Secondhand Smoke Exposure Among Nonsmoking Adolescents in West Africa

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Objectives. We estimated the prevalence and determinants of secondhand smoke (SHS) exposure among nonsmoking adolescents in 9 West African countries.

Methods. We conducted a pooled analysis with nationally representative 2006 to 2009 Global Youth Tobacco Survey data. We used descriptive statistics to determine the prevalence of SHS exposure and inferential statistics using a multivariable logistic regression model to determine factors associated with SHS exposure. We investigated average marginal effect results that show the probability of SHS exposure, adjusting for all other attributes.

Results. SHS exposure inside the home ranged from 13.0% to 45.0%; SHS exposure outside the home ranged from 24.7% to 80.1%. Parental or peer smoking behaviors were significantly associated with higher probability of SHS exposure in all 9 countries. Knowledge of smoking harm, support for smoking bans, exposure to antismoking media messages, and receptivity of school tobacco education were significantly associated with higher SHS exposure in most countries.

Conclusions. West African policymakers should adopt policies consistent with Article 8 of the World Health Organization Framework Convention on Tobacco Control and its guidelines and public health education to promote smoke-free households. (*Am J Public Health.* 2015;105:1823–1830. doi:10.2105/AJPH.2015.302661)

Exposure to secondhand smoke (SHS) is a known health hazard for both children and adults that significantly contributes to morbidity and mortality.[1] With more than 1 billion smokers worldwide, many nonsmokers are exposed to SHS, about two thirds of whom are children and adolescents.[2] Annually, SHS exposure accounts for more than 600 000 deaths among nonsmokers worldwide, about one third of whom are children.[3] In 2003, the member states of the World Health Organization (WHO) unanimously adopted the Framework Convention on Tobacco Control (FCTC), Article 8 of which requires the creation of smoke-free environments to protect nonsmokers from SHS exposure.[4] However, as of 2012, only 16% of the world's population was covered by comprehensive smoke-free policies[5]—13% among West African countries as of December 2013.[6] This limited coverage of comprehensive smoke-free policies in the West African region requires deeper analysis of the prevalence and the factors associated with SHS exposure in each country to inform policy initiatives and advocacy.

Several studies have been conducted to understand SHS exposure among nonsmoking children[7] and adults.[8] A key finding reported by most studies is that SHS exposure among children is influenced by parents' and peers' smoking behavior and family socioeconomic status.[9–11] These studies on SHS exposure have been, however, confined mostly to high-income countries, with a limited number in low- and middle-income countries (LMICs).

To address the sparse research on SHS exposure among youths in Africa[2,12] and to help further protect children in West Africa, we aimed to estimate the prevalence and identify factors associated with nonsmoking adolescents' exposure to SHS. Despite the generally low rates of smoking prevalence, we hypothesized that there would be a high level of SHS exposure among adolescents and that several other factors, including parental smoking behavior, would be identified as possible determinants because of the communitarian culture of West African countries and the general absence of comprehensive smoke-free policies.

To our knowledge, our study is the first regional-level investigation into SHS exposure among nonsmoking adolescents in the Sub-Saharan African region. A regional-level approach to tobacco-induced issues in West Africa is important because of the continuous economic integration through the Economic Community of West African States and the regional approach recently applied by transnational tobacco companies to market and promote tobacco.

We studied 9 West African countries (Cape Verde, Cote d'Ivoire, Ghana, Guinea, Mali, Mauritania, Niger, Senegal, and Togo). In 2013, whereas the total prevalence of cigarette smoking among adults ranged from 3.5% (Cape Verde and Niger) to 13.7% (Cote d'Ivoire), that of the youths ranged from 3.6% (Ghana) to 17.8% (Mauritania).[5] Although the geography and population sizes of West African countries differ, they bear similarities in culture, economic standards, tobacco use (e.g., a wide gender gap[13]) and control (e.g., limited comprehensive smoke-free policies[6,14]), and the presence and operation of the tobacco industry. All countries in the region are classified as LMICs, with the Human Development Index ranging from 0.304 in Niger to 0.586 in Cape Verde[15] and the per capita annual income ranging from $700 in Liberia to $4400 in Cape Verde. The domestic tobacco markets are controlled by transnational tobacco companies, with British American Tobacco controlling the largest market share. These similarities ensure the comparability of our results.

