

# Tobacco industry accountability - current practices, emerging issues and challenges

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**Published in**

Frontiers in Public Health



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ISSN 1664-8714  
ISBN 978-2-8325-3336-9  
DOI 10.3389/978-2-8325-3336-9

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# Tobacco industry accountability - current practices, emerging issues and challenges

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## Citation

Goel, S., Yadav, A., Kontsevaya, A., eds. (2023). *Tobacco industry accountability - current practices, emerging issues and challenges*. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-8325-3336-9

# Table of contents

- 04 **Editorial: Tobacco industry accountability - Current practices, emerging issues and challenges**  
Sonu Goel, Amit Yadav, Anna Kontsevaya and Garima Bhatt
- 08 **Stopping Smokeless Tobacco Use: A Call to Action**  
Donald Reed, Elaine Bowen, Becca Fint-Clark, Brent Clark, Nila Cobb, Kathy M. Danberry, Zona Hutson, Stephanie Lusk, Jason Rine and Natasha Robinson
- 15 **Price Policy and Taxation as Effective Strategies for Tobacco Control**  
Richard Felsinger and Ernest Groman
- 23 **Tobacco smoking and depressive symptoms in Chinese middle-aged and older adults: Handling missing values in panel data with multiple imputation**  
Xiahua Du, Rina Wu, Lili Kang, Longlong Zhao and Changle Li
- 35 **Smokeless tobacco industry's brand stretching through FM radio: A study from Delhi National Capital Region, India**  
Prashant Kumar Singh, Rupal Jain, Akansha Tyagi, Amit Yadav and Shalini Singh
- 40 **Does a human rights-based approach to harm reduction support commercialized harm reduction? Brief research**  
Neil Sircar, Mary E. Fleming and Stella A. Bialous
- 49 **A content analysis of e-cigarette marketing on social media: Findings from the Tobacco Enforcement and Reporting Movement (TERM) in India, Indonesia and Mexico**  
Nandita Murukutla, Melina S. Magsumbol, Hana Raskin, Sharan Kuganesan, Silvia Dini, Carlos Martinez-Mejia, Rachfiansyah and Benjamin Gonzalez Rubio Aguilar
- 66 **Gender dimensions of youth vulnerability toward access to cigarettes in South-East Asia: Evidence from global youth tobacco survey**  
Nancy Satpathy, Pratap Kumar Jena and Venkatarao Epari
- 74 **Examining influencer compliance with advertising regulations in branded vaping content on Instagram**  
Nathan A. Silver, Adrian Bertrand, Padmini Kucherlapaty and Barbara A. Schillo
- 81 **Association between smoking cessation and non-alcoholic fatty liver disease using NAFLD liver fat score**  
Yun Seo Jang, Hye Jin Joo, Yu Shin Park, Eun-Cheol Park and Sung-In Jang
- 91 **A "willingness to be orchestrated": Why are UK diplomats working with tobacco companies?**  
Raouf Alebshehy, Karin Silver and Phil Chamberlain



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RECEIVED 10 May 2023  
ACCEPTED 17 July 2023  
PUBLISHED 10 August 2023

CITATION  
Goel S, Yadav A, Kontsevaya A and Bhatt G  
(2023) Editorial: Tobacco industry  
accountability - Current practices, emerging  
issues and challenges.  
*Front. Public Health* 11:1220268.  
doi: 10.3389/fpubh.2023.1220268

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# Editorial: Tobacco industry accountability - Current practices, emerging issues and challenges

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## KEYWORDS

tobacco industry (TI), interference, accountability, challenges, FCTC, Article 5.3

## Editorial on the Research Topic

[Tobacco industry accountability - Current practices, emerging issues and challenges](#)

## Tobacco industry accountability

The long and intricate history of the tobacco industry (hereafter TI) is marked by periods of expansion and disintegration, changing legal frameworks, and evolving public perception of tobacco use and its detrimental effects on health (1).

The global TI is dominated by the five largest tobacco businesses, i.e., Philip Morris International, British American Tobacco, Imperial Brands, Japan Tobacco International, and China National Tobacco Company (2). These are also known to historically work together in concealing scientific evidence on the adverse effects of tobacco consumption, telling lies under oath before the US Congress, and manipulating and destroying evidence (3).

Since the mid-20th century, the evidence against tobacco products has been mounting, linking tobacco use (smoked as well as smokeless forms) to various cancers and other health problems (4). There is evidence that smoking leads to many cancers, not just lung cancer (5).

In response, tobacco companies launched aggressive marketing campaigns to reassure the general population about the safety of their products and undermine the credibility of scientific research on the harms of smoking (1). In the 1990's, public pressure and lawsuits led to a series of major legal settlements and the implementation of tighter regulations on tobacco advertising and sales (6). To circumvent this new regulatory environment, numerous tobacco firms expanded their product portfolios to include smokeless tobacco and other items containing nicotine (7). More recently, the industry has also moved its focus onto creating and marketing substitutes, notably, heated tobacco products and electronic cigarettes, misleading consumers with the term "harm reduction," or "less harmful," or "safer" used for such products (8, 9). While TI has long been criticized and subject to legal action due to its part in promoting and making money from a harmful and addictive product, TI has employed several tactics to counter the legal and public health regulations put in its way by governments in different countries (9).

## Tobacco industry tactics

It is well-documented that the TI has been using various tactics to interfere with public health policies and programs that reduce tobacco use and its associated harms (10). TI has been funding research studies that discredit proven science by sponsoring and promoting research that produces results biased in favor of its products and using them to influence public health policy through lobbying and other forms of political influence (11, 12). TI has also used its financial resources and political influence to lobby against public health policies, including tobacco taxes, smoke-free laws, advertising restrictions, and facilitating illicit trade in tobacco products through smuggling (12–15). This has included funding political campaigns and candidates sympathetic to the industry's interests and sponsoring front groups and other organizations that advocate for the industry's position (16). In addition, the TI continues to introduce and market newer products (e-cigarettes and heated tobacco products) and create a misleading perception of being a healthier option compared to traditional tobacco products through social media influencers and product placements in movies and television shows (17). Furthermore, TI has also twisted and exploited trade and other international agreements to undermine public health policies (18). Additionally, TI has used front groups to aggressively lobby for pro-industry measures influence the political and legislative process, promote misinformation, and exaggerate the industry's economic importance (19).

However, since the adoption of the World Health Organization- Framework Convention on Tobacco Control (WHO-FCTC), there have been demands for the industry to be held to a higher degree of accountability and to firewall tobacco control policies from deceitful and deceptive interference by the industry. The WHO-FCTC is a global evidence-based treaty that was developed in response to the tobacco epidemic's globalization that asserts everyone's right to the highest standard of health (20).

## WHO-FCTC Article 5.3

Article 5.3 of the FCTC and the guidelines adopted for its effective implementation recommend that TI and those working to advance its interests operate and act in an accountable and transparent manner (21). These guidelines are intended to ensure tobacco control measures are thorough and successful in averting commercial and other ingrained interests of the TI. These guidelines and principles cover interferences by TI and, as apposite (as appropriate), by individuals and organizations that work to advance the interests of the TI further (21).

Unfortunately, as more victims of tobacco use epidemic have increased, the TI sees itself as part of the solution and not the problem. It uses various tactics to stymie the government's effort to reduce tobacco users and protect public health. However, the key to tackling Tobacco Industry Interference (henceforth TII) lies in the hands of governments that adopt a comprehensive policy against TII that aligns with the WHO FCTC. Article 5.3 of the WHO FCTC requires that:

*"In setting and implementing their public health policies with respect to tobacco control, Parties shall act to protect these policies from commercial and other vested interests of the tobacco industry in accordance with national law."*

## Against all odds

Australia became the first nation to implement plain packaging regulations on tobacco products, limiting cigarette packs' branding and other promotional features in 2012. The TI contested the law in court, arbitration tribunal, and World Trade Organization (WTO), but the Australian government finally prevailed, which is believed to have reduced smoking rates nationwide (22).

Uruguay introduced several policies in 2010 to lower tobacco consumption, including banning smoking in public areas and prohibiting tobacco advertising and promotion. The tobacco industry challenged these measures, but the measures implemented by Uruguay prevailed (23).

Thailand's Ministry of Public Health filed a successful lawsuit in 2017 against the Thai subsidiary of Philip Morris International, alleging that the company had imported and sold cigarettes that did not comply with the country's regulations (24).

India notified rules requiring 85% pictorial health warnings on the packaging of tobacco products in 2014. The TI pushed back against the move. The industry filed legal challenges, claiming that the warnings were too graphic, and even closed down manufacturing units in an attempt to get their way by disrupting the economy of India. However, TI lost with landmark ruling by the Supreme Court of India that upheld the implementation of larger and stronger health warnings on all tobacco products in India (25).

The current theme of this Research Topic has meticulously captured the challenges TI poses in undermining public health practices and opportunities for intervention, along with key takeaways for policymakers to implement stronger actions. The issue comprises ten articles, two of which focus on smokeless tobacco, highlighting the degree of surrogate advertisement of Smokeless Tobacco (SLT) products and the development and assessment of a Stop Spit Tobacco Curriculum. Two manuscripts present secondary data analysis, focussing on TI's influence on tobacco use among young people and the use of multiple imputation methods to handle missing values in panel data. Three articles shed light on harm reduction and commercialized harm reduction, examining influencer-vaping brand relationships on Instagram for compliance with advertising regulations and analysis of social media marketing of e-cigarettes in countries with different regulatory policies. In addition, three papers discuss challenges in monitoring diplomats' engagement with the TI, using price-policy measures, and implementing tobacco cessation strategies to manage tobacco-induced disease burden.

The issue covers articles that bring forth several maneuvers of the TI in the current times, including the digital and social media marketing tactics for advertising Electronic Nicotine Delivery Systems (ENDS)/non-combustibles and building the narrative of harm reduction, flouting advertising regulations—brand stretching and surrogate advertising, misusing the principles of human rights



to advance commercial interests of harm reduction, marketing new dissolvable tobacco products, the actions of diplomats, which contravene the tenets and guidelines of WHO-FCTC, and attempts by TI to access laws, retailers' opposition, and suboptimal enforcement and access to cigarettes at unregulated alternative vends (outlets).

## Way forward

In order to counter these evolving challenges, it is crucial to promote evidence-based public health policies, transparency, and accountability for the tobacco industry's actions. It is essential for governments to continuously monitor all forms of media, including digital and social media, to track the online promotion and advertising of new tobacco/nicotine products and to strengthen counter-response for the same. Furthermore, the countries Party to or who have ratified WHO-FCTC should ensure that government representatives abide by provisions of Article 5.3 at both national and international levels. There is a need for strict regulation of TI behavior with effective enforcement of laws prohibiting tobacco advertising, including Corporate Social Responsibility (CSR) and other corporate promotions by the TI. Finally, building a firewalled collaboration and partnership across public health advocates, civil society organizations, and government agencies, as well as engaging academic researchers, legal experts, the public, and the media can help to highlight the industry's tactics, support evidence-based

policies to advance tobacco control and prevent such policies from any undue TII.

## Author contributions

SG, AY, and AK conceptualized the idea. GB undertook the review of the literature and prepared the first draft. SG and AY reviewed the draft and gave technical input to the original draft. All authors contributed to the article and approved the submitted version.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# Stopping Smokeless Tobacco Use: A Call to Action

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## OPEN ACCESS

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### Specialty section:

This article was submitted to  
Public Health Education and  
Promotion,  
a section of the journal  
Frontiers in Public Health

**Received:** 01 September 2020

**Accepted:** 06 May 2021

**Published:** 28 May 2021

### Citation:

Reed D, Bowen E, Fint-Clark B,  
Clark B, Cobb N, Danberry KM,  
Hutson Z, Lusk S, Rine J and  
Robinson N (2021) Stopping  
Smokeless Tobacco Use: A Call to  
Action. *Front. Public Health* 9:601890.  
doi: 10.3389/fpubh.2021.601890

In the United States, single smokeless tobacco use continues to increase in conjunction with the dual use of smokeless tobacco and other nicotine products. Problematically, much of the tobacco prevention literature and funding inundates tobacco users with smoking tobacco information while neglecting to provide them any information about smokeless tobacco. Meanwhile, American tobacco companies continually market new and dissolvable tobacco products targeted at non-smokers. New data suggests that smokeless tobacco use is, also, increasing in West Virginia and, in order to address this increased use, the West Virginia Extension Service recently partnered with the Division of Tobacco Prevention in the West Virginia Department of Health and Human Resources to develop a comprehensive spit tobacco curriculum for West Virginia students between third and sixth grade. This article details the development and assessment of the spit tobacco prevention curriculum and the resulting report from the initial pilot of the program. The curriculum was piloted across six counties with the participation of schools, after-school programs and 4-H clubs. After implementation, survey results demonstrate that youth have increased awareness of the health effects of smokeless tobacco. Throughout the article, we explore West Virginia's Cooperative Extension Service's response to this emerging public health issue and release a call to action for the National Cooperative Extension Services to join us in spit tobacco prevention.

**Keywords:** youth, smokeless tobacco, 4-H, oral health, extension service

## INTRODUCTION

This article illustrates the development, piloting, evaluation, and implementation of the Stop Spit Tobacco Curriculum in West Virginia. We highlight both the dangers of spit tobacco and the potential effects of spit tobacco on communities. The West Virginia Extension Service partnered with the Division of Tobacco Prevention in the West Virginia Department of Health and Human Resources to develop a comprehensive spit tobacco curriculum for West Virginia students in Grades 3–6. We conclude by putting out a call to action to all American Extension Professionals to prevent spit tobacco use in their own communities.

The term *spit tobacco* refers to tobacco that is not burned, is used orally, and produces the need to spit as by-product—i.e., chewing tobacco and snuff. The term *smokeless tobacco* refers to smokeless and spitless tobacco products—i.e., snus and dissolvable tobacco products. The term *spit and smokeless tobacco* refer to all tobacco products that are not ignited with fire to use.

## THE DANGERS OF SPIT TOBACCO

According to the National Summit on Smokeless and Spit Tobacco, “Smokeless and spit tobacco (SST) use is a rapidly-evolving public health threat requiring greater leadership, a shift in research and funding priorities, and local public action” (2015). While there have been many public interventions in smoking tobacco access and use—namely: Food and Drug Administration (FDA) regulations, excise taxes, public service announcement campaigns, and cessation-based phonenumber services—there are, currently, no strategies to help communities address Smokeless Spit Tobacco (SST). With the development of dissolvable tobacco products that attract both curious young people and longer-term smokers, we need programs centered around SST research and prevention more than ever before. Research conducted by the National Summit on Smokeless and Spit Tobacco has demonstrated that SST products can not only cause oral cancer, gum, and tooth disease, but can also contribute to other forms of cancer, heart disease, and strokes (1).

The harmful properties of spit tobacco have been well-documented, but many people continue to believe that SLT use is safer than cigarette use. SLT users, however, “run the same risks of gum disease, heart disease, and addiction as cigarette users, but [face] an even greater risk of oral cancer” (2). A 2015 analysis of the worldwide healthcare impact of SLT use estimates that SLT consumption by adults prior to 2010 resulted in more than 62,000 deaths from oral, pharyngeal, and esophageal cancer as well as the loss of an estimated 1.7 million disability-adjusted life years (3). In 2011, SLT sales in the United State totaled ~124.6 million lbs, a 2 million-lb increase from the 122.6 million lbs sold in 2010 (4). Additionally, tobacco use costs the United States billions of dollars in medical expenses and lost productivity (5).

SLT contains at least 30 carcinogen chemicals that are known to cause cancer, with tobacco-specific nitrosamines found to be the most harmful (6). This chemical forms during the growing, curing, fermenting, and aging of tobacco (6). While cancers caused by SLT are most likely to develop at the site where tobacco is held in the mouth (2), other places such as the tongue, cheek, gum, esophagus, and pancreas can also be affected (7). According to the American Academy of Otolaryngology (2), additional ingredients in SLT include polonium 210 (nuclear waste), n-nitrosamines (carcinogens), formaldehyde (embalming fluid), nicotine (an addictive drug), cadmium (a chemical in car batteries and nuclear reactor shields), cyanide (a poisonous compound), arsenic (a poisonous metallic element), benzene (a product used in insecticides and motor fuels), and lead (a chemical that causes nerve poisoning).

In addition to increasing an individual’s risk of cancer, SLT has many harmful effects on teeth, gums, and the mouth. The sugar in spit tobacco, for example, can cause tooth decay (7), and the coarse particles in the tobacco can irritate the gums and scratch away tooth enamel. The product can cause periodontal disease that destroys soft tissue and bone support and which can lead to

tooth loss. White patches and red sores, known as leukoplakia, may also appear in the mouth and have the potential to turn into cancer (7).

SLT has additional negative health effects on several body systems. Using the product during pregnancy increases the risk of early delivery and even stillbirth, and can affect the brain development of the fetus (8). SLT may even cause nicotine poisoning if children ingest it (9). Using SLT increases an individual’s risk of death from heart disease or stroke because use of the product has been linked to increased heart rate and blood pressure (10).

## HEALTH DISPARITIES AND WEST VIRGINIAN STATISTICS

“Health disparities are preventable differences in the burden of disease, injury, violence, or opportunities to achieve optimal health that are experienced by socially disadvantaged populations” (11). Such “populations can be defined by factors such as race or ethnicity, gender, education or income, disability, geographic location (e.g., rural or urban), and sexual orientation” (11). Such “health disparities are inequitable and are directly related to the historically and presently unequal distribution of social, political, economic, and environmental resources” (11).

“Health disparities result from multiple factors,” (also known as the social determinants of health) “including poverty, environmental threats, inadequate access to healthcare, inadequate healthcare, individual behavior choices, and education inequalities” (11). Citizens with less education are more likely to experience health risks that may include obesity and substance abuse. In reverse, research has correlated good health with academic success (11).

With exceptions for deaths due to influenza, pneumonia, and stroke, West Virginia has some of the highest rates of death due to preventative measures (12). The state also ranks among the bottom tier of states across the presented health risk factors, with even higher rates of obesity and high blood pressure within the state’s black population (12). Across all populations within the state, the obesity rate exceeds 25%, nearly the worst in the nation.

According to the 2013 West Virginia Youth Tobacco Survey, West Virginia had the second-highest ranking for male smokeless tobacco use among high school students in the nation. The percentage of male smokeless tobacco users in West Virginia (15%) was significantly higher than the national percentage (6.7%). In 2011, 25.5% of youth Surveyed in West Virginia high schools reported that they were current users of smokeless tobacco, compared to 12.8% in the United States (13).

While the state is among those in the nation with the lowest rates of health insurance coverage and dental visits, it falls within the middle range of states for the other presented measures of preventive care. As comparable with other health disparities, tobacco-related disparities are, to some extent, caused and perpetuated by social determinants of health: scarcity of resources for the poor, environmental threats, and insufficient admission to healthcare, inadequate healthcare, individual conduct choices, cultural customs, and teaching inequalities.

## LINKING TO TOBACCO USE PREVENTION AND THE 4-H HEALTHY LIVING MANDATE

4-H is the United States of America's federal youth development program, which is administered by the land-grant university and college system. Since 1914, health and healthy living have been priorities of the 4-H youth development program of the United States Department of Agriculture and the Cooperative Extension System (22). In 1994, the national 4-H headquarters established the 4-H mission mandates of science, citizenship, and healthy living to provide a more cohesive system-wide approach to youth development programming across the country (22). The healthy living mission mandate focuses on the areas of health, healthy eating, physical activity, social/emotional health, alcohol awareness, tobacco awareness, drug use prevention, and injury prevention (22).

According to the National 4-H Council of Healthy-Living Logic Model for Prevention of Alcohol, Tobacco, and Other Drugs (ATOD), activities and curricula should target youth audiences (with a special focus on new and underserved audiences), families, staff, volunteers, community leaders, partner organizations, and collaborators. Educational efforts should provide tobacco cessation information, resources, and support to young people and their families; multi-component programs targeted to different developmental stages relating to ATOD intervention; opportunities to model non-use among young people with family and friends; community mobilization campaigns to prevent and reduce ATOD use; programs with multiple components such as using environmental changes, policy changes, social marketing campaigns, and curricula that meet ATOD prevention standards for skill-building and self-efficacy; and opportunities to involve families in meaningful ways (14).

According to the Campaign for Tobacco-Free Kids (CTFK)—a national advocacy organization working on public policy and education on the dangers of tobacco use—the vast majority of all initial tobacco use begins in high school. The CTFK recommends the following steps to create an environment that encourages tobacco prevention among young people: tobacco-free school policies; comprehensive tobacco prevention education; involvement of parents and families in school efforts to prevent tobacco use; help for tobacco-using staff and students to quit; interactive tobacco-free projects for students; and the adoption of a school policy that prohibits the acceptance of funding, curricula, or other materials from any tobacco companies (15). We used the recommendations of the CTFK when developing the Stop Spit Tobacco Curriculum. The CDC recommends that prevention educators “provide instruction about the short- and long-term negative physiologic and social consequences of tobacco use, social influences on tobacco use, peer norms regarding tobacco use, and refusal skills” (16). Successful programs to prevent tobacco use address multiple psychosocial factors related to tobacco use among children and adolescents. By educating our youth about spit tobacco and

promoting prevention, the curriculum specifically follows the 4-H mission mandate.

According to the CDC, there are many factors that influence young people to begin using tobacco, which include, exposure to tobacco advertising, low self-image, lack of support or involvement from parents, the normalization of tobacco use within peer groups, and a lack of self-efficacy that contributes to resisting influences of tobacco use (17, 18). The CDC also reported that in 2016, 7.2% of middle school students reported using any form of tobacco, and 2.2–4% of high school male students reported using smokeless tobacco on or at least 1 day during the past 30 days. Our Stop Spit Tobacco prevention curriculum was geared toward students in third-sixth grade and our objective was to instill them with tobacco resistance skills for middle school, in line with the CDC's recommendations. 4-H does have a smoking prevention curriculum, Health Rocks, however, its main topic area is smoking. The statistics above show that a more targeted curriculum geared toward spit tobacco is needed (19).

Our curriculum utilized six different lessons to address spit tobacco prevention giving participants the education, media literacy, confidence to say no, and ability to get civically involved in spit tobacco policies. These lessons meet the mission mandates of 4-H. The innovation of linking the 4-H network with tobacco prevention effort has the potential to create a nationwide movement around the issue.

## PROJECT TO STOP SPIT TOBACCO

Over the past 3 years, a team of Extension Agents and a Curriculum Specialist have worked with West Virginia University Communications, the West Virginia University Prevention Research Center, and the West Virginia Division of Tobacco Prevention to complete a full Stop Spit Tobacco Curriculum. The curriculum includes speaker scripts, background information, handouts, resources, and evaluation tools. In 2014, the team worked individually to author six lessons: (1) The Body: Tobacco Bad Effects, (2) Addiction: Hard Cycle to Break, (3) Cost: Can You Afford to Spit? (4) Media: Promotion of Spit Tobacco – A Deadly Influence, (5) Say No: To Spit Tobacco, and (6) Advocacy: Your Voice Counts. Other pieces of the curriculum included a preface, an introduction, and a letter that was sent home to parents giving them tips on how to talk to their children about spit tobacco. The curriculum includes multiple hands-on activities in each section that demonstrate the topics of each lesson in a way that young people in Grades 3–6 would understand. Before the curriculum was distributed for wider use, it was piloted by Extension Agents in their home counties. Feedback was provided by the students who took part in the pilot lessons and the lessons were edited based on the student feedback.

Depending on how many activities the teacher chose to use, each lesson took ~30–45 min to complete. Lessons were delivered over a 6-week period to students or 4-Hers. A typical lesson plan included a list of the required materials, learning objectives, topic background, introduction, learning activities,

lesson conclusion, preparation notes, and a list of which national content standard the lesson met. National content standards were introduced to persuade teachers and school administrators to use the curriculum in their classrooms. All lessons came with a script to follow to encourage active discussion throughout the lesson. An appendix was included to ensure that all material was readily available to teachers, club leaders, or other facilitators to use. This is the final draft of the curriculum after feedback was provided by the pilot runs of the Stop Spit Tobacco Curriculum.

Lesson one, “The Body: Tobacco Bad Effects,” was designed to educate students about the dangers of spit tobacco by showing them the ingredients within the product and explaining how the ingredients negatively impact the body, both in the short and long term. The second lesson, “Addiction: Hard Cycle to Break,” encouraged students to take part in activities about the perils of spit tobacco addiction. The activities illustrated how difficult it is to break away from addiction, taught ways that make it easy to say “no” to spit tobacco, and provided better alternatives to using spit tobacco. Lesson three, “Cost: Can You Afford to Spit?,” was created to help young people assess the costs related to spit tobacco use and to learn about the value of spending money wisely by determining the intrinsic value of items and activities compared with the value of spit tobacco. The next lesson, “Media: Promotion of Spit Tobacco – A Deadly Influence,” helped students analyze how messages from the media and other sources influenced their health behaviors. Lesson five, “Say No: To Spit Tobacco,” was designed to help young people manage peer pressure and make thoughtful health decisions by using verbal and non-verbal skills to say “no” to friends. The last lesson, “Advocacy: Your Voice Counts,” taught students about advocacy—how it works and why it is important—through hands-on learning experiences and a stop spit tobacco advocacy project. By focusing on these topics, we are providing students with the skills that they need to make healthy decisions regarding spit tobacco while, also, encouraging them to become involved citizens in tobacco prevention. Letters that were sent home to parents opened the door for them to be involved in an ongoing conversation with their children about spit tobacco, and, in the meantime, students created media showing the consequences of using spit tobacco and were encouraged to become advocates in spit tobacco prevention. Ultimately, the educational material in the curriculum reiterated the physical and financial costs of spit tobacco. In **Table 1** below, we detail each lesson name, lesson objectives, and a sample activity.

Once the initial project was accomplished, the team of extension agents completed a pilot of the curriculum with at least 50 young people in their counties. After the pilot program, the team came back together to edit and revise the lessons based on teacher input and student evaluation. In 2016, we provided the curriculum to teachers, club leaders, and community members to pilot with their young people. The following surveys analyzed in this study are from this round of pilot tests with individuals from outside West Virginia University Extension teaching the lessons.

The survey was designed with input from the West Virginia University team, West Virginia University Prevention Research Center, and West Virginia Division of Tobacco Prevention. The

**TABLE 1 |** Curriculum Lessons.

Stop spit tobacco lesson overviews		
Name of lesson	Lesson objectives	Sample activity
Lesson One, The Body: Tobacco Bad Effects	<ul style="list-style-type: none"> <li>Students gain an understanding of the many toxic materials found in spit tobacco.</li> <li>Students understand the short-term negative impacts of spit tobacco use on the body and be introduced to some of the long-term effects.</li> </ul>	What's in that Can? – Activity showing ingredients in spit tobacco
Lesson Two, Addiction: Hard Cycle to Break	<ul style="list-style-type: none"> <li>Students understand that addiction to tobacco makes it very hard to stop the use of spit tobacco products and the ways addiction itself is harmful.</li> <li>Students understand some of the external pressures that lead to experimenting with spit tobacco and some of the outside supports that help students say no to experimentation with tobacco.</li> <li>Students discover positive alternate activities they could practice instead trying tobacco.</li> </ul>	Tied Up—Students have one string wrapped around wrist and break it. Each time they use spit tobacco another string is added, to show strength of addiction with each use.
Lesson Three, Cost	<ul style="list-style-type: none"> <li>Students understand what it costs to use spit tobacco for 1 year.</li> <li>Students learn how the “value” of using spit tobacco compares to using other items and engaging in other activities.</li> </ul>	The Cost of Spit Tobacco—Students count total amount of money in envelope equaling cost per year of spit tobacco use.
Lesson Four, Media: Promotion of Spit Tobacco – A Deadly Influence	<ul style="list-style-type: none"> <li>Students recognize the influence of media upon their purchasing decisions.</li> <li>Students recognize marketing strategies used in smokeless tobacco advertising.</li> <li>Students learn media evaluation skills to help them better determine the validity of messages used in advertising smokeless tobacco products.</li> </ul>	Creating Truthful Spit Tobacco—Students make an ad showing real impact of spit tobacco use.
Lesson Five Say No: To Spit Tobacco	<ul style="list-style-type: none"> <li>Students learn about the conditions that help someone resist using spit tobacco or participating in other risky/unhealthy behaviors.</li> <li>Students understand that one cannot get away from pressure from friends or others trying to persuade us to do many things, but one can have strategies that will help to combat pressure from friends to participate in unhealthy behaviors.</li> <li>Students learn certain facts about verbal and nonverbal refusal skills so they will be able to use the skills with confidence when they are being pressured to try risky behaviors by their friends.</li> </ul>	Discovering Positive Body Language – Students learn how body language can impact the way their message is received.
Lesson Six Advocacy: Your Voice Counts	<ul style="list-style-type: none"> <li>Students learn about the functions of advocacy and recognize the power of young people as effective advocates.</li> <li>Students learn ways to determine a cause and how to identify who the most effective people would be to receive the advocacy message.</li> <li>Students work individually or in groups to develop messages about the dangers of spit tobacco to children.</li> </ul>	The Power of Postcards—Students write postcards to community leaders advocating for policy change on spit tobacco (i.e., use in public).



**TABLE 2 |** Evaluation results.

Please select the appropriate response regarding your level of agreement in accomplishing the following tasks:

	Strongly disagree	Disagree	Agree	Strongly agree	Response total
I can list some of the ingredients in spit tobacco.	4.5% (49)	11.4% (125)	49.1% (538)	35.0% (384)	1,096
I can explain how trying spit tobacco can lead to addiction.	2.3% (25)	4.3% (47)	33.0% (361)	60.4% (661)	1,094
I can explain how tobacco company ads are misleading.	4.8% (53)	6.1% (67)	31.1% (340)	57.9% (633)	1,093
I can list other things I can buy instead of buying spit tobacco.	2.5% (27)	2.8% (31)	16.0% (175)	78.7% (861)	1,094
I know how to say no to my friends if they offer me spit tobacco.	3.4% (37)	2.5% (27)	17.1% (185)	77.0% (835)	1,084
I know how to get more involved in preventing spit tobacco use at my school or in my community.	5.9% (64)	9.1% (99)	40.5% (439)	44.5% (483)	1,085

subjects cannot be identified by the information obtained. Young people were required to take part in the Stop Spit Tobacco lessons in order to take the survey.

The surveys were given to 1,097 students following the completion of the Stop Spit Tobacco curriculum. The survey elicited information about gender, age, and location in the Stop Spit Tobacco lessons. In order to measure the effectiveness of the curriculum with the students, the survey asked them to what extent they agreed or disagreed with a statement based on a four-point Likert scale, with the options ranging from strongly disagree to strongly agree. The statements were:

- I can list some of the ingredients in spit tobacco
- I can explain how trying spit tobacco can lead to addiction
- I can explain how tobacco company ads are misleading
- I can list other things I can buy instead of buying spit tobacco
- I know how to say no to my friends if they offer me spit tobacco
- I know how to get more involved in preventing spit tobacco use at my school or in my community.

## PROCEDURES

1. Surveys were designed with input from the West Virginia University Extension Service, West Virginia Division of Tobacco Prevention, and West Virginia University Prevention Research Center.
2. Upon the approval of the IRB, West Virginia University Extension Service Agents and our community partners asked permission to voluntarily administer the survey to young people who participated in the “Stop Spit Tobacco Curriculum.”
3. Parents received a letter informing them of the project and survey and gave them the option to have their child opt out of the survey. Parents were given at least 2 weeks’ notification.
4. Any other Extension Agent (in addition to the PI) who assisted with survey evaluation implementation was trained in CITI-Human Subjects and added to the protocol before

survey evaluation administration. Extension agents were also trained in survey evaluation implementation protocols.

5. Young people who completed all six lessons of the West Virginia University Extension “Stop Spit Tobacco Curriculum” (approved by the West Virginia University Prevention Research Center and West Virginia Division of Tobacco Prevention) were asked to complete the survey for the purpose of the program evaluation.
6. Participation in the curriculum did not mandate participation in the survey evaluation. Students had the right to refuse and thus participated voluntarily.
7. Evaluation data from the survey was used to identify the strengths and weaknesses of the curriculum and allow for curriculum revisions. The survey assessed their feelings on spit tobacco use after going through the program.
8. Curriculum instructors were asked to fill out an online survey concerning lesson evaluation. Participation was voluntary.

A total of 1,097 students took part in the 2016 “Stop Spit Tobacco” pilot run across West Virginia. The results of the survey, after the implementation of the curriculum, show that 84.1% of students agree or strongly agree that they can list some of the ingredients in spit tobacco. Ninety-three percentage of student said that they strongly agreed or agreed that they can explain how trying spit tobacco one time can lead to addiction, while 89% of student agreed or strongly agreed that they can explain how tobacco company ads are misleading. Furthermore, 94.7% of students agreed or strongly agreed that they can list other things to buy instead of spit tobacco, and 94.8% students agreed or strongly agreed that they know how to say no to their friends if they are offered spit tobacco. Finally, 85% of the students agreed or strongly agreed that they know how to get more involved in preventing spit tobacco use at their school or in their community. The **Table 2** below indicates the self-reported level of knowledge gained after the entire curriculum was complete. This gained knowledge will empower these students to resist spit tobacco in the future and may even provide them with the ability to

prevent their friends, family, and community at large from using spit tobacco.

These are fairly complex topics for students in Grades 3–6 to understand. Following a review of the survey, we know that a large number of students feel they can identify the ingredients of spit tobacco and even explain addiction to it. In regard to identifying misleading spit tobacco advertisements, media literacy is high among young people. Participants know how much spit tobacco costs and can identify better ways in which to spend their money. Many of them report knowing how to say no to their friends, resist peer pressure, and even how to become involved in preventing spit tobacco use at their school and in their community. By educating third-sixth graders on these subjects, we are helping them make healthy decisions in regard to spit tobacco use and to develop essential life skills such as media literacy, leading and promoting a healthy lifestyle, and resisting peer pressure.

## CALL TO ACTION FOR THE COOPERATIVE EXTENSION SERVICE

A growing body of research indicates that school-based educational interventions—e.g., interventions that engage elementary and middle school students in interactive educational programs designed around the principles of the “social influence resistance model” to equip young people with key skills for resisting negative social influences—have been shown to be effective in reducing the age of onset and level of tobacco use (CTFK). The final lesson encourages youth to think about how they can get involved with tobacco prevention efforts in their community. Further, youth-led programs that capitalize on these principles of civic engagement have been found to be most effective (20).

The Cooperative Extension System serves as an integral partner in the development and facilitation of interactive educational curricula and programming for elementary and middle schools. As trusted members of their communities, local extension agents are equipped to partner with schools and clubs to provide interactive educational programs in elementary and middle schools. With the ability and expertise to provide effective, short-term, and interactive educational programs for audiences proven to be most receptive to prevention programs, 4-H cooperative extension programs are uniquely poised to help address the need for the development and intervention of research-based, short-term tobacco education programs.

Through the development and delivery of educational programs designed to empower young people to reach their full potential by working and learning in partnership with caring

adults, 4-H programs are able to equip and empower young people for healthy, tobacco-free lives. As cooperative extension professionals, we are in a unique situation where we can directly reach young people throughout our schools and communities to prevent the use of spit tobacco. Partnering with local and state partners and using resources such as “Stop Spit Tobacco” will help us to meet our healthy living mission mandate by preventing young people from using spit tobacco. Previous research in West Virginia shows the need for Extension Service leadership in addressing tobacco prevention needs (21).

We encourage our colleagues from across the country to utilize the Stop Spit Tobacco Curriculum in their home counties to help stop the use of spit tobacco. This curriculum will be provided to those seeking it free of charge and can be attained by contacting one of the authors at West Virginia University. As Extension professionals, we are uniquely positioned to provide substance abuse prevention education in our communities, and we should utilize our abilities to do so. Whether it be spit tobacco or any other substance, we are calling on you to take an active approach in substance abuse prevention!

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by WVU Office of Research Integrity and Compliance. Written informed consent from the participants’ legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

DR and JR: curriculum development and data analysis. EB: data analysis and manuscript editing. BF-C, BC, NC, ZH, and SL: curriculum development and manuscript development. KD: funder and manuscript development. NR: curriculum development. All authors contributed to the article and approved the submitted version.

## FUNDING

Funding for this project was provided by the West Virginia Division of Tobacco Prevention (Grant #G160019).

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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# Price Policy and Taxation as Effective Strategies for Tobacco Control

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**Objective:** Only 13% of the world's population are living in countries imposing appropriate tobacco tax-rates. This study aims to promote the implementation of price policy measures as a striking tobacco control strategy in Austria and to encourage other countries to further increase their taxes to WHO best-practice levels.

**Method:** This study used the yearly economic data from Austria from 1997 to 2015. Applying a model for regression analysis, the price elasticity of total tobacco consumption was estimated.

**Results:** Between 1997 and 2015 the price elasticity of demand for tobacco products (including cigarettes, cigars, and other tobaccos) was  $-0.661$ , however, the result is statistically insignificant. When excluding 2 anomalous years and removing a variable of the regression model the elasticity was  $-0.691$  and statistically significant, indicating that a 1% increase in tobacco prices will result in a 0.691% decrease of tobacco consumption.

