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# Predictors and Patterns of Cigarette and Smokeless Tobacco Use Among Adolescents in 32 Countries, 2007–2011

Israel T. Agaku, D.M.D., M.P.H. [a,*], Olalekan A. Ayo-Yusuf, M.P.H., Ph.D. [a,b], Constantine I. Vardavas, M.D., M.P.H., Ph.D. [a], and Gregory Connolly, D.M.D., M.P.H. [a]

[a] Department of Social and Behavioral Sciences, Center for Global Tobacco Control, Harvard School of Public Health, Boston, Massachusetts
[b] Department of Community Dentistry, University of Pretoria, South Africa

A B S T R A C T

**Purpose:** This study compared data from 32 countries to assess predictors and patterns of cigarette and smokeless tobacco (SLT) use among students aged 13–15 years old.
**Methods:** Data from the 2007–2008 Global Youth Tobacco Surveys were analyzed for students aged 13–15 years in 31 countries located in all six World Health Organization regions. In addition, the 2011 National Youth Tobacco Survey was analyzed for U.S. students aged 13–15 years. Country-specific prevalence of current smoking, current SLT use, and concurrent use patterns were assessed.
**Results:** The national prevalence of current cigarette smoking among students aged 13–15 years ranged from 1.8% (Rwanda) to 32.9% (Latvia), whereas current SLT use ranged from 1.1% (Montenegro) to 14.4% (Lesotho). In the U.S. and most European countries surveyed, current smoking prevalence was significantly higher than SLT prevalence, in contrast to patterns observed in low- and middle-income countries. Also, in most of the surveyed countries outside of Europe and the United States, SLT use among girls was as common as their use of cigarettes, and not significantly different from use by boys. When compared with U.S. adolescents, the odds of SLT use were highest among African adolescents (adjusted odds ratio = 3.98; 95% CI: 2.19–7.24) followed by those in the Southeast Asian region (adjusted odds ratio = 2.76; 95% CI: 1.38–5.53).
**Conclusions:** Region-specific patterns of tobacco use were noticed. Furthermore, it is alarming that in several low- and middle-income countries, the prevalence of SLT use among females did not differ from that among males, suggesting the possibility of a future shared burden of disease between both males and females.

IMPLICATIONS AND
CONTRIBUTION

Significant differences in the pattern of tobacco use among adolescents were observed by geographical region. Smokeless tobacco use was higher among adolescents observed in low- and middle-income countries, whereas cigarette smoking prevalence was higher in high-income countries. Moreover, in most low- and middle-income countries, no differences in smokeless tobacco use by gender were noticed, suggesting a partial transition of future burden of smokeless tobacco-related disease toward females.

Tobacco use is one of the leading preventable causes of morbidity and mortality globally. About 5 million deaths are attributable to tobacco annually and, by 2020, the figure is expected to exceed 10 million, with approximately 70% of these deaths occurring in developing countries [1]. Because tobacco experimentation and use takes places usually during adolescence—the same time when health related behaviors are usually formulated—it is important to understand the predictors and patterns of use by adolescents globally [2].

Although declines in cigarette smoking have been observed in developed nations in recent years, the reverse has occurred in several low- and middle-income countries (LMICs). Along with Asia-Pacific, the Middle East and Africa have continued to see increased cigarette volume sales at a higher rate than the rest of

* Address correspondence to: Israel T. Agaku, D.M.D., M.P.H., Department of Social and Behavioral Sciences, Center for Global Tobacco Control, Harvard School of Public Health, 401 Park Drive, East Atrium, 3rd Floor, Boston, MA 02115.
E-mail address: iagaku@post.harvard.edu (I.T. Agaku).

the world [3]. Meanwhile, the use of smokeless tobacco (SLT) products has remained unchanged in several developed and developing regions of the world [4,5]. The types of SLT products across the globe vary widely. In the Western world, low-nitrosamine SLT products such as Swedish-style snus have continued to increase in popularity in recent times [6]. Nevertheless, the reality remains that most SLT users outside of certain European countries commonly use the conventional or the traditional forms of SLT with a relatively high level of toxins [7], including oral and nasal snuff.

Adolescence, which represents the transition from childhood to adulthood, is closely tied to the structure of adult society. Adolescents are at a very critical developmental stage and may be easily susceptible to proximal or environmental influences to use tobacco [8]. Considering the cultural differences in global adult tobacco use [9], it is conceivable that adolescents' experiences with tobacco use may vary across cultures. Differences in availability, regional affordability, and cultural acceptance of tobacco may indeed play an important role in product use; however, relatively little is known about the global patterns of tobacco use among adolescents of different regions and economies [10]. Therefore, this study compared the patterns of cigarette and SLT use among adolescents aged 13–15 years from 32 countries by geographical area and gross national income (GNI) during 2007–2011.