METHODS

In the 9 West African countries we studied, a Global Youth Tobacco Survey (GYTS) was administered to collect nationally representative tobacco-related information on school-going adolescents. On the basis of established standards,[16] we included data collected between 2006 and 2009 and used the latest years the GYTS was administered and made publicly available by WHO and the US Centers

for Disease Control and Prevention for each country. We extracted data during the first half of 2014. The total sample included 12 892 nonsmoking school-going adolescents aged 13 to 15 years. The overall proportion of school enrollment among the youths aged 12 to 18 years during the time data were collected ranged from as low as about 12% in Niger to about 84% in Cape Verde.[17]

A detailed description of the GYTS has been published elsewhere.[16–20] In brief, a 2-stage cluster sampling design was used to select clusters of schools at the first stage, and classrooms within selected schools where the survey was given were randomly selected at the second stage. Regardless of age, all students available in the classrooms on the day the survey was administered were eligible to participate. However, we specifically focused on those aged 13 to 15 years who were nonsmokers because the GYTS was designed to be representative for this age group and to ensure consistency and comparability with the literature.[16,18,21]

Study Measures

The 2 outcome measures were (1) SHS exposure inside the home, and (2) SHS exposure outside the home. Respondents were asked, "During the past 7 days, on how many days have people smoked in your home in your presence?" and the responses were "0, 1–2, 3–4, 5–6, and 7 days." We converted these responses into a binary measure by clubbing all the nonzero responses to 1. We used a similar approach to code SHS exposure outside the home. The question in that case was "During the past 7 days, on how many days have people smoked in your presence in places other than in your home?"

We used the following independent variables drawn from the literature[16–20] in our analysis: age, gender, parent or peer smoking behavior, knowledge of smoking harm, whether the adolescent supported a smoking ban in public places, and exposure to antismoking media messages and antismoking school education.[18] The detailed coding of responses to these GYTS measures is available as a supplement to the online version of this article at http://www.ajph.org.

Data Analysis

We computed the prevalence estimates of SHS exposure inside and outside the home using sampling weights from the survey so that the estimated proportions are representative of the population of the respective countries. Additionally, we performed bivariate analysis between SHS exposure and the independent variables. Finally, we performed multivariable logistic regressions to estimate the associations between the independent variables and SHS exposure among the adolescents. We estimated separate models for each country for SHS exposure inside and outside the home. We conducted a Hosmer–Lemeshow test to check for the goodness of fit of the model.[22] The P value was $>.05$ for the Hosmer–Lemeshow χ^2 analysis for all the models except that of Mali and Senegal, indicating good model fit. We reported only the average marginal effects for each of the multivariable logistic regression models for SHS exposure inside and outside the home across the 9 countries because they are more intuitive and can inform both the direction and the magnitude of effects.

The average marginal effects determine the probability of exposure to SHS from the logistic regressions and we have presented them after multiplying by 100 so that the results can be interpreted as percentages. One can interpret the marginal effects as in the following example: Suppose the average marginal effect is 0.26 (26%) for the parental smoking = 1 variable for SHS exposure inside the home for Ghana data. This means the probability of being exposed to SHS inside the home for nonsmoking adolescents in Ghana is 26 percentage points higher for those adolescents whose parents smoked than for those whose parents did not smoke, adjusting for all other characteristics. The average marginal effects are different from marginal effects evaluated at a single point, such as the mean, and are more meaningful when interpreting logistic regression results.

We estimated all models using the statistical software Stata version 12.0 (StataCorp, College Station, TX).

RESULTS

The sample size for nonsmoking school-going adolescents aged 13 to 15 years ranged from 904 in Niger to 3154 in Ghana (data available as a supplement to the online version of this article at http://www.ajph.org). Boys constituted more than half of the participants in 8 of the 9 countries. The percentage of multivariable participants with at least 1 smoking parent ranged from 5.8% in Ghana to 19.8% in Senegal, and those with a close friend that smoked ranged from 10.2% in Togo to 31.4% in Mali. Across the 9 countries, at least two thirds of the adolescents were knowledgeable of health dangers related to smoking. More than half of the participants in each of the 9 countries supported a ban on smoking in public places, with the least in Ghana (55.2%) and the most in Cote d'Ivoire (89.8%). More than half of the participants were exposed to antismoking media messages only in Cape Verde (51.2%) and Senegal (75.4%), and had antismoking school education in Ghana (62.9%), Guinea (57.2%), and Mali (55.6).