**Conclusion:** The responsiveness of Austrian smokers to price changes has increased during the last decades. Because other activities showed no significance in the analysis, this study should encourage countries world-wide to use price policy and taxation more intensively in order to reduce smoking rates effectively.

**Keywords:** tobacco, taxes, price elasticity, consumption, public policy, economics

## OPEN ACCESS

### Edited by:

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### Specialty section:

This article was submitted to  
Public Health Policy,  
a section of the journal  
Frontiers in Public Health

**Received:** 10 January 2022

**Accepted:** 15 March 2022

**Published:** 05 April 2022

### Citation:

Felsinger R and Groman E (2022)  
Price Policy and Taxation as Effective  
Strategies for Tobacco Control.  
Front. Public Health 10:851740.  
doi: 10.3389/fpubh.2022.851740

## INTRODUCTION

According to the World Health Organization, tobacco is the most preventable cause of death in the world (1). To curb the tobacco epidemic multiple strategies are used such as warning labels on cigarette packages, smoking cessation and smoking bans. Tobacco tax increases are supposed to be one of the most important and most effective tools for reducing cigarette demand, for lowering the percentage of smokers, against smoking initiation, especially among the adolescents, and for decreasing adverse health effects (2–4). Despite the increasing evidence, many countries have extremely low taxes: According to the WHO report on the global tobacco epidemic 2021, only 40 countries levy taxes that represent more than 75% of the retail price of a pack of cigarettes in 2020, which is an increase of only two countries since 2018. In other words, only 13% of the world's population are living in countries imposing appropriate tax-rates. That shows that

even 13 years after the introduction of MPOWER by the WHO, raising taxes is the measure with the least adoption and improvement (5). The acronym MPOWER describes a package of six measures assisting Parties of the WHO Framework Convention on Tobacco Control (WHO-FCTC) in the implementation of specific WHO-FCTC provisions to reduce the demand for tobacco. The six components are: Monitoring tobacco use and prevention policies, Protecting people from tobacco smoke, Offering help to quit tobacco use, Warning about the dangers of tobacco, Enforcing bans on tobacco advertising, promotion and sponsorship and Raising tobacco taxes (1).

A review published in 2012 confirms that price policy is a striking tobacco control strategy with the greatest impact on young and poor people and that contrary statements about adverse economic effects are overstated or false (6). In fact, there is much evidence that tobacco tax increases can generate additional fiscal revenues, reducing tobacco-related illness and death simultaneously (2).

Austria's total tax share (inclusive VAT; in percent of the weighted average price) hardly changed during the last years and is about 77% (7). Being a Member State of the EU, Austria applies a mixed structure, constantly reducing the share of ad valorem tax and increasing that of specific tax. As of April 1st 2021, the specific excise is €68.00 per 1,000 cigarettes, the ad valorem excise 34.5% and as of April 1st 2022 the specific excise tax will be increased to €73.00, the ad valorem excise tax will be decreased to 33% (8).

Price elasticity, regarding the consumption of cigarettes and tobacco products, respectively, describes the percentage change in tobaccos demanded in response to a 1% change in price. Many studies have been conducted in different high-income countries to investigate this price elasticity and show similar results in the range of 0.25 to 0.5 (0.4 on average) (2, 6), thus tobacco consumption is *price inelastic*: e.g., Canada (−0.45 to −0.47) (9), Italy (−0.43) (10), Argentina (−0.31) (11).

In the last years there have been investigations in low-income and middle-income countries too, but the situation does not seem to be clear yet. Some studies claim that demand of cigarettes is likely to be as or even more responsive to price changes than it is in high-income countries, but others show the opposite (6, 12). Overall, the estimated price-elasticities vary within a wide range with an averaged value of about 0.5 in low- and middle income countries (5).

Wörgötter and Kunze studied the effect of price policy on cigarette demand and described tobacco product prices relative to those of other consumer goods in Austria between 1955 and 1983. The results demonstrated that Austrian tobacco consumption is price inelastic and independent of general consumption patterns. A 1% increase of cigarette prices leads to a decrease of cigarette consumption by 0.54%. Therefore, tobacco tax increases would not cause a reduction of tax revenues (13). More recent studies concerning this topic, as they are available in many other countries, do not exist in Austria.

17.3% of Austrian men and about 17% of Austrian women smoke daily or almost daily (14). Considering the high prevalence of smoking tobacco use of 32% among 15–24 year old Austrians, which is considerably higher compared to several other European countries (21.4% in Central Europe, Eastern Europe, and Central Asia) (15), it is absolutely necessary to call attention to this problem as well as to the fact that tax increases are without much doubt effective strategies to reduce smoking prevalence among minors.

## METHODS

### Data

The study population is the population of Austria. The necessary data were obtained from *Statistik Austria* (STATcube, the statistical database system of *Statistik Austria*, was utilized). Following Wörgötter and Kunze this study uses the following yearly economic data from Austria from 1997 to 2015:

- consumption expenditure of all tobacco products at constant prices of 1996
- Consumer Price Index
- Wholesale Price Index of tobacco products
- real consumption expenditure by private households in million Euros

Additionally, data about the annual average population of Austria is used.

The Consumer Price Index (CPI) is an economic indicator which measures price-changes and inflation over time. It is based on a representative selection of goods and services purchased by an average Austrian household (basket of consumer goods) and is published by *Statistik Austria* every month. In order to compare index values of different base years and to continue previous indices appropriate chaining factors are used. The therewith continued series of the “CPI 1996” (base year 1996) is published by *Statistik Austria*.

The Wholesale Price Index (WPI) displays the price trend of goods disposed by the wholesale trade. This study uses the wholesale price index of tobacco products (PITP). The basket of goods of this price index contains the following items: cigarettes (96%), cigars (1%), and tobaccos (3%). Because of several revisions a reasonable comparison of index values of different base years is possible only when using chaining factors in order to continue the series of the “WPI of tobacco products 1996” (base year 1996) till 2015.

According to the Austrian Tobacco Tax Act 1995 (§ 9), tax liability arises when transporting tobacco products in (fiscal) free circulation. By definition, this is the case when taking tobacco products from the tax warehouse or when producing tobacco products. Thus, tobacco taxes have to be paid by the owner of the tax warehouse or the manufacturer (§ 10) and are levied on the maximum retail selling price (8). Therefore, the wholesale price already includes tobacco duties and consequently it can be assumed that the wholesale price



**FIGURE 1 |** Trends of the consumption expenditure of tobaccos per person and the wholesale price index of tobacco products (PITP) 1996–2015.

and the retail selling price will increase when raising taxes on tobacco. Accordingly, the wholesale price index of tobacco products can be used to examine the effects of taxation on tobacco consumption.

## Statistical Methods

The major question of the study refers to the price elasticity of tobacco consumption in Austria between 1997 and 2015. The study uses the following model for regression analysis to answer this question:

$$\Delta \text{tc}_t = \beta_0 + \beta_1 \Delta \text{rp}_t + \beta_2 \Delta \text{tpc}_t + \beta_3 D_{04} + \beta_4 D_{09} + \beta_5 t$$

The dependent variable  $\text{tc}$  describes the logarithm of the per capita tobacco consumption at constant prices of 1996. The independent/explanatory variables  $\text{rp}$  and  $\text{tpc}$  describe the logarithms of relative prices and per capita total private consumption, respectively.  $D_{04}$  and  $D_{09}$  are dummy variables and refer to political measures taken by the Austrian government to reduce tobacco consumption in 2003 and 2009, respectively.  $\Delta$  refers to the changes compared with the previous year. The variable  $t$  displays a linear trend or rather the time factor (1 in 1997 and 19 in 2015).

Two legislative tobacco control measures were introduced in 2003 and 2009 and are represented in the equation by two dummy variables:

1.  $D_{04}$ : In 2003, Austria implemented the EU Directive 2001/37/EG (regulating the upper limits for certain substances, such as tar, nicotine and carbon monoxide, contained in cigarettes and the labeling of packages of tobacco products, including warning labels and information about ingredients) by assimilating the Tobacco Act. Since September 30, 2003, all packages of tobacco products have to fulfill the EU requirements and have to bear warning texts. Because of the possible effects of warning labels on smoking behavior (see below) (2), it can be assumed that this tobacco control measure reduced cigarette consumption among Austrian smokers in the year after the implementation. However, this effect possibly slackened during the following years because people got used to the warning messages and were better informed about the health consequences of smoking (16). Hence, the variable  $D_{04}$  respects the possible effects of this new legislative in 2004 and has a value of 1 in 2004 and 0 in all other years.
2.  $D_{09}$ : In 2008, the government adopted a smoke-free legislation relating to gastronomy. Since January 1, 2009, smoking is prohibited in rooms, where food and beverages are served, including premises, where people are accommodated such as hotels, but with several exceptions such as the permission to smoke in separated rooms. To consider these possible effects the variable  $D_{09}$  was added to

**TABLE 1** | Results of the regression analysis for the period 1997–2015.

Coefficients					
Coefficients	SD	Sig.	95% CI		
			Lower limit	Upper limit	
$\beta_0$	0.021	0.009	0.038	0.001	0.041
$\beta_1$	−0.661	0.313	0.054	−1.337	0.015
$\beta_2$	−0.719	0.812	0.392	−2.474	1.035
$\beta_3$	−0.018	0.015	0.266	−0.050	0.015
$\beta_4$	0.011	0.013	0.408	−0.017	0.039
$\beta_5$	−0.002	0.001	0.090	−0.004	0.000

the model. It can be supposed that the effectiveness of this legislation persisted over the following years and, according to the statistical method of other studies, for example Martinez et al. (11), the dummy variable  $D_{09}$  has the value of 1 between 2009 and 2015 and 0 in all other years.

In the following the remaining quoted variables are described more in detail.

- $\Delta tc$ : To calculate the real value of tobacco consumption at constant prices of 1996 the nominal value of the consumption expenditure of tobacco products in million Euros and the wholesale price index of tobacco products, which are available on *STATcube*, were used.

$$tc_t(\text{real}) = \frac{tc_t(\text{nominal})}{PITP_t} \cdot 100$$

The consumption expenditure per person was calculated by dividing the real value of tobacco consumption by the annual average Austrian population. Then an index value was generated for the yearly per capita tobacco consumption using 1996 as base year.

$$\text{Index} = \frac{tc_t}{tc_{1996}} \cdot 100$$

Further, after taking the logarithm of these index values, the absolute changes compared with the previous year were calculated. The resulting data ( $\Delta tc$ ) were used in the linear regression model.

- $\Delta tpc$ : The real value of the total private consumption was calculated by using the nominal value of the consumption expenditure by private households in million Euros and the Consumer Price Index. The subsequent steps equal those described under “ $\Delta tc$ .”
- $\Delta rp$ : The yearly wholesale price index of tobacco products (PITP) was divided by the yearly consumer price index (CPI) and the result logarithmized. For both price indices the

December values were used. Finally, the absolute differences compared with the previous year were calculated.

$$\Delta rp = \log \frac{PITP_t}{CPI_t} - \log \frac{PITP_{t-1}}{CPI_{t-1}}$$

## RESULTS

**Figure 1** shows the trend of the per capita consumption expenditure of tobacco products (index values) as well as that of the wholesale price index of tobacco products (PITP) between 1996 and 2015 in Austria.

Using *IBM SPSS Statistics* all unknown parameters of the defined model are estimated in one multiple regression analysis in order to determine the influence of the independent variables, each adjusted for the other variables. The parameters of the regression analysis are interpreted in the following way:  $\beta_1$  describes the influence of relative price changes of tobacco products ( $\Delta rp$ ) on relative changes in tobacco consumption ( $\Delta tc$ ).  $\beta_2$  describes the influence of relative changes in total private consumption ( $\Delta tpc$ ) on  $\Delta tc$ .  $\beta_3$  and  $\beta_4$  stand for the influence of the two dummy variables ( $D_{04}$  and  $D_{09}$ ), which represent political measures implemented in the observed time period, on relative changes in tobacco consumption.  $\beta_5$  shows to which extend the autonomous growth rate of tobacco consumption (i.e., independent of prices, general consumption patterns, etc.) changes annually. The parameters  $\beta_1$  and  $\beta_2$  can be interpreted as elasticities.

In the analyses using above data the coefficient of determination was estimated:  $R^2 = 0.466$  and adjusted  $R^2 = 0.260$ . This number represents the proportion of the variance in the dependent variable that is predictable from the statistical model. Accordingly, about 50% of the variance in  $\Delta tc$  can be explained by the model. The Durbin-Watson statistic was used to ascertain the presence of autocorrelation in the residuals:  $DW = 2.168$ , indicating that there is no autocorrelation.

The results of the multiple regression analysis are presented by **Table 1**. Coefficient  $\beta_1$ , typifying the price elasticity, is  $-0.661$ . However, this value is not significant at a 5% significance level (Sig. > 0.05). Moreover, the *F*-test is statistically insignificant. Thus, the regression model is statistically not significant on the whole [ $F_{(5,13)} = 2.266$   $p > 0.05$ ] and its coefficients were not be interpreted.

When looking at **Figure 1**, it is noticeable that the real tobacco consumption per person increased considerably between 1997 and 1998 although prices were constantly rising, as in all other years. The development in these 2 years seems to be in contrast to the general trend of decreasing tobacco consumption in most other years. It can be concluded that this uptrend in the very beginning of the observed time period is not explainable and it can be assumed that it has nothing to do with the Austrian price policy of tobacco products. The values of these 2 anomalous years may have an adverse



**TABLE 2 |** Results of the regression analysis for the period 1999–2015.

Coefficients						
Model	Coefficients		SD	Sig.	CI 95%	
					Lower limit	Upper limit
1	$\beta_0$	0.010	0.009	0.297	−0.010	0.031
	$\beta_1$	−0.691	0.247	0.018	−1.235	−0.146
	$\beta_2$	−1.158	0.700	0.126	−2.699	0.382
	$\beta_3$	−0.017	0.012	0.180	−0.043	0.009
	$\beta_4$	−5.232E−6	0.011	1.000	−0.024	0.024
	$\beta_5$	−0.001	0.001	0.586	−0.003	0.002
2	$\beta_0$	0.010	0.008	0.237	−0.008	0.028
	$\beta_1$	−0.691	0.230	0.011	−1.191	−0.190
	$\beta_2$	−1.158	0.656	0.103	−2.587	0.271
	$\beta_3$	−0.017	0.011	0.150	−0.041	0.007
	$\beta_5$	−0.001	0.001	0.350	−0.002	0.001
3	$\beta_0$	0.003	0.003	0.392	−0.004	0.010
	$\beta_1$	−0.711	0.228	0.008	−1.204	−0.218
	$\beta_2$	−0.813	0.551	0.164	−2.003	0.376
	$\beta_3$	−0.015	0.011	0.187	−0.038	0.008
4	$\beta_0$	0.002	0.003	0.632	−0.005	0.009
	$\beta_1$	−0.643	0.230	0.014	−1.137	−0.149
	$\beta_2$	−0.837	0.569	0.163	−2.057	0.383
5	$\beta_0$	0.000	0.003	0.966	−0.007	0.007
	$\beta_1$	−0.728	0.231	0.007	−1.221	−0.235

All independent variables were entered at one time (Model 1). Afterwards single variables were successively removed (Model 2–5) based on a particular significance level ( $F$ -value  $\geq 0.10$ ).

impact on the results, which should reflect the general trend seen in the overall period, and may be the cause for its insignificance. Therefore, a separate statistical analysis was conducted for the period 1999 till 2015, without the 2 years with antithetic trends.

Moreover, SPSS provides several methods of entering variables into the model. The first evaluation for the complete time period (see above) used “Enter.” In this case SPSS enters all variables at one time. In the following regression analysis for the shorter time period the method “Backward” was utilized: Again, SPSS enters all independent variables at one time (Model 1 below) and then removes successively single variables (Model 2–5 below) based on a particular significance level ( $F$ -value  $\geq 0.10$ ). In the conducted analysis SPSS removed the variables in the following order:

D09 (Model 2)

t (Model 3)

D04 (Model 4)

TPC (Model 5)

When using all independent variables (Model 1) the result clearly differs from the previous evaluation. A higher coefficient of determination was estimated as follows:  $R^2 = 0.579$  and adjusted  $R^2 = 0.388$ . A larger proportion of the of the variance in the dependent variable is predictable from the amended statistical analysis. However, only coefficient  $\beta_1$  is statistically significant and its value is somewhat greater or rather the price elasticity is higher than that in the previous analysis (about –0.69 vs.

–0.66). All in all the model remains statistically insignificant. Following the “Backward” procedure, SPSS removed the dummy variable D09 first. With only the four remaining independent variables (rp, tpc, D04, t) the regression model was significant on the whole: [ $F_{(4,12)} = 4.129$   $p < 0.05$ ]. When examining the coefficients in detail, it becomes obvious that each one, apart from the important coefficient  $\beta_1$ , representing the price elasticity, remains statistically insignificant. According to this estimation (using a shortened time period and after removing the dummy variable D09, i.e., Model 2), coefficient  $\beta_1$  and accordingly the price elasticity of the Austrian tobacco consumption is –0.691. Thus, it can be expected that a 1% increase in tobacco prices will result in a 0.691% decrease of tobacco consumption. Regarding coefficient  $\beta_2$ , a one percent increase of total private consumption leads to a decline of tobacco consumption by 1.158%. However, the coefficient is not statistically significant. The coefficients  $\beta_3$  and  $\beta_4$  indicate that the political tobacco control strategies, adopted during the observed time period, only marginally influenced smoking behavior. However, both coefficients are not significantly different from zero and the regression model even becomes statistically significant on the whole when removing D09. The autonomous component of tobacco consumption growth is supposed to decline by 0.1% per year, but, again, coefficient  $\beta_5$  is statistically not significant. The equation for the regression line (Model 2) is estimated as follows:



$$\Delta t c_i = 0.010 - 0.691 \Delta r p_i - 1158 \Delta t p c_i - 0.017 D_{04} - 0.001 t$$

The results of Model 1–5 (in condensed form) of this evaluation are shown in **Table 2**.

## DISCUSSION

This study examined the price elasticity of tobacco products and the dependency of general consumption patterns in Austria, using yearly economic data during the period 1997 to 2015 and applying a multiple regression analysis. The results are almost comparable with those of Wörgötter and Kunze (13) and with the situation in many other countries (see Section Introduction). Austrian tobacco consumption is still price inelastic. In comparison to similar studies from other developed countries Austria's price elasticity is above average. According to this investigation, nowadays consumers of tobacco products are probably much more price responsive than they have been 30 years ago. A price increase of 1% caused a decrease of tobacco consumption by  $\sim 0.54\%$  in the time period 1961–1983 compared to  $\sim 0.69\%$  between 1999 and 2015 in Austria. However, the corresponding confidence interval is wide and therefore the true effect is not ascertained: The confidence interval in the regression analysis varies from  $-1.191$  to  $-0.190$ . Although this range is quite wide, even at its upper limit the price elasticity is still below zero. Hence, no “perfectly inelastic” or “abnormal elastic” behavior is possible in the model. Possible reasons for the low estimates of the adjusted  $R^2$ —indicating the proportion of the variance in the price elasticity which is predictable from the statistical model—are the high number of independent variables together with the relatively low number of cases (i.e., number of years) included in the model. The unexpected increase of tobacco consumption during the years 1997 and 1998 might be a consequence of intensive public information campaigns to combat smuggling by warning the Austrian population about possible high concentrations of unwanted ingredients of illegal manufactured cigarettes (e.g., high concentrations of cadmium and lead, rat feces and even possible radioactive contamination).

Recently, Shuval et al. investigated the association between cigarette prices and smoking behavior in Israel, using retail prices of cigarettes and data from a repeated cross-sectional survey. By combining the elasticities of smoking prevalence and smoking intensity they estimated a total price elasticity of cigarette demand in a range of  $-0.46$  to  $-0.92$ , that bears comparison with the results of the present study and underlines the importance of raising tobacco prices to reduce tobacco consumption (17).

Prices of tobacco products are influenced by many different factors, but studies show that higher taxes result in price increases at least in the same proportion because of the oligopolistic structure of the cigarette market and the addictive nature of

tobacco products (18, 19). Hence, the results indicate that taxation of tobacco products is a very effective measure to reduce tobacco use in Austria and most probably more effective than other methods such as areal smoking bans or warning labels and messages.

Corresponding to the mentioned studies of price elasticity, this examination investigated the response to price increases at the population level, using Austrian aggregate consumption data. Thus, it remains unclear, how an individual Austrian smoker will react to an increase of cigarette prices (switching of brands, reducing cigarette consumption, quitting, etc.). In Mexico, an upper middle-income country, Saenz-de-Miera et al. examined the response of cigarette smokers to a tax increase at the individual level. Applying face-to-face interviews of about 45 min, the authors assessed many different smoking related perceptions and behavior before and after a 2007 cigarette tax increase (baseline and follow-up). Their results suggest, that tax increases definitely have an impact on the individual consumer: the overall self-reported cigarette price increased (12.7%), consumption decreased (29%) and the price became a more important reason to consider quitting (18).

In recent years, more and more countries introduced smoke-free laws. The WHO even states, that bans are the most widely applied policy measure (67 countries) and covered 1.8 billion people in 2020. A smoke-free environment can be effective in protecting people from the negative health effects of second-hand smoke, including cardiovascular diseases and even cancer, and in supporting smokers to stop (2, 5). Although these measures are milestones in the fight against the global tobacco epidemic, the present study indicates, that raising tobacco prices is crucial for reducing tobacco consumption. Frazer et al. analyzed 77 studies from 21 countries to assess the effects of smoking bans on health and smoking behavior. Contrary to detected positive effects on cardiovascular, respiratory and perinatal health outcomes of smokers and non-smokers, the evidence that smoke-free laws affect smoking prevalence and cigarette consumption is heterogeneous (20). Italy introduced a strict smoking ban in 2005. Shortly after the implementation data showed, that smoking prevalence decreased by 1.11% in men and 1.03% in women per year between 2004 and 2006, whereas the decline had been smaller until 2004 (0.53% in men and 0.25% in women). The smoking rate declined from 26.2% in 2004 to 25.6% in 2005 and 24.3% in 2006. Changes in smoking prevalence were only significant between 2003–2004 and 2005–2006 in men and smokers under 45 years of age. The results indicate, that the new smoking ban accelerated the decreasing smoking rate as of 2004 (21). Gualano et al. analyzed prevalence and consumption in Italy between 2001 and 2013. Smoking rates significantly declined from 28.9 to 20.6% in the observed time period, with a stronger decrease among men. A reduction in cigarette consumption was observed in almost the same manner (from 16.4 to 12.7 cigarettes per day). However, no statistically significant point of trend change associated with the introduction of the 2004 smoke-free law was found. The authors suggest to prioritize other tobacco control measures, such as price policy (22).

According to the WHO, graphic warning labels on tobacco products are the tobacco control tool with the biggest

improvement since 2007. Sixty percent of the world's population were covered by this measure in 2020 (101 countries). Deterrent pictures and warning labels are important to inform current smokers about the hazards of smoking to their health and that of people surrounding them (2, 5, 23). In fact, studies show, that warning labels are able to reduce cigarette consumption as well as smoking prevalence in different countries. After the adoption of graphic warning labels in 2000 in Canada, smoking rates significantly decreased by about 12–20%, which was higher compared to previous estimates (24). However, if a society is already well-informed about the negative consequences of tobacco consumption, every attempt to further reduce smoking rates by using tools to spread information about tobacco related illness and risks could become quite difficult. Kahnert et al. assessed the implementation of the Tobacco Products Directive 2014/40/EU (TPD2) in 2016, which required packages to carry a deterrent picture, a text warning and information for quit services. Their results indicate, that the new warning labels increase salience, but do not increase self-reported cognitive or behavioral reactions (25).

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In conclusion, this paper demonstrates that price policy and taxation are striking strategies to control the global tobacco epidemic and should encourage governments to use price policy and taxation more intensively.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

## FUNDING

Article Processing Fee will be covered by the Medical University of Vienna.

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## SPECIALTY SECTION

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

RECEIVED 06 April 2022

ACCEPTED 09 August 2022

PUBLISHED 26 August 2022

## CITATION

Du X, Wu R, Kang L, Zhao L and Li C  
(2022) Tobacco smoking and  
depressive symptoms in Chinese  
middle-aged and older adults:  
Handling missing values in panel data  
with multiple imputation.  
*Front. Public Health* 10:913636.  
doi: 10.3389/fpubh.2022.913636

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# Tobacco smoking and depressive symptoms in Chinese middle-aged and older adults: Handling missing values in panel data with multiple imputation

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**Introduction:** The high co-occurrence of tobacco smoking and depression is a major public health concern during the novel coronavirus disease-2019 pandemic. However, no studies have dealt with missing values when assessing depression. Therefore, the present study aimed to examine the effect of tobacco smoking on depressive symptoms using a multiple imputation technique.

**Methods:** This research was a longitudinal study using data from four waves of the China Health and Retirement Longitudinal Study conducted between 2011 and 2018, and the final sample consisted of 74,381 observations across all four waves of data collection. The present study employed a multiple imputation technique to deal with missing values, and a fixed effects logistic regression model was used for the analysis.

**Results:** The results of fixed effects logistic regression showed that heavy smokers had 20% higher odds of suffering from depressive symptoms than those who never smoked. Compared to those who never smoked, for short-term and moderate-term quitters, the odds of suffering from depressive symptoms increased by 30% and 22%, respectively. The magnitudes of the odds ratios for of the variables short-term quitters, moderate-term quitters, and long-term quitters decreased in absolute terms with increasing time-gaps since quitting. The sub-group analysis for men and women found that heavy male smokers, short-term and moderate-term male quitters had higher odds of suffering from depressive symptoms than those who never smoked. However, associations between smoking status and depressive symptoms were not significant for women.

**Conclusions:** The empirical findings suggested that among Chinese middle-aged and older adults, heavy smokers and short-term and moderate-term quitters have increased odds of suffering from depressive symptoms than those who never smoked. Moreover, former smokers reported that the probability of having depressive symptoms decreased with a longer duration since quitting. Nevertheless, the association between depressive symptoms and smoking among Chinese middle-aged and older adults is not straightforward and may vary according to gender. These results may have

important implications that support the government in allocating more resources to smoking cessation programs to help middle-aged and older smokers, particularly in men.

#### KEYWORDS

smoking, depressive symptoms, multiple imputation, China, missing value

## Introduction

Tobacco smoking is one of the biggest public health threats, resulting in more than 7 million deaths a year worldwide (1). In China, 50.5% of adult men were current smokers in 2018, although the figure was only 2.1% for adult women. The prevalence of current smoking was 30.2% among adults aged 45–64 years and 23.1% among adults aged 65 years or older, implying that there are more than 163 million middle-aged and older adults who smoke in China. Even though tobacco smoking has been proven to be a major cause of diseases such as cancers, heart diseases, and respiratory diseases, only 16.1% of current smokers in China plan to quit smoking within 12 months (2). Meanwhile, depression is currently becoming a significant public health problem, with more than 300 million people estimated to suffer from depression worldwide (3). The prevalence of depressive symptoms among older adults was 20.0%. Depression in late life is associated with an elevated risk of morbidity and suicide and decreased physical and cognitive functioning (4, 5).

The novel coronavirus disease 2019 pandemic has led to adverse changes in health behaviors such as smoking and physical activity and widespread mental disorders such as depression and anxiety (6, 7). The high co-occurrence of tobacco smoking and depression is a major public health concern during this unprecedented crisis. The reciprocal relationships between tobacco smoking and depression have been widely documented; for example, depression is associated with subsequent smoking behavior, and smoking exposure is associated with subsequent depression (8–12). Several previous studies have demonstrated an association between tobacco smoking and depression: tobacco smoking increases the risk of depressive symptoms. Such an association has been shown across different age groups, such as adolescents (13), adults (14, 15), middle-aged and older adults (16, 17), and elderly people (18). Conversely, few studies have shown that tobacco smoking reduces depressive symptoms

(19, 20). Furthermore, other studies have shown that depression predicts the persistence of tobacco smoking (21–25).

Previous studies document that the association between depressive symptoms and smoking is relatively stable across ages (26). However, the prevalence of both depression and smoking peaks in adolescence (27). Most studies on depression and smoking were conducted during adolescence. Few studies have explicitly focused on middle-aged and older adults (20, 28). Across the lifespan, a more modest peak in the prevalence of depression occurs in the fifth and sixth decades (29). Moreover, middle-aged and older smokers are an underserved population for smoking cessation interventions (28). Therefore, this study analyzes the association between depressive symptoms and smoking, focusing on middle-aged and older adults.

Past studies provide evidence of the association between depressive symptoms and smoking among Chinese middle-aged and older adults. On the one hand, smoking had higher odds of suffering from depressive symptoms (30); women smokers showed a higher likelihood of suffering from depressive symptoms (31). On the other hand, smokers were less likely to develop depressive symptoms (20); formerly smoking behavior was inversely associated with the risk of depressive symptoms (32). The results show a negative association between depressive symptoms and smoking using the data from the China Health and Retirement Longitudinal Study (CHARLS). In the CHARLS, there were 1,965 missing 10-item Center for Epidemiologic Studies Depression Scale (CESD-10) baseline scores and 2,888 missing CESD-10 follow-up scores among respondents in both interviews. Therefore, the CESD-10 items with missing values may lead to conflicting findings. As we know, missing values are a common challenge in most social research studies, and the problem is often pronounced in studies using self-rated instruments. Similarly, previous studies on depression may have encountered the problem of missing values (33, 34). Missing values reduce statistical power, cause bias in the estimation of the parameters, and lessen the representativeness of the samples (35).

Missingness mechanisms were first introduced by Rubin (36). Rubin distinguished three fundamental missing-values mechanisms: missing completely at random (MCAR), missing at random (MAR), and missing not at random (MNAR). MCAR occurs when the missingness is unrelated to the observed and unobserved value for a unit. Under an MAR mechanism, the probability of a missing value for an item may depend on

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Abbreviations: CESD-10, 10-item Center for Epidemiologic Studies Depression Scale; MCAR, missing completely at random; MAR, missing at random; MNAR, missing not at random; CHARLS, China Health and Retirement Longitudinal Study; CESD-D, 20-item Center for Epidemiologic Studies Depression Scale; MICE, multiple imputation by chained equations; OR, odds ratio; CI, confidence interval.



observed data but not on unobserved data. MNAR means that the probability of missingness depends on the underlying value of an item. Many researchers adopt a listwise deletion approach (complete-case analysis) to deal with missing values. This approach is based on the assumption of MCAR. However, this assumption is sometimes difficult to justify in practice (37). Therefore, various imputation methods have been developed to compensate for missing values in survey data. The methods include random selection, preceding question, question mean, individual mean, single regression, and multiple imputation. Multiple imputation is the most accurate technique for dealing with missing values when assessing depressive symptoms (33).

Overall, the difficulty of estimating the effect of smoking status on depression has led to conflicting findings in the general population. Moreover, although the association between tobacco smoking and depression has been documented, thus far, there have been no studies dealing with missing values when assessing depression. To bridge these gaps, the present study is aimed to examine the effect of tobacco smoking on depressive symptoms using panel data with a multiple imputation technique.

## Methods

### Data source

The data used in this study were obtained from the China Health and Retirement Longitudinal Study (CHARLS), launched by the National School of Development of Peking University. The CHARLS sample was drawn from 28 provinces, 150 counties/districts, and 450 villages/residential committees. Multistage stratified sampling with a probability proportional to size was used for the survey. More details on the sampling procedure and data collection process are available in the study by Zhao et al. (38). The CHARLS questionnaires include sections on household information, demographic background, health status and physical functioning, health care and insurance, work, retirement, pension, income, expenditure, assets, housing characteristics, etc.

The CHARLS is a biennially longitudinal survey of Chinese families and individuals aged older than 45 years. In the first wave in 2011, 17,337 persons (older than 45 years old) were successfully interviewed; in the three waves of full sample follow-up surveys in 2013, 2015, and 2018, 18,248 persons, 20,083 persons, and 19,584 persons were successfully interviewed, respectively. The measured variables and their respective percentages of missing values are presented in Table 1. After eliminating the measured variables with missing values <1% (871 persons), the final sample consisted of a total of 74,381 persons for the data collection waves, 58,854 with no missing values and an additional 15,527 with missing values in at least one of the measured variables.

## Measurements

### Depressive symptoms

The CESD-10 was used to assess depressive symptoms in the CHARLS questionnaire. First, the CESD-10 was developed from the full-length version of the 20-item Center for Epidemiologic Studies Depression Scale (CESD-D), which was designed as a screening instrument for depressive symptoms in older adults (39). Second, the CESD-10 indicated good predictive accuracy when compared to the CESD-D. Last, the CESD-10 has shown reasonable validity and reliability in the Chinese population and adequate validity across a range of ages in longitudinal studies (40, 41).

In the CHARLS, each respondent was asked, “How often have you felt or behaved this way during the last week?”. The survey consists of 10 items (e.g., I felt depressed, I felt fearful, my sleep was restless, and I was happy), which can be rated on a 4-point Likert scale from 0 (<1 day) to 3 (5–7 days). The range of the CESD-10 total score is 0–30, and a cutoff score of 10 or higher indicates the presence of significant depressive symptoms (39). Therefore, the variable of depressive symptoms was set as a dichotomous variable that equaled 1 if the individual self-rated CESD-10 score was equal to or >10 and equaled 0 if otherwise.

### Smoking status

In the CHARLS, each adult was asked, “Have you ever chewed tobacco, smoked a pipe, smoked self-rolled cigarettes, or smoked cigarettes/cigars?” and “Do you still have a smoking habit or have you totally stopped smoking?”. According to these two questions, all adults were divided into three mutually exclusive groups: never smoked, current smokers, and former smokers. For further analysis, the present study categorized current smokers into three subgroups (light, moderate, and heavy smokers) based on their average cigarette consumption (“In 1 day about how many cigarettes do you consume?”). Light smokers were current smokers who reported consuming from 1 to 10 cigarettes per day, moderate smokers were those who consumed from 11 to 19 cigarettes per day, and heavy smokers were those who consumed 20 cigarettes or more per day. Former smokers were categorized into three subgroups (short-term, moderate-term, and long-term quitters) based on the total number of years since the respondents had quit smoking (“At what age did you totally quit smoking?”): short-term quitters were former smokers who had quit smoking ≤1 year age, and moderate-term quitters and long-term quitters were former smokers who had quit smoking 2–5 years and ≥6 years age, respectively (42).

### Covariates

The analysis also considered the following three categories of variables as covariates to explain depressive symptoms:



TABLE 1 Frequencies and percentages of missing values for the measured variables.

Variables	Complete response, <i>N</i>	Complete %	Missing response, <i>N</i>	Missing %
<b>Depressive symptoms</b>				
CESD-10-01	67,454	89.64	7,798	10.36
CESD-10-02	66,661	88.58	8,591	11.42
CESD-10-03	67,362	89.52	7,890	10.48
CESD-10-04	67,413	89.58	7,839	10.42
CESD-10-05	65,694	87.30	9,558	12.70
CESD-10-06	68,008	90.37	7,244	9.63
CESD-10-07	68,081	90.47	7,171	9.53
CESD-10-08	67,726	90.00	7,526	10.00
CESD-10-09	67,704	89.97	7,548	10.03
CESD-10-10	67,376	89.53	7,876	10.47
Smoking status	66,228	88.01	9,024	11.99
Sex	75,203	99.93	49	0.07
Age	74,830	99.44	422	0.56
Educational attainment	73,461	97.62	1,791	2.38
Marital status	75,145	99.86	107	0.14
Rural residency	72,725	96.64	2,527	3.36
Self-rated health	72,089	95.80	3,163	4.20
Functional limitations	74,781	99.37	471	0.63
Chronic conditions	72,614	96.49	2,638	3.51
Drinking	74,607	99.14	645	0.86

“Don’t know,” “Refused,” and “Blank” equal missing.

(1) current health-related factors, including self-rated health, functional limitations, and chronic conditions; (2) several demographic characteristics that may also affect depressive symptoms, such as sex, age, educational attainment, marital status, and rural residency; and (3) in addition to smoking, another health behavior factor included in the analysis was drinking. The definitions of the variables are provided in Table 2.

## Multiple imputation of missing values

During the CHARLS investigation, the respondents were not required to answer any question in the cognition and depression section that they do not want to answer, and the interviewers went on to the next question. Moreover, the CESD-10 must be answered by the respondents themselves and cannot be answered by other family members. As a result, the proportion of missing values for the CESD-10 items was approximately 10% (see Table 1). In addition, the respondents who smoked filtered or unfiltered cigarettes answered the question about average cigarette consumption. The respondents who smoked a pipe, self-rolled cigarettes, cigars, or water cigarettes skipped the average cigarette consumption question. Therefore, missing values accounted for approximately 12% of the values for the variable of smoking status.

Testing on whether the given data set is MCAR or MAR was performed. The regular Little’s MCAR test gives a distance of 22,619.85 with the degree of freedom = 10,099 and  $p$ -value < 0.001. The test suggests that the missing data of the measured variables of interest are not MCAR under significance level 0.05. Then we used a logistic model to identify other variables predicting missing responses to the CESD-10 items and smoking status (data not shown). The logistic model predicted that the missing data of the CESD-10 items and smoking status were related to the respondents’ age. Therefore, the test provides evidence that the data is MAR. The present study adopted the MAR assumption and employed a multiple imputation technique to deal with missing values.

