 18.0)	8.3 (6.9, 10.0)	4.2 (3.1, 5.8)	20.8 (18.4, 23.5)	9.0 (6.4, 12.4)	11.4 (9.5, 13.6)	9.3 (7.4, 11.5)
Rural	22.8 (18.8, 27.4)	15.0 (12.9, 17.5)	14.7 (13.1, 16.5)	8.0 (6.8, 9.4)	22.5 (18.9, 26.5)	13.8 (10.1, 18.4)	15.8 (13.3, 18.8)	16.1 (13.8, 18.7)
Education								
No formal education	16.5 (13.9, 19.5)	17.4 (13.6, 22.0)	17.0 (15.2, 19.0)	5.8 (4.7, 7.2)	21.1 (18.5, 24.0)	18.2 (13.1, 24.6)	20.5 (16.0, 25.9)	20.7 (17.4, 24.5)
Below high school	16.5 (13.2, 20.4)	15.5 (11.4, 20.7)	9.7 (7.9, 11.8)	8.8 (6.6, 11.7)	22.8 (19.1, 26.9)	10.4 (7.8, 13.6)	14.0 (10.8, 18.0)	12.8 (10.9, 14.9)
High school	9.3 (5.1, 16.4)	10.0 (6.6, 14.9)	4.9 (3.3, 7.2)	7.0 (5.7, 8.7)	22.5 (17.8, 27.9)	8.8 (5.6, 13.5)	13.5 (11.3, 16.0)	7.7 (5.4, 10.8)
Above high school	6.4 (3.8, 10.4)	6.7 (4.3, 10.1)	5.8 (3.9, 8.5)	3.3 (2.0, 5.2)	24.2 (18.1, 31.7)	7.1 (4.1, 12.2)	8.3 (6.2, 11.1)	1.9 (0.3, 12.8)
Wealth Index								
Lowest	18.9 (15.3, 23.2)	17.9 (13.8, 22.9)	20.9 (18.1, 24.1)	5.2 (3.9, 7.0)	26.7 (21.4, 32.7)	14.2 (9.3, 21.0)	21.4 (17.7, 25.7)	21.1 (17.9, 24.6)
Low	20.4 (16.0, 25.5)	13.4 (10.1, 17.5)	18.5 (15.9, 21.4)	7.6 (6.0, 9.7)	27.9 (23.7, 32.4)	14.2 (10.2, 19.4)	16.1 (11.8, 21.6)	16.3 (12.9, 20.4)
Middle	22.2 (17.2, 28.1)	19.4 (14.3, 25.8)	12.2 (10.0, 14.8)	6.3 (4.9, 8.1)	20.4 (17.0, 24.2)	11.7 (7.8, 17.3)	11.5 (8.8, 15.0)	16.1 (13.1, 19.6)
High	11.1 (8.3, 14.7)	13.6 (10.0, 18.1)	5.1 (3.8, 6.7)	8.2 (5.7, 11.8)	19.0 (15.7, 22.7)	8.3 (5.1, 13.2)	10.7 (8.2, 13.8)	8.7 (6.5, 11.6)
Highest	7.2 (5.2, 9.9)	8.2 (5.8, 11.4)	2.1 (1.4, 3.1)	6.1 (4.1, 9.0)	15.6 (12.6, 19.2)	8.8 (6.5, 11.8)	8.2 (5.4, 12.2)	6.7 (4.8, 9.2)
Person who smokes at home								
Yes	54.3 (48.9, 59.6)	45.8 (40.6, 51.1)	52.6 (48.3, 56.8)	39.6 (34.6, 44.8)	58.4 (54.1, 62.6)	62.0 (51.6, 71.4)	28.4 (24.8, 32.4)	54.0 (49.3, 58.7)
No	6.7 (5.2, 8.7)	5.6 (4.4, 7.2)	6.1 (5.2, 7.0)	2.0 (1.6, 2.5)	11.4 (9.8, 13.2)	6.7 (4.9, 9.2)	7.0 (5.9, 8.4)	3.9 (3.0, 5.0)
Believe SHS cause serious illness in nonsmokers								
Yes	15.2 (12.7, 18.1)	13.6 (11.5, 16.0)	12.0 (10.7, 13.4)	5.9 (4.8, 7.1)	21.2 (19.0, 23.5)	11.3 (8.6, 14.7)	12.9 (11.4, 14.6)	12.4 (10.8, 14.2)
No	18.6 (14.4, 23.7)	19.8 (12.4, 30.0)	22.3 (18.6, 26.4)	8.8 (7.3, 10.6)	27.0 (21.3, 33.6)	16.6 (10.9, 24.5)	23.0 (15.4, 32.8)	21.6 (17.2, 26.6)
Exposed to at least 1 public place								
Yes	17.4 (13.3, 22.3)	13.2 (9.8, 17.7)	13.4 (10.5, 16.8)	14.5 (11.6, 17.9)	27.5 (23.5, 32.0)	18.6 (14.3, 23.8)	11.8 (8.9, 15.6)	16.8 (13.3, 20.9)
No	15.0 (12.6, 17.7)	14.5 (12.4, 16.9)	13.0 (11.7, 14.5)	5.1 (4.3, 6.0)	20.6 (18.3, 23.1)	11.6 (8.7, 15.3)	14.1 (12.3, 16.2)	13.3 (11.6, 15.1)