Secondhand Smoke Exposure Inside the Home

The percentage of adolescents exposed to SHS inside the home ranged from 13.0% in Cape Verde to 45.0% in Mali (data available as a supplement to the online version of this article at http://www.ajph.org; Table 1). Whereas the rate of SHS exposure ranged from 13.2% (Cape Verde) to 45.3% (Senegal) for boys, that of girls ranged from 12.6% (Cape Verde) to 45.8% (Mali). In terms of age, the lowest rate of SHS exposure was reported by those aged 13 years in Cape Verde (10.8%) and the highest by those aged 14 years in Mali (48.6%). Although the rate of SHS exposure inside the home among nonsmoking adolescents with at least 1 smoking parent varied from 36.9% in Cape Verde to 73.7% in Mali, those with smoking peers ranged from 22.2% in Cape Verde to 62.2% in Senegal.

Among adolescents who were knowledgeable of smoking harm, the rate of SHS exposure inside the home ranged from 13.4% in Cape Verde to 49.8% in Senegal. For adolescents who supported smoking bans in public places, 13.3% (lowest) and 46.1% (highest) were exposed to SHS inside the home in Cape Verde and Mali, respectively. Among adolescents exposed to antismoking media messages, SHS exposure inside the home varied from 17.0% in Cape Verde to 51.3% in Mali; and for those exposed to antismoking education, the rates ranged from 15.4% in Cape Verde to 51.1% in Mali.

Table 2 and data available as a supplement to the online version of this article at http://www.ajph.org show the average marginal

TABLE 1—Nonsmoking Adolescents' Exposure to Secondhand Smoke Inside the Home: Global Youth Tobacco Survey, 9 West African Countries, 2006–2009

Characteristic	Cape Verde (n = 970), %	Cote d'Ivoire (n = 1382), %	Ghana (n = 3154), %	Guinea (n = 938), %	Mali (n = 1593), %	Mauritania (n = 1217), %	Niger (n = 904), %	Senegal (n = 1124), %	Togo (n = 1610), %
Overall	13.0	29.4	14.9	23.9	45.0	32.2	21.1	44.5	17.2
Gender									
Male	13.2	28.4	15.5	22.5	44.8	34.6	23.4	45.3	19.1
Female	12.6	30.3	14.1	25.9	45.8	29.9	19.2	41.4	15.1
Age, y									
13	10.8	25.8	14.0	18.9	47.5	31.5	19.6	48.1	14.9
14	11.7	30.0	14.3	29.4	48.6	32.2	19.3	44.6	17.6
15	16.2	31.5	16.3	22.3	38.1	32.4	24.1	41.8	18.6
Parent smokes									
No	8.8	23.8	13.4	18.7	38.0	27.7	19.1	37.5	13.1
Yes	36.9	58.7	38.9	51.3	73.7	54.8	50.7	72.3	53.5
Peer smokes									
No	10.4	25.1	12.1	21.7	43.8	28.3	17.8	39.5	15.5
Yes	22.2	40.6	32.1	34.0	47.8	40.1	34.5	62.2	32.6
Knowledge of smoking harm									
No	9.8	29.4	12.1	12.8	41.7	26.8	18.9	35.2	15.2
Yes	13.4	29.4	16.5	31.9	45.9	34.3	21.5	49.8	17.9
Support smoking ban									
No	10.6	27.0	12.4	18.3	38.4	24.7	20.1	44.8	15.5
Yes	13.3	29.6	16.4	26.1	46.1	36.3	21.8	42.6	17.5
Exposed to antismoking media messages									
No	8.8	27.2	11.7	19.1	40.6	28.0	17.1	32.0	16.0
Yes	17.0	32.6	19.8	29.1	51.3	38.7	28.1	48.6	21.5
Exposed to antismoking education in school									
No	12.5	27.1	12.3	22.5	37.1	30.0	20.1	42.0	18.0
Yes	15.4	32.0	16.3	24.7	51.1	35.0	23.6	46.6	16.2