Multiple imputation is a simulation-based statistical technique that allows researchers to increase the availability of data points, thus reducing biases associated with the deletion of observations due to missing values (43). Multiple imputation has three elemental phases: imputation, analysis, and pooling. In the imputation phase,  $m$  copies of the dataset are created, with the missing values replaced by imputed values using an appropriate model. Rubin suggested that  $m = 5$  should be sufficient to obtain valid inference (44). Therefore, 5 copies were created in this study to reduce the sampling error due to imputations.

TABLE 2 Definitions of the variables used in the empirical models.

Variable	Description
<b>Depressive symptoms</b>	1 if the individual self-rated CESD-10 score was equal to or greater than 10; 0 otherwise
<b>Smoking status</b>	
Never smoked	1 if the individual who has never smoked; 0 otherwise
Short-term quitters	1 if the individual is former smoker who had quit smoking $\leq 1$ years; 0 otherwise
Moderate-term quitters	1 if the individual is former smoker who had quit smoking 2–5 years; 0 otherwise
Long-term quitters	1 if the individual is former smoker who had quit smoking $\geq 6$ years; 0 otherwise
Light smokers	1 if the individual is current smoker who reported consuming from 1 to 10 cigarettes per day; 0 otherwise
Moderate smokers	1 if the individual is current smoker who reported consuming from 11 to 19 cigarettes per day; 0 otherwise
Heavy smokers	1 if the individual is current smoker who reported consuming 20 cigarettes or more per day; 0 otherwise
Sex	1 if the individual was male; 0 for females
Age	Continuous variable, actual age in years
<b>Educational attainment</b>	
Illiteracy	1 if the individual was illiterate; 0 if otherwise
Elementary school	1 if the individual attended elementary school; 0 if otherwise
Middle school	1 if the individual graduated from middle school; 0 if otherwise
High school	1 if the individual graduated from high school; 0 if otherwise
Above 3-year of college	1 if the individual graduated from an above 3-year college; 0 if otherwise
<b>Marital status</b>	
Never married	1 if the individual was never married; 0 if otherwise
Married	1 if the individual was married; 0 if otherwise
Separated or divorced	1 if the individual was separated or divorced; 0 if otherwise
Widowed	1 if the individual was widowed; 0 if otherwise
Rural residency	1 if the individual was rural resident; 0 if otherwise
<b>Self-rated health</b>	
Poor	1 if the individual reported their health status to be poor or very poor; 0 if otherwise
Fair	1 if the individual reported their health status to be fair; 0 if otherwise
Good	1 if the individual reported their health status to be good or very good; 0 if otherwise
<b>Functionally limitations</b>	
None	1 if the individual could eat, toilet, dress, bathe/shower, get in/out of bed, and walk without difficulty; 0 if otherwise
Mild	1 if the individual had one or two difficulties in eating, toileting, dressing, bathing/showering, getting in/out of bed, or walking; 0 if otherwise
Moderate	1 if the individual had three or four difficulties in eating, toileting, dressing, bathing/showering, getting in/out of bed, or walking; 0 if otherwise
Severe	1 if the individual had five to six difficulties in eating, toileting, dressing, bathing/showering, getting in/out of bed, or walking; 0 if otherwise
Chronic conditions	The number of chronic conditions diagnosed by a doctor.
Drinking	1 if the individual drank at least once a month; 0 if otherwise

Two common imputation approaches, multiple imputation with the multivariate normal model (MVN) and multiple imputation by chained equations (MICE), are widely available in statistical software. MVN assumes a joint multivariate normal distribution of all variables and uses multivariate normal data augmentation to impute missing values of imputation variables. MVN has a theoretical justification and appears to perform well compared to the MICE (45). However, most epidemiologists work with datasets that include non-continuous variables, which cannot be modeled by MVN (46). On the other hand, MICE is a more flexible approach that does not rely on rigorous theoretical justification to impute missing

data for multiple variables based on a set of univariate imputation models (47). Therefore, the imputation process was carried out based on MICE. The present study selected conditional models based on the type of variables. MICE allows the use of logistic and Poisson regression models to impute binary variables, such as rural residency, and count variables, such as chronic conditions. Moreover, ordered logistic and multinomial logistic regression models can impute ordered categorical variables such as the CESD-10 items, educational attainment, and self-rated health, and unordered categorical variables, such as smoking status. Multiple imputation should include variables associated with the probability of missing

values (48). The variables listed in Table 2 were used in the imputation models.

In the analysis phase, each of the 5 completed datasets was analyzed using a desired statistical method. The results obtained from 5 the completed datasets were combined into a single multiple-imputation result in the pooling phase. The single parameter estimate is calculated as the mean of the  $m$  ( $= 5$ ) parameter estimates of  $\hat{Q}$ :

$$\bar{Q} = m^{-1} \sum_{i=1}^m \hat{Q}_i$$

The estimated variance of this MI estimate is calculated based on Rubin's rules as expressed below:

$$T = \bar{U} + (1 + \frac{1}{m})B$$

where  $\bar{U} = m^{-1} \sum_{i=1}^m U_i$  is the estimated within imputation variance and  $U_i$  is the estimated variance from imputed data.  $B = (m - 1)^{-1} \sum_{i=1}^m (\hat{Q}_i - \bar{Q})^2$  is the between imputation variance (37).

## Statistical analysis

Depressive symptoms may be both an antecedent and a consequence of tobacco smoking (10). Panel data, also referred to as longitudinal data in epidemiology, are a dataset in which observations of multiple subjects are collected over time. The benefit of panel data is that it is possible to control for the unknown or unmeasured determinants of depressive symptoms that are constant over time (49). Based on a four-wave unbalanced panel dataset, the current study estimated the effect of tobacco smoking on depressive symptoms and used a logistic regression model. The logistic regression model built a latent regression and was defined as follows:

$$y_{it}^* = x'_{it}\alpha + S'_{it}\beta + \varepsilon_{it}, \quad i = 1, \dots, n, \quad t = 1, \dots, T_i$$

$y_{it}^*$  is an unobserved latent variable linked to the observed binary response variable (with or without depressive symptoms).  $x'_{it}$  is the vector of the demographic characteristics and health status of an individual. The vector  $S'_{it}$  represents smoking status including heavy smokers, moderate smokers, light smokers, short-term quitters, moderate-term quitters, and long-term quitters.  $\alpha$  and  $\beta$  are the estimated coefficients.  $\mu_i$  is the unobserved and individual-specific heterogeneity, and  $\varepsilon_{it}$  is a time-varying error term.

A logistic regression model was performed to analyze the impact of tobacco smoking on depressive symptoms among middle-aged and older adults in China. The first step in the analysis, pooled logistic regression, was a starting point. After that, this study treated the data as a panel structure

and made a choice between the fixed effects and random effects logistic model. In this study, a possible unobserved variable was attitudes toward smoking, which was correlated with the time-varying explanatory variables (tobacco smoking) in the model. With such correlated heterogeneity, a fixed effects logistic model should be preferred over a random effects logistic model; however, when estimating a fixed effects logistic model, many pieces of information are lost. A random effects logistic model was also presented in this study (49, 50). The results are presented as odds ratios (ORs) along with 95% confidence intervals (CIs). All statistical analyses were conducted employing the Stata 15 statistical software package.

## Results

A descriptive summary of all variables over time is displayed in Table 3. The total sample size was 74,381 respondents, with 51.76% of the respondents being female and 32.61% aged 65 years or older. In addition, 77.88% of the respondents reported living in rural areas, and approximately 34% of the respondents completed at least middle school. The proportions of respondents with depressive symptoms were 37.55% in Wave 1, 32.26% in Wave 2, 33.68% in Wave 3, and 38.50% in Wave 4, implying that the proportions of respondents with depressive symptoms first decreased and then increased. Approximately one in four respondents has been current smokers over the years, and the proportions of light, moderate, and heavy smokers were approximately 9%, 2%, and 14%, respectively. Moreover, ~10% of the respondents were former smokers from 2011 to 2018. The proportions of short-term, moderate-term, and long-term quitters were approximately 2%, 2%, and 6%, respectively.

The results of the logistic regression analysis are shown in Table 4 as ORs. Column III of Table 4 presents the effect of tobacco smoking on depressive symptoms using the fixed effects logistic model. The results revealed that smoking status was associated with depressive symptoms. Heavy smokers had 20% higher odds of suffering from depressive symptoms than those who never smoked (OR = 1.20; 95% CI: 1.05, 1.37). Compared to those who never smoked, for short-term and moderate-term quitters, the odds of suffering from depressive symptoms increased 30% and 22%, respectively (OR = 1.30; 95% CI: 1.04, 1.63, OR = 1.22, 95% CI: 1.02, 1.47). In particular, long-term quitters had an increased likelihood of suffering from depressive symptoms than those who never smoked, but the difference was not statistically significant. The magnitudes of the ORs for the variables short-term quitters, moderate-term quitters, and long-term quitters decreased in absolute terms with increasing time-gaps since quitting. Therefore, among former smokers, the probability of suffering from depressive symptoms decreased with increasing duration of since quitting smoking.

Irrespective of the estimation method in Scenario 1, heavy smokers showed an increased probability of suffering from

TABLE 3 Description of variables in four waves (percentage).

Variable	Wave1 (2011) N = 17,108	Wave2 (2013) N = 17,940	Wave3 (2015) N = 19,832	Wave4 (2018) N = 19,501	All waves N = 74,381
<b>Depressive symptoms</b>					
Yes	37.55	32.26	33.68	38.50	35.49
No	62.45	67.74	66.32	61.50	64.51
<b>Smoking status</b>					
Never smoked	64.20	67.50	60.50	60.19	62.96
Short-term quitters	2.17	2.10	1.46	3.33	2.27
Moderate-term quitters	2.51	1.55	1.45	4.30	2.46
Long-term quitters	5.23	5.63	5.90	8.12	6.26
Light smokers	8.65	8.95	11.17	8.34	9.31
Moderate smokers	1.57	1.61	2.46	1.88	1.90
Heavy smokers	15.67	12.66	17.06	13.84	14.84
<b>Sex</b>					
Male	48.68	48.31	48.47	47.56	48.24
Female	51.32	51.69	51.53	52.44	51.76
<b>Age</b>					
45–64 years	72.48	69.37	67.49	60.99	67.39
65–84 years	26.34	29.16	30.96	36.89	31.02
≥85 years	1.18	1.47	1.55	2.12	1.59
<b>Educational attainment</b>					
Illiterate	27.42	26.68	24.88	22.78	25.35
Elementary school	39.16	39.43	40.44	42.78	40.51
Middle school	20.67	20.85	21.48	21.80	21.23
High school	10.31	10.64	10.49	10.51	10.49
Above 3-year college	2.44	2.40	2.71	2.13	2.42
<b>Marital status</b>					
Never married	0.89	0.85	0.78	0.61	0.78
Married	87.08	86.78	86.40	85.03	86.29
Separated or divorced	1.32	1.20	1.22	1.58	1.33
Widowed	10.71	11.17	11.60	12.78	11.60
<b>Rural residency</b>					
Yes	77.48	76.57	78.02	79.28	77.88
No	22.52	23.43	21.98	20.72	22.12
<b>Self-rated health</b>					
Poor	29.71	27.21	25.73	26.60	27.23
Fair	46.54	49.11	50.30	48.67	48.72
Good	23.75	23.68	23.97	24.73	24.05
<b>Functional limitations</b>					
None	83.38	82.48	80.43	81.45	81.87
Mild	11.38	12.74	14.00	12.52	12.71
Moderate	3.27	3.24	3.67	3.76	3.50
Severe	1.97	1.54	1.90	2.27	1.92
<b>Chronic conditions</b>					
Yes	67.26	66.96	61.45	79.35	68.81
No	32.74	33.04	38.55	20.65	31.19
<b>Drinking</b>					
Yes	33.26	34.61	35.48	33.76	34.31
No	66.74	65.39	64.52	66.24	65.69

TABLE 4 Logistic regression analysis of depressive symptoms.

	Scenario 1			Scenario 2
	Pooled logistic (I) ORs (95% CI)	Random effects logistic (II) ORs (95% CI)	Fixed effects logistic III) ORs (95% CI)	Fixed effects logistic (III) ORs (95% CI)
<b>Smoking status</b>				
Never smoked (ref.)	1.00	1.00	1.00	1.00
Short-term quitters	1.12 (0.97–1.28)	<b>1.19 (1.01–1.40)</b>	<b>1.30 (1.04–1.63)</b>	0.84 (0.64–1.09)
Moderate-term quitters	1.05 (0.93–1.19)	1.11 (0.95–1.29)	<b>1.22 (1.02–1.47)</b>	0.85 (0.66–1.09)
Long-term quitters	0.93 (0.82–1.05)	0.95 (0.82–1.10)	1.05 (0.88–1.26)	<b>0.82 (0.68–1.00)</b>
Light smokers	<b>1.14 (1.04–1.26)</b>	<b>1.17 (1.04–1.30)</b>	1.10 (0.96–1.27)	<b>0.66 (0.52–0.83)</b>
Moderate smokers	1.03 (0.88–1.21)	1.06 (0.89–1.27)	1.04 (0.83–1.29)	<b>0.65 (0.47–0.89)</b>
Heavy smokers	<b>1.14 (1.06–1.23)</b>	<b>1.20 (1.09–1.31)</b>	<b>1.20 (1.05–1.37)</b>	<b>0.72 (0.56–0.92)</b>
<b>Sex</b>				
Male	<b>0.61 (0.57–0.66)</b>	<b>0.54 (0.49–0.59)</b>	0.88 (0.54–1.43)	1.10 (0.66–1.82)
Female (ref.)	1.00	1.00	1.00	1.00
<b>Age</b>				
	<b>0.99 (0.98–0.99)</b>	<b>0.99 (0.98–0.99)</b>	<b>1.01 (1.00–1.02)</b>	<b>1.04 (1.03–1.05)</b>
<b>Educational attainment</b>				
Illiteracy (ref.)	1.00	1.00	1.00	1.00
Elementary school	<b>0.93 (0.88–0.98)</b>	<b>0.92 (0.86–0.98)</b>	1.11 (0.96–1.28)	1.01 (0.86–1.18)
Middle school	<b>0.70 (0.66–0.75)</b>	<b>0.65 (0.60–0.71)</b>	0.98 (0.78–1.25)	0.94 (0.74–1.18)
High school	<b>0.59 (0.54–0.65)</b>	<b>0.51 (0.46–0.57)</b>	0.82 (0.59–1.13)	0.85 (0.59–1.23)
Above 3-year college	<b>0.53 (0.44–0.64)</b>	<b>0.45 (0.36–0.55)</b>	0.89 (0.50–1.60)	0.93 (0.51–1.66)
<b>Marital status</b>				
Never married (ref.)	1.00	1.00	1.00	1.00
Married	<b>0.64 (0.51–0.80)</b>	<b>0.57 (0.43–0.76)</b>	1.17 (0.50–2.78)	0.91 (0.37–2.24)
Separated or divorced	1.23 (0.94–1.61)	1.26 (0.90–1.76)	1.90 (0.78–4.64)	1.40 (0.55–3.54)
Widowed	0.92 (0.73–1.16)	0.91 (0.68–1.21)	1.96 (0.84–4.54)	1.52 (0.63–3.71)
<b>Rural residency</b>				
Yes	<b>1.52 (1.43–1.61)</b>	<b>1.67 (1.55–1.79)</b>	1.08 (0.88–1.32)	1.01 (0.81–1.25)
No (ref.)	1.00	1.00	1.00	1.00
<b>Self-rated health</b>				
Poor (ref.)	1.00	1.00	1.00	1.00
Fair	<b>0.42 (0.40–0.44)</b>	<b>0.37 (0.35–0.39)</b>	<b>0.52 (0.48–0.55)</b>	<b>0.58 (0.54–0.62)</b>
Good	<b>0.21 (0.20–0.22)</b>	<b>0.18 (0.16–0.19)</b>	<b>0.35 (0.32–0.38)</b>	<b>0.44 (0.40–0.48)</b>
<b>Functional limitations</b>				
None (ref.)	1.00	1.00	1.00	1.00
Mild	<b>2.07 (1.96–2.18)</b>	<b>2.24 (2.10–2.39)</b>	<b>1.61 (1.49–1.74)</b>	<b>1.43 (1.31–1.56)</b>
Moderate	<b>3.63 (3.16–4.18)</b>	<b>4.49 (3.77–5.33)</b>	<b>2.91 (2.38–3.55)</b>	<b>2.74 (2.29–3.30)</b>
Severe	<b>4.98 (4.14–5.99)</b>	<b>7.28 (5.75–9.22)</b>	<b>4.97 (3.54–6.99)</b>	<b>5.97 (4.25–8.38)</b>
<b>Chronic conditions</b>				
Yes	<b>1.15 (1.14–1.17)</b>	<b>1.20 (1.18–1.22)</b>	<b>1.09 (1.06–1.13)</b>	<b>1.07 (1.03–1.10)</b>
No (ref.)	1.00	1.00	1.00	1.00
<b>Drinking</b>				
Yes	1.01 (0.97–1.06)	1.01 (0.95–1.06)	1.02 (0.94–1.11)	0.93 (0.85–1.02)
No (ref.)	1.00	1.00	1.00	1.00
Observations	74,381	74,381	35,466	27,456

Scenario 1: Apply multiple imputation to account for missing responses [seed for random number generator (54,321)]. Scenario 2: Estimate without accounting for missing responses (listwise deletion/complete case analysis). Bold indicates statistical significance,  $p < 0.05$ .

TABLE 5 Fixed effects logistic regression analysis for the complete case and multiple imputation.

	Complete case				Multiple imputation				VR <sub>MI</sub> (%)
	aORs	95% CI	SE	CV(%)	aORs	95% CI	SE	CV(%)	
Smoking status									
Never smoked (ref.)	1.00				1.00				
Short-term quitters	0.84	0.64–1.09	0.11	13.10	<b>1.30</b>	<b>1.04–1.63</b>	0.14	10.77	54.76
Moderate-term quitters	0.85	0.66–1.09	0.11	12.94	<b>1.22</b>	<b>1.02–1.47</b>	0.11	9.02	43.53
Long-term quitters	<b>0.82</b>	<b>0.68–1.00</b>	0.08	9.76	1.05	0.88–1.26	0.09	8.57	28.05
Light smokers	<b>0.66</b>	<b>0.52–0.83</b>	0.08	12.12	1.10	0.96–1.27	0.08	7.27	66.67
Moderate smokers	<b>0.65</b>	<b>0.47–0.89</b>	0.10	15.38	1.04	0.83–1.29	0.11	10.58	60.00
Heavy smokers	<b>0.72</b>	<b>0.56–0.92</b>	0.09	12.50	<b>1.20</b>	<b>1.05–1.37</b>	0.08	6.67	66.67

aORs, odds ratios adjusted on sex, age, educational attainment, marital status, rural residency, self-rated health, functional limitations, chronic conditions, and drinking. CV, the coefficient of variation. VR<sub>MI</sub>, the variation rate for complete case and multiple imputation analyses. Bold indicates statistical significance,  $p < 0.05$ .

depressive symptoms compared to those who had never smoked. Short-term quitters showed an increased probability of suffering from depressive symptoms compared to those who had never smoked (see Columns I–III of Table 4). The missing values were not imputed in Scenario 2, the results indicated that former smokers showed a decreased probability of suffering from depressive symptoms compared to those who had never smoked.

The complete case and multiple imputation analyses are shown in Table 5. The coefficient of variation (CV) of the OR offers its normalized measure of dispersion. Compared to complete case analysis, for smoking status variables, it is clearly reduced after multiple imputation. The variation rate (VR) assesses the relative variation of the OR obtained from complete case and multiple imputation analyses. For smoking status variables, the VR varied from 28.05% for long-term quitters to 66.67% for light and heavy smokers.

The smoking prevalence in China varies widely between men and women. Therefore, the current study conducted a subgroup analysis for men and women, respectively (see Table 6). The results of the fixed effects logistic model revealed that heavy male smokers, short-term and moderate-term male quitters had higher odds of suffering from depressive symptoms than those who never smoked (OR = 1.22; 95% CI: 1.05, 1.41, OR = 1.31; 95% CI: 1.05, 1.64, OR = 1.25; 95% CI: 1.02, 1.54). However, associations between smoking status and depressive symptoms were not significant for women.

## Discussion

To the best of our knowledge, this is the first research study that examined the effect of tobacco smoking on depressive symptoms among individuals aged 45 years or older in China using a nationally representative survey with a multiple imputation technique. The results indicated that among Chinese middle-aged and older adults, heavy smokers and short-term and moderate-term quitters have increased odds of suffering

TABLE 6 Fixed effects logistic regression analysis of depressive symptoms stratified by male-female.

	Male	Female
	aORs (95% CI)	aORs (95% CI)
<b>Smoking status</b>		
Never smoked (ref.)	1.00	1.00
Short-term quitters	<b>1.31 (1.05–1.64)</b>	1.45 (0.73–2.89)
Moderate-term quitters	<b>1.25 (1.02–1.54)</b>	1.17 (0.59–2.29)
Long-term quitters	1.06 (0.88–1.29)	1.15 (0.77–1.71)
Light smokers	1.13 (0.97–1.31)	1.07 (0.75–1.52)
Moderate smokers	1.05 (0.84–1.32)	0.98 (0.49–1.96)
Heavy smokers	<b>1.22 (1.05–1.41)</b>	1.07 (0.69–1.65)

aORs, odds ratios adjusted on sex, age, educational attainment, marital status, rural residency, self-rated health, functional limitations, chronic conditions, and drinking. Bold indicates statistical significance,  $p < 0.05$ .

from depressive symptoms than those who never smoked after controlling for other relevant variables. Our findings are consistent with the findings for European middle-aged and older adults (16) and American middle-aged adults (17). Therefore, local communities and primary care facilities should consider promoting health education programs for middle-aged and older smokers and improving their understanding of the hazards of tobacco smoking.

This type of analysis, however, does not identify pathways between tobacco smoking and depressive symptoms. One possible explanation is that smoking or chewing tobacco releases nicotine affecting an individual's neurocircuitry, which increases their susceptibility to depression (13, 15). Another possible explanation is from a self-medication model, suggesting that smokers use nicotine to alleviate depressed mood (9, 18, 51).

This study found that short-term and moderate-term quitters show increased odds of suffering from depressive symptoms than those who never smoked regardless of the time



elapsed since quitting, but the likelihood of having depressive symptoms declined with increasing time gaps since stopping smoking. Although the causality between smoking cessation and depression cannot be established without a longitudinal follow-up design, the decline in the prevalence of depressive symptoms after 1 year of quitting implies that smoking cessation and depressive symptoms are related. These results are comparable to other findings in the literature (52–54). In this study, former smokers reported that the probability of having depressive symptoms decreased with a longer duration since quitting, and hence, the earlier a smoker stops smoking, the greater the impact of smoking cessation on not being depressed. In other words, smoking cessation is an effective way to reduce middle-aged and older adults' risk of depression. Therefore, the government should consider allocating more resources to smoking cessation programs to help adults and adolescent smokers quit as early as possible and/or to remain non-smokers. It is also essential to tailor smoking cessation programs for middle-aged and older adults and help them quit smoking and prevent relapse.

The sub-group analysis for men and women found that associations between smoking status and depressive symptoms were significant for men but not women. Therefore, the association between depressive symptoms and smoking among Chinese middle-aged and older adults is not straightforward and may vary according to gender. According to the multiple imputed datasets, we found that the proportion of current smoking in men (54.17%) was significantly higher than in women (5.39%). However, the proportion of women with depressive symptoms (42.26%) was significantly higher than in men (28.23%). The results revealed that men are more likely to smoke and women are more likely to suffer from depressive symptoms. Given the special situation, further study will be needed to employ different types of research methods investigating gender differences in the association between depressive symptoms and smoking.

Extensive health-related surveys, such as the CHARLS, provide numerous data regarding health-related behaviors and health outcomes. However, almost every analysis faces the annoying problem of missing data. When comparing the results from multiple imputation and listwise deletion (Table 4), multiple imputation recovers a fully observed sample size. More importantly, multiple imputation restores the natural variability of the missing values. Recovering information and restoring variability may reduce bias or increase precision, which results in a valid statistical inference from multiple imputation (35, 55). It will be essential to employ multiple imputation in future analyses, when survey items on smoking status and depressive symptoms have a large number of missing values. However, researchers should be aware of hazards in multiple imputation analyses. First, multiple imputation is valid under the MAR assumption and gives biased results for MNAR mechanisms. Unfortunately, the distinction between MAR and MNAR is based on a non-testable assumption. Second, the

misspecification of the imputation model gives biased results unless enough variables predictive of missing data are included in the imputation model (56–58).

## Limitations

Although the current study employs a national survey with multiple imputation to analyze the effect of smoking status on depressive symptoms in Chinese middle-aged and older adults, several limitations should be emphasized. First, the results provide no evidence about the causal direction between smoking and depressive symptoms. The authors can only conclude that findings suggest the co-occurrence of smoking and depressive symptoms among Chinese middle-aged and older adults. Second, since the CESD-10 is a self-reported screening instrument for symptoms of depression and not a diagnostic tool, our analysis may have resulted in either an underestimation or overestimation of the association between tobacco smoking and depressive symptoms. Third, the data were obtained *via* surveys, and thus the limitations of all self-reported data exist, such as recall bias and the unreliability of responses when respondents are under pressure. Last, when the respondents' unchanging depressive symptoms across all four waves did not contribute to the likelihood, the results of the fixed effects model could be less precise and have larger standard errors.

## Conclusion

The purpose of this study was to empirically ascertain the effect of tobacco smoking on depressive symptoms among individuals aged 45 years or older in China using multiple imputed datasets. The empirical findings suggest that among Chinese middle-aged and older adults, heavy smokers and short-term and moderate-term quitters have increased odds of suffering from depressive symptoms than those who never smoked. Moreover, former smokers reported that the probability of having depressive symptoms decreased with a longer duration since quitting. Nevertheless, the association between depressive symptoms and smoking among Chinese middle-aged and older adults is not straightforward and may vary according to gender. These results may have important implications that support the government in allocating more resources to smoking cessation programs to help middle-aged and older smokers, particularly in men.

## Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: <https://opendata.pku.edu.cn/dataverse/CHARLS>.

## Author contributions

XD and CL collaboratively designed the study, developed the methodology, and interpreted the results. CL and XD led the data analysis and wrote the manuscript. RW, LK, and LZ made important contributions to the revision of the manuscript. All authors read and approved the final manuscript.

## Funding

This research was funded by the Inner Mongolia Autonomous Region Natural Science Fund (2021BS07006). The funding bodies played no role in the design of the study, the collection, analysis, and interpretation of the data or the writing of the manuscript.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## OPEN ACCESS

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## SPECIALTY SECTION

This article was submitted to  
Public Health Policy,  
a section of the journal  
Frontiers in Public Health

RECEIVED 21 July 2022

ACCEPTED 25 August 2022

PUBLISHED 14 October 2022

## CITATION

Singh PK, Jain R, Tyagi A, Yadav A and  
Singh S (2022) Smokeless tobacco  
industry's brand stretching through FM  
radio: A study from Delhi National  
Capital Region, India.  
*Front. Public Health* 10:999552.  
doi: 10.3389/fpubh.2022.999552

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# Smokeless tobacco industry's brand stretching through FM radio: A study from Delhi National Capital Region, India

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Smokeless tobacco (SLT) consumption is associated with multiple adverse health effects and mortality, with the highest burden in India. The WHO FCTC has banned tobacco advertisement, promotion and sponsorship *via* Article 13. Indian laws also prohibit any kind of direct or indirect advertisements in all forms of audio, visual, and print media; brand promotion; and sponsorship of tobacco products. However, the tobacco industry continues to find aggressive marketing ways to advertise their products. This study aims to assess the extent of surrogate advertisement of smokeless tobacco products through frequency modulation (FM) radio stations in the city of Delhi (National Capital Territory of India). In this study, the advertisements broadcasted over FM radio across different channels (private and government owned) in total 162 h were analyzed. The time duration was spread evenly over morning peak hours, off hours, and evening peak hours. It was found that multiple brands including Vimal, Kamla Pasand, and Rajshree have used surrogate advertising to market their brands that are commonly associated with smokeless tobacco products. However, no such advertisement was found to be aired on government-owned FM channels. The total surrogate advertisements broadcasted were over 286 times, where no significant difference was found in distribution among peak and non-peak hours. The study indicated that the tobacco industry is making its way to sell the products through indirect advertisements. The need of the hour is to not only enforce tobacco advertising ban laws in all forms of advertising media but also to strictly regulate smokeless tobacco products.

## KEYWORDS

brand stretching, surrogate advertisement, smokeless tobacco (SLT), tobacco industry, radio station, India



## Introduction

Smokeless tobacco (SLT) are non-combustible tobacco products, which are highly addictive in nature and can be consumed orally or nasally (1). SLT is consumed by 365 million people across the globe and has caused 0.35 million deaths in the year 2017 (2). The consumption of SLT is widespread; however, low- and middle-income countries (LMICs) share the largest burden, with nearly 82% users in southeast Asia (3). With the presence of more than 30 carcinogens in high concentrations in SLT products, it can cause adverse health outcomes, including cancer of oral cavity, pharynx, esophagus, and pancreas (1), with increased risk of oral health problems like leukoplakia, gingivitis, periodontitis, and dental caries (4). About 50% of oral cancer cases in India are traceable to SLT consumption (5). Increased risk of cardiovascular deaths, stillbirths (6), and other negative reproductive outcomes are also found to be associated with the consumption of SLT (4). Due to such detrimental effects, the World Health Organization Framework Convention for Tobacco Control (WHO-FCTC) has recommended to ban tobacco advertisement, promotion, and sponsorship under Article 13 in order to reduce the tobacco consumption (7).

According to the Global Adult Tobacco Survey (GATS) 2016–17, India, with around 200 million consumers, is one of leading SLT producers and consumers, representing about two-thirds of the global consumption of SLT (8). Across the globe, 70% of the total disease burden caused by SLT in terms of disability-adjusted life years (DALY) loss is borne by India (2). The government of India implemented Cigarettes and other Tobacco Products Act 2003 (COTPA) Section 5, which prohibits any kind of direct or indirect advertisement in all forms of audio, visual, and print media; brand promotion; and sponsorship of tobacco products (9) and also ratified the WHO FCTC in the year 2004. Yet, the tobacco industry has found creative ways to aggressively advertise and market their products, especially through brand stretching.

Brand stretching is a technique when a company extends one of its established brand names or identity to another product category. When such a strategy is applied to tobacco products, it can also be referred to as surrogate advertisement, which literally means “substitute.” Surrogate advertisement of tobacco products includes using an established brand name or identity associated with any tobacco product for other non-tobacco products (e.g., pan masala, elaichi (cardamom seeds), areca nut, dates, and mouth fresheners). In this article, the terms, “brand stretching” and “surrogate advertisement” are used interchangeably due to their similar kind of interpretation in regard to tobacco products.

There are studies that highlight different marketing strategies adopted by tobacco companies in anticipation of the implementation of COTPA in India, their prospective target population, and their influence on them (10–13). One of them emphasized the usage of similar color schemes for tobacco

and non-tobacco products, and sponsoring events as a means of marketing (12). But these studies only focused on print and audio-visual media, despite radio being less expensive and having greater reach as a medium of communication and entertainment in LMICs than television (14). To address this gap, the present study aims to assess the extent of surrogate advertisement of SLT products, specifically through audio media, which is broadcasted using popular frequency modulation (FM) radio stations in the city of Delhi (National Capital Territory of India).

## Methodology

The study utilized the advertisements broadcasted over FM radio across different channels, selected on the basis of ownership (government/private) and popularity/rating. The nine channels included in the study with their frequencies are Radio City (91.1), Hit FM (95), Radio Nasha (107.2), Radio Mirchi (98.3), Fever 104 FM (104), AIR FM Gold (106.4), Red FM (93.5), Radio One (94.3), and AIR FM Rainbow/Akashvani (102.6).

The data collection took place from 7 July 2021 to 20 August 2021. Each channel was surveyed for 2 days; thus, took 18 days to cover all the 9 channels. These channels were listened to for 9 h every day, and instances of surrogate advertisements aired over these channels in a total of 162 h were observed for analysis. The time durations for documentation were spread evenly over morning peak hours (8 am to 11 am), afternoon hours (12 pm to 3 pm), and evening peak hours (5 pm to 8 pm). Information about time and frequency of the advertisement, details of the advertisement (brand name/product endorsed) and the radio station were documented, and analysis was conducted using Microsoft Excel.

## Ethical consideration

The present study does not require an ethical review as there were no human beings or animals involved as participants in the study. The researchers have listened to publicly available data aired on different FM radio channels and documented the same in due course for analysis.

## Results

It was found that multiple companies have used the technique of brand stretching to market their tobacco products *via* FM radio. The total occurrence of surrogate advertisements broadcasting was 286 times, but no such instance was recorded to be aired on government-owned FM channels (Table 1). Thus, the average frequency of surrogate advertisement per day during study observation (excluding government-owned channels) was estimated to be



TABLE 1 Frequency of the surrogate advertisement broadcasted across different FM Radio channels selected in the present study.

Radio Channel	Day-1				Day-2				Frequency per hour
	Morning hours	Afternoon hours	Evening hours	Total frequency	Morning hours	Afternoon hours	Evening hours	Total frequency	
Radio City	4	7	7	18	9	8	6	23	2.28
HIT FM	5	5	5	15	13	10	10	33	2.67
Radio <i>Nasha</i>	7	8	8	23	4	5	8	17	2.22
Radio <i>Mirchi</i>	7	9	6	22	5	7	3	15	2.06
Fever 104 FM	3	3	5	11	4	3	4	11	1.22
Red FM	7	9	7	23	13	14	14	41	3.56
Radio One	7	8	5	20	6	4	4	14	1.89
AIR FM GOLD (government owned)	0	0	0	0	0	0	0	0	0
AIR FM Rainbow (government owned)	0	0	0	0	0	0	0	0	0

TABLE 2 List of the companies documented in the study utilizing the strategy of surrogate advertisement.

Brand	Type of advertisement		Frequency	Percentage
	Brand name	Product endorsed		
Vimal	2	233	235	82%
Kamla Pasand	28	0	28	10%
Rajshree	0	23	23	8%

20.42. There was no significant difference found in overall distribution among peak and non-peak hours. However, 10 am to 11 am was found to be the busiest hour for surrogate advertisements with maximum frequency ( $n = 44$ ), and 8 am to 9 am was found to have the lowest frequency ( $n = 22$ ).

The brands which used such strategies included Vimal with the maximum number of frequency (82%), followed by Kamla Pasand (10%) and Rajshree (8%), where Vimal covered over 235 instances of advertisements out of 286 (Table 2). Elaichi (cardamom seeds) as mouth freshener was the most endorsed product (89.5%), while remaining advertisements included brand name, tagline, or any other surrogate product (10.5%). In a few cases, companies also used the means of sponsoring other shows on FM radio in pursuance of increasing brand visibility. However, it is interesting to note that a big share of mouth freshener promotions targeted specifically women either by using female voices or by advertising women-specific products.

## Discussion

Advertising is a vital marketing technique, which has been used for centuries to influence people's emotions and

consumption behavior (15, 16). Industries use different tactics of entertainment, familiarity, social imaging, and advertisement spending to have a direct impact on consumer buying behavior (17). Similarly, exposure to tobacco advertisement is found to be associated with initiation as well as consumption of tobacco. This association is even more significant for young adults from vulnerable group (i.e., living below the poverty level and lower education level) (18). This evidence is also supported by our study where we found voice-overs of Bollywood actors have been used to allure the sentiments of particularly young audience. Phrases targeting the social desirability among youth like “*sab banenge follower*” (be the trend setter) and “*tashan ka jashan*” (celebrate your attitude), or relating to unity like “*bhashayein rang roop hai juda, par humari zubaan hai ek*” (diverse by origin and language, but united by taste) were used frequently in the advertisements. Studies also suggest that women are more likely to get influenced by advertisement for consumption of smokeless tobacco than men (19). This could be one of the reasons that a considerable share of the products documented in this article are found to be targeting women explicitly. More specifically, our findings indicate that more than half of the voice-overs used in the tobacco advertisements were of women, reiterating that the industry is putting their best efforts to lure women.

In order to combat the increase in tobacco consumption in India, tobacco advertisement has been banned under COTPA, Section 5, which is in line with the Article 13 of the FCTC and the guidelines therein. Tobacco companies utilize different channels of communication to persuade the consumers including print, audio, and audiovisual media. Studies suggest that familiarity to the brand name can have a significant psychological impact on the consumer, leading to positive buying behavior (17). Considering this, in 1995, the government of India had enacted the Cable Television Networks (Regulation) Act to regulate direct or indirect promotion of tobacco products on cable television networks. However, the regulation was relaxed for “genuine brand extensions” in 2009 and is in conflict with COTPA 2003 and its regulations besides being in violation of the WHO FCTC obligations. Unfortunately, marketing techniques involving using the same brand name and color composition still continue to be used by the tobacco companies, which are referred to as brand stretching.

