Prevalence of Dual and polytobacco use, and associated factors among adults in 18 countries-Secondary Analyses of the Global Youth Tobacco Surveys 2015-2019

Worldwide the prevalence of cigarette smoking is declining due to the implementation of evidence-based interventions, yet tobacco use still accounts for a significant disease burden. The types of tobacco products consumed have diversified since the introduction of alternative tobacco products such as electronic cigarettes, heated tobacco products, and more recently nicotine pouches. The availability of a range of tobacco products has led to the emergence of dual tobacco and polytobacco users. The reasons for consumption of non-cigarette tobacco products have been reported to reduce the cost of cigarette smoking (to overcome raising cigarette taxes), to circumvent the smoke-free policies (smokeless tobacco, electronic cigarettes, and heated tobacco products), or even to quit cigarette smoking. However, the consumption of multiple tobacco products increases the risk of tobacco-induced diseases and leads to higher levels of nicotine dependence. Most importantly, from the public health perspective consumption of multiple tobacco products may undermine the tobacco control efforts as most interventions are specifically aimed towards manufactured cigarettes. In these changing paradigms of the emergence of newer tobacco products, ongoing surveillance of the consumption of multiple tobacco products is critical to inform the regulatory policy and clinical practice to assist cessation of tobacco consumption.

Previous reports have provided national-level estimates of multiple tobacco product consumption in the USA and Hong Kong. However, to date, only two studies have provided comparable estimates from a Special Eurobarometer survey (25 countries, the year 2012 ) (and Global Adult Tobacco Surveys (44, countries, years 2008 to 2012) and Demographic and Health Surveys (19 developing countries, years 2015 and 2016). A systematic review has reported the national-level estimates of dual/poly use from 20 primary studies including those based on GATS, DHS, and Eurobarometer surveys. While these prevalence estimates are useful to quantify the population burden of dual/poly use, factors associated with multiple tobacco products in these reports identify the at-risk groups. In this direction, Agaku et al. have identified demographic and spatial factors associated with polytobacco use, while Chen et al. have reported that demographic, socio-economic factors, exposure to media, and contextual factors (country-level income, and tobacco control policy score were associated with dual/poly use. However, studying the individual-level determinants associated with dual/poly tobacco use is critical for tobacco control policymaking. Factors such as awareness about the harms of tobacco use, the existence of the smoke-free policy, and exposure to pro and anti-tobacco messages in the media and health warnings use are not studied in the existing literature. We used GATS data that gathers comprehensive information about tobacco use behaviors and information related to tobacco control factors. GATS survey data also provides updated estimates of dual and poly tobacco use for countries reported earlier. We also aimed to determine the demographic, socio-economic, and tobacco control policy-related factors associated with dual and poly tobacco use on a nationally representative sample of adults surveyed in 18 countries.

While world nations are combating the tobacco epidemic that contributed to the highest mortality since the inception of WHO, polytobacco emerges as a challenge to public health professionals and a growing concern to many developing countries. Polytobacco which takes different forms is defined as the usage of more than 2 tobacco products concurrently. The distribution of different types of tobacco products admittedly differs by region. Figures showed that 40% of youth and adult Americans are using more than two products [1]. Around 15.9% were found to be polyusers in Hong Kong[2]. High figures were also reported from lower-income countries like Timor Leste (27.1%) and Nepal (18.3) [3].

Systematic review showed that the 11.9% prevalence of polytobacco was the highest reported from Denmark in 2012 [4] .

products, the alluring form and taste of new products [5], and low-risk perception of their adverse effect [6]. Relief of boredom was the main motivator for polytobacco adoption among university students [7].

Sociodemographic factors are reported to play a role in polytobacco. Analysis of 3 representative samples from USA showed that males were more likely to be a dual user. However, dual and polyuse were less likely among respondents with higher education, income, and older age [8]. Older age, low educational attainment and income and urban dwelling were found to be associated with dual and polyuse [3]. However, no association was found between wealth of country and prevalence of dual and polyuse.

Policies and law enforcement are crucial strategies in combating tobacco epidemic. Due to its impact, the World Health Organization's Framework Convention on Tobacco Control (FCTC) is considered as the most relevant framework that aims to control tobacco advertising, promotion, and sponsorship [9].