CI = confidence interval, GATS = Global Adult Tobacco Survey.

Table 4. Predictors of Secondhand Smoke Exposure at Home by Demographic Characteristics Among Adults in Eight Sub-Saharan African Countries, GATS 2012–2018

Demographic Variable	Cameroon	Kenya	Uganda	Nigeria	Senegal	Ethiopia	Botswana	Tanzania
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Age								
15–24 y	REF	REF	REF	REF	REF	REF	REF	REF
25–44 y	1.24 (0.95, 1.63)	0.98 (0.69, 1.38)	1.10 (0.85, 1.42)	1.18 (0.81, 1.73)	1.29 (1.02, 1.62)	1.03 (0.74, 1.44)	0.97 (0.69, 1.37)	0.95 (0.68, 1.32)
45–64 y	1.51 (1.06, 2.14)	0.97 (0.61, 1.56)	1.18 (0.86, 1.62)	1.24 (0.78, 1.95)	1.20 (0.91, 1.59)	1.00 (0.61, 1.64)	0.78 (0.52, 1.19)	1.28 (0.88, 1.86)
≥65+ y	2.06 (1.13, 3.78)	1.06 (0.50, 2.24)	1.15 (0.76, 1.73)	1.86 (1.01, 3.43)	1.07 (0.67, 1.70)	0.69 (0.30, 1.61)	1.47 (0.94, 2.30)	0.50 (0.30, 0.82)
Sex								
Female	1.06 (0.82, 1.36)	1.20 (0.84, 1.71)	1.05 (0.85, 1.29)	1.24 (0.90, 1.70)	1.26 (1.04, 1.53)	1.26 (0.90, 1.78)	1.49 (1.15, 1.92)	1.35 (1.03, 1.78)
Male	REF	REF	REF	REF	REF	REF	REF	REF
Residence								
Urban	REF	REF	REF	REF	REF	REF	REF	REF
Rural	3.48 (2.22, 5.44)	0.73 (0.46, 1.14)	0.98 (0.75, 1.28)	1.64 (1.08, 2.48)	0.97 (0.73, 1.28)	1.01 (0.42, 2.44)	1.13 (0.85, 1.51)	0.99 (0.70, 1.42)
Education								
No formal education	1.44 (0.65, 3.19)	2.05 (1.14, 3.68)	0.99 (0.61, 1.60)	1.65 (0.80, 3.39)	0.56 (0.35, 0.89)	2.50 (1.18, 5.32)	1.12 (0.70, 1.80)	7.28 (0.83, 63.92)
Below high school	1.92 (0.89, 4.14)	1.92 (1.10, 3.35)	0.78 (0.46, 1.31)	2.43 (1.14, 5.16)	0.65 (0.41, 1.03)	1.15 (0.55, 2.42)	1.10 (0.70, 1.72)	5.48 (0.63, 47.70)
High school	2.00 (0.69, 5.84)	1.25 (0.66, 2.39)	0.56 (0.31, 1.01)	2.10 (1.08, 4.08)	0.78 (0.46, 1.32)	1.00 (0.48, 2.07)	1.13 (0.77, 1.66)	4.59 (0.49, 43.47)
Above high school	REF	REF	REF	REF	REF	REF	REF	REF
Wealth								