Note. All percentages are weighted. $P < .05$ for all data.

effects of each of the independent variables from the multivariable logistic regression model on SHS exposure inside the home across the 9 countries for adolescents aged 13 to 15 years. We found that neither the gender nor the age of the respondents had any significant association with the probability of SHS exposure inside the home in any of the 9 countries. However, various other characteristics of nonsmoking adolescents had a statistically significant association with the probability of their exposure to SHS inside the home. The association between parental smoking behavior and the probability of SHS exposure inside the home varied considerably between countries. The probability of SHS exposure inside the home was 20.8 (lowest) and 41.2 (highest) percentage points higher for adolescents with at least 1 smoking parent than for those with no smoking parents in Ghana and Togo, respectively, adjusting for other characteristics of nonsmoking adolescents. Similarly, the effects of peer smoking behavior on the probability of SHS exposure inside the home also varied considerably across countries. In Cape Verde, the probability of SHS exposure inside the home was 8 percentage points (lowest) higher for those adolescents with smoking peers than those without, and it was 15.5 percentage points (highest) higher in Togo.

In terms of knowledge of smoking harm, the probability of SHS exposure inside the home was statistically significant for only Guinea, Senegal, and Togo, being, respectively, 16.4, 10.9, and 4.7 percentage points higher among those who were knowledgeable about smoking harm than those who were not.

The probability of SHS exposure inside the home was 10.2 percentage points higher among those who supported a ban on smoking in public places than those who did not in Mauritania, whereas it was 13.0 percentage points lower in Senegal. By contrast, the probability of SHS exposure was 4.2 to 6.8 percentage points higher among the adolescents exposed to antismoking media messages than those not exposed in Cape Verde, Ghana, Mauritania, Niger, and Senegal.

Similarly, the probability of being exposed to SHS inside the home was 3.8 to 9.5 percentage points higher for those exposed to antismoking

TABLE 2—Average Marginal Effects of Nonsmoking Adolescents' Exposure to Secondhand Smoke Inside the Home: Global Youth Tobacco Survey, 9 West African Countries, 2006–2009

Characteristic	Cape Verde (n = 970), %	Cote d'Ivoire (n = 1382), %	Ghana (n = 3154), %	Guinea (n = 938), %	Mali (n = 1593), %	Mauritania (n = 1217), %	Niger (n = 904), %	Senegal (n = 1124), %	Togo (n = 1610), %
Gender									
Male	0.5	−1.8	−0.5	−4.5	−4.5	0.6	−2.6	0.8	2.3
Female (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Age, y									
13 (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
14	0.9	2.6	1.5	7.2	1.2	−1.0	−2.0	−1.1	2.9
15	2.0	2.7	1.9	1.1	−2.3	−2.1	2.7	−0.3	3.9
Parent smokes									
Yes	25.7***	33.8***	20.8***	29.8***	33.8***	24.2***	31.1***	35.0***	41.2***
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Peer smokes									
Yes	8.0**	12.4***	13.7***	8.5*	10.4***	8.3**	15.2***	14.1***	15.5***
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Knowledge of smoking harm									
Yes	−1.4	−1.9	2.3	16.4***	1.0	2.9	1.5	10.9***	4.7*
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Supports smoking ban									
Yes	0.3	4.9	1.4	5.2	4.4	10.2***	4.2	−13.0**	0.9
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Exposed to antismoking media message									
Yes	4.2*	3.2	4.8***	4.6	2.5	5.8*	5.7*	6.8*	2.1
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Exposed to antismoking education in school									
Yes	2.6	5.1*	3.8**	−0.4	9.5***	6.3*	2.3	5.7*	−3.6*
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
H-L $\chi^2(8)$[a]	8.2 (0.4)	11.3 (0.2)	10.8 (0.2)	9.7 (0.3)	12.6 (0.1)	10.8 (0.2)	9.7 (0.3)	5.7 (0.7)	13.0 (0.1)

Note. Average marginal effects were estimated from the multivariable logistic regression and converted to percentages.
[a]H-L $\chi^2(8)$ shows the results of Hosmer–Lemeshow test for the goodness of fit of the model with 10 groups. The values in parentheses indicate Prob > χ^2.
*P < .05; **P < .01; ***P < .001.

education than for those not exposed in Ghana, Cote d'Ivoire, Senegal, Mauritania, and Mali. By contrast, those who were exposed to antismoking education in schools in Togo had 3.6 percentage points lower probability of SHS exposure inside the home.

