

Prevalence and Factors Associated with Electronic Cigarette Use Among Adolescents Attending School in Four African Countries Using Global Youth Tobacco Survey Data from 2015 to 2019

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Abstract

Introduction

E-cigarette use among African adolescents is poorly documented, yet early signals suggest rapid penetration. We analyzed recent Global Youth Tobacco Survey (GYTS) data from four contrasting countries to quantify prevalence, determinants and policy leverage points.

Methods

We used self-reported secondary data from the GYTS using a cross-sectional study design. Overall, 15 914 adolescents aged 13–15 years from grades 7–12 were surveyed across the four countries using stratified two-stage cluster sampling. Survey-weighted multivariable logistic regression models were used to identify independent factors associated with current e-cigarette use and estimate adjusted marginal probabilities. Adjusted odds ratios and their 95% confidence intervals are reported. All statistical tests were conducted using a significance level of 0.05, with results considered significant at $p < 0.05$.

Results

The overall current e-cigarette prevalence was 4.9% (95% CI: 4.85–4.95), with marked heterogeneity between countries. Awareness of e-cigarettes was the strongest correlate of current e-cigarette use (aOR = 5.56; 95% CI: 4.60–6.70), followed by ever tried cigarette smoking (aOR = 2.69; 95% CI: 2.15–3.36), and ownership of tobacco-branded merchandise (aOR = 2.69; 95% CI: 2.17–3.34). Support for smoke-free public places (aOR = 0.56; 95% CI: 0.47–0.68) and school-based tobacco education (aOR = 0.53; 95% CI: 0.43–0.64) conferred significant protection.

Conclusion

E-cigarette use among school going adolescents in Mauritius, Seychelles, Ghana and Togo is no longer negligible with island states and young adolescents disproportionately affected. There is a need to integrate e-cigarettes into existing smoke-free laws, enforcing marketing bans and scaling classroom education. These findings offer valuable evidence to guide tobacco control.

Clinical trial number: not applicable

INTRODUCTION

The global tobacco landscape is undergoing a profound transformation, driven by the rapid emergence of e-cigarettes and other electronic nicotine delivery systems, particularly among young people^{1,2}. While conventional tobacco use remains a leading cause of preventable morbidity and mortality worldwide³, the growing popularity of e-cigarettes has introduced new complexities for public health, and drug control policies^{2,4}. Marketed as modern, discreet, and less harmful alternatives, these products have

gained traction among adolescents at a time when nicotine exposure poses serious risks to cognitive development and long-term addiction ^{1,5}. This shift threatens to undermine decades of progress achieved under the World Health Organization Framework Convention on Tobacco Control (WHO FCTC), which emphasizes the protection of children and adolescents from nicotine initiation ⁶, and directly challenges global commitments under the Sustainable Development Goals (SDGs), particularly SDG 3 on ensuring healthy lives and well-being for all ⁷.

In Africa, e-cigarette use among youths reflects a convergence of global industry influence, weak regulatory environments, and rapidly changing social norms ⁸. Although the continent has historically recorded lower smoking prevalence compared to high-income regions, it is increasingly vulnerable to aggressive marketing strategies targeting young populations ⁸. The rise of flavored e-liquids, online promotion, and peer influence has created a fertile environment for experimentation among adolescents, often in the absence of clear policy guidance ^{9,10}. Empirical evidence across sub-Saharan Africa highlights this growing challenge. In South Africa, large-scale surveys conducted in schools among high school learners revealed e-cigarette use of about 16.8% which was more than conventional cigarette smoking ¹¹. Similarly, in Nigeria, lifetime exposure to e-cigarette use among adolescents and young adults ranges from 5.8% and 19.8% ¹², while a multi-country assessment across 53 African countries demonstrated that emerging nicotine products are rapidly penetrating youth markets where regulatory frameworks remain weak ¹³.

Despite these emerging signals, significant knowledge gaps persist regarding adolescent e-cigarette use in Africa. First, most existing regional literature consists of single-country or localized institutional studies (predominantly in Southern and Western Africa), leaving multi-region comparative data scarce. Second, there is little empirical clarity on how e-cigarette use differs between mainland African nations and Small Island Developing States (SIDS) such as Mauritius and Seychelles, which face distinct trade, tourism, and marketing exposures. Third, few studies have simultaneously quantified individual behavioral correlates alongside policy-level protective factors (such as school curricula and smoke-free norms) using nationally representative, survey-weighted data across contrasting African regulatory environments.

Robust surveillance systems are essential for responding effectively to this emerging threat, and the Global Youth Tobacco Survey (GYTS) remains one of the most critical tools in this regard ¹⁴. As a standardized, school-based survey supported by WHO and partners, GYTS generates comparable evidence on tobacco and nicotine use among adolescents across countries and over time ¹⁵. In many low- and middle-income settings, where routine surveillance of drug and substance use is limited ¹⁶, GYTS bridges a vital data gap by capturing early signals of changing behaviors, perceptions, and exposures among youth.

To address these knowledge gaps, this study provides a multi-country, survey-weighted analysis of e-cigarette prevalence and determinants among school-going adolescents in four contrasting African

nations—Ghana, Mauritius, Seychelles, and Togo—using GYTS data (2015–2019). By examining patterns, determinants, and emerging trends in adolescent e-cigarette use, the study aims to generate actionable evidence to support tobacco control, youth protection, and substance use prevention efforts. In doing so, it contributes to the advancement of WHO FCTC implementation, supports progress toward the SDGs, and aligns with Africa CDC’s mandate to strengthen evidence-informed policies that protect young people from preventable health risks ^{6,7}.

METHODS

Study design

This study employed a cross-sectional analytical design using secondary data from the Global Youth Tobacco Survey (GYTS) conducted between 2015 and 2019. The analysis focused on examining factors associated with current e-cigarette use among school-going adolescents in Ghana, Mauritius, Seychelles, and Togo. GYTS is a standardized, school-based survey coordinated by the World Health Organization and partners to monitor tobacco and emerging nicotine product use among youths aged 13–15 years. The survey design allows for nationally representative estimates and comparability across countries and survey years ¹⁵.

Study setting

The study was conducted using nationally representative GYTS datasets from four countries in Africa: Ghana, Mauritius, Seychelles, and Togo. These countries were selected based on the availability of recent GYTS data that included modules on e-cigarette use. Data collection took place in public and private schools offering grades that typically enroll students aged 13–15 years. The study settings reflect diverse geographic, economic, and policy contexts, ranging from small island states to mainland West African countries, thereby providing a broad perspective on youth e-cigarette uptake within the African region.

