Addictive Behaviors 87 (2018) 162–168

Contents lists available at ScienceDirect

Addictive Behaviors

journal homepage: www.elsevier.com/locate/addictbeh

The impact and relevance of tobacco control research in low-and middle-income countries globally and to the US

Carla J. Berg[a,*], Geoffrey T. Fong[b], James F. Thrasher[c,m], Joanna E. Cohen[d], Wasim Maziak[e], Harry Lando[f], Jeffrey Drope[g], Raul Mejia[h], Joaquin Barnoya[i], Rima Nakkash[j], Ramzi G. Salloum[k], Mark Parascandola[l]

[a] Department of Behavioral Sciences and Health Education, Rollins School of Public Health, Emory University, 1518 Clifton Rd NE, Atlanta, GA 30322, United States
[b] Department of Psychology and School of Public Health and Health Systems, University of Waterloo, 200 University Avenue West, Waterloo, Ontario, N2L G1 Canada, Ontario Institute for Cancer Research, Toronto, Ontario, Canada
[c] Department of Health Promotion, Education and Behavior, Arnold School of Public Health, University of South Carolina, 915 Greene Street, Columbia, SC 29208, United States
[d] Department of Health, Behavior and Society, Bloomberg School of Public Health, Johns Hopkins University, 2213 McElderry Street, Baltimore, MD 21205, United States
[e] Department of Epidemiology, Robert Stempel College of Public Health and Social Work, Florida International University, 11200 SW 8h Street, AHC5 505, Miami, FL 33199, United States
[f] Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, 1300 South Second Street, Minneapolis, MN 55454, United States
[g] Department of Economic and Health Policy Research, American Cancer Society, 250 Williams St, Atlanta, GA, 30303, United States
[h] Centro de Estudios de Estado y Sociedad, Sánchez de Bustamante 27, C1173AAA, Buenos Aires, Argentina
[i] Division of Public Health Sciences, Department of Surgery, Washington University in St. Louis, 660 South Euclid Ave, St. Louis, MS 63110, United States
[j] Department of Health Promotion and Community Health, American University of Beirut, PO, Box 11-0236, Beirut, Lebanon
[k] Department of Health Outcomes and Biomedical Informatics, College of Medicine, University of Florida, 2004 Mowry Rd, Gainesville, FL 32610, United States
[l] Tobacco Control Research Branch, Division of Cancer Control and Population Sciences, National Cancer Institute, 9609 Medical Center Drive, Bethesda, MD 20892, United States
[m] Center for Population Health Research, National Institute of Public Health, Cuernavaca, Mexico

ARTICLE INFO

Keywords:
Global tobacco
Tobacco control
Policy
Research capacity-building
LMICs

ABSTRACT

International and cross-cultural research is critical for understanding multilevel influences on health, health behaviors, and disease. A particularly relevant area of need for such research is tobacco control. The tobacco epidemic is one of the biggest public health threats globally, killing over 7 million people a year. Research critical to addressing this public health problem has leveraged variability in tobacco use, history, product market, and policies across different countries, settings, and populations, particularly in low- and middle-income countries (LMICs) where the tobacco burden is increasing. These efforts are needed in order to advance the science and inform practice and policy in various settings, including the US. Several funding agencies provide support for international research focused on tobacco control in LMICs because of the importance and implications of such research. This paper provides some concrete examples of how such research has advanced our knowledge-base and informed practice and policy globally, particularly in high-income countries including the US. Some prominent themes emphasized in this manuscript include: the development of knowledge regarding the diverse tobacco products on the market; better understanding of tobacco use and its impact among different populations; generating knowledge about the impacts including unintended consequences of tobacco control policy interventions; and better understanding tobacco industry strategies and informing advocacy efforts. In summary, international tobacco control research, particularly in LMICs, is critical in effectively and efficiently building the evidence base to advance tobacco control research, policy, and practice globally, including the US, with the ultimate goal of curbing the tobacco epidemic.