In this study, elaichi (cardamom) as mouth freshener is the most endorsed product over various FM radio stations through brand extension of products. As observed in the Indian context, mouth fresheners (elaichi) are used after and in between meals as a traditional practice and are socially acceptable (20). This could be one of the reasons that the current study observed that elaichi was utilized more for promotion than any other surrogate products like pan masala or areca nut. During this study, it has also been observed that the tobacco companies have targeted to increase their familiarity and brand visibility among the population by means of sponsoring different shows broadcasted, despite its prohibition *via* the WHO FCTC Article 13 (7). Regardless of multiple laws altogether putting a comprehensive ban on tobacco advertisement, promotion, and sponsorship in order to safeguard the public from the tobacco epidemic, India could not succeed entirely. A research based in Europe indicates that stringent ban on tobacco advertisement along with regulation of supply, distribution, and smoke-free laws has led to steep decline in consumption of tobacco (21).

Despite the presence of laws in India for banning tobacco advertisement, promotion, and sponsorship, copious violations have been found frequently during this study. Thus, there is a need for a clear and uniform policy integrating different laws and regulations necessary to reduce tobacco advertising and consumption. However, in this study, no instance of brand stretching or tobacco advertisement on government-owned FM channels was found. This throws incandescent attention to the existing loopholes or breach of tobacco control laws in the private sector. Thus, it is salient to not only enforce the laws related to the ban on tobacco advertising but also regulate

them strictly on private platforms. Furthermore, protocols to penalize direct or indirect violators of such laws should be made more stringent to ensure greater compliance with the legal provisions.

## Limitations

The present study is based on the data documented for 9 h per day bifurcating into 3 h each for morning peak hours, afternoon hours, and evening peak hours. These 9 h assumed to be a representation of an entire day and can be extrapolated to 24 h; however, this assumption can also be counted as a study limitation. Apart from this, the study is conducted using radio channels based in the National Capital Territory of India, Delhi, where there is a possibility of high surveillance in comparison to other geographical locations, including small towns of India. Thus, there is a need to conduct this study on a large scale at different geographical locations in order to incorporate the skewness in distribution.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## OPEN ACCESS

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## SPECIALTY SECTION

This article was submitted to  
Public Health Policy,  
a section of the journal  
Frontiers in Public Health

RECEIVED 22 July 2022

ACCEPTED 27 September 2022

PUBLISHED 26 October 2022

## CITATION

Sircar N, Fleming ME and Bialous SA  
(2022) Does a human rights-based  
approach to harm reduction support  
commercialized harm reduction? Brief  
research.  
*Front. Public Health* 10:1001036.  
doi: 10.3389/fpubh.2022.1001036

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# Does a human rights-based approach to harm reduction support commercialized harm reduction? Brief research

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In recent years, the tobacco industry has been pushing a narrative that their newer lines of products—including electronic nicotine delivery devices—are offered in part to meet a social responsibility of providing potentially reduced-harm choices to their consumers. While some of the newer tobacco products might potentially be less harmful than combustible tobacco products, there is also significant deviation from the very concept of harm reduction when it is used for such a conspicuously commercialized purpose. The framing of commercialized tobacco harm reduction as a mere consumer preference by the industry is not clearly consistent with the core principles of harm reduction, let alone the human right to health and the highest attainable level of health. A human rights-based approach (HRBA) to harm reduction is a set of principles that frame an effort to respect and promote human rights, including the right to health. Whether the HRBA supports commercialized harm reduction requires study. We review industry materials from 2017 to 2022 to identify themes in the harm reduction narrative of the tobacco industry and analyse those themes using an HRBA to the tobacco harm reduction framework. Using this analysis, the industry's continued marketing of combustible products alongside their "potentially less harmful" products, and preference that their non-combustible products be regulated less strictly than cigarettes and cigars, adulterates the public health principles of harm reduction and undermines the right to health. We conclude that the tobacco industry's commercialized tobacco harm reduction is incompatible with a human rights-based approach to tobacco harm reduction.

## KEYWORDS

tobacco and tobacco product, human rights, harm reduction, public health, human rights-based approach (HRBA)

## Introduction

In recent years, the tobacco industry has been pushing a narrative that its newer lines of products—including electronic smoking devices (ESD) and more broadly electronic nicotine device systems (ENDS)—are offered in part to meet a social responsibility of providing potentially reduced-harm choices to its consumers (1).

The tobacco industry claims that its non-combustible products, such as electronic cigarettes, heated tobacco devices, snus, pouches, and chews, can help people who use cigarettes switch to a potentially less harmful alternative, thereby reducing the risks for harm from tobacco products (2). While some of these newer tobacco products are potentially less harmful than cigarettes, there is also a significant deviation of the very concept of harm reduction when it is used principally for a commercialized purpose (3). The tobacco industry itself has made clear that whatever benefit its “next-generation” products may provide, it coexists with the continued profit-making from manufacture, distribution, and sale of combustible tobacco products to consumers, with minimal if any marketing restrictions including on who may purchase these allegedly less harmful goods (e.g., non-smokers and first-time users) (4, 5). The tobacco industry wants to continue to sell harmful products directly to consumers while enjoying the social and political capital that may accrue from *also* selling potentially less—but still—harmful products directly to those same, and new, consumers.

## Harm reduction and commercialized harm reduction

Harm reduction principles emerged in the substance abuse and HIV/AIDS crises of the 1980's as a comprehensive and multi-faceted methodology towards supporting persons who engaged in risky behaviors (6). There is no single definition for harm reduction, although the principles that underscore harm reduction tend to be generalized and include commitments to human rights and social justice (5). Harm reduction absolutely includes a refrain from requiring abstinence as a precondition for receiving support or treatment. In addition, harm reduction encompasses a continuum of evidence-based social, physical, and mental healthcare that encourages positive individual change. It further includes respecting the rights of the persons who engage in the activity and delivering upon those rights through a strategy developed by and with those same persons.

Harm reduction has never meant the mere commercial or open-market offering of another addictive and harmful substance, in tandem with the original addictive and harmful substance, and in the absence of any social or medical support and infrastructure, and without cessation as an end-goal. Put more simply, there was never an offer of a less harmful heroin as a public health strategy to reduce the harm of using heroin—while offering both to the consumer at any given store. The strategy was to offer prescription methadone tied to a tightly regulated and overseen continuum of care, which encouraged cessation, one which included behavioral, medical, and social support along with naloxone and clean needles. Moreover, the principled harm reduction strategy did neither encourage or benefit from continued heroin use nor did it market opioids like

heroin and methadone to the wider public like general goods anyone may choose from.

By contrast, the tobacco industry's take on harm reduction is to offer both combustible tobacco products and “potentially less harmful” non-combustible products to everyone, current smokers and not, and put the burden on the consumer to choose which to pay for, with little if any encouragement or support for cessation. The industry frames this approach to harm reduction as “a well-established public health concept that seeks pragmatic ways to minimize the impact of an inherently risky activity without stopping it entirely” (7). Variations in this sentence proliferate across the websites and publicly available documents for the major companies, often accompanying appeals to consumer choice and the benefits of “switching” from one marketed product to another, and silence on whether a consumer could, or should, choose not to consume tobacco products at all as an end-goal.

This is a key distinction between the public health principles of harm reduction and the commercialized model of harm reduction the tobacco industry proffers (1, 3). There are products—nicotine replacement therapy drugs (NRTs)—which more clearly fall into the category of harm reduction, but the industry does not wish its “next-generation” products to be considered drugs and regulated accordingly. While there is a basis to say that with behavioral and other support, these “next-generation” products can improve smoking cessation at least as well as NRTs (8), the absence of that support does not clearly demonstrate that smokers will end their tobacco product use (9) or break their nicotine dependence (10). In other words, harm reduction is not merely having a product that is *potentially* less harmful than another product and *can* be used to reduce tobacco product use or end nicotine dependence. Even the industry's own description of harm reduction is that it is a way toward an objective; it is not, by itself, the endpoint that can be neatly achieved through telling consumers to choose their experience.

Peeters and Gilmore (1) were early to note the “opportunistic” language that the industry employs in its framing that belies any genuine commitment to harm reduction. The authors of that study note that the industry's shift to favoring harm reduction framings was partly in response to increased regulatory scrutiny and public disdain, while at the same time, the industry voiced its desire to generate new product sales without “cannibalizing” existing tobacco product profits (1). Tan et al. (11) similarly observed that the tobacco industry has been angling ‘harm reduction’ to include the continued selling of combustible tobacco products alongside the marketing and sale of non-combustible tobacco products, as part of the industry's strategy to influence discourse and policy (11). Indeed, the industry's harm reduction campaign itself arguably began after successfully influencing a 2001 report from the then-named Institute of Medicine (now National Academies of Sciences, Engineering, and Medicine) that stated, among other things, that public health interventions aimed



at reducing the harm of continued smoking were appropriate considerations—thereby opening the door for the industry's commercialized harm reduction strategy (1, 12).

## The right to health and harm reduction

The tobacco industry has been increasingly comfortable using human rights language to promote itself, although it has not yet grappled with the right to health (13). The right to health is established in principle with the Universal Declaration of Human Rights, Article 25, and as a matter of international human rights law through a series of treaties, including Article 12 of the International Covenant on Economic, Social, and Cultural Rights (14). The right to health provides that each individual is entitled to the highest attainable level of physical and mental health. Effectuating the right requires the state—whether local, subnational, or national—to progressively and proactively protect, respect, promote, and fulfill human rights. In policy and practice, this means the state must actively work to create the conditions for a healthy life, including access to health services and freedom to consent. These requirements are further embedded in global tobacco control, including the WHO Framework Convention on Tobacco Control (15, 16) and the UN Sustainable Development Goals (17–19). Indeed, the Sustainable Development Goals (20), which were envisioned to support the international human rights framework including the right to health (17, 21), have as Goal 3.a the objective of strengthening the WHO Framework Convention on Tobacco Control (FCTC) and increasing its implementation (19). The FCTC includes Article 5.3 on eliminating tobacco industry interference in public health policymaking—which could include industry subversions around harm reduction (22, 23).

Harm reduction's relationship to the right to health is axiomatic. Everyone, whatever their activity or behavior, shares the same entitlement to the highest attainable level of health; harm reduction practices are means by which states can create the environmental, social, cultural, and legal conditions to enable all persons their enjoyment of that highest attainable level of health (24). Harm reduction however is not endorsement of the activity and does not pretend that a standard below the highest attainable level of health is sufficient so far as state actors go. This is where the industry and some advocates for commercialized tobacco harm reduction go awry in their analysis: the right to health does not include nuances for industry preferences to sell its products to consumers in the least regulated way, even where one harmful product is *potentially*—an important qualifier—less harmful relative to another harmful product (25–27).

At the same time, the obligations to fulfill the right to health are primarily on the state, who may act on this obligation through developing and enforcing regulations on the

tobacco industry including limitations on what products it may lawfully market (27). Businesses have a fiduciary duty to their shareholders to produce value, which for the tobacco industry means the continued manufacture and sale of harmful and addictive products. Even so, businesses are increasingly expected to act socially responsible (28), even to the promotion of human rights, but this expectation does not supplant the duty on states to protect, respect, promote, and fulfill human rights.

## A human rights-based approach to tobacco harm reduction

Human rights-based approaches (HRBAs) are conceptual frameworks that can guide programs, projects, and policy implementation in accordance with human rights principles and human rights law (29). An HRBA to tobacco harm reduction could follow the general model for rights-based approaches to health (15, 30). The framework begins with the recognition of the right to health and the inescapable hazard that any tobacco product is to health. Whether the tobacco is burned, heated, chewed, or used to derive nicotine for e-liquid vaporization, that consumption is inherently unsafe and cannot be made safe; all tobacco products, new and old, contain harmful substances and are hazardous (27). There is no human right to purchase, sell, or otherwise use tobacco products—whatever may be said of the potential reduced risks that ENDS may provide to, and only to, current smokers (27, 31, 32). And, should there be such potential benefit for ENDS to smokers, an HRBA to tobacco harm reduction would see them regulated more like NRTs than mere commercial commodities (27).

There are two core elements with respect to an HRBA to health: (1) progressive realization using maximum available resources and (2) non-retrogression (29). An HRBA to tobacco harm reduction cannot regard as an endpoint any policy or practice that does not fulfill the right to the *highest* attainable level of health. An HRBA to any harm reduction begins and ends with the people engaging in and impacted by the harmful activity and their fundamental human rights and must meet the principles of progressive realization and non-retrogression in an accountable, equitable, and participatory manner.

The industry considers its harm reduction strategy to be supportive of health, as well as supportive of fundamental human rights, while also serving as a lucrative investment and market opportunity (33–35). We are uncertain if commercialized harm reduction can be considered a rights-based approach, particularly where it perpetuates health harms. In this article, we describe how the industry is using its commercialized harm reduction narrative and analyse commercialized harm reduction through a rights-based approach to a health framework as applied to tobacco harm reduction.

## Methodology

We searched the public documents and Internet webpages of the five biggest multinational tobacco industry companies: British American Tobacco (BAT), Philip Morris International (PMI), Imperial Brands (Imperial), Altria Group (Altria), and Japan Tobacco International (JTI). Our data and document collection were limited to those materials, in English, provided by the companies on their main corporate websites. Our search parameters were to identify content that related to harm reduction, generated by the companies themselves, from 1 Jan 2017 to 30 June 2022. Our key search terms were “harm reduction,” “reduced harm,” “less harmful,” and variations thereon. Our search period began on 1 May 2022 and concluded on 1 July 2022.

We read all pages, identified main themes, and highlighted how these themes were associated with harm reduction and human rights. From our collective experience, we know that the tobacco industry has discussed its commercialized harm reduction business in materials that also discuss sustainability, like environmental sustainability and achieving the UN Sustainable Development Goals. For this reason, we also reviewed pages and materials that primarily focus on sustainability. We exclude materials that are ancillary or unrelated to our rights-based analysis for tobacco harm reduction (e.g., financial reports).

## Results

We identified 297 documents and webpages across the five companies that mention either harm reduction (and its analogs, such as “reduced harm”) or sustainability (Table 1). As indicated in the middle column of Table 1, there is notable variation between the companies in its engagement in either of these themes, with Altria being the most prolific in its materials and JTI the least. The right-most column of the Table 1 reflects our vetting for materials that specifically include mentions for harm reduction. We found that about 81% (241) of the total number of materials initially collected included mentions for harm reduction. Here, we describe the key themes we identified from reviewing the industry’s harm reduction content and quote exemplars of these themes from industry materials. [Supplementary Table A](#) provides further data on the materials we collected and how we assessed them.

### Tobacco harm reduction as a limited venture

The gist of the industry’s approach to harm reduction is sustained consumption of a potentially less harmful product. As claimed by Imperial Brands: “harm reduction, a pragmatic

TABLE 1 Number of documents and webpages discussing harm reduction.

Company	Total number of documents/webpages that mention either “harm reduction” or “sustainability”	Vetted number of documents/webpages that discuss harm reduction
British American Tobacco	63	48
Philip Morris International	72	66
Imperial Brands	57	37
Japan Tobacco International	18	11
Altria	87	79
Total	297	241

public health approach that focuses on reducing the negative impacts of an activity rather than eliminating the behavior itself” (36). PMI offers a very similar quote: “This approach—aimed at eliminating or reducing as much as possible the negative effects rather than the activity itself—is the essence of harm reduction” (37). BAT is specific that, although they talk broadly about tobacco products and harm reduction, they are most concerned with harm reduction from the consumption of cigarettes; discussing the harm of its other products, even if less than cigarettes, is minimal (38–40). For example, BAT states that “combustible products pose serious health risks. The only way to avoid those risks is to not start—or to quit—smoking. That’s why we are changing: creating new products backed by science, that provide adult smokers with less risky alternatives” (41). Variations of this line show up in other BAT and other company materials, although we appreciate that BAT’s quote above from their 2021 ESG report includes two footnotes that significantly nuance, at best, the benefits of their product. Across companies, the primary target of its harm reduction efforts is limited to smoking cigarettes, with the enticement to switch to another tobacco product rather than reduce, let alone cease, tobacco product use.

### Tobacco harm reduction as a consumer choice

The tobacco companies echo one another in identifying consumer choices and consumer preferences as the primary driver behind tobacco use (42, 43). PMI, who has webpages committed to countering hate in society (while, buried within,

framing itself and its products as the victim of hate and unwarranted distrust) (44), contends that adult choice must allow for both the continued sale of cigarettes and the allowance of sales for potentially less harmful products—and anything else represents a form of authoritarian control (45). With no mention of their own company's commitment to lies, misinformation, and obfuscation—and having never really been trusted in the first place—while insinuating that public health policymaking is a partisan backroom affair, PMI's Senior Vice President Gregoire Verdeaux writes that after COVID-19,

*“...If we are to achieve progress, society needs to determine how personal choice and government intervention can coexist to the benefit of all. This must start with the reestablishment of trust and respect for truth. Facts matter. And so does transparency. In matters of health especially, decisions regarding rules and regulations must not be made behind closed doors and must be centered on science and objective truths, not political bias or efforts to curry favor with particular centers of influence” (45).*

BAT similarly adopts narratives that consumers should decide how to best achieve their satisfying experiences from commercial tobacco product consumption and may prefer potentially less harmful products or may prefer combustible cigarettes—absolving the manufacturer itself of any role in that decision (7, 46, 47), BAT also connects their harm reduction strategy to human rights, briefly, if significantly, noting that its harm reduction approach is in part aimed at addressing health risks and human rights (33). JTI builds on this sentiment and positions the human right to choose as fundamental to their harm reduction and sustainability strategies (48).

We note consumers can only choose from what is available to them, and the industry chooses first to make all its products available for commercial sale—those that are harm-promoting, and those that are potentially less-harm-promoting.

## Tobacco harm reduction as a public health regulatory and commercial opportunity

Across the study period, multiple documents and webpages from the companies extol their commitments to producing less harmful products. Some companies go as far as to link their commercial pursuit to public health objectives explicitly (36, 49, 50). Altria expressly sees themselves as part of the solution to smoking, while also demonstrating the profit incentive for them and undermining criticism of the patent and latent harms of their non-cigarette products, stating that

*“The FDA [US Food and Drug Administration], the public health community and tobacco manufacturers all have a role to play in addressing misinformation that hinders progress on harm reduction. We believe it is our responsibility to help create the conditions for harm reduction to succeed – through education, awareness and advocacy – as we build a strong portfolio of smoke-free products that satisfy adult smokers’ evolving interests and preferences” (51).*

JTI took a similar stance in a document submitted in response to tobacco regulations in the United Kingdom, stating that “Only by smokers moving away from combustible tobacco products to these potentially less harmful alternatives can population harm reduction be achieved” (52). Harm reduction here is framed as the endpoint for the company's strategy, implying a new equilibrium for acceptably sustained harm. Even so, the companies note limitations on their own approach to harm reduction, such as with Altria's opposition to reducing nicotine levels in its products (53).

The industry is critical of public health efforts to regulate its commercial products as it claims its ESD and other “next-generation” products could (or would) be less harmful than its cigarettes, though not so far as to say it does not support any regulation. Altria, for instance, states that its products should be regulated, but differently than other tobacco products, so as to encourage adult smokers to switch from one of their products to another one of their products—like the popular JUUL products, which Altria partly owns (54–56). Altria uses this generic appeal to adult smokers and their choice-making to both encourage industry-favorable regulation and discourage industry-unfavorable ones, public health (or at least the public health argument for restrictive regulations, e.g., prohibitions on flavors) notwithstanding (57–59).

Although harm reduction is often discussed in these industry-favorable terms, we did not find substantial discussion about cessation, non-initiation, or even the role that the “next-generation” products may play in helping reduce smoking beyond providing consumers choices in any given tobacco company's more harmful and still harmful products.

## Tobacco harm reduction as advancing sustainability

Each tobacco company considers harm reduction to be a focus area of its sustainability efforts. Sustainability works as a catch-all term; it can mean addressing climate change and reducing tobacco waste, while also meaning economic and community development, all alongside the

financial and return-on-investment sustainability important to any shareholder-held enterprise (34, 35, 47, 60–62). The companies also connect their investments in new product development, supply chain oversights, and labor practices to the UN Sustainable Development Goals and further paint themselves as eager partners in helping states achieve those targets (41, 63–65). Imperial, for example, states that consumer health is a priority for them and as part of their Environment, Social, and Governance strategy “is aligned with the relevant United Nations Sustainable Development Goals” like SDG3 on Health (63).

The industry materials utilize sustainability as a framing to accomplish multiple ends, with potentially less harmful tobacco products being part of that. For example, BAT states they are promoting sustainability “by providing adult consumers with a range of enjoyable products that carry less risk than continuing to smoke cigarettes,” in the same context of the company’s efforts to reduce its packaging and embrace a “green economy” (66). Imperial and Altria both consider reducing harm from their tobacco products a part of their environmental, social, and governance sustainability goals, which themselves are tied to long term business interests (63, 67).

## Discussion

We identified several themes in how the industry has approached its commercialized harm reduction narratives, but none of these fully capture the principles of harm reduction as laid out in public health. The industry’s written strategy seems to include the term consistently and frequently and to treat that alone as sufficient proof that what it is saying is evidence-based and true.

### A human rights-based approach to tobacco harm reduction, applied

The HRBA is a set of principles that inform policy and program development. It takes as a given that everyone is entitled to their highest attainable level of health and imposes as a duty on state (and in some instances, non-state) actors to fulfill that duty in an accountable, equitable, and participatory manner. Our framework for the HRBA to tobacco harm reduction applies the two core elements identified earlier for the HRBA: (1) progressive realization using maximum available resources and (2) non-retrogression (29). Underpinning the HRBA to tobacco harm reduction is the fulfillment of the highest attainable level of health for the individual; “potentially less harmful” may be relatively better but is undeniably not the highest attainable level of health. Furthermore, the operation

of an HRBA to tobacco harm reduction must be accountable, equitable, and participatory between the public authorities and the public itself.

This creates the first of several challenges to the industry: it is not accountable to the public. As businesses, it is accountable to shareholders who expect returns on their investment in tobacco product manufacture and sale. This runs counter, fundamentally, to public health objectives and is itself possibly irreconcilable (3, 68). Equity is also going to be difficult for the industry, given that it continues to make and sell combustible products alongside its potentially less harmful non-combustible products while blaming its own consumers for choosing poorly. Even were the industry to cease the production of its combustible products, the presumed benefits—if any—from non-combustible “next-generation” products depend on consumer consumption of and knowledge about them—which are both impacted by self-interested industry influence and marketing.

As to the core elements, progressive realization using maximum available resources is the closest to align with the industry’s preference for its harm reduction strategy—except that progressive realization still regards the end goal to be the highest attainable level of health. If there is a condition better than what the industry advocates for, what it advocates for is not going to meet this element’s requirement. As is true for harm reduction principles, cessation and non-initiation are the ultimate health objective, and achieving that becomes the framework for how a rights-based program for harm reduction is structured, with the provision of resources like social and medical support to aid an individual toward that end. Where replacement is ever considered an objective, it is done so for *current* smokers alone and requires strict guardrails on access and availability (27).

As we noted, the industry does not discuss cessation outside of performative statements discouraging smoking (it does not discourage using its smokeless products, including ESD). The industry continues to make and sell combustible products and wants to consider it changing that they *also* make other products, too, because in the industry’s narrative, it is the consumer’s own choice (and fault) to continue smoking and using the products the companies choose to sell.

And, while it may say that the best thing to do is not start—the industry is a business, and its shareholders demand sustained growth. Those consumers will need to come from somewhere. Perversely, this business fact perforates the second element on non-retrogression: *any* tobacco product, whether cigarette or not, is harmful to use or even be around when used. Were states to regulate “next-generation” products as the industry wishes—as freely available commodities, unattached to cessation and support programs—those states may contribute to deteriorations of the right to health for both tobacco product users and non-users alike.

## Is there any role that “next-generation” products may have to support public health?

The tobacco industry’s pursuit of commercialized harm reduction as a harm reduction strategy has some support from public health professionals (9, 69–71). From their perspective, whatever risks the consumption of these products have will ultimately be less than the known risks from cigarettes. An HRBA to tobacco harm reduction could utilize “next-generation” products, even if they are only potentially less harmful, but not in the manner the industry advocates. Rather, as required by the right to health and a rights-based approach to health (30), a well-regulated system where *current* smokers, alone, are provided access to these products in an accountable and supportive program aimed at cessation *could* meet the test (27). This might align with both what public health professionals beholden to the industry’s harm reduction narrative say is the potential benefit of these potentially less harmful products—a benefit realized only by smokers—and who the industry says these same products are intended for.

We do not expect this model to meet shareholder expectations, and so we do not expect the industry to adopt it in its regulatory advocacy. Consequently, the tobacco industry’s use of harm reduction can only be described as a bastardization of the harm reduction principles it claims to endorse, and their commercialized harm reduction strategy is incongruent with a human rights-based approach to tobacco harm reduction.

## Conclusion

A human rights-based approach to harm reduction does not see a commercialization of harm reduction as protecting, respecting, promoting, or fulfilling human rights. Continued use of, and initiation with, a still harmful and highly addictive tobacco product is not, and can never be, the highest attainable level of health.

If the tobacco industry wants to be sincere in its support for harm reduction, it can start by globally ending its production and manufacture of cigarettes and cigars now and not on a yet to be determined future date. If it further wants credibility, rather than consider itself as an unjustly hated pariah, it might end all marketing of its products since—as it says—nobody should start using them, and so there is no need to advertise and promote them. It could further commit to making its products only available (and tightly regulated) as therapeutic aids, in conjunction with behavioral and medical support to promote reduced use and ultimately end nicotine dependence. We would

approve if the industry does, but will not be surprised if it does not.

## Limitation

The study’s analysis is limited to the self-reported documents and content therein provided by 5 tobacco companies, which were available on their websites at the time of collection.

## Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

## Author contributions

NS and SB conceived the initial project and study plan. MF conducted primary data collection, qualitative content analysis, created tables based upon the data collection, and content analysis. NS provided review and guidance in data collection as well as conducted secondary data collection and analysis with SB, and prepared the initial draft of the manuscript. MF and SB provided revisions to the manuscript. All authors contributed to the article and approved the submitted version.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.1001036/full#supplementary-material>



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## OPEN ACCESS

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## SPECIALTY SECTION

This article was submitted to  
Public Health Policy,  
a section of the journal  
Frontiers in Public Health

RECEIVED 05 August 2022

ACCEPTED 21 October 2022

PUBLISHED 08 November 2022

## CITATION

Murukutla N, Magsumbol MS, Raskin H,  
Kuganesan S, Dini S, Martinez-Mejia C,  
Rachfiansyah and Aguilar BGR (2022) A  
content analysis of e-cigarette  
marketing on social media: Findings  
from the Tobacco Enforcement and  
Reporting Movement (TERM) in India,  
Indonesia and Mexico.  
*Front. Public Health* 10:1012727.  
doi: 10.3389/fpubh.2022.1012727

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# A content analysis of e-cigarette marketing on social media: Findings from the Tobacco Enforcement and Reporting Movement (TERM) in India, Indonesia and Mexico

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**Background:** The use of e-cigarettes is proliferating globally, especially among youth and even children. Marketing is a known risk factor for e-cigarette initiation, yet little is known of e-cigarette marketing on social media in low- and middle-income countries. This study compares e-cigarette social media marketing in India, Indonesia, and Mexico, three such countries with different regulatory environments.

**Methods:** Instances of e-cigarette marketing on social media platforms were identified via the Tobacco Enforcement and Reporting Movement (TERM), a digital tobacco marketing monitoring system. Through systematic keyword-based searches, all tobacco marketing posts observed between 15 December 2021 and 16 March 2022 were included in the analysis. The final sample included 1,437 e-cigarette-related posts on Instagram, Facebook, Twitter, YouTube, and TikTok, which were systematically content analyzed by independent coders after inter-reliability (Cohen's Kappa  $K > 0.79$ ) was established using a theory-derived codebook. The final data is represented in percentages and frequencies for ease of presentation.

**Results:** We observed e-cigarette marketing online in all countries studied, yet there was variation in the volume of marketing and types of accounts identified. In India, where e-cigarettes were comprehensively banned, we identified 90 (6%) posts; in Mexico, where e-cigarettes were partially restricted, 318 (22%) posts were observed; and in Indonesia, where there were no restrictions, 1,029 (72%) posts were observed. In both India and Mexico, marketing originated from retailer accounts (100%), whereas in Indonesia, it was primarily product brand accounts (86%). Across countries, e-cigarettes were mostly marketed directly to sell products (India: 99%, Indonesia: 69% and Mexico: 93%), though the sales channels varied. Product features, including e-liquid flavors, device colors and technical specifications, was the most prominent message framing (India: 86%; Mexico: 73%; Indonesia: 58%). Harm reduction messaging was

most popular in Mexico (8%) and was not common in Indonesia (0.3%) or India (0%).

**Conclusion:** Our study provides important insights for tobacco control stakeholders on the evolving nature of e-cigarette marketing in low- and middle-income countries. It underscores the presence of e-cigarette marketing, including in countries where comprehensive regulations exist, and suggests the importance of continuous monitoring to keep up with industry practices and strengthen tobacco control stakeholder efforts to counter them.

#### KEYWORDS

e-cigarette marketing, social media, electronic nicotine delivery systems (ENDS), FCTC, digital monitoring

## Introduction

The use of e-cigarettes is proliferating globally, especially among youth and even children (1–3). This is concerning because while the public health benefits of e-cigarettes as a cessation aid are debated, there is mounting evidence of their harm: A recent review of global research on e-cigarettes found conclusive evidence that e-cigarettes can cause respiratory disease and other adverse health outcomes, and that they serve as a “gateway” product, increasing the likelihood of never-smokers—especially youth—using combustible tobacco products (4).

Marketing is a key risk factor for e-cigarette initiation (5, 6). Exposure to e-cigarette marketing is associated with experimentation and current use of e-cigarettes among youth and children, as well as increased susceptibility of use among those who have never used e-cigarettes or combustible cigarettes (7–9). Marketing is also a key channel by which industries seek to influence the regulatory environment affecting them (10). In the case of the e-cigarette industry, this has entailed presenting e-cigarettes as a harm reduction device—a tool necessary for addicted smokers to gradually quit tobacco use—and therefore a product that should not be tightly regulated (11).

Globally, government responses to the rise of e-cigarettes and the risks they pose vary (12). As of 2021, 79 countries have adopted one or more legislative measures to regulate e-cigarettes; 32 countries have banned e-cigarette sales, while 22 have banned the advertising, promotion and sponsorship of e-cigarette devices, e-liquids or both (3). However, the internet has posed a significant challenge to the implementation of these policies (12).

## E-cigarette marketing on social media

Digital media is a core part of the e-cigarette industry’s strategy to promote products and its industry (13, 14). Social media, in particular, allows for products to be marketed to

young people across borders at low cost and under less oversight than traditional media platforms. Social media also allows for the direct integration of e-commerce platforms and for more direct, peer-like interaction with users—a strategy that tends to attract youth (3, 15, 16). Research from the United States, Australia and other high-income countries has shown that e-cigarette marketing is prevalent on social media platforms such as Instagram, Facebook, YouTube, and Twitter (17–21), and that it is associated with youth uptake of e-cigarettes (5, 8).

However, there is less known about online e-cigarette marketing in low- and middle-income countries with large online youth populations (22). This is of particular concern because of the large youth populations in countries that have been the target of e-cigarette industry ambitions (23). Emerging evidence suggests the prevalence of online e-cigarette marketing: A recent report on Indonesia, which has a nascent, fast-growing e-cigarette market (24) and a large population of youth active online (25), found that e-cigarette marketing was prevalent on social media platforms and used a range of youth-oriented tactics to promote the use of e-cigarettes and their components (26).

Moreover, there is a need for rapid, continuous data that can track the evolving practices of the tobacco and e-cigarette industry in a rapidly evolving digital environment (22). Marketing no longer consists of simply direct advertising, but also includes more covert tactics such as: event sponsorships; “corporate social responsibility” activities; and the use of less easily traceable front groups, celebrities and social media influencers (20, 27). Continuous monitoring of online e-cigarette marketing is crucial to the successful introduction and implementation of marketing laws and enforcement of violations, particularly online where it is easier for industry players to avoid oversight (22, 28).

To address this need, Vital Strategies developed a digital media monitoring system, the Tobacco Enforcement and Reporting Movement (TERM) (29) that continuously tracks online tobacco marketing in India, Indonesia and Mexico—three geographically diverse and regionally influential



countries with large populations of youth online. Evidence generated by TERM is shared regularly with stakeholders in each country, including ministries of health, tobacco control officers, academics and journalists.

The Asian region is home to more than half of the world's young people, many of whom are regularly using the internet and social media, which puts them at increased risk of exposure to tobacco and e-cigarette marketing (30). In India, in 2019, two-thirds of 504 million active internet users were between 12 and 29 years old, and in Indonesia, 44% of internet users or 118 million people are between 5 and 34, with nearly 18% between the ages of 5 and 18 (31, 32). Recent surveys in India and Indonesia have shown that youth are in fact being exposed to tobacco and e-cigarette marketing on social media (33–35). Mexico also has a large population of young people online: approximately 40% of online users are between ages 6 and 24, corresponding to 34.9 million people (36).

Data from the most recent Global Adult Tobacco Surveys in each country show that e-cigarette use among people ages 15 and above ranges from 0.02% in India to 0.6% in Mexico to 3% in Indonesia (37–39). Other studies in Indonesia have found that e-cigarette use among youth ranges from 10.7% in the city of Yogyakarta to 11.8% in Jakarta (40, 41).

At the time of this study, e-cigarette regulations across the countries also differed: In India e-cigarettes were comprehensively banned, including their importation, distribution, advertising and sale (42). In Mexico, midway through the study, the national tobacco control law was revised to ban the trade, sale, distribution, exhibition and promotion of any product that resembles a tobacco product, which was intended to apply to e-cigarettes but left room for loopholes (43). Prior to that only the importation of e-cigarettes was banned (44). Following the culmination of this study, e-cigarettes were banned outright (45). In Indonesia, there was no national law restricting the sale, use or advertising of e-cigarettes (46).

This study draws from TERM to fill the gap in knowledge on the extent and type of e-cigarette marketing prevalent on social media in these three countries. In addition, the varying policies on e-cigarettes provides an opportunity for assessing the impact of regulatory environment on online e-cigarette marketing.

## Methods

This study was conducted in three countries—India, Indonesia and Mexico—that are currently monitored by TERM, a digital media monitoring system that records instances of online tobacco marketing on social media and news sites. TERM uses a parsimonious and systematic research approach to facilitate the rapid generation of evidence for policy implementation and decision support (47). TERM was designed and is implemented by Vital Strategies with technical inputs from tobacco control experts in India, Indonesia and Mexico. Data collection and preliminary analysis is conducted by Radarr

(48), a social and digital data analytics company that uses AI and machine learning software to track publicly available posts on digital platforms. For this study, only content from social media was included in the analysis.

## Data collection

We analyzed all publicly available posts related to e-cigarettes on social media identified via TERM over a 3-month period between 15 December 2021 and 16 March 2022. This data was extracted from routine TERM monitoring in the three countries, which captured instances of tobacco marketing for conventional and newer tobacco and nicotine products, including e-cigarettes, on social media by tracking the accounts of all known tobacco companies and brand products on the social media platforms monitored by TERM. These platforms were Instagram, Facebook, YouTube, TikTok, and Twitter, with the exception of TikTok in India where it was banned.

The list of accounts for analysis were identified purposively and through exploration of online content in a multi-step process. During the first step, a list of prominent tobacco companies and product brands that were sold in each country were identified through a thorough process of consultations with tobacco control experts in each country and by reviewing Euromonitor market share reports. After obtaining a comprehensive list, active social media accounts were identified and configured in the Radarr platform for tracking. Next, additional accounts were identified by systematically searching social media content with keywords. The keywords to identify instances of online tobacco and e-cigarette marketing were systematically curated based on expert inputs and by reviewing relevant literature (49–53). Keyword-based Boolean searches, where keywords and hashtags, such as “e-cigarette” and “vape” were stitched together using special operators (“and,” “or”) with company or brand names (“Geekvape” or “#Geekvape”) were used to identify marketing instances. The Boolean search strategy was found to be particularly important for the identification of new accounts, and for newer tobacco and nicotine products, such as e-cigarettes, which had more diffused brand presences. A sample of keywords used for Boolean searches in each country is presented in [Appendix 3](#).

We included all publicly accessible, organic marketing posts from configured accounts, and posts from accounts discovered using keywords that directly or indirectly promoted conventional tobacco or new nicotine and tobacco products within the study timeframe (for details see [Appendix 1](#)). Only posts that were written in English and in the commonly spoken languages of each country (Hindi, Indonesian and Spanish) were included. Each post consisted of an image or a video, which may have been accompanied by text, hashtags or emoticons. The text accompanying each post was translated to English using Google Translate on Chrome.