## Methods

### Sources

All analyses in this study were performed on publicly available, deidentified data, which was Institutional Review board–waived as nonhuman research. Data were obtained from two different survey types: the Global Youth Tobacco Survey (GYTS) and the U.S. National Youth Tobacco Survey (NYTS).

The GYTS is a standardized, school-based anonymous questionnaire survey that collects tobacco use data at 4-year intervals from students aged 13–15 years [10]. For this analysis, we established three exclusion criteria a priori: (1) all sub-national (i.e., provincial, city, or state level) data were excluded to allow direct comparisons of country-level data; (2) all countries whose most recent national GYTS data were collected before 2007 were excluded to allow for assessment of more recent estimates; and (3) countries with no data on SLT use or those in which the question wording lumped SLT together with other smoked tobacco products were excluded to allow a uniform cross-country assessment of distinct tobacco use patterns. In total, 31 countries from the six World Health Organization (WHO) regions in which the GYTS was administered satisfied our inclusion criteria and included: seven from the African region (Botswana, Lesotho, Madagascar, Rwanda, Seychelles, South Africa, and Togo); four from the Eastern Mediterranean region (Iran, Qatar, Tunisia, and Yemen); 10 from the European region (Croatia, Estonia, Hungary, Kyrgyzstan, Latvia, the Former Yugoslav Republic [FYR] of Macedonia, Republic of Moldova, Montenegro, Serbia, and Slovenia); four from the region of the Americas exclusive of the United States (Barbados, Belize, Panama, and Trinidad and Tobago); two from Southeast Asia (Myanmar and Sri Lanka); and four from the Western Pacific region (Cook Islands, Republic of South Korea, Mongolia, and Philippines). Overall response rates ranged from 51.9% (Mongolia) to 96.0% (Botswana).

The NYTS is a repeated biennial national cross-sectional survey of U.S. middle and high school students [11]. The 2011 NYTS had an overall response rate of 72.7%.

An overview of the sample size and gender distribution by country is depicted in Table 1.

### Definitions

Current cigarette smoking was defined as a report by an adolescent that he or she smoked cigarettes on ≥1 day during the past 30 days. Current SLT use was defined as a report by an adolescent that they used chewing tobacco, snuff, or dip on ≥1 day during the past 30 days. For all 32 countries in the study, selected question items were similarly worded, thus allowing for direct comparisons.

### Data analysis

Country-specific estimates of current smoking, current SLT use, and dual cigarette-SLT use were assessed overall and by sex. Analyses were restricted to students aged 13–15 years to enhance cross-country comparability. Within-group differences were assessed using $\chi^2$ statistics ($p < .05$). Estimates with relative standard error ≥40% were deemed statistically unreliable.

To further assess regional differences in tobacco use, logistic regression analyses were performed, with current smoking, current SLT use, and dual cigarette-SLT use as primary outcomes, adjusting for age, sex, survey year, geographic region, and income category of country. Income group categorization was based on the countries' 2011 GNI (World Bank classification) [12].These included: low-income countries (GNI ≤$1,025, n = 5 countries: Madagascar, Rwanda, Togo, Kyrgyzstan, and Myanmar); lower-middle income (GNI between $1,026 and $4,035, n = 6 countries: Lesotho, Yemen, Republic of Moldova, Sri Lanka, Mongolia, and Philippines); upper-middle income (GNI between $4,036 and $12,475, n = 12 countries: Botswana, Seychelles, South Africa, Islamic Republic of Iran, Tunisia, Hungary, FYR Macedonia, Montenegro, Serbia, Belize, Panama, and Cook Islands); and high-income countries (GNI: ≥$12,476, n = 9 countries: Qatar, Croatia, Estonia, Latvia, Slovenia, Barbados, Trinidad and Tobago, South Korea, and the United States).

All analyses were weighted and performed with Stata version 11 (StataCorp 2009, College Station, TX).

## Results

### Cross-country comparison of cigarette and SLT use

Our findings indicated that the overall prevalence of current cigarette smoking among students aged 13–15 years differed by region and country, and ranged from 1.8% (Rwanda) to 32.9% (Latvia) (Table 2). The prevalence of current smoking among 13–15 year olds in the United States was 8.0%. Median prevalence of current cigarette smoking for the other regions included: African (median = 13.6; range 1.8%–21.5%); Eastern Mediterranean (median = 5.2; range 3.0%–8.3%); European (median = 15.8; range 4.4%–32.9%); the Americas exclusive of the United States (median = 9.7; range 4.3%–12.9%); Southeast Asian (median = 3.1; range 1.3%–4.9%), and Western Pacific (median = 13.2; range 6.9%–30.0%) regions. Three of the seven African countries surveyed (Madagascar, South Africa,