* Corresponding author at: Department of Behavioral Sciences and Health Education, Emory University School of Public Health, 1518 Clifton Road, NE, Room 524, Atlanta, GA 30322, United States.
E-mail addresses: cjberg@emory.edu (C.J. Berg), gfong@uwaterloo.ca (G.T. Fong), thrasher@mailbox.sc.edu (J.F. Thrasher), jcohen@jhu.edu (J.E. Cohen), wmaziak@fiu.edu (W. Maziak), lando001@umn.edu (H. Lando), jeffrey.drope@cancer.org (J. Drope), raulmejia@cedes.org (R. Mejia), barnoyaj@wustl.edu (J. Barnoya), rn06@aub.edu.lb (R. Nakkash), rsalloum@ufl.edu (R.G. Salloum), paramark@mail.nih.gov (M. Parascandola).

https://doi.org/10.1016/j.addbeh.2018.07.012
Received 4 May 2018; Received in revised form 11 July 2018; Accepted 15 July 2018
Available online 17 July 2018

1. Introduction

The tobacco epidemic is one of the biggest public health threats globally, killing more than 7 million people a year, with tobacco-related morbidity and mortality increasingly burdening low- and middle-income countries (LMICs). (World Health Organization, 2015a). Recent literature has underscored the importance of international health research (Glass, 2013; Greenwald & Dunn, 2009; Maziak, 2017) and international tobacco control research specifically, (Maziak, 2017; Parascandola & Bloch, 2016) as variability at the macro levels (e.g., policy, social, environmental) is critical for estimating the influence of these factors on health. (Glass, 2013; Greenwald & Dunn, 2009; McLeroy, Bibeau, Steckler, & Glanz, 1988). In the context of tobacco control, the variability in macro-level factors globally, particularly differences in tobacco control in LMICs versus high-income countries (HICs), has provided strategic opportunities for research examining multilevel influences on tobacco use behavior and related disease. (Glass, 2013; Greenwald & Dunn, 2009). Consideration of factors such as understanding where health risk behaviors and related diseases are most prevalent (or, in some cases, absent) may advance our knowledge regarding mechanisms and risk factors. (Glass, 2013; Greenwald & Dunn, 2009). In addition, because of increased migration and globalization of the tobacco product market, it is important to understand tobacco products and patterns of use in parts of the world where they are prominent in order to advance knowledge to inform other communities as product markets expand. Moreover, a broad range of evidence-based measures for tobacco control are being implemented globally in different ways across diverse settings, allowing estimations of policy impact and the factors that influence them.

Several funding agencies provide support for research in different countries or across countries, particularly LMICs. For example, the Fogarty International Center (FIC) at the US National Institutes of Health (NIH) has provided support for research training programs related to various public health initiatives in LMICs for over 50 years, now extending to more than 100 countries. (NIH Fogarty International Center, 2017). In 2002, FIC and its partners awarded the first International Tobacco and Health Research and Capacity Building Program (TOBAC) grants, all of which involved collaborations with institutions and scientists in LMICs. This entity and other key funding institutions, including the Bill & Melinda Gates Foundation, the American Cancer Society, Cancer Research UK, the Bloomberg Initiative to Reduce Tobacco Use, and Canada's International Development Research Centre, as well as efforts such as the Global Tobacco Surveillance System, have been critical in developing and supporting globally relevant tobacco control research, with a major focus being developing research capacity in LMICs in order to advance the evidence base for tobacco control globally, including the US.

This review aims to provide some concrete examples of how such research in LMICs has advanced tobacco control practice and policy globally, with a particular focus on the impact on US tobacco control efforts. Some prominent themes emphasized in this manuscript include: the development of knowledge regarding the diverse tobacco products on the market; better understanding of tobacco use and its impact among different populations; generating knowledge about the impacts of tobacco control policy interventions; and better understanding tobacco industry strategies in order to inform advocacy efforts (Table 1).