Secondhand Smoke Exposure Outside the Home

A higher percentage of nonsmoking school-going adolescents was exposed to SHS outside the home than inside the home in all countries. SHS exposure outside the home ranged from 24.7% in Cape Verde to 80.1% in Mali (data available as a supplement to the online version of this article at http://www.ajph.org; Table 3). The rate of SHS exposure outside the home among nonsmoking adolescents was lowest in Cape Verde and highest in Mali among both boys and girls and across all ages and among those with a smoking parent or peer, who were knowledgeable of smoking harm, who supported smoking ban in public places, who were exposed to antismoking media messages, or who received antismoking school education.

Table 4 presents the results for the average marginal effects of various factors from multivariable logistic regression model on the probability of SHS exposure outside the home. We found that the age of the respondents had no significant association with the probability of SHS exposure outside the home in any of the 9 countries and the gender of the respondent had no effect on SHS exposure outside the home in 8 of the 9 countries. Guinea was an exception in this regard: boys had 7.3 percentage points higher probability of exposure to SHS outside the home than did girls. Unlike gender and age, various other characteristics of the nonsmoking adolescents had statistically significant effects on the probability of their exposure to SHS outside the home.

Similar to SHS exposure inside the home, the effects of parental smoking on the probability of SHS exposure outside the home were significantly higher for adolescents with smoking parents than those without smoking parents,

TABLE 3—Nonsmoking Adolescents' Exposure to Secondhand Smoke Outside the Home: Global Youth Tobacco Survey, 9 West African Countries, 2006–2009

Characteristic	Cape Verde (n = 970), %	Cote d'Ivoire (n = 1382), %	Ghana (n = 3154), %	Guinea (n = 938), %	Mali (n = 1593), %	Mauritania (n = 1217), %	Niger (n = 904), %	Senegal (n = 1124), %	Togo (n = 1610), %
Overall	24.7	71.8	29.0	49.7	80.1	45.4	52.9	45.5	38.2
Gender									
Male	26.0	72.2	30.6	53.0	80.7	50.2	55.9	43.2	40.3
Female	23.8	71.1	27.3	46.8	79.3	41.8	50.4	44.4	35.6
Age, y									
13	22.7	69.3	29.0	45.2	79.9	45.1	49.9	45.1	35.0
14	22.4	71.8	28.6	54.1	80.1	47.0	54.7	46.8	39.4
15	28.9	73.7	29.4	48.6	80.3	44.3	53.5	44.4	39.4
Parent smokes									
No	21.6	70.4	27.5	47.0	79.3	44.4	51.9	40.5	35.5
Yes	42.7	81.2	50.8	64.3	84.4	53.2	68.9	61.3	57.7
Peer smokes									
No	20.1	68.7	27.1	46.7	76.0	37.9	47.9	42.1	36.4
Yes	40.5	80.2	40.5	62.9	89.8	62.4	72.7	57.8	55.3
Knowledge of smoking harm									
No	17.8	64.7	20.9	37.3	70.1	30.3	39.3	32.6	33.2
Yes	25.9	73.3	33.7	58.7	82.8	51.8	55.5	53.0	39.9
Support smoking ban									
No	20.1	65.8	23.3	37.2	69.8	35.1	47.0	42.1	29.4
Yes	25.5	72.4	33.5	54.2	82.0	51.8	56.4	45.1	39.6
Exposed to antismoking media messages									
No	19.4	66.6	22.1	45.2	77.4	35.9	47.5	32.8	35.8
Yes	29.8	79.2	39.6	54.4	83.7	60.1	62.3	49.9	46.7
Exposed to antismoking education in school									
No	24.6	70.6	24.2	46.1	74.6	42.6	49.9	40.5	36.1
Yes	25.5	73.8	31.8	52.1	84.2	49.5	61.2	52.2	41.7