**Table 1**
Characteristics of the national tobacco surveys among adolescents (GYTS-NYTS) in 32 countries during 2007–2011

| Region/country | Income category[a] | Survey year | Total sample of all students | Overall response rate, % | % of all students aged 13–15 years | % composition of girls[b] |
|---|---|---|---|---|---|---|
| African region | | | | | | |
| Botswana | Upper-middle income | 2008 | 2,207 | 96.0 | 72.8 | 58.4 |
| Lesotho | Lower-middle income | 2008 | 3,426 | 83.2 | 49.8 | 62.5 |
| Madagascar | Low-income | 2008 | 1,991 | 83.3 | 62.0 | 54.8 |
| Rwanda | Low-income | 2008 | 2,284 | 91.8 | 30.2 | 52.8 |
| Seychelles | Upper-middle income | 2007 | 1,508 | 86.0 | 57.0 | 50.6 |
| South Africa | Upper-middle income | 2008 | 8,602 | 77.9 | 46.0 | 57.7 |
| Togo | Low-income | 2007 | 4,262 | 89.9 | 46.9 | 40.4 |
| Eastern Mediterranean region | | | | | | |
| Islamic Republic of Iran | Upper-middle income | 2007 | 1,996 | 85.9 | 66.6 | 47.9 |
| Qatar | High-income | 2007 | 1,434 | 87.3 | 68.8 | 67.0 |
| Tunisia | Upper-middle income | 2007 | 2,155 | 92.4 | 70.3 | 49.9 |
| Yemen | Lower-middle income | 2008 | 1,219 | 83.5 | 52.7 | 37.5 |
| European region | | | | | | |
| Croatia | High-income | 2007 | 4,108 | 90.9 | 88.0 | 49.7 |
| Estonia | High-income | 2007 | 3,145 | 68.2 | 73.2 | 50.7 |
| Hungary | Upper-middle income | 2008 | 3,861 | 81.6 | 82.9 | 50.4 |
| Kyrgyzstan | Low-income | 2008 | 4,038 | 93.2 | 74.4 | 52.6 |
| Latvia | High-income | 2007 | 3,362 | 81.4 | 73.1 | 56.6 |
| FYR Macedonia | Upper-middle income | 2008 | 5,824 | 90.1 | 73.5 | 49.1 |
| Republic of Moldova | Lower-middle income | 2008 | 4,703 | 84.3 | 75.1 | 55.6 |
| Montenegro | Upper-middle income | 2008 | 5,723 | 92.9 | 58.5 | 51.9 |
| Serbia | Upper-middle income | 2008 | 4,727 | 89.4 | 67.4 | 54.6 |
| Slovenia | High-income | 2007 | 3,532 | 80.8 | 73.3 | 50.9 |
| Region of the Americas (exclusive of the United States) | | | | | | |
| Barbados | High-income | 2007 | 1,499 | 79.4 | 74.7 | 52.8 |
| Belize | Upper-middle income | 2008 | 1,751 | 93.9 | 61.1 | 53.0 |
| Panama | Upper-middle income | 2008 | 3,543 | 80.0 | 80.3 | 52.9 |
| Trinidad and Tobago | High-income | 2007 | 2,841 | 74.0 | 69.4 | 51.0 |
| Southeast Asia | | | | | | |
| Myanmar | Low-income | 2007 | 3,118 | 95.2 | 69.5 | 51.2 |
| Sri Lanka | Lower-middle income | 2007 | 1,764 | 85.0 | 79.8 | 49.8 |
| Western Pacific | | | | | | |
| Cook Islands | Upper-middle-income | 2008 | 734 | 91.1 | 82.6 | 53.7 |
| Republic of South Korea | High-income | 2008 | 6,046 | 93.5 | 87.7 | 47.2 |
| Mongolia | Lower-middle income | 2007 | 1,831 | 51.9 | 77.8 | 53.4 |
| Philippines | Lower-middle income | 2007 | 5,919 | 80.9 | 56.4 | 55.8 |
| United States of America | High-income | 2011 | 18,866 | 72.7 | 45.5 | 49.4 |

GYTS = Global Youth Tobacco Survey; NYTS = National Youth Tobacco Survey.
[a] Based on the World Bank's economic groups using countries' 2011 gross national incomes.
[b] Among students aged 13–15 years.

and Togo), as well as all the countries in the Eastern Mediterranean and Western Pacific regions except Yemen and Cook Islands, respectively, had significantly higher male smoking prevalence (vs. female). In contrast, with the exception of Kyrgyzstan, Moldova, and Belize, no significant gender differences in current smoking prevalence were observed in all other countries in the European and Americas regions (Table 2).

Overall prevalence of current SLT use among students aged 13–15 years ranged from 1.1% (Montenegro) to 14.4% (Lesotho). Prevalence in the European region (median = 2.4%; range 1.1%–10.9%) as in the United States (3.4%) were generally lower compared with the African (median = 7.4%; range 5.5%–14.4%); Eastern Mediterranean (median = 6.1%; range 5.1%–8.6%); the Americas exclusive of the United States (median = 5.6%; range 3.5%–9.8%); Southeast Asian (median = 6.7%; range 6.5%–6.8%); and Western Pacific (median = 7.5%; range–5.1%–13.1%) regions.