Sampling and sample size

GYTS employs a two-stage cluster sampling design to produce nationally representative samples of school-going adolescents. In the first stage, schools are selected with probability proportional to enrollment size ¹⁵. In the second stage, classes within selected schools are randomly chosen, and all students in the selected classes are eligible to participate. Sample sizes varied by country and survey year, reflecting differences in school enrollment and sampling frames, but were sufficient to generate weighted national estimates ¹⁵. The final analytic sample for this study included all students with complete information on e-cigarette use and key explanatory variables after applying survey weights to account for the complex sampling design, non-response, and post-stratification adjustments.

Data management

The analysis was conducted using a cleaned and harmonized pooled dataset derived from the Global Youth Tobacco Survey (GYTS), comprising 15,914 observations and 24 variables collected from Ghana, Mauritius, Seychelles, and Togo between 2015 and 2019. The dataset included survey design variables, socio-demographic characteristics, tobacco and nicotine use behaviors, exposure to tobacco control measures, and indicators of social and media influence. Survey weights (FinalWgt), primary sampling units (PSU), and stratification variables (Stratum) were retained and applied in all analyses to appropriately account for the complex, multistage sampling design and to ensure nationally representative estimates.

Socio-demographic variables included age in completed years, sex, and school grade, country of residence, survey year, and socioeconomic status. Tobacco-related behavioral variables were coded as binary indicators (Yes/No) and included ever tried cigarette smoking, ever tried smokeless tobacco, exposure to smoking in public places, exposure to smoking within school premises, and intentions to use tobacco within the next 12 months. Awareness and use of alternative nicotine products were captured through variables indicating awareness of e-cigarettes, current or recent e-cigarette use, which served as the primary outcome variable, and ever use of shisha.

Perception of tobacco control policies, exposure to school based anti-electronic cigarette education, marketing, and social influences was assessed using variables indicating support for banning smoking in enclosed public spaces and in public places, whether respondents had been taught about the dangers of tobacco use in school, exposure to tobacco use or advertisements via television and radio or other media, ownership or recognition of tobacco-branded promotional items, and peer influence measured by whether close friends had offered tobacco products. All variables were checked for completeness and internal consistency prior to analysis. Records with missing data on the primary outcome were excluded, and complete-case analysis was used for covariates to ensure analytical robustness and reproducibility. Participants with missing data were compared with those with complete information using chi-square tests for categorical variables and the Mann-Whitney U test for age related continuous variables. This comparison was crucial in assessing potential selection bias.

The pooled Global Youth Tobacco Survey dataset comprised 15,914 participants from Ghana, Mauritius, Seychelles, and Togo. The completeness of the primary outcome, explanatory variables, and survey design variables was assessed before the analysis was conducted. The primary outcome variable, current e-cigarette use, was available for all 15,914 participants. However, 2,554 (16.0%) of the participants had missing information on at least one of the explanatory variables, resulting in 13,360 (84.0%) participants with complete information across the specified analysis variables Fig. 1.

Flow diagram showing the selection of participants with complete information across specified analytic variables from the Global Youth Tobacco Survey datasets from Ghana, Mauritius, Seychelles, and Togo, 2015–2019.

Data analysis

All statistical analyses were conducted using Python version 3.12 (Python Software Foundation, Wilmington, DE, USA). Data processing, management, and descriptive analyses were performed using the *pandas* and *numpy* libraries. Survey-weighted analyses incorporated the complex sampling design by applying sampling weights, primary sampling units, and stratification variables using the *statsmodels* library to generate weighted prevalence estimates and adjusted odds ratios (aORs) with 95% confidence intervals ^{17,18}. All statistical tests were conducted using a significance level of 0.05, with results considered significant at $p < 0.05$.

Descriptive statistics, including frequencies and percentages, were used to summarize the distribution of current e-cigarette use by socio-demographic characteristics, behavioral factors, and variables related to tobacco control policy. The Chi-square test of association was utilized to determine associations between various factors and current e-cigarette use status. In addition, multivariable survey-weighted logistic regression was used to identify factors independently associated with current e-cigarette use ¹⁸. Variable selection was done using Akaike Information Criterion (AIC) with age, sex, and grade included a priori to account for key demographic and educational differences. Age, sex, school grade, country, and survey year were included as covariates to adjust for demographic, contextual, and temporal variation. To further illustrate non-linear patterns and subgroup interaction effects across age, sex, and awareness, model-adjusted marginal probabilities were computed directly from the final multivariable logistic regression model while holding other covariates at their weighted sample means. Data visualizations were generated using *matplotlib* and *seaborn*. All analyses followed reproducible workflows with version-controlled code to ensure transparency and replicability ¹⁷.

RESULTS

Characteristics of study participants

Table 1 presents the demographic, environmental, and policy-related characteristics of the participants. Based on weighted estimates, the study population was predominantly aged between 13 and 15 years, with the highest proportion observed among 15-year-olds (32.69%), followed by those aged 14 years (25.49%) and 13 years (24.33%). Younger adolescents aged 11–12 years accounted for a smaller share of the weighted sample (7.17% combined), while those aged 16–17 years constituted 10.32%. Males represented a slightly higher proportion of participants (52.15%) compared to females (47.85%). As shown in Table 1, students in lower secondary school grades accounted for the majority of respondents, particularly those in Year 8 (33.57%) and Year 9 (31.91%), while upper secondary grades (Years 11 and 12) together represented less than 2% of the weighted sample.

Behavioral indicators related to tobacco and nicotine use are also summarized in Table 1. A large majority of adolescents reported never having tried cigarette smoking (90.27%) or smokeless tobacco (91.82%). However, nearly one in ten youths (9.73%) reported having ever tried cigarette smoking, while

8.18% reported ever using smokeless tobacco. Awareness of e-cigarettes was relatively limited, with only 15.23% of respondents reporting having heard of e-cigarettes. Current e-cigarette use, the primary outcome of interest, was reported by 4.89% of adolescents, while 8.26% reported having ever used shisha. Intentions to smoke in the next 12 months were low overall, with 5.73% of youths indicating future smoking intentions, as detailed in Table 1.