Note. All percentages are weighted. $P < .05$ for all data.

except in Mali, Mauritania, and Niger. The excess probability ranged from 9.7 percentage points in Cote d'Ivoire to 23.0 percentage points in Togo. Across all countries, the probability of being exposed to SHS outside the home was significantly higher for adolescents with than those without smoking peers, except in Senegal, where the effects were not significant. The excess probability varied from 8.6 percentage points in Cote d'Ivoire to 21.1 percentage points in Niger. Compared with respective referent populations, probabilities of SHS exposure outside the home were significantly higher among nonsmoking adolescents who were knowledgeable of smoking harm, supported a ban on smoking in public places, were exposed to antismoking media messages, and received antismoking education in school in 7, 4, 8, and 5, respectively, of the countries.

DISCUSSION

Although SHS is an established health hazard,[1] children and adolescents still constitute the majority of people exposed to it.[2] Article 8 of the WHO FCTC and its guidelines oblige governments to create smoke-free environments to protect nonsmokers from the dangers of SHS exposure. Although all 16 countries in the West African region have ratified the WHO FCTC, only 2 (Burkina Faso and Ghana) had comprehensive smoke-free policies as of January 2015. Scientific evidence is a key rationale for tobacco control policy initiatives and advocacy,[23] and our study provides evidence on the prevalence and determinants of SHS exposure inside and outside the home among nonsmoking school-going adolescents aged 13–15 years in 9 West African countries.

Despite the generally low (but increasing) rates of smoking (3.5%–13.7% among adults and 3.6%–17.8% among adolescents[5]), our results show that 1 in 10 (Cape Verde) and 1 in 2 (Mali and Senegal) nonsmoking school-going adolescents were exposed to SHS inside the home, and 1 in 4 (Cape Verde) and 4 in 5 (Mali) were exposed to SHS outside the home among the 9 African countries. This situation poses a major public health problem because noncommunicable diseases are expected to be

TABLE 4—Average Marginal Effects of Nonsmoking Adolescents' Exposure to Secondhand Smoke Outside the Home: Global Youth Tobacco Survey, 9 West African Countries, 2006–2009

Characteristic	Cape Verde (n = 970), %	Cote d'Ivoire (n = 1382), %	Ghana (n = 3154), %	Guinea (n = 938), %	Mali (n = 1593), %	Mauritania (n = 1217), %	Niger (n = 904), %	Senegal (n = 1124), %	Togo (n = 1610), %
Gender									
Male	0.3	−1.5	0.9	7.3*	−2.4	1.3	1.0	−2.0	0.9
Female (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Age, y									
13 (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
14	−1.1	2.6	−0.2	2.0	0.2	−2.9	1.0	−1.1	4.3
15	3.5	4.9	−0.3	−4.6	3.8	−5.9	2.2	2.4	1.3
Parent smokes									
Yes	16.9***	9.7**	19.7***	12.8**	3.2	6.8	12.5	13.6***	23.0***
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Peer smokes									
Yes	18.9***	8.6**	8.8***	10.2*	11.6***	18.9***	21.1***	6.1	18.5***
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Knowledge of smoking harm									
Yes	5.4	5.9	8.7***	13.8***	11.8***	15.5***	10.4*	17.8***	5.5*
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Support smoking ban									
Yes	4.7	5.7	4.8**	15.4***	8.0**	11.3***	3.6	−4.3	6.4
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Exposed to antismoking media message									
Yes	6.3*	11.3***	13.4***	5.1	4.0*	13.8***	10.9**	10.6**	7.3*
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Exposed to antismoking education in school									
Yes	−0.6	2.0	6.3***	1.9	10.9***	6.0*	10.4**	7.4*	4.6
No (Ref)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
H-L $\chi^2(8)$[a]	1.8 (0.9)	10.3 (0.2)	14.5 (0.1)	13.4 (0.1)	27.2 (0.0)	8.7 (0.4)	13.2 (0.1)	23.8 (0.0)	13.4 (0.1)