Focusing on tobacco use patterns among girls, our findings indicated that in the United States as well as in all countries in the European region surveyed (except Kyrgyzstan), SLT use was significantly lower than cigarette smoking among females. In contrast, in all surveys in the African, Americas, Eastern Mediterranean, Western Pacific, and Southeast Asian regions (with the exception of Seychelles, Cook Islands, and the Philippines), female prevalence of SLT use were either significantly higher or did not significantly differ from their smoking prevalence.

Finally, our results also indicated that more than half of all current SLT users aged 13–15 years in the 10 European countries surveyed as well as in the United States concurrently smoked cigarettes. This pattern was also noted, albeit to a smaller extent, in the other regions assessed (Table 2).

*Multivariate analysis by region and income*

A pooled multivariate logistic regression analysis indicated that the likelihood of cigarette smoking increased with age, and was higher among adolescents aged 14 (adjusted odds ratio [aOR] = 1.34 95% CI: 1.15–1.57) and 15 years old (aOR = 1.89; 95% CI: 1.58–2.27) when compared with 13 year olds. However, no significant differences in SLT use by age were observed. By geographic region, U.S. adolescents had the highest likelihood of being current smokers, but the lowest likelihood of being current

**Table 2**
Comparison of cigarette and SLT use patterns among adolescents (GYTS-NYTS) aged 13–15 years in 32 countries during 2007–2011