All participants reported exposure to smoking in public places. In contrast, exposure to smoking at school was reported by 23.87% of the participants. Support for tobacco control measures was relatively high, with 66.71% supporting bans on smoking in enclosed public spaces and 65.98% supporting bans in public places. Slightly over half of respondents (52.54%) reported having been taught about the dangers of tobacco use in school. Media exposure to tobacco promotion remained notable, with 44.66% reporting exposure via television and 15.66% via radio, while 8.36% reported owning or recognizing tobacco-branded promotional items. Country and year-specific weighted distributions, as shown in Table 1, were dominated by Ghana (74.34%) and Togo (22.75%), with Mauritius and Seychelles contributing smaller proportions.

Table 1
Descriptive Statistics of Study Participants in Ghana, Mauritius, Seychelles, and
Togo: 2015–2019

Characteristics	n	Percentage	
		Unweighted	Weighted
Age (years)			
11	379	2.38	2.51
12	1,549	9.73	4.66
13	3,853	24.21	24.33
14	3,866	24.29	25.49
15	3,991	25.08	32.69
16	1,579	9.92	6.85
17	697	4.38	3.47
Sex			
Male	7,798	49	52.15
Female	8,116	51	47.85
Grade			
Year 7	1,003	6.3	7
Year 8	3,540	22.24	33.57
Year 9	5,764	36.22	31.91
Year 10	3,362	21.13	26.49
Year 11	1,852	11.64	0.97
Year 12	393	2.47	0.06
Ever tried cigarette smoking			
No	12,926	81.22	90.27
Yes	2,988	18.78	9.73
Ever tried smokeless tobacco			
No	14,888	93.55	91.82
Yes	1,026	6.45	8.18
Exposed to smoking in public places			

Characteristics	n	Percentage	
		Unweighted	Weighted
Age (years)			
Yes	15,914	100	100
Exposed to smoking at school			
No	11,051	69.44	76.13
Yes	4,863	30.56	23.87
Ban on closed spaces smoking			
No	5,413	34.01	33.29
Yes	10,501	65.99	66.71
Ban on public places smoking			
No	6,197	38.94	34.02
Yes	9,717	61.06	65.98
Taught smoking dangers			
No	8,228	51.7	47.46
Yes	7,686	48.3	52.54
Saw tobacco adverts on TV			
No	8,199	51.52	55.34
Yes	7,715	48.48	44.66
Heard tobacco adverts on radio			
No	13,606	85.5	84.34
Yes	2,308	14.5	15.66
Owned tobacco logo product			
No	14,348	90.16	91.64
Yes	1,566	9.84	8.36
Close friends smoke			
No	14,349	90.17	92.8
Yes	1,565	9.83	7.2
Intend to smoke in next 12 months			

Characteristics	n	Percentage	
		Unweighted	Weighted
Age (years)			
No	14,644	92.02	94.27
Yes	1,270	7.98	5.73
Heard of e-cigarettes			
No	11,608	72.94	84.77
Yes	4,306	27.06	15.23
Ever used shisha			
No	14,388	90.41	91.74
Yes	1,526	9.59	8.26
Country			
Ghana	5,430	34.12	74.34
Mauritius	4,123	25.91	2.58
Seychelles	2,453	15.41	0.33
Togo	3,908	24.56	22.75
Year			
2015	2,453	15.41	0.33
2016	4,123	25.91	2.58
2017	5,430	34.12	74.34
2019	3,908	24.56	22.75
Socioeconomic Status			
Low	8,039	50.52	38.08
Middle	4,210	26.45	39.12
High	3,665	23.03	22.79
Current e-cigarette use			
No	14,938	93.87	95.11
Yes	976	6.13	4.89

Electronic cigarette use

Table 2 presents weighted percentages of current e-cigarette use across demographic, behavioral, environmental, and perceptions on tobacco control policies among adolescents included in the study. Marked age-related differences were observed. The highest prevalence of current e-cigarette use was among 11-year-olds (12.01%, 95% CI: 11.73–12.29), followed by adolescents aged 15 years (7.35%, 95% CI: 7.29–7.42) and 16 years (7.25%, 95% CI: 7.11–7.38). Lower prevalence estimates were observed among those aged 13 years (2.57%, 95% CI: 2.53–2.62) and 14 years (2.64%, 95% CI: 2.60–2.69). Differences by sex were minimal, with comparable prevalence among males (4.80%, 95% CI: 4.76–4.84) and females (4.98%, 95% CI: 4.94–5.03). By educational level, prevalence increased with advancing grade, rising from 0.56% (95% CI: 0.52–0.60) in Year 7 to 12.41% (95% CI: 11.95–12.88) in Year 11, before declining slightly in Year 12 (8.64%, 95% CI: 7.06–10.22).

Behavioral factors showed the strongest associations with current e-cigarette use (Table 2). Adolescents who had ever tried cigarette smoking had substantially higher prevalence of current e-cigarette use (23.34%, 95% CI: 23.16–23.53) compared to those who had never smoked cigarettes (2.90%, 95% CI: 2.88–2.92). Similarly, those who had ever tried smokeless tobacco reported higher prevalence of e-cigarette use (26.48%, 95% CI: 26.27–26.69) than their counterparts who had not (2.97%, 95% CI: 2.94–2.99). Ever use of shisha was also associated with higher prevalence of e-cigarette use (22.55%, 95% CI: 22.35–22.75), compared to non-shisha smokers (3.30%, 95% CI: 3.27–3.33). Intention to smoke in the next 12 months was another factor associated with current e-cigarette use reported by 25.33% (95% CI: 25.08–25.58) of those expressing future smoking intentions, compared to 3.65% (95% CI: 3.62–3.67) among those without such intentions.

Environmental exposure and policy-related variables also demonstrated clear gradients in e-cigarette use (Table 2). Exposure to smoking at school was associated with more than double the prevalence of current e-cigarette use (8.34%, 95% CI: 8.26–8.42) compared to students not exposed to smoking on school premises (3.81%, 95% CI: 3.78–3.84). Adolescents who reported hearing tobacco advertisements on radio had a substantially higher prevalence (10.63%, 95% CI: 10.53–10.74) than those without such exposure (3.82%, 95% CI: 3.79–3.85). Ownership of tobacco-branded promotional items and peer smoking were both strongly associated with e-cigarette use, with prevalence exceeding 22% among those exposed. In contrast, protective patterns were observed among adolescents who supported bans on smoking in enclosed public spaces (4.64% vs. 5.39%) and public places (4.03% vs. 6.55%), and among those who had been taught about the dangers of smoking at school (3.66% vs. 6.25%).