Note. Average marginal effects were estimated from the multivariable logistic regression and converted to percentages.
[a]H-L $\chi^2(8)$ shows the results of the Hosmer–Lemeshow test for the goodness of fit of the model with 10 groups. The values in parentheses indicate Prob > χ^2.
*$P < .05$; **$P < .01$; ***$P < .001$.

the leading cause of mortality in Sub-Saharan Africa by 2030.[24]

The high rates of SHS exposure among nonsmoking adolescents in West African countries should attract the attention of policymakers and the public health community for several reasons. First, SHS is a confirmed health hazard.[1] Studies have found that exposure to SHS increases the incidence of wheeze and asthma in children and young people by at least 20%[25] and bronchitis in infants by 2 and a half times.[26]

Second, adolescents are a vulnerable population because they lack the ability to avoid SHS either inside or outside the home, which suggests the need for protection as required by the WHO FCTC and international human rights conventions such as the Convention on the Rights of the Child. The lack of avoidance of SHS exposure among youths in West African countries is exacerbated by the communitarian culture, which limits the rights of children compared with those of adults. This phenomenon may explain why in places such as Mali, although about 1 in 10 (youths and adults) smokes,[5] up to 4 in 5 nonsmoking adolescents reported SHS exposure outside the home.

Third, although the main culprit for the increasing trend in tobacco use in LMICs, including West African countries, is the tobacco industry, studies suggest that youths' SHS exposure increases the likelihood of future tobacco use because youths see this as socially acceptable behavior.[18] Evidence from elsewhere suggests that up to 90% of regular smokers begin smoking as minors,[27] which implies that protecting youths from SHS exposure with comprehensive smoke-free policies and educational and advocacy campaigns will produce dual benefits: preventing youths from the dangers of SHS exposure and reducing the uptake in tobacco use.[28] Additionally, when this high level of exposure is coupled with the fact that more than 50% of adolescents in these countries support a ban on smoking in public places, it should encourage policymakers to pursue smoke-free public places, including 100% smoke-free school campuses. Moreover,

for predominantly Muslim countries such as Guinea, Mali, Mauritania, Niger, and Senegal that have high SHS exposure, religion can be incorporated into tobacco control activities by amplifying existing "fatwas," or religious rulings against smoking.[29]

In delineating the probabilities of exposure, we found that unlike previous studies in other parts of Sub-Saharan Africa,[30] demographics (age and gender) were generally not significantly associated with SHS exposure. However, consistent with previous studies,[12,30] parental smoking behavior significantly resulted in a higher probability of SHS exposure inside or outside the home in almost all 9 countries. Although having a smoking parent resulted in a significantly higher probability of SHS exposure inside the home in all the countries, it resulted in a higher probability of SHS exposure outside the home in 6 of the 9 countries. These results are consistent with studies involving nonsmoking adolescents from 192 countries[2] and never-smoking adolescents from 168 countries.[21]

This situation presents policy challenges because although conventions such as the WHO FCTC and Convention on the Rights of the Child require the protection of this vulnerable population from the dangers of SHS, there is resistance to government interference in private and social life. Thus, comprehensive smoke-free policies could protect adolescents from SHS exposure outside the home, and public education campaigns could inform parents of the dangers of SHS exposure for their nonsmoking adolescents and promote smoke-free households. When peers provide SHS exposure, there is a need for the empowerment of nonsmoking adolescents so that they can insist on their rights to a smoke-free environment. Additionally, public health workers can engage communities to take actions against youths' exposure to SHS, which could be very potent in communitarian societies.[31]

The results of the other factors—knowledge of smoking harm, support for a ban on smoking in public places, exposure to antismoking messages, and antismoking education in school—varied greatly across the 9 countries. Our study shows that knowledge of smoking harm was associated with probability of SHS exposure inside (3 of 9 countries) and outside (7 of 9 countries) the home, which is consistent with an earlier study in South Africa.[12]

In contrast with earlier studies, when knowledge of smoking harm, support for a smoking ban in public places, and exposure to antismoking media messages were negatively associated with probability of SHS exposure,[32] we identified positive relationships. However, our results on the association of these factors with the probability of SHS exposure are similar to those of earlier studies conducted using GYTS data in which the 3 factors were positively associated with increased SHS exposure among never-smoking adolescents in 168 LMICs[21] and increased susceptibility to cigarette smoking among never-smoking adolescents.[18]