| Country | Prevalence of current smoking | | | Prevalence of current SLT use | | | Combined use of cigarettes and SLT products | | |
|---|---|---|---|---|---|---|---|---|---|
| | Overall % (95% CI) | Boys % (95% CI) | Girls % (95% CI) | Overall % (95% CI) | Boys % (95% CI) | Girls % (95% CI) | Overall prevalence of dual use % (95% CI) | Proportion of cigarette smokers that use SLT % (95% CI) | Proportion of SLT users that smoke cigarettes % (95% CI) |
| **African region** | | | | | | | | | |
| Botswana | 14.3 (10.9–17.7) | 18.1 (12.9–23.3) | 10.9 (7.3–14.4) | 11.3 (9.3–13.4) | 11.3 (7.6–15.1) | 11.4 (9.0–13.8) | 4.3 (2.9–5.6) | 30.8 (26.0–35.5) | 37.7 (28.5–46.9) |
| Lesotho | 10.1 (6.4–13.8) | 11.8 (5.8–17.9) | 7.5 (4.4–10.6) | 14.4 (10.9–18.0) | 14.7 (9.0–20.4) | 13.6 (9.5–17.7) | 3.0 (1.6–4.4) | 29.8 (20.3–39.2) | 22.0 (14.8–29.3) |
| Madagascar | 19.3 (14.5–24.1) | 30.7 (22.3–39.1) | 10.2 (4.7–15.6) | 5.7 (.4–11.1) | 6.2 (.8–11.5) | 5.4 (.1–11.8)[a] | 2.3 (.5–4.0) | 11.7 (3.9–19.5) | 38.7 (.1–80.7)[a] |
| Rwanda | 1.8 (.7–3.0) | 3.0 (1.3–4.6) | .9 (.1–2.0)[a] | 7.4 (4.6–10.2) | 8.3 (3.6–13.0) | 6.0 (3.1–8.9) | .3 (.1–.7)[a] | 17.5 (.1–44.8)[a] | 4.7 (.1–12.0)[a] |
| Seychelles | 21.5 (16.3–26.7) | 23.2 (16.7–29.6) | 20.0 (14.4–25.6) | 5.5 (2.9–8.1) | 5.2 (2.1–8.3) | 5.4 (2.8–8.0) | 1.7 (.5–2.8) | 7.8 (3.1–12.4) | 38.7 (18.0–59.4) |
| South Africa | 13.6 (11.4–15.8) | 17.9 (15.1–20.8) | 10.6 (7.7–13.4) | 8.1 (5.9–10.3) | 9.5 (6.8–12.3) | 6.8 (4.6–9.0) | 2.8 (2.1–3.6) | 20.9 (15–26.7) | 48 (38.7–57.3) |
| Togo | 6.2 (3.0–9.3) | 9.1 (4.0–14.2) | 1.7 (.9–2.4) | 6.2 (4.8–7.6) | 6.9 (4.6–9.2) | 4.8 (3.0–6.6) | 1.4 (.1–2.7)[a] | 22.8 (9.0–36.7) | 24.1 (3.9–44.4)[a] |
| **Eastern Mediterranean region** | | | | | | | | | |
| Islamic Republic of Iran | 3.0 (1.2–4.9) | 5.1 (2.1–8.1) | .9 (.2–1.5) | 5.1 (3.4–6.8) | 5.4 (3.1–7.6) | 4.8 (2.8–6.8) | .3 (.2–.5) | 12.0 (3.0–20.9) | 7.4 (3.7–11) |
| Qatar | 6.5 (4.4–8.6) | 13.4 (8.9–18.0) | 2.3 (.4–4.1) | 7.0 (4.9–9.2) | 7.6 (5.5–9.8) | 6.1 (3.3–8.9) | 1.0 (.4–1.7) | 17.3 (7.2–27.3) | 14.6 (5.9–23.3) |
| Tunisia | 8.3 (6.4–10.2) | 15.1 (12.0–18.2) | 1.6 (.6–2.7) | 4.5 (3.2–5.8) | 6.2 (3.8–8.6) | 2.9 (1.8–4.0) | 1.0 (.3–1.7) | 12.2 (4.2–20.1) | 23.1 (10.1–36.1) |
| Yemen | 3.9 (2.1–5.8) | 4.2 (1.7–6.6) | 1.6 (.5–2.7) | 8.6 (5.2–11.9) | 8.2 (3.9–12.5) | 8.4 (1.7–15.1) | .9 (.1–2.0)[a] | 27.1 (.1–60.9)[a] | 11.3 (.2–23.1) |
| **Europe** | | | | | | | | | |
| Croatia | 24.1 (19.7–28.4) | 21.7 (17.6–25.8) | 25.6 (20.3–30.9) | 1.9 (1.5–2.3) | 2.7 (1.8–3.6) | 1.1 (.6–1.7) | 1.5 (1.1–1.9) | 6.4 (4.5–8.4) | 82.5 (72.9–92.1) |
| Estonia | 27.2 (23.3–31.0) | 28.2 (23.3–33.1) | 26.2 (21.3–31.1) | 6.9 (4.7–9.1) | 9.4 (6.2–12.6) | 4.5 (2.8–6.3) | 4.4 (2.8–6.1) | 16.2 (10.5–21.9) | 63.6 (52.8–74.3) |
| Hungary | 23.2 (18.9–27.4) | 21.5 (16.1–26.9) | 23.6 (19.1–28.0) | 1.7 (1.2–2.2) | 2.1 (1.5–2.7) | .9 (.2–1.7) | 1.1 (.4–1.8) | 4.8 (2.3–7.2) | 76.0 (41.7–110.3) |
| Kyrgyzstan | 4.4 (3.2–5.6) | 6.8 (4.7–9.0) | 2.2 (1.1–3.3) | 2.5 (1.7–3.3) | 3.3 (1.9–4.7) | 1.8 (.8–2.8) | 1.1 (.6–1.6) | 25.5 (17.3–33.7) | 71.9 (53.3–90.5) |