The content created by influencers that was shared or cross-posted by tobacco companies or product brand accounts was included in our dataset. However, posts originating from the personal social media accounts of influencers, brand ambassadors and journalists were excluded from the dataset since it was unclear if they reflected the official position of the tobacco companies and because it was difficult to discern financial or material relationships with the product brands, which was a criterion for inclusion in our study.

A total of 6,337 instances of online tobacco marketing were identified in the study period. Of those, 1,437 posts (23%) about e-cigarettes were extracted for analysis in this paper.

## Data coding

A standardized codebook was developed based on the published literature (49–53), expert inputs and initial data exploration. The full codebook is available in [Supplementary Appendix 1](#). The following are the key analyses conducted on the posts that are reported in this paper:

- **Product type:** We categorized all posts based on the type of product marketed, such as: smoking tobacco, which included indigenous products like bidis in India and kreteks in Indonesia; smokeless tobacco; allied products (e.g., surrogate products or those non-tobacco products to which the company or product brand has been extended); e-cigarettes; and other newer products, including heated tobacco products and nicotine pouches. While TERM at large analyzes marketing of allied products, this category was not applicable to this analysis of e-cigarette marketing (for more details see [Supplementary Appendix 1: Codebook](#)).
- **Account type:** This entailed designating the social media account as created by tobacco or nicotine product brands, company brands, third-party retailers or product/company-affiliated community groups.
- **Product brand:** Name of promoted product.
- **Company:** Name of the parent company.
- **Country of origin:** Country where the parent company was located.
- **Platform:** Social media platforms, including Facebook, Instagram, Tik Tok, etc.
- **Engagement:** Sum of audience engagement including number of likes/loves, comments/replies and shares.
- **Marketing tactics:** The type of marketing strategy used, which captured the intention of the marketer, such as selling products or creating brand endearment and loyalty.
- **Message framing:** Underlying theme around which the whole message of the post was built.

The Radarr digital platform was programmed to code the content according to the codebook. Trained human coders,

including three authors to this paper (SD, SK, CM-M), then checked the coding to ensure its accuracy. They also manually conducted the content analysis for some of the more subjective variables according to the coding framework. Following careful discussion, particularly with study lead (NM) and second author (MM), the coders were trained to use the coding framework and independently analyzed 10% of the dataset for the two categories that were deemed to be the most complex and open to subjective interpretation: marketing tactics and message framing ([Table 1](#)). Once inter-rater reliability of Cohen's kappa ( $K > 0.79$ ) was established in coding of 10% of posts on the variables "marketing tactics" and "message framing," the coders then went on to code the remaining content independently. Any discrepancies were discussed with the study lead and resolved by the study team.

## Data analysis

We used Microsoft Excel for Mac (v.16.6.1) and Stata/Standard Edition for Mac (v.17.0) to conduct descriptive analyses of the types of tobacco or nicotine products marketed, social media platforms used, social media accounts, and marketing tactics and message framing used.

We conducted a bivariate analysis of the distribution of one variable across the categories of a second variable through cross-tabulation. Specifically, we described social media platforms on which companies made accounts, engagement metrics based on different types of message framing, and e-cigarette marketing by types of accounts across social media platforms. In addition, we analyzed engagement by each type of message framing and social media platform. We also described the product brands and parent companies observed in each country. Examples of each marketing tactic and message frame were provided for each country ([Tables 2, 3](#)).

## Ethics review

This study does not meet the criteria for human subjects review. Our methodology involved the analysis of publicly available marketing content from commercial accounts. There was no involvement of human research participants in the conduct of this research.

## Results

### Prevalence of e-cigarette marketing on social media

A total of 6,337 instances of tobacco marketing were observed during the three-month study period. The volume of tobacco marketing observed in this study was highest in Indonesia, followed by India and Mexico (see

TABLE 1 Definition of marketing tactics and message framing used in the analysis for this paper.

Variable		Description
Marketing tactic	Direct advertising	Promotes the sale or use of tobacco and new nicotine and tobacco products, such as e-cigarettes and heated tobacco products, in a general way.
	Price promotions	Promotes the sale or use of tobacco products through price discounting.
	Events, occasions, sponsorships	Pairs the tobacco product brand with events, occasions, sponsorships and contests. Any publicized events, occasions or contests, used for promoting tobacco companies, including “any form of contribution,” financial or otherwise.
	Corporate social responsibility	Pairs the company/brand or product with socially responsible activities (e.g., water conservation projects, financing vaccination drives)
	General profile raising	Intended to raise the profile of the brand/company but does not fall into any of the other categories.
Message framing	Community celebrations and festivals	Posts commemorating a specific event or community celebration. This category also includes posts commemorating birthdays or deaths of famous people including religious figures and politicians.
	Entertainment	Posts that promote the product as being entertaining and fun. This category also includes posts that use entertainment-related content including memes, funny videos or jokes.
	Environment eco-awareness	Any post that addresses climate change, conservation, sustainable development goals, or support for environment/conservation.
	Glamorization	Posts that associate use of products as aspirational, luxurious or part of an ideal, fashionable lifestyle.
	Health claims	Posts that present the product as healthier than other products or as less harmful than conventional tobacco products.
	Informational	Posts that instruct viewers how to use a product. This category also includes posts that provide background information on the company.
	Personal care and wellness	Posts that associate products with relaxation or stress management. This category also includes posts that frame products as being used for social bonding, including forming community around use of the product with like-minded peers.
	Product features	Posts that primarily emphasize the available choices of product flavors and design including device colors, as well as technical specifications of the product. Posts without any text descriptions or keywords that only display the product are also included in this category.
	Social welfare	Posts that showcase activities sponsored or supported by the company/brand that are meant to improve their public image. Any posts associating the company with social welfare schemes, livelihood initiatives, women’s empowerment, entrepreneurship, educational scholarships, etc.

Supplementary Figure 1). That said, the largest proportion of e-cigarette marketing relative to other tobacco products was found in Mexico, where it made up 75% of the total volume of tobacco marketing; e-cigarette marketing made up a smaller share of marketing in Indonesia (28%) and India (4%).

In India and Indonesia, marketing for smoking products comprised the largest share of marketing (64 and 69%). In India, with the exception of marketing for bidis, this marketing was surrogate marketing or brand extensions used to indirectly promote smoking products, while in Indonesia, consumer interest groups indirectly promoted smoking products. In Mexico, 22% of marketing was for smoking products (exclusively cigars), which were promoted as indigenous products as part of a proud cultural heritage.







We observed a small proportion of marketing of newer tobacco and nicotine products: Heated tobacco products were marketed in Mexico (2%) and Indonesia (1%) and there were

no such instances in India. Marketing for nicotine pouches were observed only in Indonesia (2%).

## Profile or types of accounts promoting e-cigarettes on social media


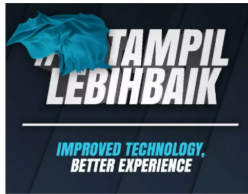

All the e-cigarette social media content identified for this study was obtained from 35 accounts, including 7 in India, 15 in Indonesia and 13 in Mexico (Appendix Table 2). In Indonesia, the sources of e-cigarette marketing were predominantly product brand accounts (86%), followed by accounts operated by community groups affiliated with product brands (12%) and third-party retailers (2%) (Supplementary Figure 2). In India and Mexico, all accounts (100%) promoting e-cigarettes belonged exclusively to third-party retailers.

TABLE 2 Examples of e-cigarette marketing tactics observed in India, Indonesia, and Mexico.

Marketing Tactic   Country	India	Indonesia	Mexico
Price promotion	 <p>Source: Vape Bar India Instagram page  <a href="https://www.instagram.com/p/CZjtS_1PGWg/">https://www.instagram.com/p/CZjtS_1PGWg/</a></p>	 <p>Source: Upods_id Instagram page  <a href="https://www.instagram.com/p/CamctgaPLnb/">https://www.instagram.com/p/CamctgaPLnb/</a></p>	 <p>Source: La Vaperia Vape Shop Facebook page  <a href="https://www.facebook.com/660288400780252/posts/2314899645319111/">https://www.facebook.com/660288400780252/posts/2314899645319111/</a></p>
Caption translation	Get 10 pcs and get 3 free. Offer valid till 14 february. Get your vapes now	Flash Sale 3.3 !!! Upods Again Ngadin Flash Sale 3.3 Lho. Discount 20% for certain products... # Switchit # switchgang # oleapapeupods # everyone canswitch	LAST HOURS! 🛒 Do not stay without your Christmas present 🎄. 10% discount throughout the store 🔥 making an equal to or greater than \$ 1,200.00 pesos. Use the coupon: Christmas10 🛒... #vapermexican #Instavape #itsjustvapor #Vapeators #vapelove
Direct advertising	 <p>Source: vape_wholesaler_india Instagram page  <a href="https://www.instagram.com/p/CYVu7FxpJsd/">https://www.instagram.com/p/CYVu7FxpJsd/</a></p>	 <p>Source: GeekVape Twitter account  <a href="https://twitter.com/GeekvapeTech/status/1480447946831581186">https://twitter.com/GeekvapeTech/status/1480447946831581186</a></p>	 <p>Source: ecig.mx Facebook page  <a href="https://www.facebook.com/720882044675543/posts/4689966671100374/">https://www.facebook.com/720882044675543/posts/4689966671100374/</a></p>

(Continued)

TABLE 2 (Continued)

Marketing Tactic   Country	India	Indonesia	Mexico
Caption translation	No text	<p>👑 DF XP 77W Kit 👑 - The Crown Has Arrived! 📱 Multi-Use Digi-Crown Customizable 📱 LED Effects 📱 Safety Protection Switch 📱 4.5 ml XP Pod Tank... #geek #GEKUP #Digiflavor #XP77 #Crown Not for U.S. Market. <a href="https://t.co/u72pncurip">https://t.co/u72pncurip</a>.</p>	<p>The Vape Pen 22, a classic in starter kits, now in its new and improved version. Come for yours and finally stop the habit of smoking.</p> <p>#Smok #vapefriends #vapeworld #vapearnoesfumar #vapestyle #handcheck #elvapeosalvidas 🚫 #vapenations #vapecommunity #vapefamily #elvapeonoestabaco</p>
Events, occasions, sponsorships	NA	 <p>Source: voopoo_indonesia Instagram page <a href="https://www.instagram.com/p/CaoRDj0pwe7/">https://www.instagram.com/p/CaoRDj0pwe7/</a></p>	NA
Caption translation		<p>In the midst of the silence of the Nyepi holiday, make the moment a moment for introspection so that peace always accompanies us. Happy Nyepi New Year Saka 1944. #Harinyepi2022</p>	
General profile raising	NA	 <p>Source: Upods_id Instagram page <a href="https://www.instagram.com/p/CY1CKL5P0H_/">https://www.instagram.com/p/CY1CKL5P0H_/</a></p>	 <p>Source: Kapital Smoke &amp; Vapor Facebook page <a href="https://www.facebook.com/669235996458669/posts/4520081384707425/">https://www.facebook.com/669235996458669/posts/4520081384707425/</a></p>
Caption translation		<p>Let's Having a Better Experience Than Ever With Us Switch Gang!.. #Switchit #Switchgang #Kitterapeupods #upodsIndonesia</p>	<p>Goodbye 2021. Hello 2022! 🍷🍷🍷🍷</p> <p>That this coming year we can all live together the best emotions. #vapes</p>

(Continued)

TABLE 2 (Continued)

Marketing Tactic   Country	India	Indonesia	Mexico
			#vapestagram #mexico #cdmx #love #art #style #travel #followme #newyear #smile #music #girl #vapes #vapestagram Exclusive product for of age. This product contains nicotine, an addictive substance. Do not share content with minors.

In Indonesia, the accounts (Facebook and Instagram) run by community groups were associated with the product brand HexOhm and included a link to more than 100 local chapters across the country. Posts featured group gatherings with members touting HexOhm products and branded clothing and banners ([Supplementary Images 1, 2](#)).

In all three countries, accounts were found to frequently promote sales avenues for the purchase of e-cigarettes (see [Supplementary Figures 3A-C](#) for examples). In India, Instagram accounts predominantly directed traffic to phone numbers, in particular on WhatsApp, for sales. They tended to claim free and fast delivery nationwide, wholesale options and authentic products. In Mexico, accounts tended to direct traffic to both online stores as well as physical, brick-and-mortar stores. In Indonesia, accounts often included links to their online stores and information on where to pick up products in person; some included the Linktree app which links to the e-commerce sites Tokopedia, Shopee and others. In both Indonesia and Mexico, information on where to buy products in person was often directly provided, whereas it was not in India.

## Marketing tactics used to promote e-cigarettes

In all three countries, direct advertising was the tactic most frequently observed for e-cigarettes (99% in India, 93% in Mexico, 69% in Indonesia; see [Supplementary Figure 4](#)). Direct advertising posts explicitly promoted the purchase and use of e-cigarettes, and showed clear images of the product, product brand name and trademark logos (see images in [Table 2](#) for examples).

Price promotions were observed but constituted a small fraction of the overall share of tactics employed in all three countries, ranging from 1% in India to 3% in Indonesia. General marketing to raise the profile of the product brand or company was also observed to a small degree in Indonesia

(2%) and Mexico (4%). In Indonesia alone, marketing using events, special occasions and sponsorships constituted a significant share of the tactics used (27%). For example, HexOhm posted images of its community groups during member meetings or at events. Likewise, holiday greetings, such as VOOPOO wishing its followers a happy Nyepi (day of silence) holiday, were posted on behalf of the brand ([Table 2](#)). One example of highlighting brand sponsorships through contests includes GeekVape soliciting viewers to predict the Champions League result, in which the football team they sponsor, Paris Saint-Germain, was participating, to win prizes.

## E-cigarette and e-liquid product brands promoted most frequently






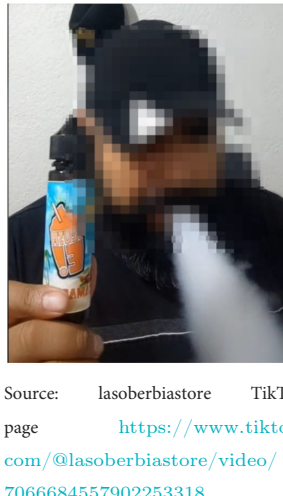
We observed a total of 63 product brands, with the greatest variety of e-cigarettes, especially e-liquids, being promoted in Mexico ( $N = 48$ ), and the fewest in India ( $N = 9$ ). Of these, we were able to identify the parent company for 23 different product brands; these product brands and the place of origin of their parent company, is presented in [Supplementary Figures 5A,B](#). Four product brands were marketed in all countries: Vapresso, VOOPOO, UWELL and SMOK. The country of origin of the products promoted was predominantly China (77%), followed by the U.S. (18%). In Indonesia alone, we found one instance of a locally owned e-cigarette brand being promoted (4%).

## Social media channels used for e-cigarette marketing and engagement by platform

In all three countries, most marketing occurred on Meta platforms, particularly Facebook and Instagram



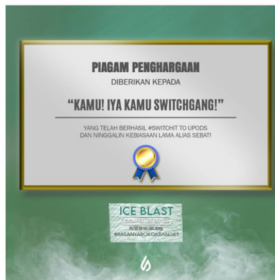



TABLE 3 Types and examples of message framing used in India, Indonesia, and Mexico.

Message frame   Country	India	Indonesia	Mexico
Product features	 <p>Source: indian_vape_shop Instagram page <a href="https://www.instagram.com/p/CYoBRVYJM4Y/">https://www.instagram.com/p/CYoBRVYJM4Y/</a></p>	 <p>Source: geekvape.indonesia Instagram page <a href="https://www.instagram.com/p/CYLq50lviOx/">https://www.instagram.com/p/CYLq50lviOx/</a></p>	 <p>Source: kapitalismokeandvapor Instagram page <a href="https://www.instagram.com/p/CaillQLhvN3/">https://www.instagram.com/p/CaillQLhvN3/</a></p>
Caption translation	<p>#SMOK #IPX80 🍷🍷  ✓IPX67 protection  ✓80 watt ✓3000mah battery ✓0.96-inch display.  WARNING: This product is intended to be used with e-liquids that may contain nicotine. Nicotine is an addictive chemical. For adult use only.  #smoktech #smokipx80 #vape #clouds #smoking #ecig #ecigs #vapes #vapekit #vapekits #vaporsofinstagram #vaper #vapefeed #vapegirl #vapegram #vapegirls #vapelove #vapelite #vapefam #vapegear #vapebox #vapefamous #vapefamily #vapenation #vapestagram #vapeon #vapestuff #vaporizers</p>	<p>What if Mimin says, “NEW YEAR NEW COLOR”  Maybe it's not the same as the one in the photo, but are you ready for the new L200 color? 🍷  Mimin already has 5 colors</p>	<p>It is manufactured with first quality ingredients, includes a mesh resistance that offer maximum flavor, with a high steam output, has a rechargeable grade battery, with 15 ml of premium liquid and 5% nicotine salts. # Fantasy # vapes #vapestagram #mexico #cdmx #love #Art #style #travel #followme #fitness #beautiful #vapes #vapestagram...  Exclusive product for those of legal age.  This product contains nicotine, addictive substance. Do not share content with minors # fantasia</p>
Entertainment	 <p>Source: vapers_stop_india Instagram page <a href="https://www.instagram.com/p/CZJsWCxl9yq/">https://www.instagram.com/p/CZJsWCxl9yq/</a></p>	 <p>Source: GeekVape Indonesia Facebook page <a href="https://www.facebook.com/105583304120083/posts/631142141564194/">https://www.facebook.com/105583304120083/posts/631142141564194/</a></p>	 <p>Source: lasoberbiastore TikTok page <a href="https://www.tiktok.com/@lasoberbiastore/video/7066684557902253318">https://www.tiktok.com/@lasoberbiastore/video/7066684557902253318</a></p>


(Continued)

TABLE 3 (Continued)

Message frame   Country	India	Indonesia	Mexico
Caption translation	<p>#reels #instagram #reelsinstagram #trending #love #viral #explore #instagood #explorepage #tiktok #reelitfeelit #india #follow #instadaily #photography #reel #followforfollowback #likeforlikes #fyp #like #memes #foryou #reelsvideo #fashion #music #reelkarofeelkaro #reelsindia #instagramreels #ke #bhfyp</p>	<p>After being observed 🚬 vapes_aby turned out to be tricky, it could be like it. What's because it uses a 65FC obelisk so yes</p>  <p>Source: GeekVape Indonesia Facebook page <a href="https://www.facebook.com/GeekVape.Indonesia/videos/setelah-sekian-lama-kami-lalui-kami-temukan-tim-yang-solid-persaudaraan-pemuda-k/1253690881782732/">https://www.facebook.com/GeekVape.Indonesia/videos/setelah-sekian-lama-kami-lalui-kami-temukan-tim-yang-solid-persaudaraan-pemuda-k/1253690881782732/</a></p>	<p>Slush Tamarind !!!!!!! #dinoterraza #eciquid #vapeordie #lasoberbiastore #cirality #Vapeo #Vapearessalud</p>  <p>Source: kapitalsmokeandvapor Instagram page <a href="https://www.instagram.com/p/CY7lZXor3mj/">https://www.instagram.com/p/CY7lZXor3mj/</a></p>
Personal care and wellness	N/A		
Caption translation	N/A	<p>After all this time we went through, we found: - a team of solid-brotherhood - creative youth and became an extraordinary community. Instead. We will do something extraordinary, something new, something to remember !!! So, don't miss it. Make sure you monitor every latest info from us! #Geekvape #geekvapeindonesia #Geekvapetech #probolingo #vapecommunity #vapenation</p>	<p>In this 2022, as you, we want to break with the routine. With the Relx Pods, there is a true change of air. # Vapes #vapestagram #mexico #cdmx #love #art #style #travel #followme #fitness #beautiful #smile #music #girl #vapes #vapestagram... Exclusive product for adults. This product contains nicotine, addictive substance. Do not share content with minors.</p>
Health claims	N/A	 <p>Source: upods_id Instagram page <a href="https://www.instagram.com/p/CYTQE-jvhCY/">https://www.instagram.com/p/CYTQE-jvhCY/</a></p>	 <p>Source: kapitalsmokeandvapor Instagram page <a href="https://www.instagram.com/p/CY2bzzvDogK/">https://www.instagram.com/p/CY2bzzvDogK/</a></p>

(Continued)

TABLE 3 (Continued)

Message frame   Country	India	Indonesia	Mexico
Caption translation		Happy yes for you who have managed to stop smoking! For those of you who are still struggling, hopefully it can stop the habit as soon as possible. Don't forget, upods are always present as an alternative cigarette for those of you who want to stop smoking!	What effects does the vape have in the physical skills of athletes?  When you think about professional athletes, you do not come to mind smoking or even vape, but there are hundreds of athletes who use vapes. Those who smoked before vape, quickly realized that they had a much better pulmonary capacity and their resistance went out in a matter of weeks. In addition, former smokers experienced much more strength after quitting smoking and noted that they can raise weights significantly larger than before.... exclusive product for graders. This product contains nicotine, addictive substance. Do not share content with minors.

(Supplementary Figure 6A). In India, all e-cigarette marketing was observed on Instagram (100%). In Mexico, e-cigarette marketing was mostly observed on Facebook (56%), followed by Instagram (43%). In Indonesia, e-cigarette marketing was mostly observed on Facebook (51%), followed closely by Instagram (48%).

We also measured the platforms on which the marketing received the highest engagement, which captures the sum of likes/loves, reshares and replies/comments (Supplementary Figure 6B). In India, all posts were observed on Instagram, and therefore we could not measure if platforms generated different engagement rates. In Indonesia, posts on YouTube (1%) generated the highest average engagement per post (484), whereas in Mexico, posts observed on TikTok (1%) had the highest average engagement (89).

The videos on YouTube in Indonesia that generated high engagement were created by “e-cigarette reviewers” who tried out different products on behalf of retailers. They used an episode format, where the hosts reviewed e-cigarette devices and tried e-liquid flavors, while trading jokes. On TikTok in Mexico, most videos featured the unboxing of e-cigarette devices with popular songs playing in the background; in one of the videos, the viewer was told that this was their sign to stop smoking cigarettes for good and suggested that the company could recommend “e-cigarette” kits.

We also analyzed how the type of social media account related to the choice of platform used (Supplementary Figure 6C). This was most relevant to Indonesia where there were a variety of different types of

accounts. We observed that third-party retailers tended to promote e-cigarettes on Instagram (56%) and YouTube (44%), while product brand accounts mostly used Facebook (52%) and brand-associated community groups used Instagram (52%).

## Message framing used for e-cigarette marketing and engagement by message type

In all three countries, “product features” was the frame by which e-cigarettes were predominantly marketed: 86% of posts in India, 58% in Indonesia and 73% in Mexico used this frame (Supplementary Figure 7A). These posts tended to highlight features such as: device colors and a “stylish,” “modern,” “luxurious” and “futuristic” design; technical specifications such as design that prevents air flow leakage and the number of puffs per unit for disposable devices; and the convenience and usability of the products, such as touch screen indicators of battery life, milliamp-hours or voltage, and the portability of devices for daily use. The customizability of products was emphasized and e-liquid flavors were highlighted to appeal to different tastes, including playful takes on minty or fruit flavors such as “mean mango,” “fruit punch,” “peach pleasure” and “blue slushee (Supplementary Image 3).” Other e-liquid names include “cheezz delight,” “cola man” and “custard monster,” which refer to ultra-processed foods and drinks.

The next most commonly used message frame varied across countries: in India, it was entertainment (13%); in Indonesia, it was informational, which included instruction on how to use products or provided information on the product brand or company (14%); and, in Mexico, it was health claims (8%). In Mexico, the hashtag #elvapeosalvavidas (#vapingsaveslives) was used in 48% of posts that promoted the health benefits of e-cigarettes over combustible cigarettes. Posts that promoted e-cigarettes as being healthier than combustible cigarettes were very uncommon in Indonesia (0.3%) and non-existent in India. See Table 3 for examples from each country.

We measured the type of message framing that had the highest average audience engagement, which is calculated by combining likes/loves, shares and comments/replies (Supplementary Figure 7B). Average engagement may serve as a proxy of the effectiveness of online marketing strategies, however, this measure is sensitive to outliers and needs to be interpreted carefully. In India, one post providing information on Juul products received the highest average engagement (2,933), however, given that this one post skewed the distribution of engagement metrics, we determined that overall, on average, posts touting product features generated the highest average engagement in India (132). In Indonesia, on average, entertaining posts generated the most engagement (322); this largely included reposted videos of users doing tricks with e-cigarettes, as well as humorous videos. In Mexico, posts making health claims about e-cigarettes being safer than combustible cigarettes had the highest average engagement (14).

## Discussion

Our study found several common features in e-cigarette marketing in India, Indonesia and Mexico, but also some important distinctions that likely reflect the political, economic and social contexts of the countries.

E-cigarette marketing was prevalent in all three countries but it varied in volume and share of overall tobacco marketing. The volume of e-cigarette marketing was highest in Indonesia, followed by Mexico and India. However, as a share or percentage of total tobacco marketing, e-cigarette marketing was highest in Mexico, where it dwarfed marketing of other tobacco products (75%). In India and Indonesia, which have among the world's largest smoking tobacco markets that include indigenous products like bidis and kreteks (54, 55), e-cigarette marketing made up a smaller share of the overall marketing (28% in Indonesia and 4% in India).

The regulatory environments in the three countries may explain the patterns of marketing observed. At the time of this study, regulations were strongest in India, where e-cigarettes were comprehensively banned (42). They were weakest in Indonesia, which has neither strong tobacco control regulations nor any governing e-cigarettes (46). And were in flux in

Mexico, where regulations on tobacco products and e-cigarettes were strengthened both during and after the study (44). The differences in regulatory environment appear to be mirrored in the observed patterns of marketing in the three countries. E-cigarette marketing was lowest in India, whereas, consistent with the lax regulatory environment in Indonesia, not only did we observe a high volume of e-cigarette marketing there but also a varied mix of products, like heated tobacco products and nicotine pouches. In fact, the marketing observations in our study are consistent with the openness of the Indonesian market to newer products where British American Tobacco/Bentoel's Velo, Indonesia's first nicotine pouch, and Philip Morris International/Sampoerna's heated tobacco product, IQOS, have launched (56, 57). In Mexico, consistent with its evolving regulatory environment at the time of this study, we observed a volume of marketing that fell between that in India and Indonesia. The overall level of regulation and marketing observed also matched up with e-cigarette use rates in each country, which were highest in Indonesia (3%) and lowest in India (0.02%) (37, 39).

The regulatory environment may also have had an effect on the profile of marketers in the three countries. These were exclusively third-party retailers in India and Mexico—we found no instances of product or company brands promoting e-cigarettes in these two countries. In India, where e-cigarettes are strictly banned, viewers were encouraged to reach out to retailers more covertly using provided telephone numbers, often via WhatsApp. We did not observe accounts linking to websites, despite evidence that shows that online e-cigarette retailers were still prevalent after the e-cigarette ban (58). In Mexico, accounts often provided links to online stores, along with other contact methods, like emails and telephone numbers, and locations of physical stores. In contrast, in Indonesia, e-cigarettes were primarily promoted by product brand accounts, followed by brand-affiliated community groups and third-party retailers. Indonesian accounts frequently provided links to online stores and other contact methods, as well as to Linktree pages that connect viewers to a range of e-commerce apps where purchases can be made.

Formal tobacco enterprises, particularly transnational companies with significant business interests, are less prone to be seen to take the risk of violating regulations—or incurring regulations in countries where this is a possibility—by explicitly promoting e-cigarettes. It is possible that in such countries as India or Mexico, global tobacco companies may be using more covert means of promotion, such as through the use of influencers, or ostensibly by backing the third-party retailers that promote these products, a tactic seen in the promotion of cigarettes (59). Third-party retailers, on the other hand, are likely to be fragmented and more easily able to avert oversight. This was evident in how their promotions clearly pictured products with brand logos via public accounts, suggesting a lack of concern with discovery. Thus, our data suggests

the importance of monitoring efforts that investigate covert means of promotion in countries with existent or forthcoming regulations. It also suggests the importance of considering the role played by third-party retailers in the promotion of e-cigarettes and the utility of complementary interventions, such as vendor licensing, to stop their proliferation.

Direct advertising to promote purchase was the predominant purpose of e-cigarette marketing in all three countries. We found that product features, known from previous studies to appeal to youthful tastes, were highlighted (60, 61). The posts appealed to youth desire for a variety of e-liquid flavors. They emphasized the look of the devices, such as the variety of colors in which they were available. And they highlighted the technological advances of the products, such as battery life, appealing to the youthful orientation toward new technology (62, 63).

E-cigarettes were also associated with favorable cultural representations in the posts observed in our study, thus attempting to normalize their use. Sales promotions in both Indonesia and Mexico were frequently tied to holidays, and a culture of giving e-cigarettes as gifts was promoted. E-cigarettes were glamorized in posts in Indonesia to promote their desirability. This form of “social selling” is often geared toward youth and new users (64) and attempts to establish new social norms (65).

Harm reduction messaging was less prevalent than expected in all three countries. Direct harm reduction messaging was most common in Mexico (8%), followed by Indonesia (0.3%), and was not observed in India at all (0%). The prominence of explicit harm reduction messaging in Mexico, frequently accompanied by the hashtag #elvapeosalvavidas (vaping saves lives) may have been an attempt to rally e-cigarette users to counter government efforts during this period to restrict e-cigarettes. In fact, in May 2022, in the months following the period of analysis reported in this paper, Mexico enacted a complete ban on e-cigarettes (66).

The message framing that garnered the most engagement also varied by country: In India, where directly selling products appeared to be the primary goal of most posts, product features garnered the most engagement, whereas in Indonesia, where accounts engaged more in social selling, entertaining posts had the highest engagement. This included many user-submitted videos of e-cigarette tricks, which have been associated with e-cigarette use (67). In Mexico, amid the national policy debate on e-cigarettes, posts that positioned e-cigarettes as a smoking harm reduction tool received the most engagement.

The message frames used for the promotion of e-cigarettes observed in our study have several important implications for tobacco control efforts. Foremost, they underscore attempts to normalize e-cigarette use in these countries, suggesting the need for strong counter-marketing efforts by governments and tobacco control campaigners. Furthermore, they call into question the argumentation frequently made by e-cigarette

promoters for e-cigarettes as a harm reduction device. Our study presents evidence of e-cigarettes being promoted most often as a desirable product and habit, and not as a harm reduction aid, which is the argument frequently used to claim regulatory exemptions for e-cigarettes (68). Governments and public health practitioners would be well-advised to question the premise for e-cigarettes given the inconsistency in its promotion.

Meta platforms, including Facebook and Instagram, were the most frequently used platforms for promotion. The opacity of WhatsApp provides a cover for the covert sales of e-cigarettes, despite bans being in place in countries like India. Our study highlights the relative ineffectiveness of company policies, like those by Meta, in reducing violations. Improved monitoring and reporting of tobacco marketing in these platforms is warranted.

Finally, our study highlights the generally diffused nature of e-cigarette product brands. We found 63 e-cigarette and e-liquid product brands marketed across the three countries, but only four e-cigarette product brands that were marketed in all three countries: Vaporesso, UWELL, VOOPOO and SMOK. We did not identify any e-cigarette product brands owned by global tobacco companies or their subsidiaries. In our study, of the products that we could identify parent companies for, 77% of the e-cigarette product brands being marketed were of companies with headquarters in China, where 95% of the world's e-cigarettes are manufactured (69); another 18% came from brands owned by U.S.-headquartered companies; and there was one locally-owned company in Indonesia (4%). Our study findings are consistent with what has been observed of the e-cigarette industry as a diversified—there were more than 460 e-cigarette product brands on the global market as of 2017—and opaque industry that makes identifying, tracking and regulating key players both a challenge and a necessity (70).

## Limitations

There are limitations to our study worth noting. First, our study was by design, purposive in its selection of social media accounts and while every effort was made, *via* expert inputs, crowdsourcing, and systematic complementary searchers, to make the lists exhaustive, our findings may not be representative of the full extent and breadth of online e-cigarette marketing within the three countries studied. For instance, our study may not have picked up the highly covert ways of online promotion, such as through the use of influencers, targeted paid ads, peer-to-peer marketing, or through private groups that online search tools, like Radarr, cannot access. TERM collects shared and earned media, which offer potential for wide exposure, but the monitoring system does not collect paid or owned media, which are also important parts of the marketing model (71). The rapid, implementation-focused approach of our study is intended to provide policymakers



with dipstick indications of the evolving nature of tobacco marketing present in their contexts. Future studies using comprehensive surveillance methods would be important to more fully explore the scale of e-cigarette marketing present in these countries.

Second, our study focused on identifying and analyzing marketing content explicitly directed at these countries. Given the cross-border nature of social media, it is possible that online users in the three countries in our study were exposed to global campaigns of transnational corporations or online activities occurring in other countries. In a related vein, it cannot be claimed that the list of accounts monitored by our study was entirely complete for those countries. As evident by the wide variety of product brands unearthed by our study, the market for e-cigarettes is evolving and relatively opaque. Multiple studies of varied methodologies, including surveys of online users to measure exposure and studies of retail sales, will be required to triangulate data and create a fuller picture of the extent of e-cigarette marketing that is prevalent online.

Third, this study used data collected during a limited study period of 3 months, and therefore cannot offer insights into marketing practices that occur outside of that period. However, TERM is a continuous media monitoring system that presents data *via* regular reports that can be used to supplement findings in this study (47).

Finally, the current approach to the selection and analysis of content is text-based. This would mean that any content that solely contained images would not be included for analysis. This limitation in the search parameters may have missed accounts or posts on heavily visual media such as YouTube or TikTok, where captions and hashtags are less often provided. This would mean that our study findings may have overrepresented Meta platforms, including Facebook and Instagram, and underrepresented the role of platforms like YouTube and TikTok in promoting e-cigarettes. However, given that Meta platforms, and particularly Instagram, continue to be the platforms of choice for e-cigarette-related content (20) and that little to nothing was known about the type of e-cigarette marketing on these platforms in the three countries studied, our findings add significant value. Future studies might consider how to better incorporate imagery in the identification of instances of online tobacco marketing.

## Conclusion

Our findings have several policy implications. First and foremost, our study highlights the importance of rapid and continuous digital media monitoring to track and respond to the presence of tobacco marketing online. Our study shows a presence of online marketing and a variety of promoters and

brands, suggesting an essentially opaque environment requiring much further discovery. Agile systems, like TERM, that are built on crowdsourced and expert inputs, can play a crucial role in complementing the more comprehensive surveillance efforts present in countries to respond to the constantly evolving industry tactics in digital environments. Our findings underscore the importance for tobacco control stakeholders, from governments to researchers and advocates that monitor the industry, to consider how a range of methods can be pooled and applied to triangulate information on tobacco marketing and industry behavior.

Second, our study suggests the inconsistency in arguments made for e-cigarettes. While e-cigarettes are promoted in policy dialogues as a means of harm reduction, it is evident from our study that e-cigarettes are presented in marketing, particularly to youth, as desirable consumables—not as a health aid. This is evident from the appealing flavoring, attractive presentation, and staging of e-cigarettes as technologically cutting edge. Our study underscores the need for governments, media and tobacco control advocates to call into question the public health justifications used by the e-cigarette industry, and the necessity of efforts to counter-message efforts to normalize e-cigarette and tobacco use.

Finally, our study highlights the importance of clear and comprehensive regulation. Our findings show that bans or restrictions on e-cigarettes may help effectively curb online e-cigarette marketing, particularly marketing originating directly from product brands. That said, our findings of third-party retail promoters in countries like India with strong regulations suggests the need for a comprehensive and complementary set of policies to prevent violations that may otherwise slip under the radar.

In conclusion, our study provides important insights for tobacco control stakeholders from governments, researchers, advocates to the media, on the evolving nature of e-cigarette marketing in low and middle-income countries and suggests the importance of continuous monitoring to keep up with industry practices and to strengthen counter-response.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Author contributions

NM: conception, study design and direction of data analysis, data interpretation, and writing. MM: study design and direction of data analysis, data interpretation, literature review, and writing. HR: study design, data interpretation, literature review, and writing. SK, SD, and CM-M: data analysis. R and BA: review

of writing. All authors contributed to the article and approved the submitted version.

## Funding

The TERM study is a project of Vital Strategies' Tobacco Control Program, which receives funding from Bloomberg Philanthropies.

## Acknowledgments

The authors would like to acknowledge Vital Strategies colleagues Rachel Rothenstein-Henry for data visualization support, Karen Schmidt for editorial support, and Stephen Hamill, Rebecca Perl, Tracey Johnston, and Alyssa Mouton for their review.

## Conflict of interest

Authors NM, MM, HR, SK, SD, CM-M, R, and BA were employed by Vital Strategies.

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.1012727/full#supplementary-material>

### SUPPLEMENTARY IMAGE 1

A HexOhm Mojokerto community meet in Indonesia promoted via the product brands' Instagram page.

### SUPPLEMENTARY IMAGE 2

A HexOhm Palu community meet in Indonesia promoted via the product brands' Instagram page.

### SUPPLEMENTARY IMAGE 3

Examples of different types of flavors used to market e-cigarettes.

### SUPPLEMENTARY FIGURE 1

Volume and proportion of tobacco marketing by product type in India, Indonesia, and Mexico.