Exposure to marketing and tobacco advertisement contributed to dual and poly usage among adolescents[10]. Peer influence [11, 12] and lack of enforcement recognizable risk factors among adolescent as well .

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METHODS

Data source

We used Global Adult Tobacco Surveys (GATS) data from 18 countries from 2015 to 2021 (Table 1) (available at https://nccd.cdc.gov/gtssdata/Ancillary/DataReports). In brief, GATS is a series of cross-sectional nationally representative household surveys of adults 15 years of age or older survey as part of the global tobacco surveillance system to systematically monitor adult tobacco use and track the key tobacco use behaviors and tobacco control indicators. The GATS uses a geographically clustered multistage sampling methodology to identify the specific households. First, a country was divided into Primary Sampling Units, segments within these Primary Sampling Units, and households within the segments. Then, a random sample of households is selected. The GATS interview consists of two parts: the Household Questionnaire and the Individual Questionnaire. The Household Questionnaire (household screening) and the Individual Questionnaire (individual interview) were conducted using an electronic data collection device.

Measures

**The types of tobacco products consumed**.

We used the following questions in the GATS questionnaire to identify the tobacco products. Questions about tobacco smoking i.e., “Do you currently smoke tobacco on a daily basis, less than daily, or not at all?” Those who responded as daily or non-daily were asked to report the number smoked daily or weekly by asking “On average, how many of the following products do you currently smoke each day? Also, let me know if you smoke the product, but not every day”. This question covered smoking products such as manufactured cigarettes, hand-rolled cigarettes, kreteks, bidi, Pipes full of tobacco, cigars, or cheroots, or cigarillos, and water pipes. Participants who reported smoking any of the smoking tobacco products at least once unit per day or week were considered current tobacco smokers of each of these smoking products. The question “Do you currently use smokeless tobacco daily, less than daily, or not at all? covered snuff use by mouth and nose, chewing tobacco, and betel quid with tobacco. However, we considered any type of smokeless tobacco as a single entity. In addition, in some countries (List them), questions about the current use of electronic cigarettes, and heated tobacco products were also included. These are “Do you currently use electronic cigarettes or any other vaping device on a daily basis, less than daily, or not at all?” and “Do you currently use heated tobacco products on a daily basis, less than daily, or not at all?” We included all the responses for daily as well as non-daily to list the current users of different tobacco product users in each country. For this, we included all tobacco product data collected in GATS countries.

**Single, dual, and poly tobacco users**

From the current users of tobacco products in each country, we coded single, dual, and poly users. Individuals who currently use any one type of tobacco product were considered as single; those currently using any two tobacco products as dual users and more than two products as poly-tobacco users.

**Covariates**

The covariates included at the household level were wealth index, and rules at home about smoking indoors; at the individual level were sociodemographic factors, and respondents’ awareness about the harms of tobacco use, exposure to anti-tobacco factors such as ‘health warnings on cigarette packs, information about dangers of smoking seen in various media; protobacco factor i.e., seeing any advertisements or signs that promote tobacco products.

**Individual and household covariates**

Individual-level were included age (continuous variable), sex (male and female) educational attainment (no education, primary, secondary, high school, and higher). The knowledge score about the health effects of cigarette smoking was computed as the sum of scores responses given to two questions about the health effects of cigarette smoking. Based on what you know or believe, does smoking tobacco cause serious illness? And “Based on what you know or believe, does smoking tobacco cause the following? (range of health effects varied by country. The response ‘yes’ was scored ‘1’ and ‘no’ or ‘don’t know’ as ‘0’. Household smoking rules regarding smoking indoors were asked as “Which of the following best describes the rules about smoking inside of your home: Smoking is allowed, anywhere, smoking is allowed?” (Allowed, not allowed but the exception, never allowed and no rules). For each country, the household wealth index was calculated based on the ownership and possession of the list of household items (varied by each country) by principal components analyses to obtain household asset score that was used to rank individuals into wealth quintiles reflecting the socio-economic status i.e., poorest to richest.