This phenomenon may be explained by the lack of youth avoidance behavior in societies such as those in our study and the smoking behavior of familial relations that thwart the effectiveness of efforts to improve people's knowledge of smoking harm and modify their smoking behavior through policies such as a ban on smoking in public places and media and educational campaigns. Social acceptability of smoking among these adolescents may also make them tolerant of SHS exposure. Therefore, although our results highlight the need to critically assess how knowledge about smoking is communicated to youths in these countries, they simultaneously highlight the need to close any gaps between the message communicated to youths about tobacco use and adult tobacco use behavior and create a policy environment that protects nonsmokers. These results show the need for further qualitative investigation to identify why these factors are positively associated with the probability of SHS exposure and susceptibility to smoking in other studies,[18] in not only LMICs such as West African countries but also worldwide.

Limitations

We assessed SHS exposure using a self-report questionnaire without any objective measurement, such as the volume of tobacco-related particulate matter in the air, and biomarkers, such as saliva cotinine, tobacco-specific nitrosamines in the urine, or nicotine level in the hair. We, thus, may have underestimated the number of those exposed to SHS because previous studies found higher levels of SHS exposure on the basis of tobacco biomarkers than on self-reported exposure.[33,34]

Additionally, the GYTS data included only adolescents who attended school on the day the survey was administered. Moreover, the GYTS relies on a self-administered questionnaire with no independent verification of the responses. Furthermore, there is a lack of information on specific venues of SHS exposure among adolescents outside the home, which suggests the need for WHO and Centers for Disease Control and Prevention and their collaborators to collect such information to inform local legislation designed to protect the public, and particularly youths, from SHS. Nonetheless, this study provides the first, to our knowledge, regional-based analysis of SHS exposure in Sub-Saharan Africa on the basis of comparable domestic-generated data.

Conclusions

In the midst of sparse research on SHS exposure in LMICs, including those in Sub-Saharan Africa, and comprehensive smoke-free policy stasis in the WHO African region, we examined the prevalence and determinants of SHS exposure among nonsmoking school-going adolescents aged 13 to 15 years in 9 comparable West African countries with nationally representative GYTS data. Whereas the overall rate of SHS exposure inside the home ranged from 13.0% in Cape Verde to 45.0% in Mali, that of SHS exposure outside the home ranged from 24.7% in Cape Verde to 80.1% in Mali.

Regardless of the venue, the main determinants of SHS exposure were the smoking behavior of parents and peers. With no known safe level of SHS exposure and SHS exposure contributing to uptake in tobacco use as well, it is important for policymakers to adopt comprehensive smoke-free policies that are consistent with the WHO FCTC and its guidelines, create 100% smoke-free school campuses, educate adults about the health dangers of SHS exposure, promote smoke-free households, empower nonsmoking youths to insist on their rights to smoke-free environments, and incorporate religion (e.g., fatwa in predominantly Muslim countries) into tobacco control.

It has been estimated that tobacco-induced noncommunicable diseases such as cancer, cardiovascular diseases, and respiratory diseases will be the leading causes of mortality in Sub-Saharan Africa by 2030. Therefore, it is

imperative that these countries take the necessary preventive and curative actions to thwart the emergence of chronic diseases, including those related to SHS exposure, and protect people from SHS exposure, particularly vulnerable ones such as youths. In this respect, the Economic Community of West African States can provide a collaborative forum for action to be taken to address the exposure of youths to SHS as required by the WHO FCTC. ■

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This article was accepted March 1, 2015.

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H. M. Mamudu wrote the first draft of the article with input from all other authors. S. P. Veeranki and D. M. Kioko managed the data. R. M. John analyzed the data with input from S. P. Veeranki. A. E. Ogwell Ouma provided substantive input to writing and revising the article. All authors interpreted the results and contributed to revising the article.

Acknowledgments

We would like to thank the Department of Health Services Management and Policy and the College of Public Health for providing logistical support for the research.

Human Participant Protection

No protocol approval was necessary because data were obtained from secondary sources.

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