2. Diversity of tobacco products

International tobacco research is particularly relevant today with the expansion of tobacco product offerings, which has, in some cases, outpaced development of an evidence-base regarding their health effects. Understanding such differences in nicotine delivery and exposure across products is critical in developing effective interventions, both in local contexts and beyond those in which they are studied. (Maziak, Eissenberg, & Ward, 2005; Stanfill, Connolly, Zhang, et al., 2011).

2.1. Waterpipe/Hookah

Historically, waterpipe tobacco smoking had been too rare to be a public health priority outside of the Eastern Mediterranean Region. (World Health Organization, 2015b). However, in more recent years, waterpipe use has become increasingly popular among youth globally. (Maziak, Taleb, Bahelah, et al., 2015). Research conducted in the Eastern Mediterranean Region has been integral in developing our knowledge base regarding waterpipe smoking, highly applicable to understanding its use in the US and globally. For example, the Syrian Center for Tobacco Studies and the American University of Beirut have made valuable contributions to the literature regarding the epidemiology of waterpipe use, how to structure surveillance measures for waterpipe smoking based on its unique use patterns, its toxic and addictive properties, measurement methods for assessing waterpipe smoking topography, and recommendations on policies and regulations. (Al Ali, Rastam, Ibrahim, et al., 2015; Asfar, Ward, Al-Ali, & Maziak, 2016; Salloum, Asfar, & Maziak, 2016; Shihadeh, Antonios, & Azar, 2005; World Health Organization, 2015b; World Health Organization, 2018a; World Health Organization, 2018b). These prior research efforts advanced the science regarding waterpipe smoking, guiding other countries such as the US in how to respond to the waterpipe epidemic. (Maziak, 2017).

2.2. Smokeless tobacco

Smokeless tobacco use in the US is relatively low overall (~3%) but is much higher among some subgroups (e.g., young rural males). (Agaku & Alpert, 2015). On a global scale, the greatest disease burden from smokeless tobacco use occurs in LMICs. (National Cancer Institute and Centers for Disease Control and Prevention, 2014). Thus, data derived from countries with high numbers of exclusive smokeless tobacco users, such as India, have been critical to characterizing the impact of smokeless tobacco use on cancer, oral lesions, adverse reproductive outcomes, and other effects. (Agaku, Filippidis, Vardavas, et al., 2014; Berg, Ajay, Ali, et al., 2015). In fact, research has documented higher risks ratios for smokeless tobacco products used in the Indian subcontinent than in America. (Asthana, Labani, Kailash, Sinha, & Mehrotra, 2018). India has implemented some novel policies and interventions targeting smokeless tobacco use, including bans on some product types (i.e., gutka), graphic warning labels, and national media campaigns. (National Cancer Institute and Centers for Disease Control and Prevention, 2014). Experience and data from countries heavily impacted by smokeless tobacco use can advance the science in other countries, including HICs such as the US.

3. Populations & settings

The literature regarding cultural, racial, and ethnic differences in tobacco use and related disease can also be informed by research in LMICs.

3.1. Low-income populations/settings

Research in HICs has documented that tobacco use prevalence, as well as exposure to tobacco products and tobacco smoke, is increasingly concentrated in populations of low education, with racial/ethnic differences in patterns and cessation rates. (Drope et al., 2018). Within LMICs, lower income is usually associated with increased tobacco use prevalence as well, (World Health Organization, 2014) providing opportunities to further understand the complexities of tobacco use prevention and cessation in low-income groups in HICs, including the US. For example, Project Quit Tobacco International in India and Indonesia gained considerable insight into developing and disseminating effective tobacco cessation treatment in low-resource settings, particularly by integrating tobacco treatment into medical and nursing educational

Table 1
Examples of LMIC tobacco control research efforts and global implications.