Variations in current e-cigarette use was observed across countries, survey years, and socioeconomic status (Table 2). The prevalence was highest in Mauritius (11.32%, 95% CI: 11.05–11.59) and Seychelles (7.39%, 95% CI: 6.76–8.02), followed by Ghana (5.77%, 95% CI: 5.74–5.81), and lowest in Togo (1.23%, 95% CI: 1.20–1.26). A similar pattern was observed across survey years. Adolescents from lower socioeconomic status had the highest prevalence of current e-cigarette use (6.71%, 95% CI: 6.65–6.76),

compared with those from middle (3.72%, 95% CI: 3.68–3.76) and higher socioeconomic categories (3.85%, 95% CI: 3.80–3.91).

Table 2
E-cigarette use in Ghana, Mauritius, Seychelles, and Togo: 2015–2019

Characteristics	Weighted % (95% CI)
Age (years)	
11	12.01 (11.73–12.29)
12	4.06 (3.93–4.18)
13	2.57 (2.53–2.62)
14	2.64 (2.60–2.69)
15	7.35 (7.29–7.42)
16	7.25 (7.11–7.38)
17	5.72 (5.55–5.89)
Sex	
Male	4.80 (4.76–4.84)
Female	4.98 (4.94–5.03)
Grade	
Year 7	0.56 (0.52–0.60)
Year 8	4.10 (4.05–4.15)
Year 9	4.07 (4.02–4.11)
Year 10	7.74 (7.67–7.82)
Year 11	12.41 (11.95–12.88)
Year 12	8.64 (7.06–10.22)
Ever tried cigarette smoking	
No	2.90 (2.88–2.92)
Yes	23.34 (23.16–23.53)
Ever tried smokeless tobacco	
No	2.97 (2.94–2.99)
Yes	26.48 (26.27–26.69)
Exposed to smoking in public places	
Yes	4.89 (4.86–4.92)

Characteristics	Weighted % (95% CI)
Age (years)	
Exposed to smoking at school	
No	3.81 (3.78–3.84)
Yes	8.34 (8.26–8.42)
Ban on closed spaces smoking	
No	5.39 (5.34–5.44)
Yes	4.64 (4.60–4.67)
Ban on public places smoking	
No	6.55 (6.49–6.60)
Yes	4.03 (4.00–4.07)
Taught smoking dangers	
No	6.25 (6.20–6.30)
Yes	3.66 (3.62–3.70)
Saw tobacco adverts on TV	
No	5.48 (5.44–5.53)
Yes	4.15 (4.11–4.19)
Heard tobacco adverts on radio	
No	3.82 (3.79–3.85)
Yes	10.63 (10.53–10.74)
Owned tobacco logo product	
No	3.27 (3.24–3.29)
Yes	22.68 (22.48–22.88)
Close friends smoke	
No	3.55 (3.53–3.58)
Yes	22.10 (21.89–22.31)
Intend to smoke in next 12 months	
No	3.65 (3.62–3.67)
Yes	25.33 (25.08–25.58)

Characteristics	Weighted % (95% CI)
Age (years)	
Heard of e-cigarettes	
No	2.32 (2.30–2.35)
Yes	19.17 (19.03–19.30)
Ever used shisha	
No	3.30 (3.27–3.33)
Yes	22.55 (22.35–22.75)
Country	
Ghana	5.77 (5.74–5.81)
Mauritius	11.32 (11.05–11.59)
Seychelles	7.39 (6.76–8.02)
Togo	1.23 (1.20–1.26)
Year	
2015	7.39 (6.76–8.02)
2016	11.32 (11.05–11.59)
2017	5.77 (5.74–5.81)
2019	1.23 (1.20–1.26)
Socioeconomic Status	
Low	6.71 (6.65–6.76)
Middle	3.72 (3.68–3.76)
High	3.85 (3.80–3.91)

Determinants of e-cigarette use

Figure 2 presents adjusted odds ratios (aORs) and 95% confidence intervals from the final survey-weighted logistic regression model. After adjustment, several demographics, behavioral, environmental, and policy-related factors remained independently associated with current e-cigarette use.

Age showed a non-linear association with e-cigarette use after adjustment (Fig. 2). Compared with the reference age group, adolescents aged 13 years (aOR = 0.38; 95% CI: 0.21–0.68) and 14 years (aOR = 0.40; 95% CI: 0.22–0.71) had significantly lower odds of current e-cigarette use, while those aged 17

years also demonstrated reduced odds (aOR = 0.41; 95% CI: 0.20–0.83). No statistically significant differences were observed among adolescents aged 12, 15, or 16 years. Sex was not independently associated with current e-cigarette use, with females showing similar odds to males after adjustment (aOR = 1.13; 95% CI: 0.94–1.36). In contrast, school grade was strongly associated with e-cigarette use with students in Year 8 (aOR = 4.27; 95% CI: 2.32–7.87), Year 9 (aOR = 2.50; 95% CI: 1.35–4.64), Year 10 (aOR = 3.57; 95% CI: 1.93–6.59), and Year 11 (aOR = 2.60; 95% CI: 1.12–6.02) exhibiting significantly higher odds of e-cigarette use compared with the reference grade. The association for Year 12 was not statistically significant.

Behavioral and social factors equally demonstrated associations with current e-cigarette use. Adolescents who had heard of e-cigarettes were over five times more likely to be current e-cigarette users (aOR = 5.56; 95% CI: 4.60–6.70). Ownership of tobacco-branded promotional items was associated with nearly threefold higher odds of e-cigarette use (aOR = 2.69; 95% CI: 2.17–3.34), as was ever trying cigarette smoking (aOR = 2.69; 95% CI: 2.15–3.36). Peer influence remained significant, with adolescents whose close friends smoked having more than twice the odds of e-cigarette use (aOR = 2.44; 95% CI: 1.93–3.09). Intentions to smoke in the next 12 months (aOR = 1.67; 95% CI: 1.29–2.15) and ever using shisha (aOR = 1.56; 95% CI: 1.24–1.95) were also independently associated with higher odds of current e-cigarette use.