**Pro and anti-tobacco covariates**

Individual exposure to the pro-tobacco factor was asked in the last 30 days, have you noticed any advertisements or signs promoting cigarettes in the following places? (Yes, no, not applicable and refused). The list of media ranged from stores, radio, television etc., and varied by country. Exposure to at least one advertisement was considered as a protobacco factor. Anti-tobacco factors exposure to dangers of tobacco was asked as “In the last 30 days, have you noticed any information in \*newspapers or in magazines\* about the dangers of use or that encourages quitting of the following tobacco products? (different questions covered various media and tobacco products). Response as ‘yes’ to at least one question was considered as exposure to the danger of tobacco use in media. Exposure to health warnings on cigarette packs was asked as “In the last 30 days, did you notice any health warnings on cigarette packages? (yes, no and not seen any cigarette packs.

**Country-level covariates**

We classified each country during the survey according to the World Bank taxonomy i.e., a low-income country (LIC), an upper middle-income country (uMIC), a lower middle-income country (lMIC), or a high-income country (HIC). This information was obtained from the World Bank website (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bankcountry-and-lending-groups). The WHO MPOWER data were extracted from the WHO reports on the global tobacco epidemic for the year close the survey year. The MPOWER indicators cover the six evidence-based strategies for fighting the global tobacco epidemic: (1) monitoring tobacco consumption and the effectiveness of preventive measures; (2) protecting people from tobacco smoke; (3) offering help to quit tobacco use; (4) warning about the dangers of tobacco; (5) enforcing bans on tobacco advertising, promotion, and sponsorship; and (6) raising taxes on tobacco. For each of these measures, a score of 1 was assigned if data were lacking entirely, if no data from 2009 onward were available, or if available data were not both recent and representative of the national population. Scores of 2 to 4 (for M) and 2 to 5 (for P, O, W, E, and R) represent a scale from the weakest to the strongest level of tobacco control policy in the relevant country. A score was ascertained for each of the 6 dimensions, and the 6 scores were summed to obtain the MPOWER score. The highest possible MPOWER score was 29.

Statistical analyses

The national-level weighted prevalence estimates and their 95%CI were calculated for single, dual, and polytobacco use. The estimates were calculated by adjusting for the complex sampling design used by GATS using svyset” and “svy” commands in Stata 13.0 commands on STATA 17.

RESULTS

**Survey country characteristics and prevalence of tobacco use**

The survey countries, survey year, sample characteristics, and MPOWER scores are shown in Table 1. Of the 18 countries, two were HIC (Russia and Uruguay) and two were LIC (Ethiopia and Tanzania) while rest were MIC. The sample surveyed ranged from the highest of 74,037(India) to 4,347 (Senegal). The overall response rates were over 80% in 17 countries, with a lowest of 64.4% in Ukraine to 98.2% in Russia. MPOWER score ranged from 17 (Ethiopia) to 28 (Romania).

Overall (both sexes) weighted prevalence (%) of any tobacco product use, single dual and poly tobacco use in the entire survey population are shown in table 2 whereas sex-wise estimates are shown in supplement. Any type of tobacco product use prevalence was <10 in four countries (Costa Rica, Tanzania, Senegal, and Ethiopia) and > 30 in four countries (Bangladesh, Indonesia, Romania, Russia, and Romania). Prevalence of single product use was comparable to any type of tobacco product use (example ≥30 for Bangladesh, Indonesia, and Russia). Prevalence of dual product use was <1 in (Costa Rica, Tanzania, Senegal, Ethiopia, Botswana, and Uruguay) but in other countries ranged from 1.3 (Philippines) to 4.3 (Russia) poly-tobacco use was <1 in most countries and 0 in countries (table 2). Sex-wise, all prevalence rates single product use were higher among men. However, in six countries prevalence of single product use was higher than 10 among women (Bangladesh-25.6, Romania-18.8, Uruguay-17.9, Russia-16.4, Mexico-15.7, and India-13.3). Dual use among men was ≥4 in six countries but among the women it was about 2 in three countries (Mexico, Romania, and Russia). In both sexes the prevalence of poly-tobacco use was <1 (except Romania).