Area	Example	Example implications
Understanding diverse tobacco products	Waterpipe	• Advanced knowledge base regarding the epidemiology of waterpipe use, how to structure surveillance measures for waterpipe based on its unique use patterns, its toxic and addictive properties, and on policy and regulation recommendations • Provided instruments for tobacco smoke research (e.g., the waterpipe smoking topography device)
	Smokeless tobacco	• Provided evidence that smokeless tobacco products cause addiction, precancerous oral lesions, cancer of the oral cavity, cardiovascular events, esophageal and pancreatic cancer, and adverse reproductive outcomes (e.g., stillbirth, pre-term birth, low birth weight)
Understanding tobacco use in various populations and settings	Low-income populations/ settings	• Provided data regarding the complexities of tobacco use prevention and cessation in low-income groups • Showed feasibility of low-cost cessation interventions to assist underserved populations and of incorporating tobacco into medical and nursing curricula as an integrated part of education
	Populations with low knowledge/perceived risk	• Provided data regarding misperceptions regarding tobacco use and cessation among the less educated and medically compromised • Developed and tested messaging strategies to address misperceptions that can apply to such populations in the US
	Racial/ethnic groups	• Advanced science regarding determinants of smoking and barriers to cessation in Latinos • Methodologies used have been leveraged to address tobacco use among other minority populations in the US
Evaluating policies and policy impact	Regulating product design (e.g., flavoring)	• Provided real-world data regarding impact of a menthol ban to inform how policies in the US should be written to minimize loopholes that tobacco companies can exploit and the resulting unintended consequences, and to provide estimates of the population impact of such a ban • Provided data to inform FDA regulation that likely impeded industry introduction into the US of the range of flavor capsule varieties that may have attracted youth in other countries
	Product labeling • Light/mild • Pictorial health warning labels • Plain packaging • Package inserts	• Provided data to estimate the impact on bans of misleading descriptors such as “light” and “mild” on cigarette packages • Established the evidence base regarding the effectiveness of graphic pictorial warnings on cigarette packs and estimates regarding their population impacts • Provided evidence of the effectiveness of plain cigarette packaging and adding package inserts with cessation messages to complement warnings about the health effects of smoking on pack exteriors
	Pricing and taxation	• Developed evidence base regarding the effects of price and tax policies to prevent and reduce tobacco use
	Emerging product policy	• Built an evidence base to advance policy development, implementation, and impact regarding ENDS
Understanding tobacco industry strategies and informing advocacy efforts	Smoke-free air policy	• Established evidence to combat opposition: the vast majority of most populations prefers smoke-free places; there are few implementation or compliance issues; the benefits of such policies exceed the costs; and ventilation and filtration systems do not eliminate the health risks posed by secondhand smoke exposure
	Economic impact on tobacco farmers	• Provided data that smallholder tobacco farmers are rarely economically prosperous and that tobacco control has very little effect or positive effect on them
	Impact of taxation on illicit trade	• Provided evidence that the tobacco industry may be complicit in illicit trade or misrepresents illicit trade to undermine taxation

curricula. (Nichter, Nichter, Muramoto, & Project Quit Tobacco, 2010; Yamini, Nichter, Nichter, et al., 2015). This approach can be applied and studied in other contexts in order to inform domestic approaches to integrating tobacco cessation in low-resource settings, as well as other chronic disease prevention education, into medical and nursing education.

3.2. Populations with low knowledge/perceived risk

While the US population on average is generally informed of the health risks of tobacco use, subgroups with less knowledge of tobacco's health risks also exist. (U.S. Department of Health and Human Services, 2014). FIC-funded research has documented limited knowledge regarding tobacco use and exposure risks in LMICs that might inform work in the US. Research conducted by Project Quit Tobacco International in India and Indonesia found that tobacco users, particularly those with diabetes and lung disease, held misperceptions regarding tobacco use and cessation (e.g., no benefit of quitting once diagnosed); this research was able to address a number of them. (Nichter, Padmawati, & Ng, 2016; Thankappan et al., 2014). This research provided data relevant to the US, given that tobacco users, particularly medically complex users (e.g., those with multiple, chronic conditions), are less informed about tobacco-related risks. (Borrelli, Hayes, Dunsiger, & Fava, 2010).