Environmental exposures and perceptions of tobacco control policies exhibited varying associations with e-cigarette use. Exposure to tobacco advertising on radio (aOR = 1.50; 95% CI: 1.21–1.86) and exposure to smoking within school environments (aOR = 1.32; 95% CI: 1.09–1.61) were associated with increased odds of e-cigarette use. In contrast, exposure to tobacco use on television was inversely associated with current e-cigarette use (aOR = 0.66; 95% CI: 0.54–0.79). Adolescents who supported bans on smoking in public places had significantly lower odds of e-cigarette use (aOR = 0.56; 95% CI: 0.47–0.68), as did those who reported being taught about the dangers of smoking at school (aOR = 0.53; 95% CI: 0.43–0.64). Additionally, adolescents who had never tried smokeless tobacco had substantially reduced odds of e-cigarette use (aOR = 0.18; 95% CI: 0.14–0.21).

Model-Adjusted Marginal Probabilities of E-Cigarette Use

Overall Marginal Probabilities (Fig. 3).

As shown in Fig. 3, the adjusted marginal probability of current e-cigarette use varied across age. The highest adjusted marginal probability was observed at age 11 (4.68%), followed closely by ages 15 (3.85%) and 16 (3.62%). A slight dip was noted among early adolescents aged 13 and 14 (1.83% and 1.91%, respectively), while the probability decreased again at age 17 (1.97%).

Adjusted marginal probabilities of e-cigarette use by Age and Sex (Fig. 4)

When stratified by sex (Fig. 4), females consistently showed slightly higher adjusted marginal probabilities of e-cigarette use than males at each age. For example, among 11-year-olds, the adjusted marginal probability for females was 5.25% compared with 4.68% for males. This pattern was maintained across all age groups, with the largest gap observed at age 15 (females: 4.32%, males: 3.85%). Despite these differences, both sexes exhibited similar non-linear trends with peaks in early and mid-adolescence and lower marginal probabilities at age 13 and 17.

Adjusted marginal probabilities of e-cigarette use by Age, Sex, and Awareness (Fig. 5).

Figure 5 further illustrates the influence of prior awareness of e-cigarettes on predicted use. Adolescents who had heard of e-cigarettes had markedly higher marginal probabilities compared with those who had not. For instance, among 11-year-old females, the adjusted marginal probability increased from 5.25% (no prior awareness) to 23.53% (prior awareness), and among 11-year-old males, from 4.68% to 21.42%. Females generally maintained slightly higher marginal probabilities than males within both awareness groups, consistent with the age-sex stratification in Fig. 3.

DISCUSSION

This study estimated the prevalence and factors associated with e-cigarette use among school-going adolescents in four African countries using data from the 2015–2019 GYTS. The overall prevalence of current e-cigarette use was 4.9%. However, striking geographic contrasts were evident: the prevalence was substantially higher in island states; Mauritius (11%) and Seychelles (7%); than in mainland Ghana (6%) and Togo (1%), echoing patterns seen in other small-island developing states. Together, these findings signal that e-cigarette use among African adolescents has moved beyond isolated experimentation into a measurable, policy-relevant phenomenon, while simultaneously establishing a long-overdue surveillance baseline that fulfils WHO FCTC obligations and provides the first adolescent ENDS data point for SDG monitoring in West Africa and the Indian Ocean region.

The 4.9% pooled prevalence is below the 2022 US estimate of 14%¹⁹ and much lower than the pooled mean prevalence of 18.9% of Latin-American countries²⁰. Because the GYTS captures only in-school youth¹⁵, the true population rate may be higher. WHO FCTC Article 20 obliges parties to “establish surveillance systems for tobacco and related products”²¹; this baseline satisfies that clause and supplies SDG indicator 3.a.1²² with its first adolescent ENDS data point for West-Africa and the Indian-ocean islands. Ghana’s 2023 Tobacco Control Regulations still lack an e-cigarette definition; inserting one sentence and repeating the GYTS biennially would meet treaty duty without new legislation²³.

Mauritius and Seychelles outpaced Ghana and Togo. This might be as a result of duty-free concessions and several tourists visiting these islands per year who turn luggage into marketing channels²⁴. The FCTC Articles 6 (tax) and 15 (illicit trade) therefore become more relevant for islands than for mainland hinterlands²¹. Mauritius restricted the manufacture, importation, distribution and selling of ENDS or

ENNDS and accessories marketed for use in or with ENDS/ENNDS in order to address the increase in e-cigarette use and consequently prevent the health risks associated with its use ²⁵.

Age was another factor associated with e-cigarette use. E-cigarette use peaked among adolescents aged 11 years old and those between 15 and 16 years old. A study done in South Africa reviewed a similar curve interpreted as early curiosity followed by consolidation of a nicotine repertoire at the end of lower-secondary school ¹¹. The FCTC Article 16 obliges parties to prohibit sales to minors ²¹, yet most African countries have not prioritized emerging products such as e-cigarettes ^{8,26}. Inserting “any nicotine-delivery product” into existing juvenile-smoking statutes would harmonize definitions across the four countries. SDG 4 (quality education) offers the delivery platform: the earlier peak coincides with primary-to-junior-high transition, a moment when life-skills curricula are already being revised. Embedding e-cigarette lessons into the curriculum would satisfy the FCTC Article 12 (education) at zero marginal cost ^{21,27}.

Hearing about e-cigarettes had an adjusted odds ratio of 5·6. Recognition now comes less from television (aOR 0·66, protective) than from Instagram and TikTok influencers who evade advertising bans. The FCTC Article 13 mandates a “comprehensive ban on tobacco advertising, promotion and sponsorship, including internet and other new technologies” ²¹. Only Mauritius has applied its 2020 Advertising Act to social-media accounts ²⁸.

Several behavioral factors such as ever-use of cigarettes (aOR 2·7) ²⁹, shisha (aOR 1·6) and having friends who smoke (aOR 2·4) were associated with e-cigarette use ¹². This conforms with existing literature which review that poly-substance users are more likely to vape ^{30,31}. Integrated substance-use interventions rather than vertical programmes would be more effective in addressing this problem. Adolescents with close friends who smoked were twice as likely to use e-cigarettes. This aligns with several studies that have found associations between friends smoking status ^{31,32}. Having friends who smoke represents a major independent correlate and key peer level risk factor. However, normative peer pressure and modeling of risky behaviors may still play a role in smoking initiation ²⁷.

Being taught in school about the dangers of tobacco and supporting smoke-free public places each halved the odds of current e-cigarette use. Being taught in school about the dangers of smoking and implementing smoke free policies have been shown to be protective against tobacco use by several writers ^{13,27,33}.