| Latvia | 32.9 (26.9–38.8) | 36.3 (30.7–41.9) | 30.2 (23.7–36.6) | 10.9 (7.3–14.5) | 12.1 (8.2–16.0) | 9.5 (5.9–13.1) | 6.7 (4.2–9.1) | 20.3 (13.2–27.4) | 61.6 (53.9–69.2) |
| FYROM | 9.8 (7.1–12.4) | 9.7 (6.9–12.5) | 9.8 (6.9–12.7) | 3.0 (2.2–3.9) | 3.2 (2.0–4.4) | 2.8 (1.8–3.9) | 1.4 (.9–2.0) | 14.9 (9.2–20.6) | 58.0 (47.2–68.9) |
| Republic of Moldova | 11.3 (9.2–13.5) | 18.5 (14.7–22.3) | 5.6 (4.1–7.0) | 3.8 (2.5–5.1) | 5.2 (3.3–7.2) | 2.6 (1.3–3.9) | 2.4 (1.4–3.3) | 21.0 (13.4–28.7) | 77.2 (70.2–84.2) |
| Montenegro | 5.1 (3.9–6.2) | 5.7 (4.1–7.3) | 4.4 (2.9–5.9) | 1.1 (.7–1.5) | 1.1 (.7–1.6) | .9 (.4–1.4) | .7 (.4–.9) | 12.8 (7.7–17.9) | 69.0 (52.9–85.1) |
| Serbia | 9.3 (6.5–12.1) | 9.3 (5.8–12.8) | 8.9 (6.3–11.5) | 1.2 (.6–1.9) | 1.6 (.7–2.6) | .7 (.1–1.3) | .7 (.2–1.3) | 8.0 (2.8–13.2) | 70.4 (48.1–92.6) |
| Slovenia | 20.3 (16.0–24.5) | 15.2 (10.0–20.4) | 23.0 (18.3–27.6) | 2.2 (.8–3.7) | 2.0 (1.0–3.1) | 1.8 (.1–3.9)[a] | 1.6 (.2–2.9)[a] | 7.8 (1.9–13.6) | 78.3 (57.1–99.6) |
| **Region of the Americas (exclusive of the United States)** | | | | | | | | | |
| Barbados | 11.6 (8.6–14.7) | 14.3 (9.9–18.7) | 9.3 (5.9–12.7) | 9.8 (7.9–11.8) | 11.5 (8.8–14.3) | 8.2 (5.9–10.4) | 2.7 (1.4–4.0) | 23.8 (13.4–34.3) | 27.5 (16.6–38.3) |
| Belize | 7.7 (5.4–10.1) | 11.7 (7.8–15.6) | 4.4 (2.0–6.8) | 5.7 (3.4–8.0) | 5.8 (2.8–8.7) | 5.5 (3.2–7.8) | .5 (.1–.9) | 6.8 (1.9–11.7) | 9.1 (1.9–16.4) |
| Panama | 4.3 (2.8–5.9) | 5.9 (3.7–8.1) | 2.8 (1.4–4.2) | 3.5 (2.5–4.6) | 3.8 (2.1–5.4) | 3.2 (2.1–4.3) | .5 (.2–.8) | 11.1 (5.0–17.3) | 14.0 (6.7–21.3) |
| Trinidad and Tobago | 12.9 (9.5–16.3) | 14.7 (10.4–19.1) | 10.3 (6.3–14.3) | 5.5 (4.0–7.0) | 5.4 (3.4–7.5) | 5.5 (3.9–7.1) | .4 (.1–.9) | 3.0 (0–7.2.0)[a] | 7.1 (.1–16.3)[a] |
| **Southeast Asia** | | | | | | | | | |
| Myanmar | 4.9 (3.5–6.3) | 8.5 (5.8–11.2) | 1.3 (.4–2.2) | 6.5 (4.9–8.1) | 10.3 (7.4–13.1) | 2.7 (1.7–3.7) | 1.4 (.7–2.0) | 28.4 (16.3–40.5) | 23.5 (15.3–31.6) |
| Sri Lanka | 1.3 (.2–2.3)[a] | 1.6 (.2–3.0)[a] | .9 (.1–2.1)[a] | 6.8 (4.5–9.0) | 9.6 (6.0–13.2) | 3.9 (1.6–6.1) | .2 (.1–.4)[a] | 17.2 (.1–40.6)[a] | 2.7 (.1–6.5)[a] |
| **Western Pacific** | | | | | | | | | |
| Cook Islands | 30.0 (25.0–35.1) | 28.2 (19.5–36.8) | 31.5 (24.1–38.9) | 8.7 (5.8–11.7) | 10.5 (6.8–14.2) | 7.3 (3.5–11.1) | 4.3 (2.5–6.1) | 14.5 (8.9–20.0) | 51.5 (34.0–69.0) |
| South Korea | 8.8 (7.2–10.4) | 10.8 (8.6–13.0) | 6.3 (4.8–7.7) | 6.2 (5.4–7.0) | 7.2 (6.0–8.5) | 5.0 (4.2–5.9) | 1.9 (1.3–2.5) | 21.7 (16.6–26.7) | 30.8 (23.4–38.2) |
| Mongolia | 6.9 (3.9–9.8) | 11.0 (7.0–14.9) | 3.3 (.6–5.9) | 13.1 (3.1–23.1) | 15.0 (6.1–23.8) | 11.4 (.1–22.9)[a] | .9 (.3–1.6) | 13.4 (.8–25.9)[a] | 7.0 (2.9–11.0) |
| Philippines | 17.5 (14.5–20.4) | 23.5 (19.4–27.5) | 12.0 (9.1–14.8) | 5.1 (3.8–6.3) | 4.7 (3.0–6.4) | 5.2 (3.7–6.7) | 1.0 (.5–1.6) | 6.1 (3.1–9.1) | 20.9 (11.8–30.0) |
| United States of America | 8.0 (6.7–9.2) | 8.2 (6.9–9.6) | 7.6 (6.1–9.1) | 3.4 (2.7–4.2) | 5.2 (3.9–6.5) | 1.6 (1.1–2.0) | 1.7 (1.2–2.1) | 21.3 (16.9–25.7) | 51.9 (44.1–59.7) |