3.3. Racial/ethnic groups

A particularly relevant example regarding the impact of international research on US tobacco control can be gleaned from research generated in Mexico and Guatemala. Indeed, Latinos represent the largest minority in the US, Mexicans and Guatemalans represent the two largest migrant Latino groups in the US, and the patterns of smoking among US Latinos are different compared to other US ethnic groups. (Saccone, Emery, Sofer, et al., n.d.; Kaplan, Bangdiwala, Barnhart, et al., 2014). Research funded by international agencies has documented determinants of smoking and smoking cessation, including the frequency of smoking, the availability of single cigarettes, (Thrasher, Villalobos, Barnoya, Sansores, & O'Connor, 2011) the lack of cessation medications, (de Ojeda, Barnoya, & Thrasher, 2013; Viteri, Barnoya, Hudmon, & Solorzano, 2012) and the impact of tax increases. (Saenz de Miera Juarez, Thrasher, Reynales Shigematsu, Hernandez Avila, & Chaloupka, 2014). In addition, several projects implemented in Argentina have provided information about tobacco use among indigenous people, (Alderete, Kaplan, Gregorich, Mejia, & Perez-Stable, 2009) about cessation services provided to Latinos, (Mejia, Perez Stable, Kaplan, et al., 2016) and about the effect of tobacco portrayals

on adolescents in entertainment media. (Mejia, Perez, Pena, et al., 2017). Not only has this research informed our understanding of tobacco use and cessation among Latinos, the methodologies used to document the availability of cessation medications in Guatemala was also adapted to document the lack of these medications in African American communities in St. Louis. (Barnoya, Jin, Hudmon, & Schootman, 2015).

4. Evaluating policy & policy impact

Policy evaluation is a critical example of an opportune application of knowledge from one country to another. Many countries are introducing new and innovative tobacco control policies but implementing them in different ways and on different timelines. Evaluating the intended and unintended consequences of a policy implemented in one country can inform whether and how that policy could be implemented in another country.

4.1. Regulating product design

A major feature of tobacco products is flavor. In the US, cigarettes with characterizing flavors, with the exception of menthol, were banned in 2009; however, prohibiting menthol-flavored cigarettes continues to be considered. International research shows how major multinational tobacco companies are experimenting with other flavor descriptors on cigarette packs. For example, research in LMICs is finding that brand varieties with unconventional descriptors (e.g., “ruby burst”, “mix”) are being used to signify flavors despite not using traditional “characterizing” flavor terms. (Cohen et al., 2016). The use of such descriptors appears to have grown most rapidly for flavor capsule cigarettes, a product design innovation that is sustaining and growing tobacco markets in some countries. (King, 2014; Thrasher et al., 2017). NIH-funded research in Mexico and Australia has documented how this design feature contributes to misconceptions of reduced risk (Thrasher, Abad-Vivero, Moodie, et al., 2016) and appeals to youth. (Abad-Vivero, Thrasher, Arillo-Santillan, et al., 2016). Such studies informed the FDA ban of Camel Crush Bold from the US market and, in conjunction with FDA regulatory authority, likely have impeded industry introduction into the US of the range of flavor capsule varieties that are increasingly popular elsewhere. (MacGuill, 2017).

4.2. Product labeling

Product labeling has a critical influence on tobacco use behaviors. (Borland, Wilson, Fong, et al., 2009; Yong, Borland, Cummings, et al., 2016). Thus, the impact of labeling on tobacco use in various countries can inform global tobacco control efforts. One important feature of product labeling involves health warning labels that communicate the risks of tobacco products. Pictorial health warnings were first introduced in Canada in 2001, where much of the initial research on the effects of pictorial warnings was conducted. Findings from NIH-funded research and research from the International Tobacco Control (ITC) Project, which conducts research across several LMICs, (Fong, Cummings, Borland, et al., 2006) consistently demonstrate the superiority of graphic pictorial warnings across countries and over time (Swayampakala, Thrasher, Hammond, et al., 2015) and has provided data to estimate population-level impact. (Huang, Chaloupka, & Fong, 2014). This literature led to the inclusion of pictorial warnings in the 2003 WHO Framework Convention on Tobacco Control (World Health Organization, 2009) and informed the US FDA's 2011 rule requiring pictorial warning labels on cigarettes. (U.S. Food and Drug Administration, 2011).