Lowest	1.03 (0.55, 1.94)	1.45 (0.76, 2.75)	10.42 (6.26, 17.35)	0.68 (0.36, 1.32)	2.43 (1.56, 3.81)	1.17 (0.44, 3.15)	1.98 (1.16, 3.37)	1.60 (0.94, 2.74)
Low	1.39 (0.77, 2.52)	1.08 (0.60, 1.95)	9.26 (5.72, 14.98)	1.05 (0.59, 1.86)	2.56 (1.73, 3.77)	1.38 (0.53, 3.56)	1.65 (0.91, 2.97)	1.40 (0.79, 2.48)
Middle	1.90 (1.14, 3.16)	1.60 (0.89, 2.89)	6.64 (3.98, 11.07)	0.74 (0.40, 1.35)	1.77 (1.23, 2.54)	1.30 (0.58, 2.92)	1.04 (0.60, 1.80)	1.55 (0.97, 2.46)
High	1.26 (0.74, 2.16)	1.36 (0.68, 2.73)	2.66 (1.56, 4.54)	1.05 (0.58, 1.91)	1.56 (1.08, 2.25)	0.84 (0.45, 1.57)	1.31 (0.76, 2.23)	0.90 (0.52, 1.56)
Highest	REF	REF	REF	REF	REF	REF	REF	REF
Believe SHS cause serious illness to nonsmokers								
Yes	1.02 (0.70, 1.48)	0.61 (0.35, 1.05)	0.71 (0.54, 0.93)	0.72 (0.51, 1.00)	0.76 (0.56, 1.04)	1.04 (0.59, 1.85)	0.61 (0.41, 0.92)	0.72 (0.50, 1.03)
No	REF	REF	REF	REF	REF	REF	REF	REF
Person who smokes at home								
Yes	17.12, (12.92, 22.70)	13.67 (9.86, 18.97)	16.14 (12.88, 20.24)	27.55 (20.05, 37.84)	10.48 (8.45, 12.99)	22.16 (13.62, 36.03)	4.56 (3.60, 5.79)	26.41 (18.96, 36.80)
No	REF	REF	REF	REF	REF	REF	REF	REF
SHS exposure in at least 1 public place								
Yes	1.48 (1.10, 2.01)	1.01 (0.72, 1.46)	1.56 (1.13, 2.14)	27.55 (20.05, 37.84)	1.48 (1.10, 2.00)	1.67 (1.13, 2.48)	1.04 (0.74, 1.45)	1.72 (1.21, 2.46)
No	REF	REF	REF	REF	REF	REF	REF	REF

AOR = Adjusted Odds Ratio; and CI = Confidence Interval; REF = Reference, GATS = Global Adult Tobacco Survey.

= 1.49; 95% CI: 1.15, 1.92), Senegal (AOR = 1.26; 95% CI: 1.04, 1.53), and Tanzania (AOR = 1.35; 95% CI: 1.03, 1.78). SHS exposure at home was associated with those in urban versus rural areas in Cameroon (AOR = 3.48; 95% CI: 2.22, 5.44) and Nigeria (AOR = 1.64; 95% CI: 1.08, 2.48). Further detailed logistic regression results for education levels and wealth index are available in [Table 4](#).