95% CI = 95% confidence intervals; FYROM = former Yugoslav Republic of Macedonia; GYTS = Global Youth Tobacco Survey; NYTS = National Youth Tobacco Survey; SLT = smokeless tobacco.
[a] Estimates with relative standard errors ≥40%.

**Table 3**
Adjusted logistic regression analyses assessing predictors of cigarette and SLT use patterns among adolescents (GYTS-NYTS) aged 13–15 in 32 countries during 2007–2011

| Characteristic | Current cigarette smoking (n = 16,043) aOR, 95% CI | Current SLT use (n = 7,570) aOR, 95% CI | Combined use of cigarettes and SLT products (n = 2,734) aOR, 95% CI |
|---|---|---|---|
| Sex | | | |
|   Male | 1.00[ref] | 1.00[ref] | 1.00[ref] |
|   Female | .64 (.57–.73) | .52 (.44–.62) | .37 (.28–.49) |
| Age, years | | | |
|   13 | 1.00[ref] | 1.00[ref] | 1.00[ref] |
|   14 | 1.34 (1.15–1.57) | .9 (.75–1.08) | 1.09 (.75–1.57) |
|   15 | 1.89 (1.58–2.27) | 1.1 (.89–1.37) | 1.36 (.95–1.96) |
| Geographical region[a] | | | |
|   United States | 1.00[ref] | 1.00[ref] | 1.00[ref] |
|   African region | .27 (.13–.59) | 3.98 (2.19–7.24) | 3.36 (.77–14.76) |
|   Eastern Mediterranean region | .04 (.02–.10) | 2.46 (1.20–5.03) | .57 (.11–2.90) |
|   Europe region | .33 (.15–.70) | 1.12 (.63–1.99) | 1.71 (.42–7.05) |
|   Region of the Americas (exclusive of the United States) | .12 (.05–.26) | 1.83 (.98–3.40) | .55 (.12–2.42) |
|   Southeast Asia region | .04 (.02–.08) | 2.76 (1.38–5.53) | .98 (.22–4.36) |
|   Western Pacific region | .21 (.10–.42) | 1.92 (1.07–3.42) | 1.27 (.37–4.31) |
| Income grouping of country[b] | | | |
|   Low income | 1.00[ref] | 1.00[ref] | 1.00[ref] |
|   Lower middle income | .93 (.69–1.27) | 1.47 (1.10–1.97) | .93 (.45–1.92) |
|   Upper middle income | 1.05 (.80–1.40) | 1.03 (.73–1.46) | 1.02 (.61–1.68) |
|   High income | .97 (.75–1.24) | 1.66 (1.19–2.32) | 1.90 (1.18–3.07) |
| Survey year (per unit increase)[c] | .56 (.46–.68) | 1.00 (.86–1.17) | 1.02 (.71–1.46) |

Multivariate model adjusted for all factors listed in table.
95% CI = 95% confidence intervals; aOR = adjusted odds ratios; n = total number of tobacco users combined for each product; ref = referent; SLT = smokeless tobacco.
  [a] Based on the World Health Organization's geographic categorization of countries into six regions. The United States was analyzed as a separate referent region.
  [b] Based on the World Bank's categorization of countries into economic groups using countries' 2011 gross national incomes.
  [c] Survey period during 2007–2011 was modeled as a ordinal variable and assessed per unit increase in years.

SLT users. Compared with the U.S., the likelihood of being a current SLT user was highest among adolescents from Africa (aOR = 3.98; 95% CI: 2.19–7.24) followed by those in the Southeast Asia (aOR = 2.76; 95% CI: 1.38–5.53) and Eastern Mediterranean (aOR = 2.46; 95% CI: 1.20–5.03) regions. By income category, adolescents in lower-middle income (aOR = 1.47; 95% CI: 1.10–1.97) and high-income (aOR = 1.66; 95% CI: 1.19–2.32) countries were more likely to use SLT compared with those in low-income countries. Likelihood of dual tobacco product use was highest among adolescents in high-income countries (aOR = 1.90; 95% C.I: 1.18–3.07). (Table 3).

## Discussion

This study showed specific differences in tobacco use patterns among adolescents aged 13–15 years old by both geographical region and income. Specifically, adolescents from Africa, Southeast Asia, and the Western Pacific regions were more likely to be current SLT users than adolescents from any other region, whereas the likelihood of cigarette smoking among adolescents was more noted among U.S. and European adolescents. Finally, dual tobacco product use was higher among high-income countries. Such differences in tobacco use patterns may arise from differences in cultural/religious norms, availability of different types of tobacco products, local and national tobacco control strategies, and differences in tobacco industry influence [13].

A novel finding in our study was that SLT use among girls was as common as cigarette smoking in most LMICs or even more common than cigarette smoking in others. More so in most LMICs, SLT use among girls was as prevalent as among boys. This is consistent with previous research that indicated narrow sex

differences in other tobacco use among young people in many parts of the world with traditionally lower tobacco prevalence among women compared with men [10]. Because several oral and systemic diseases have been attributed to SLT use including oral cancer, it is likely that we may notice an increase in the morbidity of SLT-attributable diseases among females within the context of country specific SLT use [14–16].

In parts of Africa, Southeast Asia, and the Western Pacific region, SLT products may be locally manufactured from home-grown tobacco. The ubiquitous nature of traditional SLT products in such countries may not only make tobacco very accessible to adolescents, but might also make adoption of some Western policies difficult, particularly in the light of relatively weak regulatory frameworks for tobacco control at a regional or national level [7]. In addition, the tobacco industry may have targeted youths in some LMICs by introducing branded and flavored SLT products that may be attractive to adolescents. For example, the Swedish-style snus product, Zip was recently introduced into Nigeria in 2010 by the West African Tobacco Company and is currently marketed as a flavored (menthol) product [5]. The introduction of such branded and flavored novel tobacco products may have significant implications for tobacco use among youths. For example, such products may become starter products for cigarette smoking because of the flavors or sweeteners in certain of these SLT products, coupled with their relatively lower prices that may appeal to the "newbies" [17,18].