Additional labeling strategies that have been shown to be effective for reducing smoking rates in other countries include banning misleading descriptors such as “light” and “mild” on cigarette packages (2001), (Blanke & da Costa e Silva, 2004; Cohen, Yang, & Donaldson, 2014) plain packaging, (Nagelhout et al., 2015; Yong et al., 2016) and adding package inserts (i.e., small leaflets inside of cigarette packs) with messages about cessation benefits and recommendations that complement warnings about the health effects of smoking on pack exteriors. (Thrasher, Osman, Abad-Vivero, et al., 2015; Thrasher, Swayampakala, Cummings, et al., 2016). Evidence from countries taking novel approaches to product labeling can be especially valuable to countries, such as the US, that may be considering new regulations.

4.3. Pricing and taxation

Raising the price of tobacco products is considered one of the most effective ways to reduce consumption (Chaloupka, Straif, & Leon, 2011; Ross, Blecher, Yan, & Hyland, 2011; U.S. Department of Health and Human Services, 2014) and is a highly recommended tobacco control strategy worldwide. (U.S. Department of Health and Human Services, 2014; U.S. National Cancer Institute and World Health Organization, 2016; World Health Organization, 2010). This literature provides an important resource to inform tobacco pricing regulations and tax policies at the national and subnational level. Indeed, cigarette affordability, more than just the price, has been shown to determine cigarette consumption. (Blecher & van Walbeek, 2004). While cigarettes have become more affordable in many LMICs, some LMICs have implemented strong and effective tobacco control policies, which have led to decreased cigarette consumption. (Chaloupka, Yurekli, & Fong, 2012). In terms of taxation, past experience shows that not all tax initiatives are equally successful; for example, how a tax is structured and the influence of other economic changes can impact whether a tax increase achieves its intended goal or not. (Chaloupka et al., 2011; Chaloupka et al., 2012). Evidence from diverse economic settings, particularly LMICs, is important to continue to expand the evidence base on effective tobacco taxation policy and its impact on tobacco use behavior globally, including the US. (International Agency for Research on Cancer, 2011).

4.4. Emerging product policy

In light of the emergence of new tobacco products on the global market, it is critical to share experiences regarding policy development, implementation, and evaluation across countries. As one example of such efforts, the Robert Wood Johnson Foundation funded a series of meetings to inform US policy development to regulate electronic nicotine delivery systems (ENDS). This effort involved continued collaboration with researchers globally, including those from LMICs, to build a strong evidence base and to learn from experiences in other countries in policy development, implementation, and impact. As part of this effort, a mechanism to regularly scan for and confirm ENDS policy developments at the national level was developed. The results of this work were widely disseminated through a website that features summaries and a searchable database describing product classifications, policy domains, and regulatory mechanisms employed by countries to regulate ENDS. (Johns Hopkins Bloomberg School of Public Health, 2017; Kennedy, Awopegba, De Leon, & Cohen, 2017).

5. Informing advocacy efforts

International research is critical in supporting advocacy efforts. Specifically, such research can provide empirical evidence for a salient policy argument or counter-arguments to address commonly used arguments opposing tobacco control.

5.1. Smoke-free air policies

Globally, when smoke-free policies were first implemented, opponents (frequently organized by the tobacco industry) argued that such policies were not in accord with public sentiment, compliance would be

difficult, the hospitality industry would be negatively impacted economically, and ventilation systems sufficiently protected against secondhand smoke exposure. (Drope, Bialous, & Glantz, 2004; Hyland, Barnoya, & Corral, 2012; Zelnick, Campbell, Levenstein, & Balbach, 2008). However, international research, including research in LMICs, has established each claim is false: the vast majority of populations across countries prefers smoke-free places; few implementation or compliance issues arise; benefits of such policies exceed costs; and ventilation and filtration systems do not eliminate health risks posed by secondhand smoke. (Thrasher, Besley, & Gonzalez, 2010; Barnoya et al., 2011; Blanco-Marquizo, Goja, Peruga, et al., 2010; Hyland, Cummings, & Wilson, 1999; Hyland, Travers, Dresler, Higbee, & Cummings, 2008; International Agency for Research on Cancer, 2009; Scollo, Lal, Hyland, & Glantz, 2003; Thrasher et al., 2011; Weber, Bagwell, Fielding, & Glantz, 2003).