Discussion

Based on GATS data from 2012 to 2018, it was found that an estimated 26.6 million adults in SSA were exposed to SHS at home, which is the total of the weighted estimated number of adults exposed to SHS at home in each of the eight participating countries in this study. Overall, the prevalence of SHS exposure at home ranged from 6.6% (95% CI: 5.7%, 7.6%) in Nigeria to 21.6% (95% CI: 19.4%, 24.0%) in Senegal. Thus, besides Senegal, SHS exposure at home in the SSA countries in the study was less than 15.0%, which is lower than studies using GATS data from other regions of the world.^{31,32} In this regard, Nazar et al.³¹ found in a study involving 15 LMICs that SHS exposure at home ranged from 17.4% in Mexico to 73.1% in Vietnam. The relatively low prevalence of SHS exposure at home in these eight SSA countries could reflect the low smoking prevalence in these countries ([Supplementary Table 1](#)) and the region³³ although other studies have indicated that the region presents the greatest threat in terms of future growth in smoking.¹¹

The findings in this study further show that the distribution of SHS exposure at home varied within countries by sociodemographic characteristics, which also highlighted disparities in an exposure. In particular, SHS exposure at home compared to those with above high school was associated with non-formal education or less than primary complete in two countries (Ethiopia and Kenya), and lowest wealth index compared to highest wealth index in three countries (Botswana, Senegal, and Uganda).

The multivariable regression analysis also showed a strong association between living with someone who smokes and SHS exposure at home. This is consistent with previous studies that have found that people who smoke are less likely to adopt smoke-free rules at home.³⁴⁻³⁶ Thus, living with someone who smokes presents an increased risk of being exposed to SHS in the home.³⁷ In addition, the analysis showed that adults exposed to SHS in public places were more likely to be exposed at home. This reflects the potential benefits of public smoke-free policies translating to adoption of smoke-free rules at home.

The findings in this study, coupled with those of previous studies involving adolescents in SSA, revealed a high magnitude of SHS exposure at home.^{17,18} Despite variations, SHS exposure at home was prevalent in all countries, suggesting the importance of interventions that support adoption of voluntary smoke-free home rules that could help protect nonsmokers from SHS exposure. Adoption of smoke-free home rules has the benefit of protecting at home for those who do not smoke, preventing youth initiation, and also the associated increase in quit attempts and a reduction in cigarettes smoked.^{38,39} As the U.S. Surgeon General's report suggests, adopting voluntary smoke-free home rules is a strategy to protect nonsmokers such as children from SHS at home.¹ Furthermore, the adoption of voluntary smoke-free home rules could be achieved by raising awareness and

educating the public about the dangers of SHS, counseling, intervention by health care providers, and home visits.⁴⁰

Country interventions to prevent SHS exposure at home would need to address specific related disparities identified in the study. High SHS exposure at home was found in low socio-economic status (SES) populations (lower education, lower wealth index, and older adults), which is similar to studies from elsewhere^{31,41,42} and suggests the need for focused intervention that reaches these subpopulations. Although there are limited examples from LMICs, a community-based smoke-free home initiative in Indonesia offers a good example that could be used to reach low SES populations through adoption of smoke-free home rules with a focus to change norms to make smoking in the homeless socially accepted.⁴³ This initiative in Indonesia was important to changing community-wide smoking norms inside homes,⁴³ and this is an intervention that SSA countries could emulate.

In addition to adopting smoke-free home rules, cessation support for adults who smoke is important to preventing SHS exposure in the home.⁴⁴ Cessation support such as education, brief advice, and counseling, could help increase the adoption of smoke-free home rules and encourage quit attempts among adults who smoke.⁴⁴⁻⁴⁶ The eight SSA countries could consider adopting low-cost interventions that have been used in various LMICs to help persons who smoke to quit. These include the introduction of nicotine replacement therapies (NRTs), behavioral counseling, and brief advice.^{47,48} Additional factors that could play a role in getting persons who smoke to quit include brief advice by health care providers and integrating advice into existing health care programs focused on at-risk populations, provision of free quitlines, mobile cessation services, and medication.⁴⁹