The different patterns of tobacco use in LMICs relative to certain European countries and the United States underscores the fact that a "one-size-fits-all" approach to tobacco control may not be as efficient in denormalizing tobacco use among adolescents as interventions tailored to the unique tobacco environment and cultural differences in adolescent development in each

country. Although adolescence is a time of tremendous growth and potential, it is also a time of considerable risk during which social contexts exert powerful influences. For instance, it may well be that U.S. and European adolescents culturally have earlier expectations for behavioral autonomy than adolescents in LMICs [19,20], with the result that smoking uptake is observed at an earlier age in the United States and Europe. That SLT use, which is culturally acceptable among adults in a number of LMICs [21], was more popular among LMIC adolescents (including among girls), may reflect a greater adult influence during adolescence in these countries and/or that this is a more discrete behavior that can be performed without being noticed by an adult. It may therefore be that different culturally tailored interventions are needed in denormalizing smoking and SLT use among adolescents in the different regions. Nevertheless, there a number of interventions that would be universally applicable to preventing adolescents from taking up cigarette smoking and/or SLT use. Some proven interventions recommended by the WHO MPOWER package include raising taxes on tobacco products, warning about the dangers of tobacco use with hard-hitting media messages, banning or restricting tobacco promotional activities, and implementing and enforcing smoke-free policies [22].

In a bid to implement comprehensive tobacco control measures, several LMICs have passed or proposed tobacco control legislation based primarily on the WHO's Framework Convention on Tobacco Control—a document that addresses mainly cigarettes and to a lesser extent SLT products [23]. Hence, no specific mechanism for regulating SLT products exists in several LMICs. However, experience from developed nations has shown that tobacco control policies must be inclusive of SLT products to be effective. The relatively stricter regulation of tobacco products (including SLT products) in the United States and several European countries may account for some of the differences in use patterns when compared with other regions in the study. According to the 2013 Euromonitor report, complete bans or restrictions in SLT sale and use are in place in Estonia, Hungary, Latvia, Lithuania, FYR Macedonia, and Slovenia [24]. In the United States, recent advances in tobacco control have included increased federal taxes on cigarettes and SLT products and restrictions in the marketing of tobacco products [25,26].

Notably though, laudable advances have been made in some LMICs to regulate SLT products as part of a comprehensive tobacco control effort. For instance, in South Africa, the sale and promotion of SLT products carries the same restriction as other smoking tobacco products; therefore, manufacturers of SLT products face considerable challenges in creating awareness of existing and new products. Legislation in South Africa also restricts point-of-sale displays within 1 m of the cash register and SLT products are required to have a warning label, although not rotating as with cigarettes and no tax as with cigarettes [24]. Similarly, India also has warning labels on SLT products, and, in 2011, required tobacco manufacturers to change SLT packaging from nondegradable plastic to paper sachets bearing the name of the tobacco company [24]. This has contributed to declines in unbranded SLT products in the Indian market. In addition, several states in India have banned gutkha under the Food Safety and Standards Regulation [24].

Our finding of high rates of concurrent cigarette smoking among current users of SLT products in Europe, the United States, and several other countries in the Americas and Western Pacific regions may suggest a possible role of SLT as a gateway to smoking among adolescents. However, we are not able to advance this as our data are limited by the cross-sectional nature of the survey. It is however interesting to compare the patterns of tobacco use identified through an analysis by geographical region versus a breakdown by country income. Our analysis indicated specific differences that may be more explainable by the regional differences in cultivation, promotion, and social acceptance of tobacco products than the actual income of the country. Further research is needed to assess this hypothesis.

*Strengths and limitations*

This study covers a significant gap in the literature by assessing patterns of cigarette and SLT use among adolescents globally. Its strengths include the standardized sample frame and questionnaire and nationally representative data obtained from 32 countries in all WHO regions. However, these findings are also subject to a number of limitations. First, tobacco use was self-reported and may have resulted in underestimates. Second, novel SLT products such as Swedish-style snus and dissolvable tobacco products were not included in the analysis because data were unavailable for most countries; this may have resulted in underestimating current SLT prevalence in countries with such products. Third, these data apply only to adolescents that attend school. However, in most of the countries assessed, the majority of adolescents aged 13–15 years are enrolled in traditional school; thus, the results may be representative of most of the students in this age bracket in the respective countries [10]. Finally, these findings may not be generalizable to the entire WHO regions because there were limited countries for which data that met our inclusion criteria were available.

This study has demonstrated that although use patterns of cigarette and SLT products among adolescents varied widely globally, certain similarities within regions were observed, with SLT use more common among adolescents in Africa and Southeast Asia, where SLT cultivation and use is widespread. On the contrary, dual use was more common in high-income countries. Furthermore, the relatively high prevalence of SLT use among females in several LMICs is alarming, stressing the need to address the issue of SLT use among both sexes.

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