This study has several limitations. The study was restricted to in-school adolescents aged 13–15 years, potentially underestimating overall youth prevalence. The cross-sectional study design precludes causal inference; we cannot confirm that the identified predictors caused e-cigarette use. Self-reported data may be susceptible to recall and social-desirability bias, potentially leading to underestimation of the true prevalence of e-cigarette use. Additionally, the surveys spanned 2015–2019, so the rapidly evolving e-cigarette market and policy landscape since COVID-19 may not have been captured, and country-level

sample sizes varied, leading to wider confidence intervals for Mauritius and Seychelles in some sub-analyses. The study findings have limited generalizability to the broader African context as it only included data from four countries.

Despite these limitations, the study has strengths. The use of nationally representative, pooled Global Youth Tobacco Survey data from four African countries with high response rates and standardized methodologies, enabling cross-country comparability and region-specific estimates previously absent in the literature; the application of survey weights and multivariable adjustment for complex sampling design ensures internally valid, policy-relevant effect measures, while the triangulation of descriptive statistics, multi-variable regression, and model-adjusted marginal probability visualizations strengthens the reliability of the observed associations.

This study reveals that e-cigarette use among school going adolescents was three times higher in Mauritius and Seychelles (island nations) than in Ghana and Togo. The highest use was observed among adolescents aged 11 years, highlighting a critical window of vulnerability. E-cigarette awareness emerged as the strongest factor associated with current e-cigarette use. Yet, simple interventions such as teaching the harmful effects of e-cigarettes and maintaining strong smoke-free norms were highly effective, halving the odds of e-cigarette use. A multi-pronged approach is essential in addressing this emerging threat through effective tobacco control policies, early prevention efforts, and targeted education. Comprehensive tobacco control strategies that target emerging products like shisha and e-cigarettes will be critical for protecting young people's health in Ghana, Mauritius, Seychelles and Togo and similar African contexts.

Abbreviations

AIC – Akaike Information Criterion

aOR – Adjusted Odds Ratio

CDC – Centers for Disease Control and Prevention

CI – Confidence Interval

ENDS – Electronic Nicotine Delivery Systems

ENNDS – Electronic Non-Nicotine Delivery Systems

FCTC – Framework Convention on Tobacco Control

GYTS – Global Youth Tobacco Survey

LMICs – Low- and Middle-Income Countries

NCDs – Non-Communicable Diseases

PSU – Primary Sampling Unit

SDGs – Sustainable Development Goals

SES – Socioeconomic Status

WHO – World Health Organization

Declarations

Ethical approval

Ethical approval for this secondary analysis was obtained from the University of Zambia Biomedical Research Ethics Committee (Ref. No. 7265-2025), and the National Health Research Authority of Zambia (Ref. No. NHRA-2899/14/11/2025). The study was conducted in accordance with the principles of the Declaration of Helsinki. Access to the anonymized Global Youth Tobacco Survey (GYTS) datasets was granted through the World Health Organization (WHO) Non-communicable Diseases (NCD) Microdata Repository. The study used de-identified data only, and the authors had no access to information that could identify individual participants. The data were accessed between 1 April 2025 and 31 December 2025.

Consent to participate

The requirement for informed consent was waived for this secondary analysis because it involved publicly available, fully anonymized retrospective data. During the original GYTS surveys, informed consent was obtained from participants and/or their parents or legal guardians, in accordance with the ethical requirements of the participating countries.

Consent to publish

Not applicable. This manuscript does not contain any individual-level identifiable information or personal data requiring consent for publication.

Author's contributions

JS performed data management, analysis and drafting the paper; WN, DM and CZ reviewed the data management, analysis and the draft paper. All authors approved the final draft manuscript.

Data availability

The datasets analyzed during the current study were obtained from the Global Youth Tobacco Surveys and are publicly available. Access to the raw data can be requested from the World Health Organization (WHO) through the WHO NCD Microdata Repository or by contacting the WHO NCD Surveillance Team at ncdmicrodata@who.int, subject to approval and relevant data-sharing agreements. The dataset analyzed

during the current study are available at <https://extranet.who.int/ncdsmicrodata/index.php/home>. The analytical code used in this study is available from the corresponding author upon reasonable request.

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Competing interest

We declare that there was no competing interest. The paper was prepared as part of the Doctoral Studies in Global Health at University of Geneva.

