# Never-Smoking Adolescents' Exposure to Secondhand Smoke in Africa

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**Introduction:** Though Africa is in Stage 1 of the tobacco epidemic, lack of effective public smoking laws or political will implies that secondhand smoke (SHS) exposure may be high in youth. The study objective is to estimate prevalence and identify determinants of SHS exposure among never-smoker adolescents in Africa and make cross-country comparisons.

**Methods:** Pooled data from the Global Youth Tobacco Surveys conducted in 25 African countries during 2006–2011 were used. Based on the venue of exposure in past 7 days, SHS was categorized into exposure inside, outside, and overall exposure (either inside or outside of the home), respectively. Data were analyzed in 2015 using logistic regression models to identify factors related to SHS exposure in three venues.

**Results:** About 21% and 39% of adolescents were exposed to SHS inside or outside of the home, with overall exposure of 45%. In all 25 African countries, parental smoking was significantly associated with SHS exposure inside the home (ORs ranging from 3.02 [95% CI=2.0, 4.5] to 14.65 [95% CI=10.0, 21.5]). Peer smoking was associated with SHS exposure outside the home in 18 countries (ORs ranging from 1.45 [95% CI=1.0, 2.1] to 3.00 [95% CI=1.8, 5.1]). Parental smoking, peer smoking, and anti-smoking messages in media were identified as three major factors associated with SHS exposure.

**Conclusions:** A significant proportion of never-smoking adolescents in Africa are exposed to SHS, suggesting the need for countries to adopt policies to protect never smokers through the implementation of the WHO Framework Convention on Tobacco Control.

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## Introduction

Secondhand tobacco smoke (SHS) exposure and its health and economic effects have been well documented.[1,2] SHS is significantly associated with increased risk of mortality, with approximately 600,000 deaths attributed to SHS exposure globally,[2] and about one third of these deaths are children.[3] Given that 80% of smokers currently reside in low- and middle-income countries (LMICs), a greater proportion of SHS-attributable deaths and exposure in never-smoking adolescents occur in LMICs.[2] In addition, previous studies, including animal models, have reported that SHS is more carcinogenic to exposed nonsmokers than smokers who actively inhale mainstream smoke.[4,5] Countries in Africa are in Stage 1 of the tobacco epidemic curve,[6] meaning prevalence of tobacco use is low; however, exposure to SHS is possibly high, and augmented by paucity of research. Therefore, using nationally representative data from 25 African countries, the study objective is to assess SHS exposure among never-smoking adolescents and identify key correlates associated with it.

Adolescents are at greater risk of SHS exposure in countries where public and home smoking are not restricted.[7] A previous study reported that approximately 30.4% and 44.2% of never-smoking adolescents in 168

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LMICs have been exposed to SHS inside and outside of homes, respectively,[8] identifying a need for estimating these exposures in different countries for country- or region- specific interventions and policy development. Studies using single country or local populations[9,10] have been conducted to assess the scope of SHS exposure in Africa; however, there is no study conducted on cross-country comparisons. In this study, Global Youth Tobacco Survey (GYTS) data were used to assess SHS exposure among adolescents to spur policy and advocacy actions in establishing smoke-free environments.

## Methods

### Study Population

Study data were obtained from GYTS administered in 25 African countries during 2006–2011. GYTS has been administered more than once; however, to provide the latest estimates, the most recent survey for countries that have conducted the survey more than once was used.[8,11,12] Only countries with national-level data were included. Three countries (Zambia, Sao Tome and Principe, and Rwanda) were excluded from the analysis owing to incomplete information on study variables and sampling weights. The detailed description of the GYTS sampling methodology and administration has been provided in an earlier publication.[13] In brief, the GYTS is a school-based survey and employs a two-stage cluster sampling design to collect representative data on tobacco use among youth aged 13–15 years. The clusters of schools proportional to student enrollment were selected during the first stage, followed by random selection of classes during the second stage. The survey questionnaire was administered to all students in selected classes. The sampling frame of GYTS includes adolescents aged 13–15 years; therefore, respondents aged $<13$ years or $>15$ years were not included.[8,12] The IRB at the University of Texas Medical Branch approved the study.

### Measures

Study outcomes were SHS exposure inside home, outside home, and overall (either inside or outside home). An adolescent was defined as a never smoker if they reported neither smoking nor experimenting with tobacco product in their lifetime. SHS exposure was ascertained by an adolescent self-reported response about people smoking in their presence inside the home ("SHS exposure inside home") or outside ("SHS exposure outside home") on at least one occasion within 7 days prior to survey administration. In addition, overall SHS exposure was determined with adolescents' reports of exposure to SHS either inside or outside home.

Age (13, 14, or 15 years), sex (male/female), parental smoking behavior (no/yes), peer smoking behavior (no/yes), knowledge about tobacco harm (no/yes), support for public smoking ban (no/yes), exposure to smoking messages in media (no/yes), exposure to anti-smoking messages in media (no/yes), anti-tobacco education in schools (no/yes), exposure to tobacco industry promotions (no/yes), and the country and year of survey administration were included as possible covariates.[8,14] GYTS questions from which the study variables were derived and the respective GYTS responses, as well as coding of responses are described in the Appendix (available online).

### Statistical Analysis

Data management and analyses were conducted using SAS, version 9.4, in 2015. Sampling weights, adjusted for multistage cluster sampling effects, nonresponses, and post-stratification of the sample relative to grade and sex distribution in the population were used to calculate representative population from which the sample was drawn. Differences in all three types of SHS exposure variables by each independent variable were determined using chi-square tests. Multivariable logistic regression models were employed to identify correlates associated with SHS exposure inside home (Model 1), outside home (Model 2), and either inside or outside home (Model 3), respectively, for all 25 African countries. All models were checked for regression diagnostics and no important correlation that warranted omission of variables was identified. Adjusted point estimates along with respective 95% CIs are reported. A $p$-value $<0.05$ was considered significant for statistical inferences.

## Results

A total of 34,046 school-going adolescents representing approximately 4 million youth in the 25 African countries were included. More than half of the participants were female in each country, except for Eritrea, Niger, and Togo, where male adolescents were predominant. Approximately 29%, 36%, and 35% of adolescents were aged 13, 14, and 15 years, respectively (Appendix Table 1, available online). Approximately 16% of participants (ranging from 6% in Ghana to 34% in Madagascar) reported at least one of their parents smoked tobacco, and 17% (ranging from 6% in Malawi to 39% in Seychelles) reported at least one of their peers smoked tobacco (data not shown).

Prevalence of SHS exposure inside home, outside home, and overall was 21.4%, 39.1%, and 44.5%, respectively. SHS exposure inside home ranged from 13.0% in Cape Verde to 42.6% in Equatorial Guinea; SHS exposure outside home ranged from 24.3% in Cape Verde to 80.4% in Mali; and overall SHS exposure ranged from 29.6% in Cape Verde to 83.7% in Mali. Highest levels of SHS exposure were reported in Mali, whereas lowest were reported in Cape Verde (Figure 1). Results of bivariate analysis of three types of SHS exposure (no/yes) with adolescent characteristics showed significant differences in SHS exposure by most adolescent characteristics (Appendix Table 2, available online).

In a pooled analysis of data from 25 countries, after adjusting for other variables, parental smoking (OR=6.11, 95% CI=5.2, 7.1), peer smoking (OR=2.07, 95% CI=1.8, 2.4), knowledge about tobacco harm