### SUPPLEMENTARY FIGURE 2

Percentage of e-cigarette marketing by account type in India, Indonesia, and Mexico.

### SUPPLEMENTARY FIGURE 3

(A–C) Avenues for purchase of e-cigarettes promoted in Instagram posts in India, Indonesia, and Mexico.

### SUPPLEMENTARY FIGURE 4

Marketing tactics used to promote e-cigarettes in India, Indonesia and Mexico.

### SUPPLEMENTARY FIGURE 5

(A) E-cigarette product brands with known parent companies marketed in India, Indonesia, and Mexico. (B) Origin of parent companies of e-cigarette product brands with known parent companies marketed in India, Indonesia, and Mexico.

### SUPPLEMENTARY FIGURE 6

(A,C) Percentage of e-cigarette marketing by social media platforms in India, Indonesia, and Mexico. (B) Total engagement and average engagement by platform in India, Indonesia, and Mexico.

### SUPPLEMENTARY FIGURE 7

(A) Volume of e-cigarette marketing by message framing in India, Indonesia, and Mexico. (B) Total engagement and average engagement by message framing in India, Indonesia, and Mexico.

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## OPEN ACCESS

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## SPECIALTY SECTION

This article was submitted to  
Public Health Policy,  
a section of the journal  
Frontiers in Public Health

RECEIVED 23 June 2022

ACCEPTED 13 October 2022

PUBLISHED 10 November 2022

## CITATION

Satpathy N, Jena PK and Epari V (2022)  
Gender dimensions of youth  
vulnerability toward access to  
cigarettes in South-East Asia: Evidence  
from global youth tobacco survey.  
*Front. Public Health* 10:976440.  
doi: 10.3389/fpubh.2022.976440

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# Gender dimensions of youth vulnerability toward access to cigarettes in South-East Asia: Evidence from global youth tobacco survey

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**Background:** Youths are lured to smoking to make them tobacco customers. Limiting access to tobacco products by youths is a proven strategy to reduce youth tobacco use. This study aimed to examine the burden of cigarette smoking and access to tobacco by youth in South-East Asia (SEA).

**Methods:** The burden along with the physical (methods of obtaining cigarettes), financial (cigarette affordability by pocket money), and illegal (sale to minors) access to cigarettes among school-going boys and girls were examined by analyzing the Global Youth Tobacco Survey (GYTS) data (2013–2016) from seven SEA member countries. Descriptive statistics using country-specific GYTS sample weight was used to estimate parameters with 95% confidence intervals.

**Results:** The proportion of youths reporting cigarette smoking was highest in East Timor [boys: 55.57 % (51.93–59.21) and girls: 11.35% (9.12–13.59)] and lowest in Sri Lanka [boys: 2.96% (2.91–3.0) and girls: 0%]. Smoking prevalence was higher among boys than girls. Smoking among boys and girls was positively correlated ( $r = 0.849$ ,  $p = 0.032$ ). The most common method of obtaining cigarettes was “buying it from a store/kiosk/street hawker” and “other sources.” Except in Indonesia, financial access was limited for most youths. Financial access had a positive but negligible influence on cigarette smoking. Despite legal restrictions on sales to minors, students could obtain cigarettes from vendors.

**Conclusion:** Contextual cigarette smoking and access to cigarettes by youths despite the legal ban and unaffordability is a concern. Country-specific socio-cultural-economic and legal dimensions need to be examined to limit cigarette use among youths.

## KEYWORDS

access, youth, cigarettes, tobacco, global youth tobacco survey, South East Asia



## Introduction

The use of tobacco kills eight million people annually (1). In many countries, the cigarette is the most commonly used tobacco product, and most smokers start cigarette smoking when they are still minor (2). Nearly nine out of 10 cigarette smokers try their first cigarette before the age of 18 years (2). Evidence shows that adult smokers with less quit intention have a history of initiating smoking in their adolescence (3). This scientific information is being used by tobacco industries to target youths for increasing sales and overall consumption.

In 2020, South-East Asia Region (SEAR) reported the highest prevalence of tobacco consumption in the world, which was around 27.9% (4). The average prevalence of tobacco use among men and women was 46 and 9.7%, respectively (5). According to the World Health Organization, tobacco use in SEAR is expected to decrease to 25.1% by 2025, following a downward trend in all regions (5). However, the consumption of multiple tobacco products is increasing, which is in sync with increased tobacco promotion by the tobacco industries in this region that seeks to build a greater consumer base among the youth (6). Therefore, reducing tobacco use among youths is the key to ending the tobacco epidemic (7). Smoking among the youths is systematically monitored through the Global Youth Tobacco Survey (GYTS) (8), which generates evidence for policy formulation and implementation of tobacco control strategies (9).

A crucial component of the comprehensive tobacco control policy is to limit the availability and demand for tobacco products to dissuade children and young people from starting to smoke. This is a mandate of those who have ratified the WHO Framework Convention on Tobacco Control (FCTC). Except for Indonesia, every other country in the SEA has signed and ratified the WHO FCTC. Besides, the enforcement of compliant FCTC comprehensive tobacco legislation differs from country to country. Indonesia is a country that is neither a signatory nor a party to the FCTC (10, 11).

Age and access limitations on the sale of tobacco products have been implemented in several nations with varying degrees of effectiveness due to resource constraints associated with enforcing these laws. The less obvious reason could be that the prohibition creates the concealed perception that tobacco consumption is an adult habit, therefore, increasing its allure among teenagers. As a result, any publicity or activities aimed at enforcing the law could make younger people more likely to want to smoke (9). Disallowing self-service displays and vending machines is seen as a more efficient and realistic measure to minimize access to tobacco products among the youth (12, 13). One further measure that falls under the purview of restricting access is the response to the introduction of new types of tobacco products onto the market (14). Consequently, one preemptive

action that could be taken would be to prevent the introduction of new types of tobacco products.

Evidence demonstrates that comprehensive tobacco control strategies such as taxing, warning, and banning are required before limiting access to tobacco products (15). Before imposing any intervention to limit access to tobacco products for youth, we have to understand how and where they have access. Thus, this study examines the prevalence of cigarette use and youth vulnerability to access to cigarettes in the South-East Asia (SEA) region using GYTS data in the context of country-specific youth tobacco control policy environments.

## Methods

Context of GYTS data is from publicly available GYTS, a standardized and internationally comparable school-based survey among students aged 13–15 years from 8<sup>th</sup> and 9<sup>th</sup> grades. The GYTS is a part of the Global Tobacco Surveillance System that helps countries to monitor tobacco control activities as per the WHO Framework Convention on Tobacco Control (FCTC) and is funded by WHO and CDC.

The GYTS selects a representative sample of students from each nation using a two-stage cluster sampling technique. All schools are included in the sampling frame in a geographically defined area that contains any of the specified grade levels. At the initial stage, the probability that a school will be chosen is proportionate to the number of pupils enrolled in each grade. In the second stage of sampling, classes within the specified schools are selected at random. Classes within the selected schools were selected using a simple randomization technique. All students in chosen grade courses attending school on the day the survey is administered are eligible to participate in a self-administered survey. Participation is voluntary and anonymous (16). The GYTS has a set of 54 standard questions in English and local languages as per need (8). The questions mainly focus on the prevalence of smoked and smokeless tobacco among youths in schools, their accessibility to various tobacco products, their desire to quit smoking, their exposure to media and advertising, and their exposure to secondhand smoke (SHS).

Data were available for seven WHO SEA member countries. Bangladesh, Bhutan, East Timor, Indonesia, Myanmar, Sri Lanka, and Thailand conducted GYTS from 2013 to 2016 consecutively. The selection of countries was based on publicly available data. The achieved sample size ranged from 1,503 in Sri Lanka to 3,186 in Indonesia. Among the sample population total of 9,675 boys and 10,911 girls were considered with sizes ranging from 767 to 2,803 boys and 736 to 3,178 girls. The GYTS response rate ranged from 81.9% in Sri Lanka to 100% in Bangladesh (1).

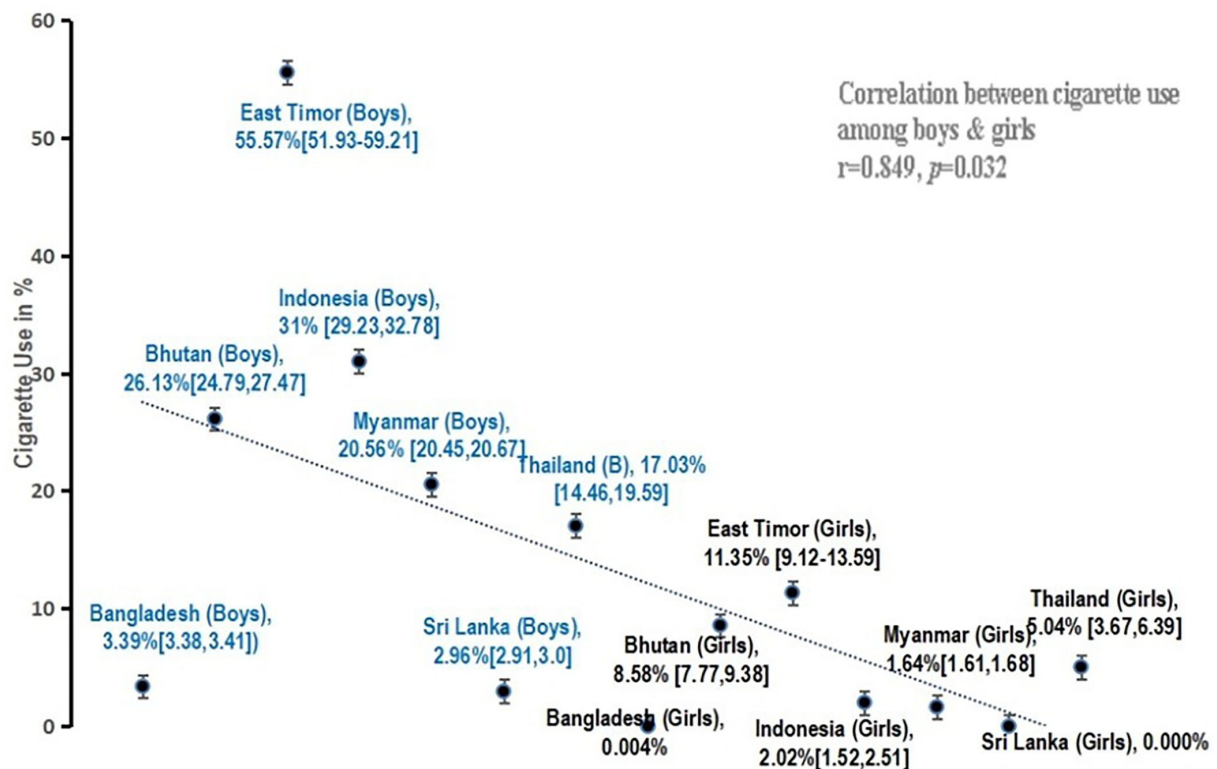


FIGURE 1  
 Prevalence of cigarette smoking among school-going children in seven SEA member countries.

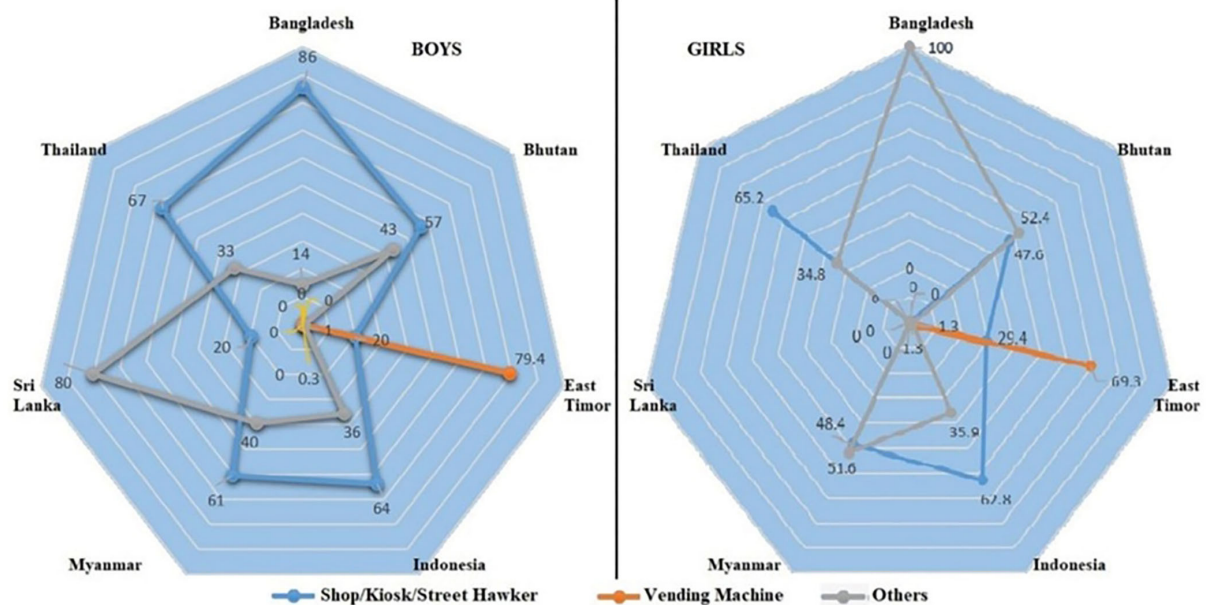


FIGURE 2  
 Physical access to cigarette smoking among school-going children in seven SEA member countries.

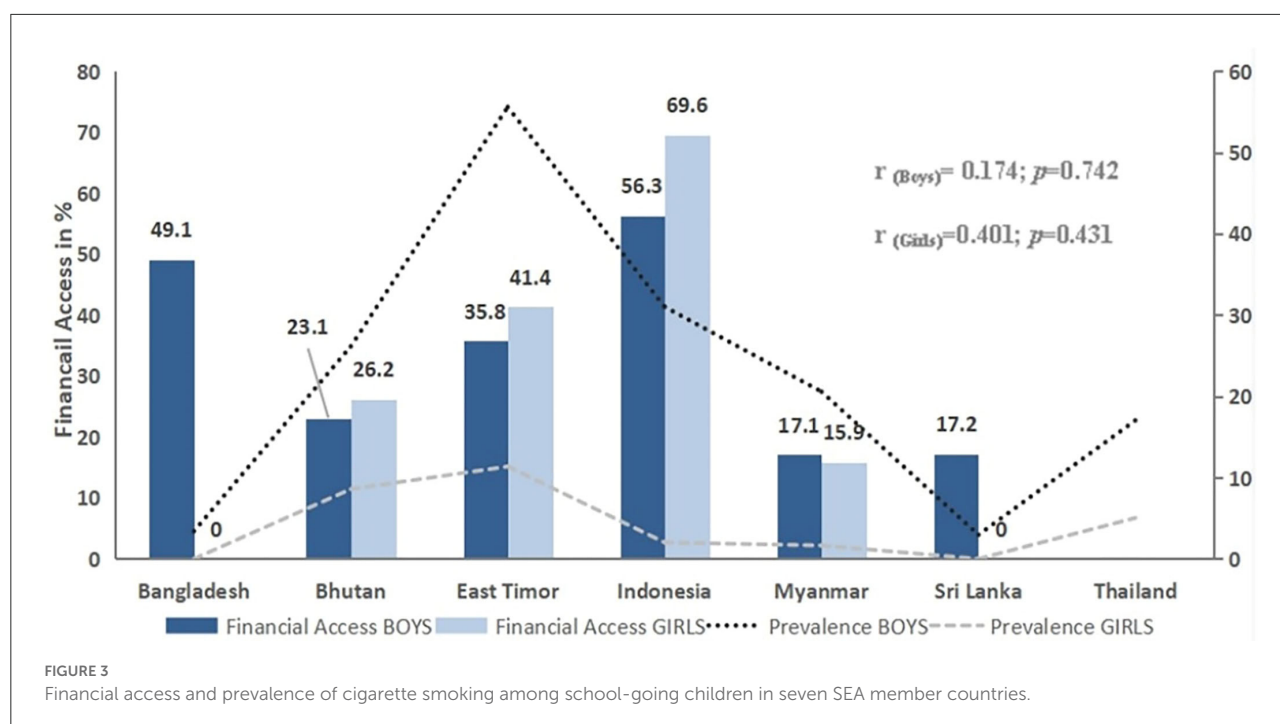


TABLE 1 Tobacco control (TC) policy environment for tobacco use restriction among youths and access to cigarettes by youths in seven South-East Asia member countries as per the Global Youth Tobacco Survey.

Country (GYTS Year)	Bangladesh (2013)	Bhutan (2013)	East Timor (2013)	Indonesia (2014)	Myanmar (2016)	Sri Lanka (2015)	Thailand (2015)
WHO FCTC signatories and ratification	14-06-04	23-08-04	22-12-04	–	21-04-04	11-11-03	08-11-04
Entry into force	27-02-05	27-02-05	22-03-05	–	27-02-05	27-02-05	27-02-05
First school tobacco control policy	2005	2010	2016	2009	2006	2006	2017
Prohibition of sales to or by minors& tobacco vending machines	2005	2010	2016	2012	2006	2015	2017
Legal age for sale or purchase of tobacco	18 Years	18 Years	17 Years	18 Years	18 Years	21 Years	18 Years
Vendor denied cigarette due to age	13	50.9	51.8	38.4	33.2	67.7	61
Boys (%)							
Girls (%)	0	52.0	48.1	41.9	48.4	0	46.4

## Study variables

This study examined physical access (method of obtaining cigarettes), illegal access (sales to minors), financial access (financial affordability, i.e., pocket money exceeding a pack of 20 cigarettes), and cigarette smoking. The analysis was further gender stratified, which represents a socio-cultural factor. The proportion of students reporting one or more cigarettes during the preceding 30 days of the survey was used to estimate the prevalence of current smoking (16). Students, who smoked currently, were asked about their primary mode of obtaining cigarettes. Physical access to cigarettes was assessed by the question, “During the last 30 days, how did you usually get

your cigarettes?” with the following answers: “I bought them in a store, shop or from a street vendor”; “I bought them from a vending machine”; “I gave someone money to buy them for me”; “I borrowed them from someone else”; “I stole them”; “An older person gave them to me”; or “I got them some other way.” The last four options were combined to form “other” sources.

The financial access was identified by the GYTS question “During an average week, how much money do you have that you can spend on yourself, however, you want?” and “On average, how much do you think a pack of 20 cigarettes cost?” (17). In this study, when the pocket money for 7 days was adequate to purchase a pack of

cigarette packs, then it was considered to have financial access to cigarettes.

Illegal access was determined when the youth had access to cigarettes from vendors despite the country's legal provisions banning sales to and sales by a minor. GYTS question "During the past 30 days, did anyone ever refuse to sell cigarettes because of your age?" along with the responses "I did not try to buy cigarettes during the past 30 days"; "Yes, someone refused to sell cigarettes because of my age"; and "No, my age did not keep me from buying cigarette" were analyzed and triangulated with country-specific tobacco control policy provision for tobacco restriction among youths.

## Data management and analysis

A descriptive statistical analysis was performed using the SPSS data processor version 21.0. Cigarette smoking prevalence was calculated as the sample number and weighted percentage. The weighting factor was incorporated into each student to account for nonresponse (by class and school) and variation in selection probability at the school and class levels. For physical access, a radar plot was present to illustrate various preferred methods for obtaining a cigarette. A dual Y-axis graph was used to describe financial access with the prevalence of cigarette smoking aged among 13–15 years school-going boys and girls in the SEA countries. The 95% confidence interval was also estimated for cigarette use prevalence. GYTS sample weight was used in the analysis. Correlation statistics were used as per the requirement.

## Ethical considerations

The GYTS data set is available in the public domain from CDC for researchers. Therefore, an ethics review was not deemed necessary.

## Results

The burden of cigarette smoking aged among 13–15 years school-going boys and girls in the SEA countries were in the range of nil to 55.57% as shown in [Figure 1](#) with their relative positions.

Cigarette smoking was lower in Sri Lanka (boys-3%, girls-0%) and Bangladesh (boys-3.4%, girls-0.004%) among both boys and girls. The highest prevalence was seen in East Timor (boys-55.57%; girls-11.35%). The prevalence of cigarette smoking was higher among boys as compared with girls. However, there was a strong positive correlation ( $r = 0.849$ ,  $p = 0.032$ ) between cigarette smoking among boys and girls ([Figure 1](#)).

The methods of physical access to cigarettes differed from one country to another ([Figure 2](#)). The most preferred method for obtaining a cigarette was from a store/shop/street hawker followed by other sources such as getting it from someone else/some other way; except for East Timor, where buying from vending machines was the most common method. Similarly, the most preferred methods of obtaining cigarettes among girls were from other sources than from stores/shops/street hawkers; except in East Timor, where vending machines, followed by stores/shops/street hawkers, were the favored methods of buying cigarettes.

The proportion of currently smoking boys who had obtained their cigarettes from a store/kiosk/shop was highest in Bangladesh (85.6%) and lowest in East Timor (20.1%), whereas "other" sources of obtaining cigarettes among currently smoking boys were highest in Sri Lanka (80.3%) and lowest in East Timor (0.5%). Boys getting their cigarettes from the vending machine were observed only in East Timor (79.4%) and Indonesia (0.3%). The proportion of currently smoking girls who had obtained from the store/kiosk/shop was highest in Thailand (65.2%) and lowest in Sri Lanka (0.01%), whereas "other" sources of obtaining cigarettes among currently smoking girls were highest in Bangladesh (100%) and lowest in East Timor (1.3%). Girls getting their cigarettes from the vending machine were observed only in East Timor (69.3%) and Indonesia (1.3%).

Data on financial access were available for all countries except for Thailand. Except for Indonesia and in all other countries, the pocket money for 7 days was inadequate to purchase a pack of cigarettes for most of the students. Girls' cigarette smoking was more than 2% in Bhutan, East Timor, and Indonesia, and financial access among girls was seen as higher as compared with boys. There was a positive but weak (statistically insignificant) correlation between financial access and cigarette use among boys and girls ([Figure 3](#)).

The review of the legal framework suggests that Bangladesh, Bhutan, East Timor, Myanmar, Sri Lanka, and Thailand ratified WHO FCTC in 2003 and 2004. Between 2005 and 2017, the countries enacted their national tobacco control legislation and school tobacco control policies, while GYTS was implemented between 2013 and 2016. East Timor and Thailand lacked tobacco control legislation at the time of GYTS, including a prohibition on tobacco sales to or by minors and vending machines. Despite limits on tobacco sales to minors in other countries, vendors supplied cigarettes to the majority of students, with the highest percentages for Bangladeshi boys (87%) and Indonesian girls (58.1%) ([Table 1](#)).

## Discussion

In this study, the overall prevalence of current cigarette smoking among youth ranges from nil (girls in Sri Lanka) to 55.57% (boys in East Timor). A comparison of all available data



is that the prevalence of current cigarette smoking is increasing in Bhutan, Indonesia, and Myanmar, while it is decreasing in Sri Lanka only. This study finds a higher prevalence of cigarette smoking among boys and girls in East Timor as compared with the other six countries (18). A study in East Timor also showed similar findings that the overall relevance of cigarette smoking among youth is 51% with the rate among boys at 59% and girls at 28%, respectively (19). The purchase of cigarettes from a store, shop, or street vendor was by far the most preferred method, followed by purchases made from other sources, such as friends or colleagues, or other methods. Evidence suggests that underage prohibitions in SEA member countries are not well-enforced, and adolescents have relatively easy access to tobacco *via* shops and stores (20). Despite insufficient pocket money, youths have easy access to cigarettes. The review of existing studies indicates that SEA member countries have not yet fully implemented and/or enforced laws that would make tobacco products less affordable and accessible (21). These laws include taxes, the sale of single cigarettes or loose tobacco products, and minimum legal smoking ages (22).

Framework Convention on Tobacco Control has been in place since 2004 to flatten the tobacco pandemic curve. Article 6 (tobacco taxation), Article 13 (ban on tobacco advertisements, promotions, and sponsorship), and the FCTC demand control steps have the propensity to protect the youths from tobacco use (23, 24). In addition, supply reduction by eliminating the illegal trade of tobacco products (Article 15) and restricting the selling of tobacco products to and by minors (Article 16) have also been implicated in minimizing the number of youth smokers (25).

Varying levels of enforcement of tobacco control policies across the SEA region might be the reason for the differential prevalence of cigarette smoking and access to cigarettes by youths. Youths' cigarette purchase is highly price-sensitive, which makes them vulnerable to less expensive purchases; getting is a blessing in disguise due to the availability of single sticks for the purchase of cigarettes, which is familiar in some countries (16). Full implementation of Article 16 faces critical barriers in the form of the attempt by the tobacco industry to undermine access laws, retailers' opposition, incomplete enforcement, and access to cigarettes at unregulated alternative outlets (17).

The vulnerable youth population was the victim of the higher prevalence of smoking due to the economic growth and the presence of a stronger tobacco industry in the region (26). Furthermore, the definition of the legal age for youths in buying cigarettes by country-specific tobacco control legislation varies. Despite the ban, most students can get their cigarettes from stores or shops or kiosks with limited objection from the vendors that are a cause of concern (27).

The differential tobacco use burden across countries in the SEA region and genders within countries, following full implementation of comprehensive tobacco control measures, may be the result of contextual sociocultural norms and adult

tobacco use (28). The projected one billion tobacco global fatalities in this century (15) can be effectively countered by the successful implementation of various provisions of FCTC, especially Article 16 (29). To curtail the factors affecting youth tobacco use, dissuading illegal sales to those under 18 years of age should be strictly enforced with existing anti-tobacco laws. Anti-tobacco legal provisions are effective only when comprehensive tobacco control measures are in place (30).

## Limitations

Self-reported data from 13 to 15 years of school-going students may be subjected to misreporting and may not be representative of the entire youth community in the given country. The GYTS survey years 2013–2016 may limit describing recent smoking behavior.

## Conclusion

Youth access to cigarettes is highly contextual and can defy legal restrictions and financial affordability. Boys consistently outnumbered their girl counterparts in smoking tobacco use emphasizing the need for an additional high-risk tobacco control approach for boys. Comprehensive tobacco control policies aimed at limiting youth access to tobacco products should be studied in the context of the respective country's social-cultural, financial, and regulatory surroundings. Tobacco promoter's activity needs to be linked with youths' access to tobacco products. The Global Youth Tobacco Survey may be routinely implemented to monitor tobacco use among youths and the effectiveness of the tobacco control policy.

## Implications for policy and practice

Evidence suggests that interventions such as limiting access to tobacco products can successfully be implemented only if comprehensive tobacco control measures such as taxation, health warnings, and bans are in place. Understanding how and where youths have access to cigarettes can help in devising effective tobacco control strategies. Restricting access and age restrictions on tobacco product sales have been enforced in many countries with varying success, due to resource constraints that inhibit the implementation of these laws. Access to cigarettes among youths is very contextual and can defy legal provisions and financial affordability. Comprehensive tobacco control strategies aimed at restricting youths' access to tobacco products may be viewed in the context of country-specific socio-cultural, economic, and legal environments.



## Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: <https://www.cdc.gov/tobacco/global/gtss/gtssdata/index.html>.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the (patients/participants OR patients/participants legal guardian/next of kin) was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

NS, PJ, and VE equally contributed to the study design, data analysis, and interpretation. NS made the first draft. PJ and VE

have critically reviewed with substantial contributions to the content. All authors participated in the conceptualization of the study, reviewed, and approved the manuscript.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## OPEN ACCESS

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## SPECIALTY SECTION

This article was submitted to  
Public Health Policy,  
a section of the journal  
Frontiers in Public Health

RECEIVED 22 July 2022

ACCEPTED 16 December 2022

PUBLISHED 09 January 2023

## CITATION

Silver NA, Bertrand A, Kucherlapaty P  
and Schillo BA (2023) Examining  
influencer compliance with advertising  
regulations in branded vaping content  
on Instagram.  
*Front. Public Health* 10:1001115.  
doi: 10.3389/fpubh.2022.1001115

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# Examining influencer compliance with advertising regulations in branded vaping content on Instagram

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**Background:** Youth and young adults are exposed to vaping advertisements on social media sites, despite regulations and guidelines intended to reduce the prevalence of such content on these platforms. This research uses replicable criteria to identify vaping influencers who have worked with vaping brands to promote vaping products on Instagram and documents the extent to which posts by these users comply with existing advertising regulations.

**Methodology:** We conducted three google searches collecting eight different vaping influencer lists, with a total of 575 unique influencers. We limited our sample to public accounts with 100,000 followers or more ( $n = 54$ ). An initial sample of 360 Instagram posts was used to identify an analytic sample of 262 vape-related posts from 2021. We conducted a conceptual content analysis to first identify unambiguous vaping advertisements (branded content), and then code ads for compliance with existing regulations.

**Results:** On average, the 54 Instagram accounts had 265,851.9 followers ( $sd = 383,349.8$ ) and 4,158 posts ( $sd = 7,302.1$ ). Most posts featured vaping products 239 (91.2%), with 186 (76.2%) posts being unambiguously branded vape advertisements and 31 (14.3%) even including purchase links in the post itself. However, one post complied with FTC disclosure guidelines. Although 50 (20.9%) had warning labels, only 8 (15.1%) were fully compliant with FDA warning label guidelines.

**Discussion:** Findings demonstrate minimal compliance with existing regulations among influencers known to have financial relationships with vaping brands. Most influencer posts are unambiguous, branded, vaping advertisements. Implications for barriers to regulating influencer content and the need for greater enforcement resources are discussed.

## KEYWORDS

advertising, promotion, tobacco industry, social media, Instagram

## 1. Introduction

Youth and young adults are often exposed to tobacco advertising through social media use. (1–3) As of 2021, an estimated 84% of young adults reported using at least one social media site (4, 5). Moreover, 53% of American youth report past 30-day exposure to tobacco advertisements on social media sites (1). Instagram, a visual social media platform most popular among youth and young adults (6), is particularly problematic, as an increase in vaping-related content (7) has created a platform where users are far more likely to be exposed to visually appealing vape advertisements than tobacco control and educational content (8). Exposure to vaping content on social media sites is associated with both lower risk perceptions as well as increased likelihood of initiation and habitual use of vaping products (9, 10). Youth vaping remains a prevalent public health problem with documented habitual use as early as middle school and an estimated 14.1% of high school students (11) and 9.7% of young adults 18–24 reporting current use (12). In light of the clear pathway between exposure to vaping content on social media and use and progression of vaping behavior, updated marketing policies that extend to social media platforms like Instagram are needed.

The stated aim of tobacco marketing restrictions in the Master Settlement Agreement (MSA) is “prohibiting tobacco companies from taking any action to target youth in the advertising, promotion, or marketing of tobacco products” (13). Youth-targeted ad characteristics like cartoons are strictly prohibited in advertisements promoting cigarettes and smokeless tobacco products (14). Moreover, “youth-targeting” was also conceptualized as the placement of ads where young people are likely to be exposed. As a result, promotional materials are not allowed near schools, at sporting events, or in youth-oriented magazines. Furthermore, cigarettes and smokeless tobacco cannot be promoted on broadcast media given the probability of youth exposure (14). Although a clear goal of the MSA was to keep tobacco ads off of platforms where youth exposure was likely, the MSA does not apply to newer products, like vaping, or newer mediums, like social media. Thus, there is a need for updated restrictions on advertising that are consistent with the current tobacco product and media landscape.

In the years following the deeming of e-cigarettes as tobacco products to be regulated by The U.S. Food and Drug Administration (FDA) Center for Tobacco Products (CTP), FDA CTP has issued guidance as to what constitutes youth appealing advertising, specifically highlighting the way “Marketers seek to create “brand ambassadors,” [i.e., social media influencers] who promote the product in the context of their online communications” (15). However, the ambiguous space between private citizens and hired brand representatives

occupied by social media influencers has made effective regulation elusive. Vaping companies often contract with influencers who are paid for their ability to target a niche audience (16) of potential buyers (17); and have become a vehicle for promoting products on social media, especially Instagram (18). Because influencers can also share organic, unpaid content, it can be difficult to identify which posts are subject to commercial regulation (18).

Instagram posts are potentially subject to a hodgepodge of existing regulations. The U.S Food and Drug Administration (FDA) prohibits unsubstantiated claims about health benefits or modified risk of vaping (19), and requires a nicotine health warning label to occupy at least 20% of an advertisement (20, 21). The Federal Trade Commission (FTC) issued guidelines for disclosing relationships between social media influencers and brands (22). Finally, Instagram’s branded content policies explicitly prohibit promotion of “tobacco products, vaporizers, electronic cigarettes, or any other products that simulate smoking” (23). However, previous research shows low compliance with FDA nicotine health warning requirements (24), low compliance with FTC disclosure guidelines among social media influencers (25), and limited impact of such restrictions on the volume of branded content still prevalent on Instagram (26). At the time data was collected for this study, hashtags such as #vape (31 million posts), #vapelife (17 million posts), and #vapecommunity (11.9 million posts) highlight the prevalence of vape-related content, while #vapestore (2.49 million posts) clearly indicates that a substantial portion of such posts are commercial (27).

The current research is based on the assumption that limited enforcement of existing regulations observed by previous research is the result of ambiguity regarding commercial vs. organic posts. Like previous research, we examine Instagram posts for compliance with existing regulatory guidelines. However, we go one step further in adding “explicitly branded content” by “known hireable entities” as criteria for inclusion. To inform the development of a policy framework for regulating advertising on Instagram, we take the perspective of a vaping brand seeking to hire social media influencers to promote vaping products on Instagram. We first identify a sample of known vaping influencers (i.e., hireable content creators easily identified *via* web search), capture a sample of their most recent content, identify branded vape content from within their most recent content We thus propose two research questions:

RQ1: What percentage of the most recent posts by known vaping influencers are unambiguously ads (i.e., promote branded vaping content)?

RQ2: How often are unambiguous vaping ads by vaping influencers in violation of existing regulations?

## 2. Methods

### 2.1. Procedure

A replicable protocol was established to systematically sample posts from known vaping influencers on Instagram who are available for hire. We then conducted a conceptual content analysis with two trained coders to identify posts that met our proposed criteria for unambiguous vape ads (e.g., promoted branded vaping products for sale) and identify their compliance with existing regulations.

### 2.2. Influencers and content sampling

We sought to mimic the process a brand might go through in finding an influencer to hire to promote a vaping product. We developed an online google search protocol to identify websites listing vaping influencers active on Instagram using an established definition of an influencer as “third-party actors who have established a significant number of relevant relationships to influence on organizational stakeholders through content production, content distribution, interaction, and personal appearance on the social web” (28). These lists were compiled by bloggers, sites advertising influencers for hire or Instagram users outside of the platform and required no log-in to access them and provided links to each influencer’s account. Our Google searches provided an initial sampling frame of 575 unique accounts, with between 1,042 and 2.6 million followers each. From those, we focused on the top 60 accounts with 100,000 followers or more. Two accounts were no longer active, and four were private, giving us a user sample of  $n = 54$  unique vaping influencers. To sample the influencers’ most recent activity, starting in October 2021, we downloaded a maximum of ten of the most recent posts from 2021. Several users had <10 posts from 2021, yielding an initial sample of  $n = 360$  posts made by vaping influencers unambiguously identified as available for hire to promote vaping brands on Instagram. The full search protocol is documented in Figure 1.

### 2.3. Codebook development

Our codebook and content analysis followed best practices established in *The Content Analysis Guidebook* (29). It is recommended that at least 10% of the sample be withheld to establish reliability, and that researchers and coders set multiple coding practices and meet frequently to discuss and resolve discrepancies. Given that we coded for concrete features that can be discreetly identified as present or absent (e.g., warning labels, disclosures etc.) rather than abstract features that are more subject to interpretation (e.g., ad themes or emotional appeals), we set a higher threshold for reliability of Krippendorff’s

alpha >0.8 and trained two research assistants to code the same reliability sample of  $n = 66$  posts. After reliability was established, the remaining posts were divided equally between the two coders. Coders first identified vape posts which were then coded for unambiguous ad characteristics (e.g., branded content), FTC brand relationship disclosure violations, and FDA claims or warning label violations. Table 1 presents all coded features, a summary of criteria used to identify coded features, and the resulting Krippendorff’s alpha values.