The distribution of single, dual and poly-tobacco use in both sexes is shown in table 3 and sex-wise in supplement. The proportion of tobacco users (in both sexes) who are dual product user was about 25% of higher in five countries namely Bangladesh (23.4%), Botswana (25.9%), Ethiopia (28.6%), India (30.1%), and Mexico (34.5%) while poly-tobacco use was higher than 10% in Ethiopia (15%), Indonesia (10.6%), and Kazakhstan (13.2%). Sex-wise the proportion of dual product use among women was higher than men in five countries namely Bangladesh, Botswana, Mexico, Senegal and Tanzania where in all countries except Bangladesh poly-tobacco use among men was higher than women (supplement)

Table 1 presents an analysis of the associations observed between dual product use and polytobacco use with socio-demographic, tobacco-related, and country-level factors among the entire survey population within 18 GATS countries during the years 2015-2021.

In this analysis, respondents were categorized into three groups: single-product use, dual product use, and polytobacco use, with single product use serving as the reference category for comparison at the outcome level. Firstly, it was observed that sex was significantly associated with polytobacco use compared to single product use. Secondly, age is associated with both dual product use and polytobacco use in contrast to single product use. Furthermore, education was associated, with dual product use being linked to individuals with secondary education compared to those with no education, while polytobacco use was associated with individuals having completed high school in comparison to those with no education. Additionally, wealth quintile is also associated, with both dual product use and polytobacco use being more prevalent in the fifth wealth quintile when compared to the first wealth quintile.

Notably, the not allowed of tobacco with exceptions as a home rule was associated with an increased likelihood of both dual product use and polytobacco use as compared to never allowed as home rules. This pattern persisted when comparing polytobacco use to situations without enforced home rules.

Further, at least one advertisement is more likely use dual and poly tobacco use compared with single product use.

In terms of health warnings, the absence of warnings, specifically when respondents reported "Don't see any cigarette packages," was found to be associated with polytobacco use when compared to single product use, diverging compared with where no health warnings were reported. The MPOWER score also demonstrated a noteworthy association with dual product use compared to single product use. Lastly, regarding income countries, our analysis indicated that both upper middle-income countries and low-income countries exhibited a lower use for dual and poly tobacco use compared to high-income countries.

Table 2 presents an analysis of the associations observed between association of single, dual and polytobacco use with socio-demographic, tobacco-related, and country-level factors among the entire survey population within 18 GATS countries during the years 2015-2021. In this analysis, respondents were categorized into four groups: no tobacco use, single product use, dual product use, and polytobacco use, with no tobacco use serving as the reference category for comparison. Firstly, it was observed that age was significantly associated with single-product use when compared to no product use. Secondly, sex (less likely in women compared to male) was associated on both dual product use and polytobacco use in contrast to single product use. Furthermore, education was associated, with single product dual product use being linked to individuals with primary and above education (less likely) compared to those with no education, while polytobacco use was associated with primary and secondary education (less likely) in comparison to those with no education. Additionally, wealth quintile is also associated, with single product use (more likely) compared to first wealth quintiles and dual product use was more likely among second and fifth quintiles compared to first quintile and polytobacco use being more prevalent in the fourth and fifth wealth quintile when compared to the first wealth quintile.

Notably, homes rules were associated (any or ever home rules) with single, dual and polytobacco uses compared with never allowed as home rules. Further, knowledge score is also associated with single and poly tobacco use (compared to no tobacco use).

Further, seen at least one danger is more likely use single, dual and poly tobacco use compared with no danger. Similarly, seen at least one advertisement is more likely use single, dual and poly tobacco use compared with no advertisement.

In terms of health warnings, "Don't see any cigarette packages and having health warnings were associated with single, dual product and poly tobacco use compared with no health warnings. The MPOWER score is also positively associated with single, dual product, and poly tobacco use compared to no product use. Lastly, regarding income countries, single tobacco use was more likely in upper and lower-middle income while less likely in low-income countries compared to high-income countries. Similarly, dual product was less likely in upper-middle, lower-middle- and low-income countries compared to high-income countries. While, in poly tobacco use, in contrast to single-use, upper middle and lower middle were less likely to use and low income were more likely to use product compared to high income countries.