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Figures

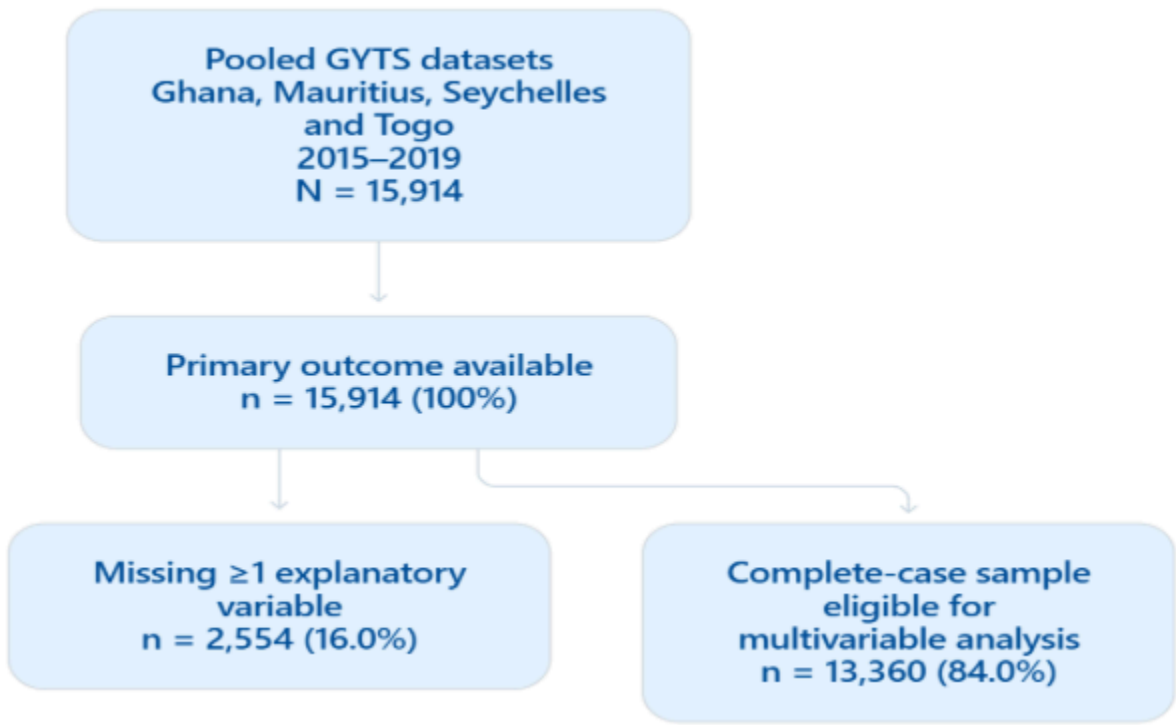
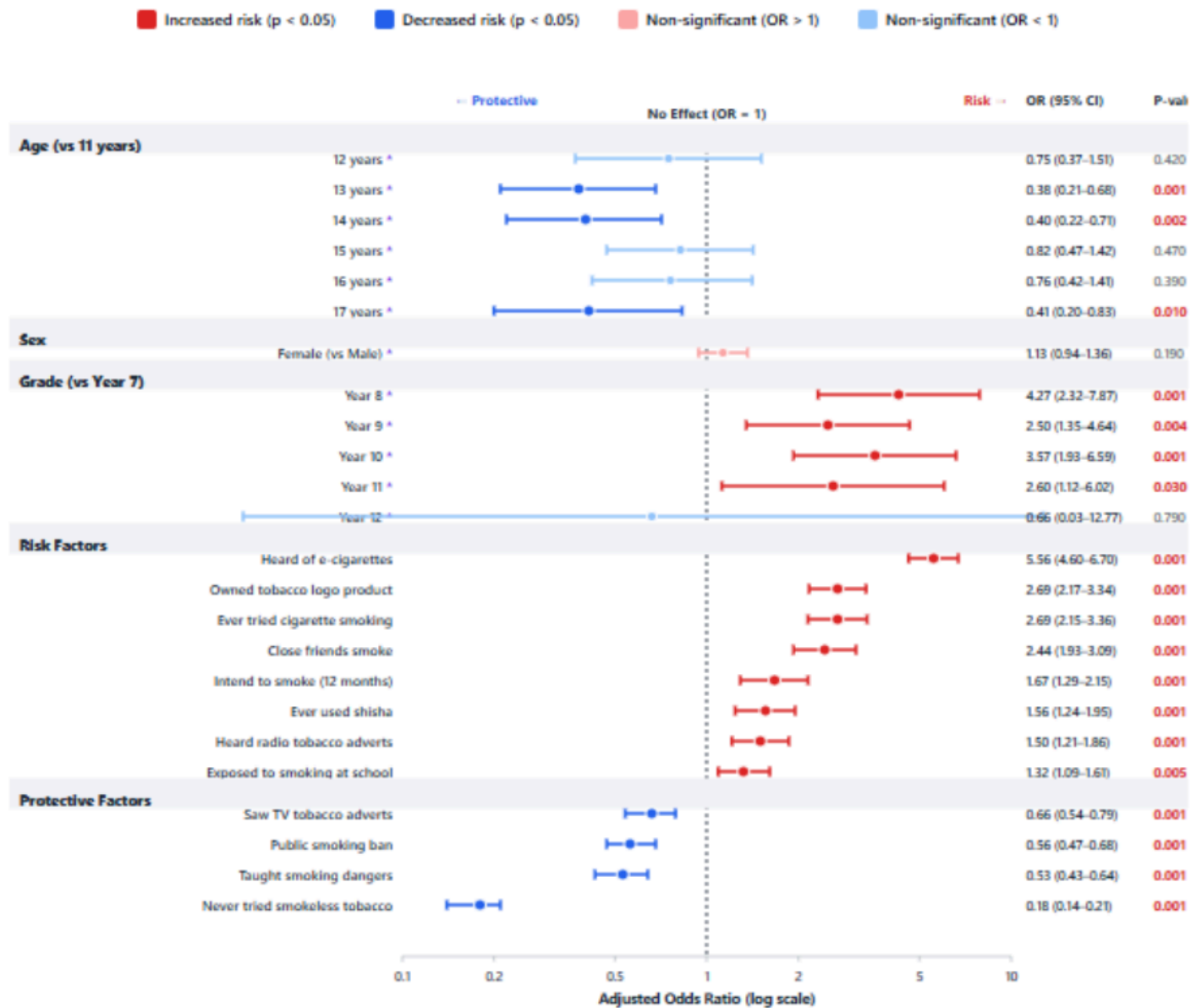


Figure 1

Flow diagram showing selection of the analytic sample from the pooled Global Youth Tobacco Survey (GYTS) datasets (2015–2019).



* A priori variables (Age, Sex, Grade) were always included in the model
 Reference categories: Age 11 years, Male, Year 7

Figure 2

Determinants of of e-cigarette use in Ghana, Mauritius, Seychelles, and Togo: 2015-2019