### 2.4. Identifying relevant content

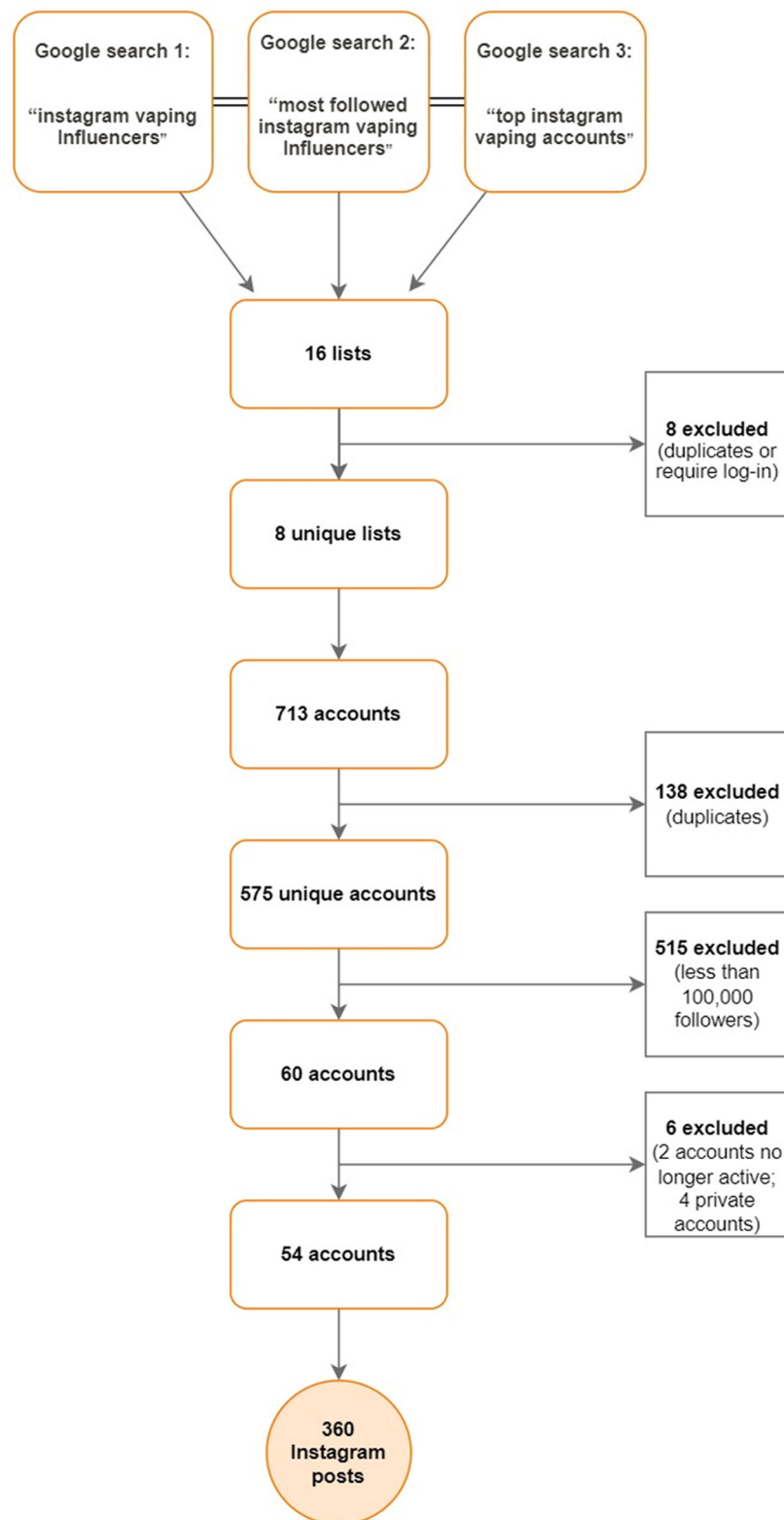
Not all posts by vaping influencers were related to vaping. We developed strict rules to determine whether a post was a vaping post or not. Our two coders identified the presence of at least one of the following key elements in the image: a vape device or parts including e-juice, coils, mouthpieces etc., 258 (98.47%),  $\alpha = 1$ , vaping behavior such as a vape cloud, 85 (32.44%),  $\alpha = 1$ , or a person, 80 (30.53%),  $\alpha = 1$ , or group of people, 2 (0.76%),  $\alpha = 1$ , actively drawing (inhaling from a vape). Ambiguous images (e.g., a cloud potentially though not clearly from vapor) were resolved using explicit cues in the text of the post (e.g., a vaping brand or hashtag that linked the cloud to vaping). We focused our analyses on  $n = 262$  unambiguous vaping posts from  $n = 54$  vaping influencers on Instagram.

## 3. Results

Information about each influencer was pulled directly from the bio section of their Instagram account. On average, the 54 vape influencer accounts had 265,851.9 followers ( $sd = 383,349.8$ ) and 4,158 posts ( $sd = 7,302.1$ ). The influencer accounts were not limited to individual people  $n = 28$  (51.8%), but also included brands,  $n = 15$  (27.8%), and other commercial entities such as retailers or shops,  $n = 17$  (31.5%), both of which are violations of Instagram’s internal policy. Influencer bios included links to vaping stores  $n = 17$  (31.5%). The accounts also had hashtags in their bios  $n = 17$  (31.5%) including vape-specific hashtags (e.g., #vaping, #vapelife).

At the post level, nearly all posts featured vaping products,  $n = 239$  (91.2%). Hashtags intended to reach online vaping community members (e.g., #vapelife, #vapefam, #vapeon) were frequent throughout the sample. Despite 186 posts (76.2%) being unambiguously branded, only 1 post complied with FTC requirements of disclosing brand relationships. Moreover, 31 (14.3%) posts provided links to purchase the advertised product, signifying but not disclosing a paid relationship between influencer and brand. Violations of FDA’s rules regarding unauthorized claims were rare (one post highlighted modified risk). However, only 50 posts (20.9%) had any warning label,





**FIGURE 1**  
Flow chart of key search terms, lists, and post selection.

TABLE 1 Krippendorff's alpha accessing reliability of coded post characteristics with summary of criteria.

Category	Post characteristic	Summary of criteria	$\alpha$
Vape ad	Vaping product	Presence of vaping products such as devices or device parts or e-liquids	1
	Branded	Presence of a product brand is clearly visible within the image	0.90
Instagram violation	Company	Post was by a specific company-owned account	0.96
FTC violation	Links to purchase	Post included link or redirection (link in bio) about where to buy an advertised product	0.95
	Review	Presence of a critical assessment or evaluation of the product featured on the image	0.94
	Disclosure	The presence of a statement indicating a financial relationship between the influencer and the product or brand in the post, including money, gifts, or other perks of monetary value	0.91
FDA violation	Modified risk/Harm reduction	Presence of a statement indicating the product featured in the image as being a modified risk tobacco product	0.97
	Warning label	Presence of health warning labels	0.97
	Warning Label and Image	Presence of a warning label across the post and covers 20% of the image	1
	Cartoon image	Presence of a cartoon character in the image	0.96
	Flavor visible	Presence of a flavor clearly visible within the image	0.82

with 8 (15.1%) of those being fully compliant with 20% of the image covered by a warning label. Finally, three posts used cartoon imagery in opposition to the FDA's warning about use of youth appealing advertisement.

## 4. Discussion

This research adds to the growing body of evidence highlighting the importance of addressing tobacco promotion on Instagram (3, 24, 26, 30–32). Although social media and the use of influencers pose unique challenges to regulators (18), our findings suggest that a significant amount of content includes egregious violations of already established rules. Nearly half of the influencer accounts we identified were vaping brands or retailers, many of whom use hashtags such as #vapelifes, #vaping, and #vapefam among others in their posts to disseminate such content among 10s of millions of ostensibly organic posts, all in clear violation of Instagram's stated policy. Moreover, with more than 90% of posts featuring specific products and more than 75% of posts including obvious branding, most of these posts were unambiguous vaping ads—explicit promotion of branded vaping products. Only eight were compliant with FDA guidelines and one was in compliance with FTC guidelines.

The most important takeaway from this research is that FTC disclosure guidelines for influencers to disclose brand relationships are insufficient. Our design identifies influencers who actively seek and maintain relationships with brands, post branded content that unambiguously promotes specific vaping products, and are for the most part, not in compliance with FDA, FTC, or Instagram advertising guidelines.

In conjunction with previous research identifying content promoting vaping on Instagram (26, 33), it is clear that greater resource allocation toward enforcement of existing regulations is needed.

Our findings also highlight the limitations of regulating influencer-based advertising at the level of the brand-influencer relationship. Like previous research, we show clear collaboration between brands and influencers to promote specific vaping products (24, 25). Conceptually, promotion of a specific brand or line of products is an ad. However, legally, in the absence of a disclosed financial relationship, such posts may be interpreted as organic and thus not subject to advertising restrictions. Regulating broadcast or print media at the level of the financial relationship between medium and brand was effective because billboards, ad space on TV, radio, magazines, or sports stadiums all necessarily implied a financial relationship wherein brands purchased ad space and were thus subject to advertising regulations. Posting on Instagram about a favorite product does not necessarily entail a financial relationship. In fact, there is undoubtedly a disincentive to disclose otherwise obvious relationships, as doing so would subject posts to regulatory scrutiny to which organic posts are exempt. Regulation of vaping promotion on Instagram likely requires a legal and conceptual definition of an ad that can be applied at the level of the post, as our analysis suggests the status quo is ineffective.

The generalizability of these findings is limited by our sampling method. We focus on influencers whose financial relationships to vape brands are easily identifiable through a systematic web search. As a result, our sample of influencers is likely not representative of the far broader population of

vape influencers employed by vaping brands and the tobacco industry. Moreover, by focusing on the last 10 posts rather than a random sample of each users' post history we provide more of a "snapshot in time" rather than a generalizable accounting of the percentage of influencer posts that are in violation of extant guidelines. Nevertheless, this study provides strong evidence that vaping ads comprise a significant portion of vaping content, but still appear to be exempt from regulatory enforcement.

## 4.1. Conclusion

There are inevitable challenges to regulating content on a platform like Instagram where organic users and users with commercial interests alike contribute to a seemingly endless onslaught of content that runs the gamut from personal artistic expression to branded product advertisements. Clear, unambiguous guidelines are needed to differentiate commercial content from organic content. The aim of a lot of vaping content on Instagram is not ambiguous including clearly branded and commercial-oriented promotion of specific vaping products. This study adds to the mounting pile of evidence highlighting the need for better enforcement of existing guidelines while also highlighting the potential need for better defined parameters for identifying commercial content subject to regulatory enforcement.

## Data availability statement

The datasets used in this study are publicly available on Instagram. The weblinks for all content used has been collated in the supplementary material. A copy of the coding instrument used can be made available upon request to the corresponding authors.

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## Author contributions

This study was conceptualized by NS and AB. The codebook was created by AB with input and supervision by NS and BS. PK supervised coding and conducted our analysis. NS, AB, PK, and BS contributed to the writing of the manuscript. All authors contributed to the article and approved the submitted version.

## Funding

This work was supported by Truth Initiative.

## Acknowledgments

The authors would like to thank Jamie Humphrey, Lan Margosis, Zahra Ehtesham, and Donna Vallone, who provided invaluable support.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## OPEN ACCESS

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## SPECIALTY SECTION

This article was submitted to  
Public Health Policy,  
a section of the journal  
Frontiers in Public Health

RECEIVED 10 August 2022

ACCEPTED 27 January 2023

PUBLISHED 17 February 2023

## CITATION

Jang YS, Joo HJ, Park YS, Park E-C and Jang S-I  
(2023) Association between smoking cessation  
and non-alcoholic fatty liver disease using  
NAFLD liver fat score.

*Front. Public Health* 11:1015919.

doi: 10.3389/fpubh.2023.1015919

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# Association between smoking cessation and non-alcoholic fatty liver disease using NAFLD liver fat score

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**Background:** Smoking is well known to be associated with a higher prevalence and incidence of liver diseases such as advanced fibrosis. However, the impact of smoking on developing nonalcoholic fatty liver disease remains controversial, and clinical data on this is limited. Therefore, this study aimed to investigate the association between smoking history and nonalcoholic fatty liver disease (NAFLD).

**Methods:** Data from the Korea National Health and Nutrition Examination Survey 2019–2020 were used for the analysis. NAFLD was diagnosed according to an NAFLD liver fat score of  $>-0.640$ . Smoking status was classified as into nonsmokers, ex-smokers, and current smokers. Multiple logistic regression analysis was conducted to examine the association between smoking history and NAFLD in the South Korean population.

**Results:** In total, 9,603 participants were enrolled in this study. The odds ratio (OR) for having NAFLD in ex-smokers and current smokers in males was 1.12 (95% confidence interval [CI]: 0.90–1.41) and 1.38 (95% CI: 1.08–1.76) compared to that in nonsmokers, respectively. The OR increased in magnitude with smoking status. Ex-smokers who ceased smoking for  $<10$  years (OR: 1.33, 95% CI: 1.00–1.77) were more likely to have a strong correlation with NAFLD. Furthermore, NAFLD had a dose-dependent positive effect on pack-years, which was 10 to 20 (OR: 1.39, 95% CI: 1.04–1.86) and over 20 (OR: 1.51, 95% CI: 1.14–2.00).

**Conclusion:** This study found that smoking may contribute to NAFLD. Our study suggests cessation of smoking may help management of NAFLD.

## KEYWORDS

smoking, smoking behavior, smoking history, smoking cessation, tobacco, pack-years, nonalcoholic fatty liver disease

## Introduction

Nonalcoholic fatty liver disease (NAFLD) is the most common chronic liver disease. It is a condition in which neutral fat accumulates excessively in the liver (1, 2). Although there are some differences in its frequency from country to country, it has been reported that 6.3 to 33% and an average of approximately 20% of patients worldwide have been affected by the disease (3). The prevalence of NAFLD is rapidly increasing in Asian countries due to the increase in Westernized eating habits, obesity, and the diabetic population (4, 5). In addition, between 10 and 29% of patients with nonalcoholic fatty hepatitis develop cirrhosis within 10 years and between 4 and 27% of patients develop liver cancer (6, 7). Furthermore, patients with NAFLD have a higher mortality rate than healthy controls, and the mortality rate related to liver disease is also high (8–11). Therefore, NAFLD must be managed immediately due to its expected serious public health burden and significant social costs (12, 13).



Tobacco smoke contains more than 7,000 chemicals, of which at least 250 are known to be harmful, such as ammonia and hydrogen cyanide (14, 15). Smoking is closely related to chronic diseases, such as cardiovascular diseases, cancer, and type 2 diabetes (16–19), which are also related to NAFLD (20–22). Previous studies have suggested smoking is associated with increased prevalence and incidence of liver diseases (23, 24). In particular, it has been reported to be an independent risk factor for the progression of advanced fibrosis in patients with primary biliary cirrhosis (23) and chronic hepatitis C (24).

A positive association between smoking and NAFLD has been continuously reported (25–27). An experimental study suggested cigarettes accelerated the progression of NAFLD in obese mice-fed diets (25). Furthermore, a study conducted in mice without apolipoprotein E, a condition wherein fatty liver is easily occurs, found that nicotine in electronic cigarettes (e-cigarettes) causes genetic mutations and promotes NAFLD outbreaks (26). Other studies have shown that the activation of sterol regulatory element-binding proteins (SREBPs), which stimulate the synthesis of fatty acids in the liver, is associated with NAFLD (27). These studies provided evidence of the mechanism of the relationship between smoking and the prevalence of NAFLD. However, most studies are experimental studies conducted on animals, and there are not many studies conducted on humans.

Therefore, this study aimed to examine the association between smoking history and NAFLD in a representative population and to explain whether smoking behavior plays a potential role in developing NAFLD.

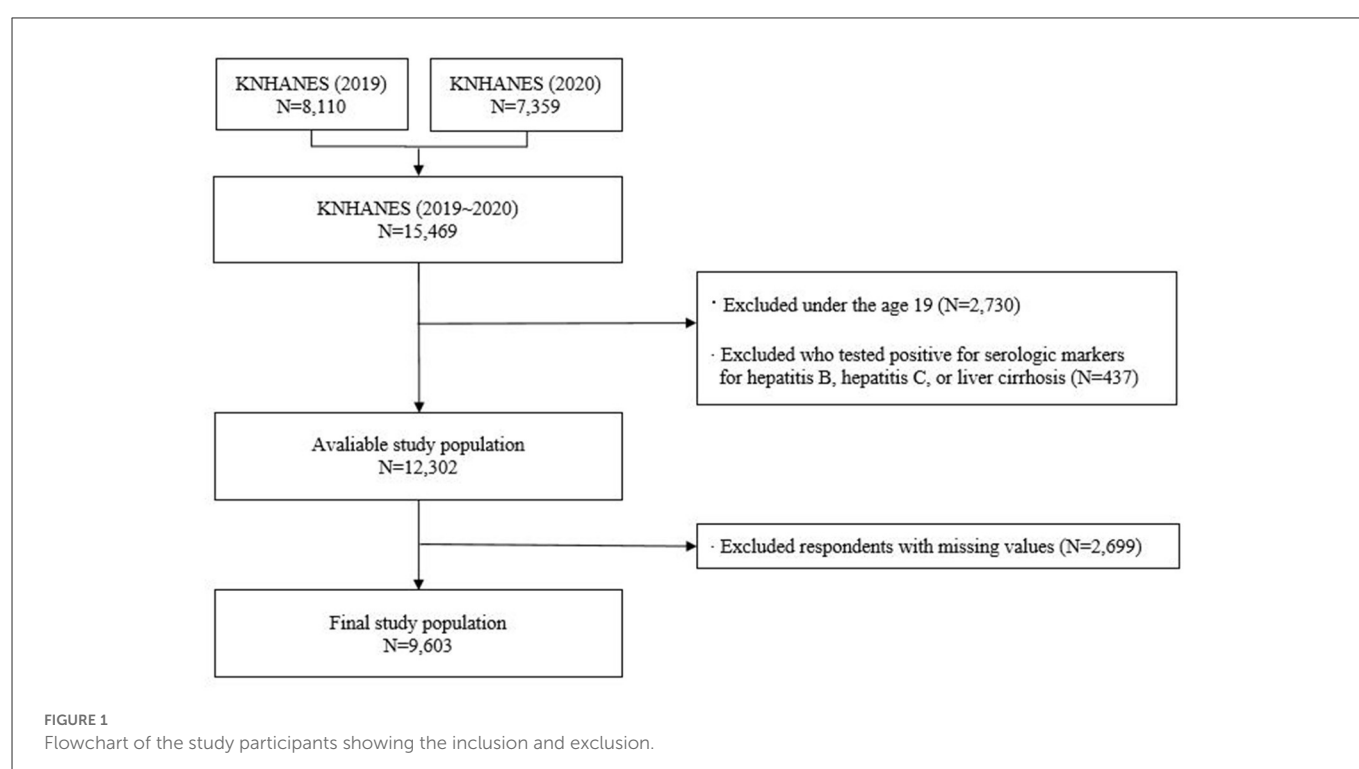
## Materials and methods

### Data

The study used cross-sectional data from the 2019–2020 National Health and Nutrition Examination Survey (KNHANES), conducted by the Korea Centers for Disease Control and Prevention Agency (KDCA). The KNAHENS is a self-report survey using a stratified, multistage, cluster sampling design conducted annually for South Koreans of all ages to evaluate the health and nutritional status. The survey provides data for the evaluation and development of health policies and programs and does not require ethical approval from the ethics review board, as the KNHANES conforms to the Declaration of Helsinki.

### Study population

Of the 15,469 survey participants, we excluded those under 19 years of age and those who did not participate in a KNHANES smoking questionnaire survey ( $n = 2,730$ ). Furthermore, participants who tested positive for serologic markers for liver diseases (hepatitis B, hepatitis C, and liver cirrhosis) were excluded ( $n = 437$ ). Participants with missing data were also excluded ( $n = 2,699$ ). Consequently, a final sample of 9,603 participants was analyzed in this study (Figure 1). As a study that examined the effects of smoking on NAFLD, participants with alcohol-related fatty liver disease were also excluded based on their biochemical and clinical profiles.



## Variables

The main dependent variable was the prevalence of NAFLD. NAFLD was diagnosed according to the NAFLD liver fat score developed by the Department of Medicine and the Minerva Medical Research Institute at Helsinki University (28). The NAFLD liver fat score formula was derived using a multivariate logistic regression model using metabolic syndrome, type 2 diabetes, fasting insulin (fS), serum aspartate aminotransferase (AST) ratio, and AST to serum alanine aminotransferase (ALT) ratio (28): NAFLD liver fat score =  $-0.89 + 1.18 \times \text{metabolic syndrome (yes = 1 / no = 0)} + 0.45 \times \text{diabetes (yes = 2 / no = 0)} + 0.15 \times \text{fS-insulin (}\mu\text{L)} + 0.04 \times \text{fS-AST (U/L)} - 0.94 \times \text{AST/ALT}$ . Participants were considered to have NAFLD if their liver fat score of NAFLD was  $> -0.640$  as the optimal cutoff point (28).

The primary independent variable was the smoking status of the participants, which was divided into three groups: (1) nonsmokers, (2) ex-smokers, and (3) current smokers. This was defined based on the questions: 'Do you currently smoke conventional cigarettes?'; "Do you currently smoke e-cigarettes?". This classification was the same as that of a previous study that used the same research tool to investigate smoking behavior (29).

The covariates included demographic factors (sex, age, marital status, and educational level), socioeconomic factors (household income, region, and occupational categories), behavioral health patterns (current drinking status, physical activity), and health-related factors (body mass index (BMI), diagnosis of hypertension, and diagnosis of diabetes).

## Statistical analysis

All estimates were calculated using sample weight procedures to improve representativeness and generalize the data. Clusters and strata were assigned to the study population. The general characteristics of the study group, represented by frequencies and percentages for categorical variables, means and standard deviations for continuous variables, were based on descriptive analysis. After adjusting for covariates, a multiple logistic regression analysis was performed to assess the relationship between smoking and NAFLD. Subgroup analyses were also performed according to age, current drinking status, physical activity, BMI, and diagnosis of hypertension and diabetes. Furthermore, we also performed a subgroup analysis for a more complete analysis of smoking behavior, including smoking cessation status (SCS) and pack years. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

## Results

Table 1 shows the characteristics of the study population. Of the 9,603 participants, 4,063 were men (42.3%) and 5,540 were women (57.7%). Among males, 1,249 (30.7%) were current smokers, 1,674 (41.2%) were ex-smokers, and 1,140 (28.1%) were nonsmokers. Among the females, 259 (4.7%) were current smokers, 312 (5.6%) were ex-smokers, and 4,969 (89.7%) were nonsmokers.

In total, 1,433 (35.3%) men and 1,278 (23.1%) women reported NAFLD.

Table 2 presents the results of the multiple regression analysis for the relationship between smoking and NAFLD stratified by sex after adjusting for all covariates. Among male participants, the odds ratios (OR) for NAFLD among ex-smokers and current smokers were 1.12 (95% confidence interval [CI]: 0.90–1.41) and 1.38 (95% CI: 1.08–1.76), respectively. In women, the OR for NAFLD among ex-smokers and current smokers were 1.32 (95% CI: 0.86–2.01) and 1.18 (95% CI: 0.76–1.83), respectively. Ex-smokers and current smokers exhibited an increasing trend of OR for NAFLD compared to that in nonsmokers, although there were statistically significant associations only in current smokers among males.

Figure 2 presents the results of the stratified subgroup analysis of the association between SCS and pack years, indicating the effect of the number of cigarettes and the smoking period on NAFLD according to smoking behavior. In general, with nonsmokers as the reference category, the OR for NAFLD increased linearly as smoking cessation decreased and pack years increased in males. Specifically, an ex-smoker with smoking cessation for  $<10$  years (OR: 1.33, 95% CI: 1.00–1.77) and a current smoker (OR: 1.38, 95% CI: 1.08–1.76) had the strongest statistically significant association compared to a nonsmoker, as classified based on the smoking cessation period. Furthermore, an ex-smoker and current smoker with 10 to 20 pack years (OR: 1.39, 95% CI: 1.04–1.86) and over 20 pack years (OR: 1.51, 95% CI: 1.14–2.00), respectively, was more likely to have a strong relationship with NAFLD compared to a nonsmoker.

Table 3 shows the results of the independent variable subgroup analysis, representing the ORs for NAFLD stratified by the smoking status. Among current male smokers, cases of never or occasional drinking (OR: 1.78, 95% CI: 1.14–2.78), adequate physical activity (OR: 1.55, 95% CI: 1.09–2.21), BMI indicating overweight (OR: 2.31, 95% CI: 1.40–3.83), no diagnosis of hypertension (OR: 1.42, 95% CI: 1.07–1.87), and no diagnosis of diabetes (OR: 1.39, 95% CI: 1.08–1.79) showed the strongest associations with NAFLD compared to male nonsmokers. In women, drinking 2 to 4 times per month (current smokers: OR: 1.39, 95% CI: 1.08–1.79), normal BMI (ex-smokers: OR: 2.74, 95% CI: 1.28–5.88), and BMI indicating stage 2 and 3 obesity (ex-smokers: OR: 4.36, 95% CI: 1.14–16.71) showed the strongest associations with NAFLD compared to those in nonsmokers.

## Discussion

The general findings were that there is an association between smoking and NAFLD, and the risk of having NAFLD has a dose-dependent negative association with the duration of smoking cessation and a positive association with pack years. Given these results, our study suggests that ex-smokers with an SCS of fewer than 10 years had associations similar to those seen in current smokers, while ex-smokers whose SCS was more than 20 years had no association. Furthermore, we found a strong linear association between the duration of smoking and the number of cigarettes smoked per day. These findings are consistent with the results of a previous study (30) and may provide supporting evidence for an association between smoking

TABLE 1 General characteristics of the study population.

Variables		Nonalcoholic fatty liver disease (NAFLD)													
		Male							Female						
		Total		Yes		No		P-value	Total		Yes		No		P-value
		N	%	N	%	N	%		N	%	N	%	N	%	
Total (N=9,603)		4,063	100.0	1,433	35.3	2,630	64.7		5,540	100.0	1,278	23.1	4,262	76.9	
Smoking Behavior								0.0014							0.5628
	Nonsmoker	1,140	28.1	354	31.1	786	68.9		4,969	89.7	1,156	23.3	3,813	76.7	
	Ex-smoker	1,674	41.2	629	37.6	1,045	62.4		312	5.6	65	20.8	247	79.2	
	Current smoker	1,249	30.7	450	36.0	799	64.0		259	4.7	57	22.0	202	78.0	
Age (Mean, SD)		51.6	17.2	52.2	15.9	51.3	17.9	<0.0001	51.8	16.4	49.8	16.3	58.6	14.9	<0.0001
Marital status								0.0185							0.1441
	Married	2,884	71.0	1,043	36.2	1,841	63.8		3,664	66.1	835	22.8	2,829	77.2	
	Divorced, Separated	166	4.1	67	40.4	99	59.6		343	6.2	94	27.4	249	72.6	
	Single, widow	1,013	24.9	323	31.9	690	68.1		1,533	27.7	349	22.8	1,184	77.2	
Educational level								0.8249							<0.0001
	Middle school or below	878	21.6	317	36.1	561	63.9		1,715	31.0	621	36.2	1,094	63.8	
	High school	1,472	36.2	513	34.9	959	65.1		1,787	32.3	381	21.3	1,406	78.7	
	College or over	1,713	42.2	603	35.2	1,110	64.8		2,038	36.8	276	13.5	1,762	86.5	
Household income								0.6334							<0.0001
	Low	651	16.0	224	34.4	427	65.6		1,046	18.9	353	33.7	693	66.3	
	Mid-low	985	24.2	364	37.0	621	63.0		1,360	24.5	334	24.6	1,026	75.4	
	Mid-high	1,129	27.8	396	35.1	733	64.9		1,488	26.9	297	20.0	1,191	80.0	
	High	1,298	31.9	449	34.6	849	65.4		1,646	29.7	294	17.9	1,352	82.1	
Region								0.2872							<0.0001
	Metropolitan	1,720	42.3	584	34.0	1,136	66.0		2,466	44.5	502	20.4	1,964	79.6	
	Urban	1,505	37.0	540	35.9	965	64.1		2,034	36.7	459	22.6	1,575	77.4	
	Rural	838	20.6	309	36.9	529	63.1		1,040	18.8	317	30.5	723	69.5	
Occupational categories								0.6403							<0.0001
	White	1,155	28.4	422	36.5	733	63.5		1,263	22.8	174	13.8	1,089	86.2	
	Pink	404	9.9	137	33.9	267	66.1		835	15.1	191	22.9	644	77.1	
	Blue	1,308	32.2	449	34.3	859	65.7		822	14.8	217	26.4	605	73.6	
	Inoccupation	1,196	29.4	425	35.5	771	64.5		2,620	47.3	696	26.6	1,924	73.4	
Current drinking status								0.0315							<0.0001
	Never or occasionally	1,273	31.3	435	34.2	838	65.8		3,310	59.7	892	26.9	2,418	73.1	
	2–4 times/month	1,478	36.4	498	33.7	980	66.3		1,633	29.5	297	18.2	1,336	81.8	
	2–4 times/week	1,312	32.3	500	38.1	812	61.9		597	10.8	89	14.9	508	85.1	
Physical activity								<0.0001							<0.0001
	Adequate	1,906	46.9	613	32.2	1,293	67.8		2,216	40.0	425	19.2	1,791	80.8	
	Inadequate	2,157	53.1	820	38.0	1,337	62.0		3,324	60.0	853	25.7	2,471	74.3	
BMI								<0.0001							<0.0001
	Normal	1,155	28.4	132	11.4	1,023	88.6		2,494	45.0	175	7.0	2,319	93.0	
	Underweight	92	2.3	3	3.3	89	96.7		272	4.9	6	2.2	266	97.8	
	Overweight	1,069	26.3	274	25.6	795	74.4		1,116	20.1	268	24.0	848	76.0	

(Continued)

TABLE 1 (Continued)

Variables		Nonalcoholic fatty liver disease (NAFLD)													
		Male							Female						
		Total		Yes		No		P-value	Total		Yes		No		P-value
		N	%	N	%	N	%		N	%	N	%	N	%	
	Obesity of stage 1	1,472	36.2	796	54.1	676	45.9		1,351	24.4	597	44.2	754	55.8	
	Obesity of stages 2&3	275	6.8	228	82.9	47	17.1		307	5.5	232	75.6	75	24.4	
Diagnosis of hypertension								<0.0001							<0.0001
	Yes	1,105	27.2	530	48.0	575	52.0		1,290	23.3	577	44.7	713	55.3	
	No	2,958	72.8	903	30.5	2,055	69.5		4,250	76.7	701	16.5	3,549	83.5	
Diagnosis of diabetes								<0.0001							<0.0001
	Yes	466	11.5	299	64.2	167	35.8		500	9.0	339	67.8	161	32.2	
	No	3,597	88.5	1,134	31.5	2,463	68.5		5,040	91.0	939	18.6	4,101	81.4	
Year								0.0018							0.1354
	2019	2,088	51.4	689	33.0	1,399	67.0		2,932	52.9	653	22.3	1,983	77.7	
	2020	1,975	48.6	744	37.7	1,231	62.3		2,608	47.1	625	24.0	2,279	76.0	

history and NAFLD. Smoking cessation reduces the incidence of NAFLD. However, due to the low number of female smokers in Korea, we could not find a relationship between smoking and NAFLD among females. However, although not statistically significant, the OR of former smokers and current smokers was higher than that of nonsmokers. This reflects the recall bias of self-reported data due to the poor perception of female smokers in Korea (31).

Smoking has been identified, as an adjunct to obesity, as a causative factor for NAFLD in animal and clinical studies (25, 32). This study found no association between smoking behavior and NAFLD in men with stages 1, 2, and 3 obesity; however, in overweight men and normal women, smoking behavior was a significant risk factor associated with NAFLD compared to nonsmoking. This supports the results of a previous study (33) suggesting that while severe obesity directly affects NAFLD in BMI groups, smoking may have an independent relationship in normal or overweight groups. A mechanism that explains the independent role of BMI in the association between smoking and NAFLD is that the antiestrogenic effect of cigarette smoking leads to a change in body fat distribution (34–36). Therefore, normal and overweight smokers who may not be evaluated for NAFLD should receive more attention to prevent NAFLD.

According to the multiple parallel hits hypothesis theory, the pathophysiological mechanisms of NAFLD indicate the causes of insulin resistance, genetic and epigenetic factors, mitochondrial dysfunction, endoplasmic reticulum stress, microbiota, chromatin low-grade injury, and dysfunction of adipose tissue (37, 38). In insulin-resistant patients, liver fat production can be further induced by activation of transcription factors such as SREBP-1 (38, 39). Many studies have shown that tobacco increases lipid accumulation in liver cells by regulating the activity of 5'-AMP-activated protein kinase (AMPK) and SREBP-1, two important molecules involved in lipid synthesis (27, 40–42). It is considered a mechanism between smoking and NAFLD, especially based on

previous studies that show a decisive role in liver fat accumulation in SREBP-1, when tobacco smoke is exposed to mice and cultured hepatocytes (27).

However, the effects of smoking on NAFLD remain controversial, with inconsistent results (43). One study reported that active smoking was associated with fibrosis in patients with NAFLD (25), but another study showed a lack of significant relationship between active smoking and NAFLD (44). Several experimental studies in mice have shown that nicotine, a dangerous substance in cigarettes, promotes the development of NAFLD or accelerates its progression (25–27). A systematic review and meta-analysis of 20 observational studies showed that smoking was significantly associated with NAFLD (43). Furthermore, second-hand smoking increases the risk of NAFLD around 1.38 times (43). Based on these mechanisms, experimental studies and cohort studies that consider additional confounders are needed.

This study had several limitations. First, it was a cross-sectional study. It may not establish temporal relations and may have found an inverse causal relationship. Therefore, caution is warranted when interpreting the results. More research is needed to clarify the association between smoking and NAFLD. Second, KNHANES data were collected through self-report surveys. Hence, data on health-related status, socioeconomic variables, and smoking status may not be reliable and accurate. In particular, this can lead to recall bias and is likely to be underestimated in the case of smoking. Third, although the liver fat score for NAFLD was demonstrated for the ROC curves for detecting NAFLD (sensitivity of 86% and specificity of 71%), there were still tiny errors of false-positive or false-negative results. In addition, due to the characteristics of the KNHANES called secondary data, the diagnosis of NAFLD was not measured by the instrument investigation, so steatosis could not be confirmed by methods such as CAP, ultrasound, and liver biopsy. Therefore, we calculated and considered the NAFLD liver fat score instead. Fourth, it could not differentiate among the various smoking types, such as

TABLE 2 Results of factors associated between smoking and nonalcoholic fatty liver disease.

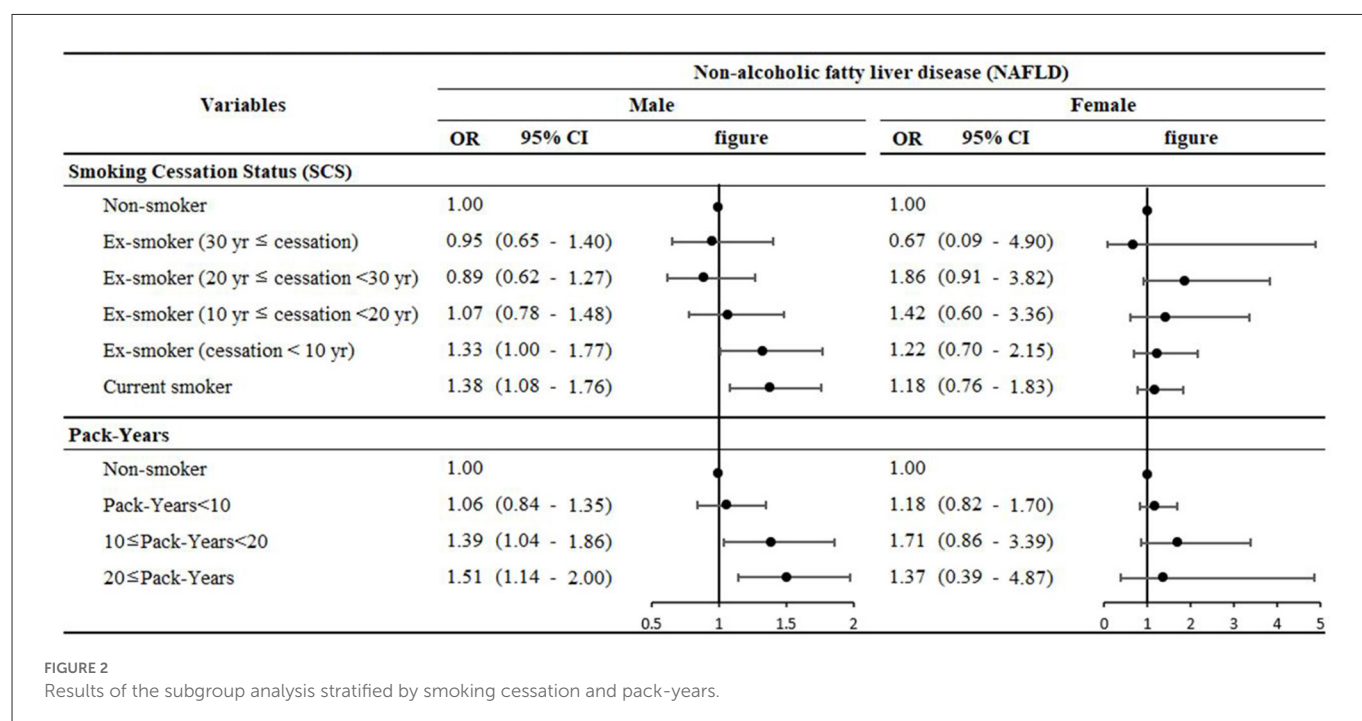
Variables		Nonalcoholic fatty liver disease (NAFLD)			
		Male		Female	
		OR	95% CI	OR	95% CI
Smoking Behavior					
	Nonsmoker	1.00		1.00	
	Ex-smoker	1.12	(0.90 – 1.41)	1.32	(0.86 – 2.01)
	Current smoker	1.38	(1.08 – 1.76)	1.18	(0.76 – 1.83)
Age		1.00	(1.00 – 1.01)	1.01	(1.00 – 1.83)
Marital status					
	Married	1.00		1.00	
	Divorced, Separated	1.29	(0.80 – 2.07)	1.31	(0.93 – 1.84)
	Single, widow	0.84	(0.64 – 1.10)	0.91	(0.72 – 1.13)
Educational level					
	Middle school or below	1.00		1.00	
	High school	1.07	(0.79 – 1.44)	1.03	(0.78 – 1.36)
	College or over	1.06	(0.77 – 1.45)	0.73	(0.53 – 1.01)
Household income					
	Low	1.04	(0.74 – 1.44)	0.83	(0.60 – 1.16)
	Mid-low	1.17	(0.92 – 1.49)	0.73	(0.55 – 0.95)
	Mid-high	0.97	(0.78 – 1.21)	0.68	(0.51 – 0.89)
	High	1.00		1.00	
Region					
	Metropolitan	1.00		1.00	
	Urban	1.06	(0.87 – 1.30)	1.12	(0.91 – 1.38)
	Rural	1.08	(0.85 – 1.38)	1.34	(1.01 – 1.77)
Occupational categories					
	White	0.88	(0.65 – 1.19)	0.81	(0.61 – 1.07)
	Pink	0.78	(0.55 – 1.09)	0.94	(0.72 – 1.23)
	Blue	0.71	(0.55 – 0.92)	0.63	(0.48 – 0.82)
	Inoccupation	1.00		1.00	
Current drinking status					
	Never or occasionally	1.00		1.00	
	2–4 times/month	0.89	(0.72 – 1.09)	0.85	(0.70 – 1.04)
	2–4 times/week	1.06	(0.86 – 1.31)	0.60	(0.43 – 0.84)
Physical activity					
	Adequate	1.00		1.00	
	Inadequate	1.44	(1.20 – 1.71)	1.33	(1.11 – 1.59)
BMI					
	Normal	1.00		1.00	
	Underweight	0.50	(0.14 – 1.78)	0.44	(0.17 – 1.15)
	Overweight	2.84	(2.09 – 3.86)	4.21	(3.28 – 5.41)
	Obesity of stage 1	10.44	(7.94 – 13.72)	11.48	(8.92 – 14.78)
	Obesity of stages 2&3	50.57	(32.58 – 78.48)	62.42	(41.29 – 94.35)

(Continued)



TABLE 2 (Continued)

Variables		Nonalcoholic fatty liver disease (NAFLD)			
		Male		Female	
		OR	95% CI	OR	95% CI
Diagnosis of hypertension					
	No	1.00		1.00	
	Yes	1.42	(1.14 – 1.77)	1.96	(1.55 – 2.48)
Diagnosis of diabetes					
	No	1.00		1.00	
	Yes	4.36	(3.28 – 5.80)	6.06	(4.41 – 8.31)
Year					
	2019	1.00		1.00	
	2020	1.06	(0.88 – 1.27)	0.95	(0.79 – 1.15)



conventional cigarette use, electronic cigarette use, or both. Besides, we could not calculate the pack years for e-cigarettes because the KNHANES did not include this information. Finally, we cannot exclude the possibility of unrecognized confounders, although we adjusted for known confounders in the relationship between smoking and NAFLD.