Furthermore, countries adopting Article 8 of the WHO Framework Convention on Tobacco Control (WHO FCTC) and its guidelines could see a reduction in exposure to SHS inside the home.⁵⁰ Article 8 of WHO FCTC addresses the adoption and implementation of effective measures to protect people from exposure to tobacco smoke in indoor workplaces, public transport, indoor public places and, as appropriate, other public places.⁵⁰ As signatories to the WHO FCTC, SSA countries are required to adopt effective smoke-free policies to protect vulnerable populations (Guidelines for implementation of Article 8).⁵⁰ Despite strong public support,⁵¹ SSA countries fall behind other regions of the world in adopting and developing Guidelines to implement Article 8,^{52,53} suggesting the critical need for research to understand SHS exposure in these countries to guide policy change. Although at the time the GATS data was collected, all eight countries in this study had enacted some form of smoke-free policies ([Table 1](#)), their policies had either exceptions and/or designated smoking areas.⁵¹ Estimates from the GATS data for these eight countries on SHS exposure among those who visited bars and night clubs ranged from 60.4% in Ethiopia to 86.1% in Kenya; universities ranged from 12.5% in Uganda to 57.0% in Senegal; and schools ranged from 4.7% in Uganda to 20.7% in Senegal,⁵⁴⁻⁶¹ suggesting the need for initiatives to address SHS exposure in these venues.

It has been well-established that there is no safe level of SHS exposure¹⁻³; therefore, the findings of this study have implications for tobacco control and research. Substantial number of adults were exposed to SHS in the eight African countries in this study, indicating that SHS exposure is a much bigger public health issue because research suggests that

vulnerable populations such as children, women, and those with disabilities are disproportionately affected by SHS.¹² Furthermore, much of the SHS exposures occur in households with people who smoke, which suggests the need to include the home environment in tobacco control efforts across these countries. Regarding research, this study suggests the need for more quantitative and qualitative research on SHS exposure in subpopulations in countries across Africa to examine subjectively and objectively the circumstances under which people are exposed to SHS to inform initiatives to protect nonsmokers from the deleterious effects of such exposures.

This study has at least three limitations. First, using self-reported data may have introduced bias due to recall of information or social desirability. Given errors observed on self-report SHS exposure studies,⁶² the use of objective biomarker studies such as serum cotinine test could be an important consideration in future studies. Secondly, variation in the timing of the surveys may make it difficult to compare the results across countries, as surveys were implemented at separate times over 8 years. Nonetheless, this is the first study, to the best of our knowledge, on SHS exposure among adults in multiple SSA countries using nationally representative data, with results that can be extrapolated to nearly half of the population in the SSA region. Finally, a wealth index was used as an approximation of SES which, could be affected by context-specific factors such as country development level; however, the wealth index is a well-accepted proxy measure of SES in household surveys and is a distinct measure of household SES from income and consumption measures.⁶³

Conclusion

The results of this study show the variability of prevalence and factors associated with SHS exposure at home among adults in eight African countries and demonstrate that exposure is strongly associated with living with someone who smokes tobacco. Additionally, results for some of the countries show that SHS exposure at home was high among those in lower SES populations, suggesting that focused intervention for subpopulations is needed in the countries. Finally, SHS exposure at home was found to be strongly associated with those exposed to SHS in public places in most of the countries assessed. This finding raises the importance of implementing Article 8 of the WHO FCTC to protect nonsmokers from the deleterious effect of SHS exposure. Overall, the findings of this study suggest the critical need to adopt smoke-free home rules to protect vulnerable nonsmokers from SHS exposure.

Supplementary Material

A Contributorship Form detailing each author's specific involvement with this content, as well as any supplementary data, are available online at <https://academic.oup.com/ntr>.

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Disclaimer

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Declaration of Interests

The authors have declared that no competing interests exist.

Data Availability

GATS Data used in this study are available at Global Tobacco Surveillance System Data (GTSSData): Explore by Indicator | OSH | CDC.

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