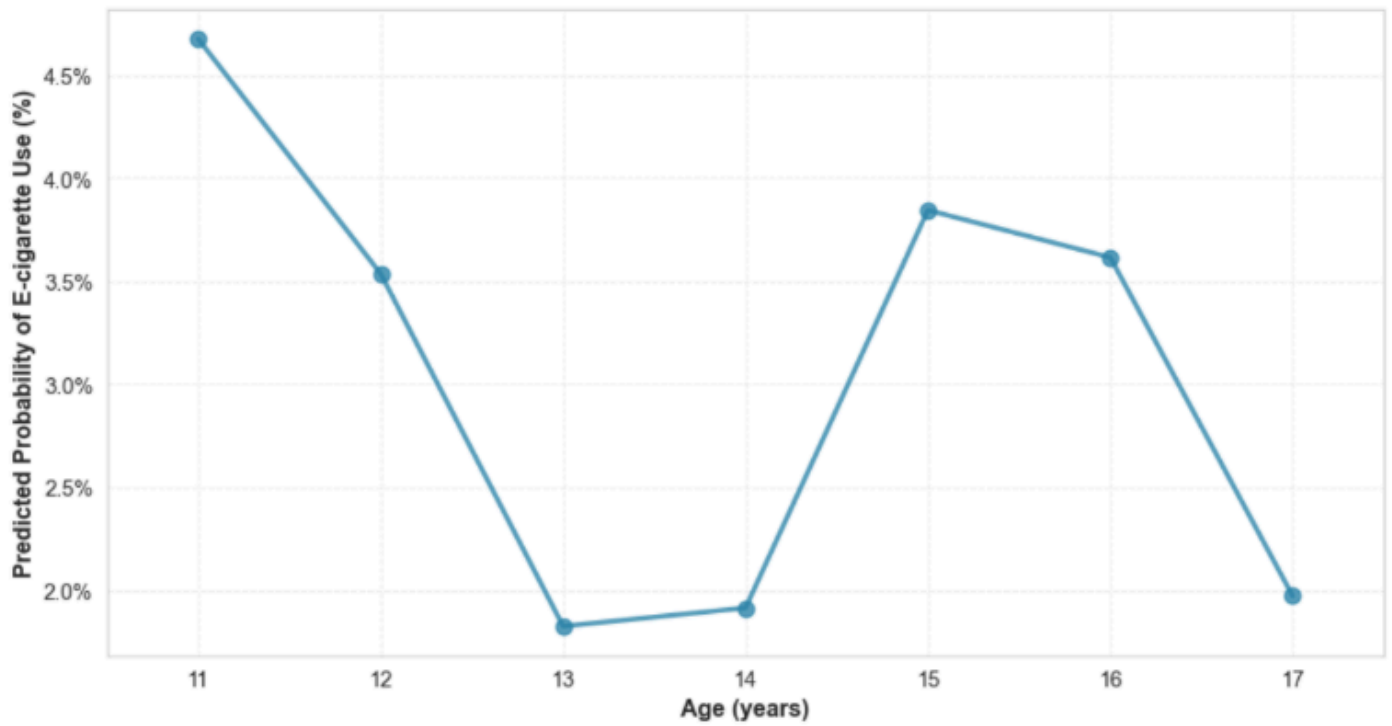


Figure 3

Adjusted marginal probabilities of e-cigarette use by age in Ghana, Mauritius, Seychelles, and Togo: 2015-2019

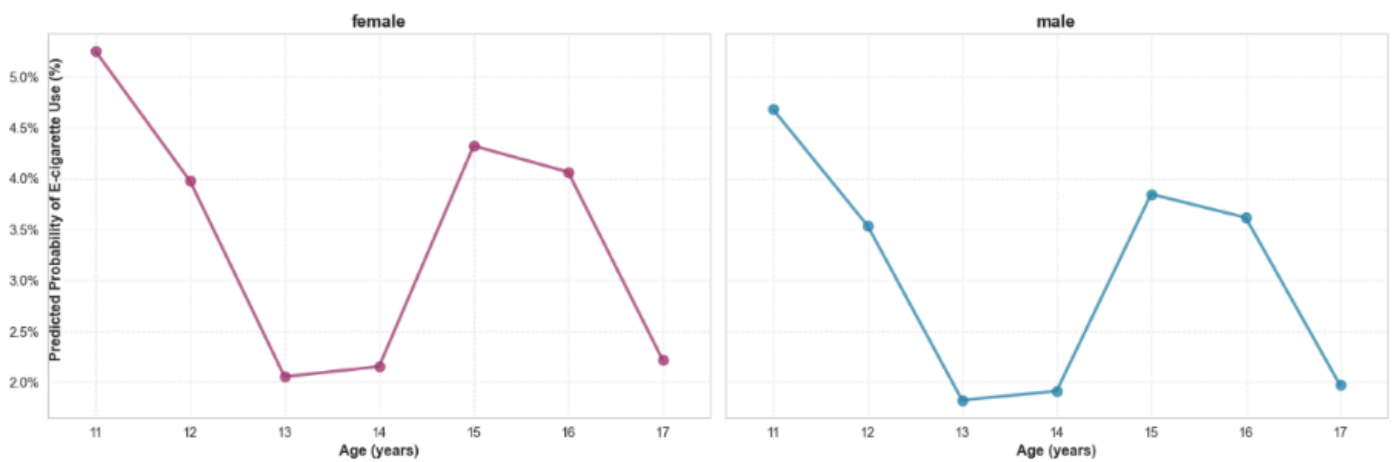


Figure 4

Adjusted marginal probabilities of e-cigarette use by age and sex in Ghana, Mauritius, Seychelles, and Togo: 2015-2019

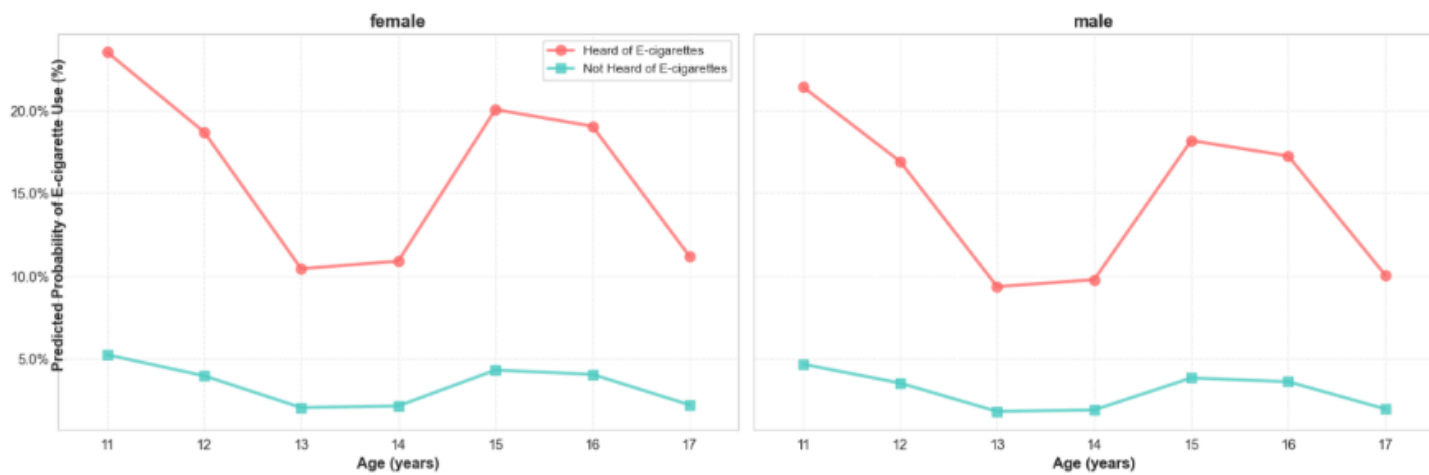


Figure 5

Sex stratified adjusted marginal probabilities of e-cigarette use by age and whether the adolescent heard or not heard of e-cigarette in Ghana, Mauritius, Seychelles, and Togo: 2015-2019