Despite these limitations, our study had several notable strengths. First, the study was based on the KNHANES data, a nationally representative dataset collected by the KDCA. This is useful for health-related research because it is updated annually to reflect the changes in the actual health situation of Koreans. In addition, it is a statistic that can generalize the study results to the general population because the survey is performed by reliable and representative random cluster sampling. Second, we calculated the SCS and pack years for ex-smokers and current smokers. The study showed a significant association between current smoking

behavior in men and smoking status considering SCS and pack-years. Therefore, our results suggest that smoking status has the opportunity to be considered as a measure of intervention to reduce the risk of NAFLD when SCS and pack years are taken into account.

## Conclusion

In conclusion, this study found that current smoking was associated with NAFLD in men in the South Korean population. In particular, we suggest an association between NAFLD and ex-smoker and current smoker status with a short smoking cessation period or many pack years. Given these results, smoking has a potential effect on NAFLD, and smoking cessation should be considered in the prevention and management of NAFLD. It is

TABLE 3 Results of subgroup analysis stratified by independent variables.

		Nonalcoholic fatty liver disease (NAFLD)										
		Male						Female				
		Non	Ex-smoker		Current smoker			Non	Ex-smoker		Current smoker	
		OR	OR	95% CI	OR	95% CI		OR	OR	95% CI	OR	95% CI
<b>Age</b>												
	20–29	1.00	0.53	(0.21 – 1.37)	1.06	(0.54 – 2.09)		1.00	0.82	(0.18 – 3.63)	1.12	(0.32 – 3.92)
	30–39	1.00	0.71	(0.33 – 1.51)	1.18	(0.65 – 2.16)		1.00	1.68	(0.41 – 6.84)	0.62	(0.15 – 2.51)
	40–49	1.00	1.35	(0.71 – 2.58)	1.47	(0.76 – 2.86)		1.00	1.40	(0.61 – 3.22)	0.74	(0.26 – 2.13)
	50–59	1.00	1.14	(0.62 – 2.08)	1.38	(0.72 – 2.62)		1.00	2.67	(1.06 – 6.73)	3.16	(1.12 – 8.86)
	60–69	1.00	1.58	(0.94 – 2.67)	1.51	(0.83 – 2.76)		1.00	0.78	(0.33 – 1.86)	1.07	(0.44 – 2.63)
	≥70	1.00	0.98	(0.58 – 1.66)	0.99	(0.43 – 2.27)		1.00	0.71	(0.18 – 2.85)	0.38	(0.10 – 1.39)
<b>Current drinking status</b>												
	Never or occasionally	1.00	0.97	(0.64 – 1.46)	1.78	(1.14 – 2.78)		1.00	1.12	(0.60 – 2.06)	0.61	(0.33 – 1.13)
	2–4 times/month	1.00	1.05	(0.74 – 1.50)	1.21	(0.84 – 1.76)		1.00	1.30	(0.59 – 2.87)	2.28	(1.14 – 4.56)
	2–4 times/week	1.00	1.52	(0.95 – 2.43)	1.56	(1.01 – 2.42)		1.00	2.56	(0.95 – 6.95)	0.91	(0.36 – 2.31)
<b>Physical activity</b>												
	Adequate	1.00	1.07	(0.77 – 1.50)	1.55	(1.09 – 2.21)		1.00	1.28	(0.67 – 2.44)	0.99	(0.48 – 2.03)
	Inadequate	1.00	1.15	(0.84 – 1.58)	1.28	(0.90 – 1.83)		1.00	1.33	(0.78 – 2.28)	1.27	(0.74 – 2.19)
<b>BMI</b>												
	Underweight	1.00	–	–	–	–	–	1.00	–	–	–	–
	Normal	1.00	1.32	(0.74 – 2.34)	1.14	(0.57 – 2.25)		1.00	2.74	(1.28 – 5.88)	2.16	(0.96 – 4.85)
	Overweight	1.00	1.63	(0.96 – 2.75)	2.31	(1.40 – 3.83)		1.00	0.79	(0.25 – 2.49)	1.04	(0.41 – 2.65)
	Obesity of stage 1	1.00	0.97	(0.71 – 1.33)	1.14	(0.82 – 1.60)		1.00	0.77	(0.38 – 1.57)	1.01	(0.52 – 1.96)
	Obesity of stages 2&3	1.00	0.86	(0.28 – 2.60)	1.73	(0.63 – 4.77)		1.00	4.36	(1.14 – 16.71)	1.21	(0.25 – 5.81)
<b>Diagnosis of hypertension</b>												
	No	1.00	1.07	(0.82 – 1.41)	1.42	(1.07 – 1.87)		1.00	1.33	(0.81 – 2.19)	1.28	(0.79 – 2.07)
	Yes	1.00	1.16	(0.74 – 1.82)	1.05	(0.62 – 1.78)		1.00	1.35	(0.61 – 2.99)	0.90	(0.34 – 2.37)
<b>Diagnosis of diabetes</b>												
	No	1.00	1.06	(0.83 – 1.35)	1.39	(1.08 – 1.79)		1.00	1.29	(0.83 – 2.01)	1.22	(0.76 – 1.95)
	Yes	1.00	1.79	(0.85 – 3.80)	0.91	(0.39 – 2.13)		1.00	2.14	(0.24 – 19.16)	1.19	(0.30 – 4.67)

best to stop smoking considering health status and behavior to avoid serious diseases. More prospective studies and clinical trials are required to clarify the relationship between smoking history and NAFLD.

## Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: <https://www.kdca.go.kr/index.es?sid=a2>.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## Author contributions

YSJ designed the study, collected data, performed statistical analysis, and drafted the manuscript. YSJ, HJJ, YSP, E-CP, and S-IJ contributed to the discussion. S-IJ is the guarantor of this work, has full access to all the study data, and assumes responsibility for the integrity of the data and the accuracy of the data analysis. All authors reviewed and edited the drafts of the manuscript, approved the final version, and approved the final manuscript.

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## Funding

This study was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea Government (MSIT) (No. 2022R1F1A1062794).

## Acknowledgments

The authors express sincere appreciation to our colleagues and professor from the Department of Public Health, Graduate School of Yonsei University, for their advice on this manuscript. We thank KDCA, which provided the KNAHNES.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## OPEN ACCESS

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## SPECIALTY SECTION

This article was submitted to  
Public Health Policy,  
a section of the journal  
Frontiers in Public Health

RECEIVED 24 June 2022

ACCEPTED 09 February 2023

PUBLISHED 17 March 2023

## CITATION

Alebshehy R, Silver K and Chamberlain P (2023)  
A “willingness to be orchestrated”: Why are UK  
diplomats working with tobacco companies?  
*Front. Public Health* 11:977713.  
doi: 10.3389/fpubh.2023.977713

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# A “willingness to be orchestrated”: Why are UK diplomats working with tobacco companies?

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**Background:** The tobacco epidemic is global and addressing it requires global collaboration. International and national policies have been adopted to promote collaboration for tobacco control, including an obligation on diplomatic missions to protect public health from the vested interests of the tobacco industry. However, incidents of diplomats engaging with the tobacco industry are still occurring despite these regulations. This paper presents a case study of a British ambassador actions, and it points to some of the challenges researchers face in monitoring such incidents.

**Methods:** The incident studied in this paper was first identified through regular media monitoring conducted by the Tobacco Control Research Group at the University of Bath. The incident was further investigated by using the tools made available by the United Kingdom (UK) Freedom of Information Act, including submitting a request, asking for internal review, and submitting a complaint to the Information Commissioner's Office.

**Results:** We identified clear evidence of the UK ambassador to Yemen opening a cigarette factory, part owned by British American Tobacco (BAT), in Jordan. Our investigation revealed a lack of documentation of this and similar incidents of interaction between diplomats and the tobacco industry. We raise concerns about the actions of diplomats which contravene both national and international policies.

**Discussion:** Monitoring and reporting such activities produces several challenges. Diplomats' interactions with the tobacco industry represent a major concern for public health as such interactions seem to be systematically repeated. This paper calls for action to better implement national and international policies to protect the public health including in low- and middle-income countries (LMICs).

## KEYWORDS

Framework Convention on Tobacco Control (FCTC), international law, tobacco industry, Article 5.3, diplomat, lobbying, foreign affairs, LMICs

## Introduction

There are multiple documented incidents of diplomatic representatives acting contrary to national and international law and apparently lobbying for the tobacco industry, particularly in Low- and Middle-Income Countries (LMICs), and the evidence suggests that diplomats, including ambassadors, have been utilized in many countries to serve the commercial interests of tobacco companies (1–4). While the activity has been documented worldwide, this strategy for interference is much more concentrated, originating largely in the big transnational tobacco companies. It is no coincidence that British American Tobacco (BAT), Philip Morris International and Japan Tobacco all have a presence in Geneva, the home of the World Health Organization and other key international



organizations including the World Trade Organization (WHO) and the International Labor Organization, all arenas where tobacco companies aim to exert influence (5).

This paper gives a summary of incidents where diplomats have contributed towards the promotion of tobacco companies, often in contravention of obligations under the WHO Framework Convention on Tobacco Control (WHO FCTC) (6). We detail a case of a United Kingdom (UK) ambassador engaging with the tobacco industry in Jordan and Yemen. We suggest such actions privilege business interests over those of public health. The exposure of such activities, and the continuous monitoring of the tobacco industry, is a requirement of the WHO FCTC. We make recommendations for research and policy change, including more rigorous documentation of diplomats' engagement with the industry. This would inform policy makers of the policies necessary to protect countries, especially LMICs, from such incidents.

## Background

Tobacco control regulations vary from one country to another. In national level tobacco control acts, the main aim is to protect public health within the jurisdiction of the country, without much focus on other populations. Therefore, there is usually an absence of policies regulating diplomats' actions abroad. However, the tobacco epidemic is a global one and therefore cross-border measures have been adopted by governments to tackle it. Additionally, there are international regulations which, while not specific to tobacco, are applicable to the tobacco control context. Relevant national and international regulations are summarized in **Box 1**.

Although monitoring diplomats' engagement with the tobacco industry is challenging, incidents of contact with the industry are documented by countries who are both Parties and Non-Parties to the WHO FCTC. High-level lobbying has been documented in Africa, Asia, Europe, and elsewhere, as tobacco companies have long received support from overseas missions (14–17). Although the incidents occurred in many countries, they have each been linked to one of the so-called “Big Four” transnational tobacco companies: Imperial Brands (previously Imperial Tobacco); British American Tobacco; Phillip Morris International; and Japan Tobacco International.

In this paper, we present a case related to BAT, one of the two transnationals based in the UK. It acts as a case study which helps to understand what diplomatic interactions with tobacco industry involve and might therefore guide further research looking at other instances of engagement by BAT and other transnational companies.

Early incidences of UK diplomats operating on behalf of tobacco companies have been identified in internal tobacco industry documents (18–23). These were before the WHO FCTC came into force. In recent years these continuing activities have been exposed *via* media investigations, questions in Parliament, and Freedom of Information (FOI) requests (1, 24–33). These show a strong public interest in examining how the diplomatic services engage with the tobacco industry. Examples of these activities by UK diplomats and others are summarized in **Box 2**. In this case study, an FOI request is used to investigate a case of a senior UK diplomat engaging with the tobacco industry.

## Methods

### Identifying the incident of this case study

Tobacco Tactics was launched in 2012 as an output from the Tobacco Control Research Group (TCRG) at the University of Bath. Since 2019, TCRG has been part of the global tobacco industry watchdog STOP. TCRG researchers regularly monitor and collect information on tobacco industry. The case studied in this paper was identified through media monitoring. Within a media article, there was a mention to a British ambassador attending the opening of an event celebrating an expansion of tobacco company in Jordan. There was not much information available in public domain about the incident or why the ambassador attended the event in contravention of national and international policies. Therefore, a decision was made to further investigate this incident.

### The methodology of investigation

Many countries have public access laws which give citizens the right to inspect documents held by their governing authorities. The exact nature of these access laws varies from country to another, but they generally allow any person to request a copy of any document held by government provided in doing so it doesn't breach confidentiality or other laws.

In the UK, the Freedom of Information Act was introduced in 2000 and came into effect in 2005. The Act excludes private companies, but information can be obtained in certain cases where they interact with the government. The presumption in the Freedom of Information Act is that material should be released but there are multiple exemptions that can be applied to justify withholding it. The Freedom of Information processes are overseen by the Information Commissioner's Office which can adjudicate on requests and ensure the Act is applied appropriately. Any person requesting information under the act has the right to appeal to the Information Commissioner's Office and if need be, to go all the way to the UK Supreme Court (the final court of appeal) if they believe the law has been wrongly applied (61). In this paper, an FOI request was used as the main tool to further investigate this incident of a British ambassador attending an event celebrating the expansion of a tobacco company in Jordan. The process included requesting an internal review by the Foreign, Commonwealth and Development Office, and a formal complaint to the Information Commissioner's Office, the UK's independent authority set up to uphold information rights in the public interest.

### Results: UK ambassador engaging with tobacco industry in Jordan and Yemen

The UK signed the WHO FCTC Treaty in 2003 and ratified it in 2004. In 2016, the UK initiated the FCTC 2030 project to support LMICs in tobacco control and implementation of the WHO FCTC (62). There are strong arguments that the UK diplomats' engagement with the tobacco industry is incompatible with the UK's leadership in global tobacco control. In 2019, the UK was placed number one in the Global Tobacco Industry

### BOX 1 Regulations related to diplomats and engagement with tobacco industry.

#### International law

Under international law, tobacco control measures are covered by two treaties: the World Health Organization Framework Convention on Tobacco Control (WHO FCTC), entered into force in 2005; and the Protocol to Eliminate Illicit Trade in Tobacco Products, entered into force in 2018. The WHO FCTC is one of the most rapidly and widely embraced treaties in United Nations history with 182 Parties (6).

Article 2 of the WHO FCTC states that it respects its Parties rights and obligations under other international agreements if they are compatible with the Parties' obligations under the WHO FCTC. In Article 4, the WHO FCTC recognizes the importance of international cooperation in establishing and implementing effective tobacco control measures. It highlights the need for comprehensive multisectoral measures to tackle the epidemic at international levels. This points to the need for a leading role from diplomatic missions to promote such collaboration among different countries.

In this context, it is important to flag the Vienna Convention on Diplomatic Relations, entered into force in 1964, that states in Article 31 that "The immunity of a diplomatic agent from the jurisdiction of the receiving State does not exempt him from the jurisdiction of the sending State." This points to the legal requirement for diplomats to respect regulations issued in their own state, which in some cases would include guidance on avoiding engagement with tobacco industry abroad. Article 41 of the Vienna Convention states that "it is the duty of all persons enjoying such privileges and immunities to respect the laws and regulations of the receiving State. They also have a duty not to interfere in the internal affairs of that State" (7). Considering that there are 182 Parties to the WHO FCTC, this flags the overall need of diplomats to respect the WHO FCTC obligations globally.

In addition to the recognized need for international collaboration to tackle the tobacco epidemic, countries which are Parties to the WHO FCTC commit to certain actions to fight the tobacco epidemic. The treaty particularly includes Article 5.3 that states that "In setting and implementing their public health policies with respect to tobacco control, Parties shall act to protect these policies from commercial and other vested interests of the tobacco industry in accordance with national law." In Article 5.4, the treaty requires Parties to cooperate in formulating measures for its implementation. In Article 20.4.c it requires Parties to cooperate with international organizations to have a global system to collect and disseminate information on the tobacco industry (6).

In addition to the Articles included in the WHO FCTC that highlight the need for international collaboration and the necessity of this collaboration in countering the tobacco industry, since the treaty came into force, the Parties have decided to develop and progress its implementation in many Conferences of Parties, known as COPs. In the third COP, the implementation guidelines of Article 5.3 were adopted, which included that "Parties should not grant incentives, privileges or benefits to the tobacco industry to establish or run their businesses" and to interact with tobacco industry "when and to the extent strictly necessary to enable them to effectively regulate the tobacco industry and tobacco products" (8). The sixth COP decided to urge parties to "raise awareness and adopt measures to implement Article 5.3 and its implementing Guidelines among all parts of government including diplomatic missions" (9). Another decision was made in the sixth COP to require governments to make sure the tobacco industry doesn't influence international trade and investment instruments and to "take into account their public health objectives in their negotiation of trade and investment agreements" (10).

#### National regulations

Some countries have adopted national policies to regulate diplomats' interactions with the tobacco industry: the UK published guidelines for overseas posts on support to the tobacco industry (11); Australia issued guidance for public officials on interacting with the tobacco industry (12); and the United States has policies prohibiting actions such as promotion of the sale or export of tobacco or actions seeking the reduction or removal of non-discriminatory restrictions by foreign governments on tobacco product marketing (13).

Interference Index, a report which ranks countries worldwide based on how well they implement and comply with Article 5.3 and its implementation guidelines (63).

However, the UK has failed to maintain such a position in the second and third editions of the Index (64). Diplomats appear to have repeatedly lobbied with the tobacco industry in LMICs in these instances (1). The incident related in this case study is not only evidence such behavior is ongoing but it also indicates a concerning lack of transparency when it comes to monitoring the UK's commitment to international treaties.

TCRG researchers found a news article (65) about the Kamaran company in Yemen (66), which is 31% owned by BAT and partially Yemen state-owned (67). The article presented a document that shows Kamaran gave money to a newspaper for the role played by the newspaper in combatting the illicit tobacco trade, and for supporting national companies, after the newspaper asked for money. The article also revealed how the company engaged in the civil war in Yemen and funded an armed group. In addition, it mentioned that the British ambassador attended the opening of an event celebrating an expansion of the company in Jordan.

A Kamaran press release found on its website, in Arabic, celebrated the opening of a new factory in a free trade zone in Jordan. This allows the factory to benefit from tax and customs relief. The company reported that officials from three countries attended the opening, including the British ambassador to Yemen, the Jordanian ambassador to Yemen and the Yemeni ambassador to Jordan (68). Further investigation identified a video (69) that shows (at 9:45) that Michael Aron (70), the then British Ambassador, attended the opening of the BAT's factory and was interviewed by the media. He highlighted in the video that BAT has investments in Yemen and this investment would benefit both BAT and Yemen. It is worth noting that this factory is in a free trade zone in Jordan, within the airport area, that provides multiple incentives to investors, as detailed in the statement of a Jordanian official in the same video.

As part of the investigation of this incident, the TCRG submitted an FOI request in September 2021 to the British Foreign, Commonwealth and Development Office requesting a list of all contacts UK embassy officials had had with tobacco companies in Yemen and Jordan for the period from 1 January 2018 to 29

## BOX 2 incidents of diplomats engaging with tobacco industry.

### The United Kingdom

Incidents of British diplomats' direct interventions for the benefit of the tobacco industry, spanning decades from the 1960s to the 1990s, were recorded in Indonesia (20), Mexico, where the British Ambassador confirmed his "willingness to be orchestrated when requested" (21, 22), and Cambodia, where the British Ambassador was "keen to encourage a BAT investment" (23).

In 1991 the British ambassador in Argentina hosted a dinner for British business interests in the country with a chance to meet government officials. A Foreign Office minister was present and among those attending were representatives from BAT (34). A year earlier BAT reported that a lobbying effort to persuade the Argentinian government on easing tax rises was "supported by the British Ambassador" (18).

In 1992, when BAT wanted to buy a cigarette firm in Czechoslovakia, they received advice from the British Ambassador who, according to BAT, was "very well informed about the current situation." However, it appeared that Phillip Morris International had already done the same: "[the British Ambassador] commented that the American Embassy were already claiming victory for Philip Morris." Nonetheless the British Ambassador advised BAT on who they should lobby in the government (19).

Further incidents have been documented since the WHO FCTC came into force in 2005, and after the adoption of relevant COP decisions including the implementation guidelines of Article 5.3.

In 2012, the British Ambassador in Panama lobbied over tax increases and the impact of cigarette smuggling on BAT, "one of the most important British Companies" (27, 35). The tobacco industry often cites an increase in the illicit tobacco trade as an argument not to increase tax, an argument found to lack substance (36, 37).

There is a documented "global pattern of engagement" by British officials for the benefit of BAT (1, 2), a high profile example being in Bangladesh, a country with one of the highest prevalence rates of tobacco use. The British High Commissioner lobbied over several years on behalf of BAT in respect of a court case instigated in 2013 by the Bangladesh Board of Revenue over an alleged £170 million in unpaid sales tax (1, 24, 38, 39). The exposure of this activity by advocates in Bangladesh in 2017 led to UK media coverage and questions in Parliament (25, 26, 40, 41). However, the UK Minister of State for the Foreign and Commonwealth Office argued that the demands of the government of Bangladesh, was "discriminatory" against BAT (41, 42).

In 2015, diplomats were found to be supporting BAT's business interests in Pakistan, including attending meetings where BAT lobbied against plans for larger health warnings on cigarette packets (27–30, 43). Implementation of this policy was then delayed allowing BAT to comply, a success for another common industry tactic (44, 45). A more recent FOI confirmed that in 2020, staff from the UK high commission in Pakistan attended a promotional event for a BAT's new nicotine pouch product Velo (31).

In addition to interventions by diplomatic staff, FOI requests also showed that UK officials had repeated contact with tobacco companies in Panama, Venezuela, Laos, Cuba, and Burundi (26, 32, 33). However a government minister said: "The Government does not catalogue the representations it makes on behalf of companies" (42, 46). This appears contrary to requirements for transparency spelled out in the UK government's own guidelines. In addition, attendance at events organized or sponsored by tobacco companies is prohibited by the guidelines. Other fora, including meetings and events organized by local chambers of commerce and other business organizations, are attended by diplomats and mission staff. However, details are not usually publicly disclosed, and information provided in FOIs can be scant (26).

### The United States

Over 30 years ago, in 1990, United States Trade Representative aggressively lobbied for American tobacco companies to access the Thai market (47). More recently, in 2017, the United States Ambassador to Vietnam endorsed the activities of the United States and the Association of Southeast Asian Nations Business Council. At the time, Phillip Morris International was vice-chair of its key committee on customs and trade, and led a trade delegation to meet with government officials, a delegation which included representatives of the tobacco company (48).

### Switzerland

In 2019, the Swiss embassy officials lobbied the President of the Parliament of the Republic of Moldova, for Phillip Morris International to be given an opportunity to contribute to new tobacco legislation including on heated tobacco products in which the company has an interest (3, 49–51). Phillip Morris International donated funding for the inauguration party of the new Swiss Embassy building in Moscow the same year (52, 53).

### Japan

Diplomats from Japan have helped tobacco companies to promote their activities in multiple countries. In 2015, the Japanese Ambassador to Ethiopia was present at the signing of the deal when Japan Tobacco International acquired 40% of the national tobacco company (54). Japanese missions have helped publicize tobacco company activities in Tanzania and Zambia (55, 56). In 2021, the Japanese Ambassador lobbied the government of Bangladesh on behalf of Japan Tobacco International criticizing taxation changes and other commercial factors impacting the tobacco company (57–59).

### Germany

In May 2022, the German ambassador to Beirut, visited the offices of the "Regie," the Lebanese Tobacco and Tobacco Inventory Administration, also present was the First Secretary for Financial Affairs who "was briefed on the achievements of the 'Reggie' in the fields of agriculture, industry, trade and others, and the societal role it has played in recent years" [translated from Arabic] (60).

September 2021, including incidents of diplomats attending or arranging meetings or functions and responding to correspondence or phone calls from the tobacco industry.

An initial response was received from the Foreign, Commonwealth and Development Office stating that the information would be provided by October 2021, then repeated communications were received delaying the response monthly for 4 months. The TCRG responded stating that it was minded to refer the whole issue to the Information Commissioner's Office. A response was finally received in February 2022, 5 months after submitting the initial FOI. However, the response failed to mention the incident when the UK ambassador engaged with the tobacco industry, and the Section 43 exemption on commercial confidentiality was used. The response also discloses that diplomats invited BAT to a British-Jordanian government event "the London Initiative," an international conference on trade and investment to be held in London in February 2019 (71–73). This invitation does not align with the WHO FCTC, as it is not an interaction necessary for the regulation of the tobacco industry and its products.

Within the same month, February 2022, an internal review was requested by the TCRG arguing that contacts between government officials and the tobacco industry are governed by the WHO FCTC to which the UK is a Party, and that the treaty requires Parties to limit contacts with the tobacco industry, to be transparent about any contacts and to report and disclose any contacts. The TCRG clarified that these discussions with the industry are of public interest not just in the UK, but also in the Middle East Region which has its own obligations to the WHO FCTC. The TCRG pointed out that the UK is not demonstrating leadership or good practice in the region by withholding information on contacts with the tobacco industry. The TCRG also highlighted that the FOI request asked for contacts between embassy officials in Yemen and Jordan and the tobacco industry between 1 January 2018 and 29 September 2021, however the response ignored the incident of the British Ambassador Michael Aron attending the opening of a new factory for the Kamaran company within the requested period.

A response was received from the Foreign, Commonwealth and Development Office in April 2022 stating that "... I am therefore satisfied that this exemption is engaged. The public interest arguments for and against release were also set out in detail in the response and I find that the balance of the public interest lies in favor of maintaining the exemption." A complaint to the Information Commissioner's Office was submitted within same month by the TCRG, and a response in May 2022 from the Information Commissioner's Office stated that the case was eligible for investigation and that a case officer would be allocated.

In December 2022, the Information Commissioner's Office decided that the Foreign, Commonwealth and Development Office should "disclose the information previously withheld under Section 43." It also decided that in failing to respond and disclose all non-exempt information within 20 working days of receipt of the request, the Foreign, Commonwealth and Development Office breached Section 10 (time for compliance with request) of the Freedom of Information Act.

The decision referred to the Foreign, Commonwealth and Development Office stating that the ambassador attended the event, opening the factory, but that "no formal record of the event was recorded and that there was no briefing prepared ahead of the

event," and that the Foreign, Commonwealth and Development Office "would only record details of more formal meetings and not receptions/launch events such as this." The decision number is IC-167611-D5S9 and is available at <https://ico.org.uk/>.

In December 2022, after the Information Commissioner's Office decision, the Foreign, Commonwealth and Development Office shared information which it had previously withheld: "We were approached by East of England Trading Co (UK company owned by a British Jordanian) to support them in a commercial conflict they had with the Government of Jordan related to their tobacco shipment that was held at their warehouses at Aqaba Free Zone. FCDO were unable to offer support as it was tobacco related."

## Discussion

In this case study, it is challenging to identify the extent of contravention of national and international policies, given the lack of information and transparency around government engagement. However, with the limited available data, the following points can be highlighted.

- The engagement between government officials with the tobacco industry appears to be a violation to the implementation guidelines of Article 5.3 of the WHO FCTC principle that limits interactions only to the extent necessary to regulate the tobacco industry and its products. Attending a factory opening does not seem to meet this standard of a necessary meeting.
- The fact that the tobacco manufacturer is established in a free trade zone with incentive provided to investors raises questions on the compliance to the implementation guidelines of Article 5.3 of the WHO FCTC principle requiring no preferential treatment or incentives to be given to the tobacco industry.
- The lack of information about the support provided by the UK ambassador to the tobacco industry and the initial use of the Section 43 exemption, despite a public interest consideration in how it should be applied; the final confirmation by the Foreign, Commonwealth and Development Office that the ambassador attended the event; and the statement that such incidents are not regularly reported all contradict the implementation guidelines of Article 5.3 of the WHO FCTC principle that requires the Parties to be transparent when interacting with the tobacco industry. Similarly:
- The Foreign, Commonwealth and Development Office response used the Section 43 exemption that applies in trade situations, even though the COP to the WHO FCTC decided before in decision FCTC/COP6 (19) that Parties are required to make sure the tobacco industry doesn't influence international trade and investment instruments and governments "take into account their public health objectives in their negotiation of trade and investment agreements."
- The fact that this manufacture engages Yemen, a country in emergency, contradicts the WHO FCTC COP decision FCTC/COP8 (20) that requires Parties facing complex emergencies to continue to fulfill their obligations under the WHO FCTC to the extent possible, and more importantly...

to pay special attention to Article 5.3 of the WHO FCTC and related Guidelines.

- The participation of the UK ambassador in the factory opening appears to contradict the UK's revised guidelines for overseas posts on support to the tobacco industry. The guidelines clearly state that "Posts must not... Attend or otherwise support receptions or high-profile events, especially those where a tobacco company is the sole or main sponsor and/or which are overtly to promote tobacco products or the tobacco industry (such as the official opening of a UK tobacco factory overseas)."
- In addition to the violations above related to the incident of opening a tobacco factory, the Foreign, Commonwealth and Development Office response to the FOI disclosed that diplomats invited BAT to a British-Jordanian government event "London Initiative," another case which appears to contradict requirements of Article 5.3 of the WHO FCTC.

The Foreign, Commonwealth and Development Office final response stated that when asked for support by a tobacco company, they "were unable to offer support as it was tobacco related." This implies that they are aware of the specific requirements when it comes to dealing with the tobacco industry. This situation raises two fundamental questions: did the ambassador attend the opening despite knowing this is against the national guidance and the international treaty guidelines? And if so, what power or influence does the tobacco industry have to make a UK ambassador act in contrary to his government's guidance and the obligations of an international treaty?

For countries like the UK that want to play a leading global role in tobacco control, the whole government should be aligned to this purpose. In this case study, it seems that while the UK funded tobacco control activities in Jordan through the FCTC 2030 project, its diplomats were engaging with a tobacco company which was expanding in the country at same time. This contradiction raises a question around the UK's priorities specifically in Yemen and Jordan, and in LMICs more generally. Does the UK want to support BAT or promote public health? The UK's image as a global public health leader is further tarnished when the British ambassador engages with a tobacco company accused of fuelling civil war. The sensitivity about such actions is especially acute in a region where the UK has a long colonial history. Making economic threats, as in the case of the Japanese diplomats in Bangladesh, indicates that some governments might use their diplomats to intimidate those acting against big tobacco's corporate interests.

The tobacco epidemic was recognized as a global threat to public health decades ago. The need for international collaboration in tackling tobacco use was identified as a necessity in the WHO FCTC treaty almost two decades ago. Diplomats' behavior in engaging the tobacco industry is a major risk for such global collaboration and undermines global public health efforts to address the epidemic. There is a huge concern around equity when a country does very well in tobacco control within its own borders, but still supports the tobacco industry overseas. Prioritizing one country's own economic benefit over another's public health is just not fair.

Discriminatory actions against the tobacco industry are a right given by international law to governments as a tool to be used in tackling the tobacco epidemic. For example, the implementation guidelines of Article 5.3 of the WHO FCTC urge Parties to exclude the tobacco industry from any health setting related to tobacco control and it urges Parties to decline corporate social responsibility activities by the tobacco industry. The treaty does not consider the tobacco industry as a normal industry, but describes it as the vector of the tobacco epidemic. Therefore, diplomats' actions in supporting the tobacco industry helps to potentially normalize the tobacco industry a business like any other, contrary to public health measures and aims.

The fact that the information about diplomats' engagement with the tobacco industry is very challenging to get, and that such interactions are sometimes protected by legal exemptions from disclosure, creates an extra burden on Parties and civil society in their efforts to fulfill the WHO FCTC treaty requirements of monitoring and exposing the tobacco industry. Investigating the case study presented in this paper took from August 2021 to December 2022 to be concluded.

The British ambassador claimed in media that there are benefits to Yemen from tobacco industry expansion and from BAT's presence. This claim coming from a high official is an action which undermines public health efforts in the host country. While the WHO FCTC treaty bans corporate social responsibility to avoid giving the industry the image of being a responsible partner, such behavior from the diplomat contradicts the core aim of the treaty and undermines its value.

## Conclusion and recommendations

We have set out in this paper a case study of the activities of diplomats which strongly suggest that the both the spirit and the rules of the WHO FCTC have been breached. We have also set out a brief historical context to show that there is a much longer history in many countries of the diplomatic corps serving tobacco industry needs. It is fair to say that the business of governments abroad is very often business—representing the interests of domestic corporations which employ voters, pay taxes and make donations, and can wield political influence. Nonetheless, other commercial activities are not regulated by the WHO FCTC and the treaty is clear on what is and what is not prohibited in this area. Our case study, we suggest, is not technical transgression in isolation but a pattern of egregious subversion of an international treaty.

We call the Parties to the WHO FCTC to confirm the extent of Article 5.3 to ensure that government representatives abroad abide by its provisions as closely as they would at home. The COP guidance could give particular focus to this issue and require that both the home and the hosting country disclose any information related to tobacco industry discussions to the public through its relevant transparency processes. Therefore, if a diplomat wanted to send a lobbying letter to a minister in their host country, they should expect that this letter to be publicly available. By acting in this way, the guidance is not identifying particular countries or



particular companies—it is merely ensuring that the same effective level of activity is demanded globally.

At a national level, we call the governments to raise awareness on policies and procedures to be followed abroad when dealing with the tobacco industry. We strongly recommend adoption of standardized procedures to report on any interaction between diplomats and tobacco industry. A template that includes specific details—who, what, why, where, how, and the outcome of any interaction—should be completed for all interactions and disclosed.

The information gathered here was available from public sources using different methods but none of which required special status. The use of public access laws to extract information and hold governments and the industry to account is one which we feel could be deployed more effectively. Tobacco control advocates might wish to consider how they could use this research, what support they might need from the global community and how this information could be shared to have maximum impact. There is a real opportunity here to intensify the spotlight on tobacco industry interference in this particular sphere.

## Author contributions

RA identified this case study, conducted the investigation including the processes of FOI, internal review, and the Information Commissioner's Office investigation requests and prepared the manuscript. KS contributed to the writing and reviewing of the manuscript providing an overview of the similar

incidents globally. PC provided guidance to the investigation process and contributed to the writing and reviewing of the manuscript. All authors read and agreed on the final manuscript.

## Funding

The authors received funding for this work from Bloomberg Philanthropies, as part of the Bloomberg Initiative to Reduce Tobacco Use. The funders played no role in the research.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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