5.2. Economic impact on tobacco farmers

The tobacco industry has argued that tobacco control threatens the economic livelihoods of small-scale tobacco farmers, undermining tobacco control efforts at local, national, regional, and global levels despite steady declines in tobacco farming in recent years. (Lencucha, Drope, & Labonte, 2016). However, rigorous empirical findings across multiple and varied contexts has helped to generate evidence that small-scale tobacco farmers are rarely economically prosperous and that tobacco control has very little short-term effect on them, in countries such as Kenya, (Magati, Li, Drope, Lencucha, & Labonté, 2016). Malawi, (Makoka, Drope, Appau, et al., 2016) and Zambia. (Goma, Drope, Zulu, Li, & Banda, 2017). Research in Indonesia found that former tobacco farmers are typically economically better off than their peers who have continued to grow tobacco. (Drope, Li, & Araujo, 2017). Moreover, beginning in 2008, 458 farm families in China participated in a project to substitute food crops for tobacco, which resulted in increases of 21% to 110% in farmers' annual income. (Li, Wang, Xia, Tang, & Wang, 2012). These findings are highly relevant to the US, particularly in the Southeastern region where a history of tobacco farming continues to influence lawmakers' tobacco policy decisions. (Berg et al., 2015; Berg, Solomon, Bailey, et al., 2016).

5.3. Impact of taxation on illicit trade

Another often-used argument against efforts to raise tobacco taxes is that increases in taxation lead to increased illicit trade. However, an increasing body of empirical literature across a wide range of contexts, including LMICs, demonstrates that, not only is the tobacco industry complicit in illicit trade in many circumstances, but that the industry fundamentally misrepresents illicit trade to intimidate policy makers into wrongly believing that it will undermine taxation. (Fooks, Peeters, & Evans-Reeves, 2014; Gilmore et al., 2014; Smith, Savell, & Gilmore, 2013; Stoklosa & Ross, 2014).

6. Conclusions

In conclusion, research that leverages variability in tobacco use, history, product market, and policies across different countries, settings, and populations has provided and will continue to build an evidence base to advance the state of the science and inform policy and practice globally, including in the US. This international and cross-country research, particularly in LMIC's that are increasingly impacted by the tobacco burden, contribute substantially to the ultimate goal of eradicating the tobacco epidemic.

Funding

This publication was supported by the following funding sources: Carla J Berg receives funding from the US Fogarty International Center/National Cancer Institute (1R01 TW010664-01). Geoffrey T Fong was supported by grants from the US National Cancer Institute (P01 CA200512), the Canadian Institutes of Health Research (FDN-148477), and a Senior Investigator grant from the Ontario Institute for Cancer Research. James F Thrasher receives funding from the US Fogarty International Center/National Cancer Institute (R01 TW009274 and R01 TW010652) and US National Cancer Institute (R01 CA167067). Joanna Cohen is supported by a grant from Bloomberg Philanthropies as part of the Bloomberg Initiative to Reduce Tobacco Use. Wasim Maziak is supported by the US National Institute on Drug Abuse (R01DA035160), US Fogarty International Center (R01TW010654), and U54MD012393-01 for the FIU-RCMI. Harry Lando received funding from the US Fogarty International Center (R01 TW005969 and R56TW009265). Jeffrey Drope receives funds from the Fogarty International Center, National Cancer Institute, and Office of Behavioral and Social Sciences Research (R01 TW010898). Raul Mejia receives funding from the Global Health Leadership Award from the International Development Research Centre, Canada, as well as the US Fogarty International Center/National Cancer Institute (R01 TW009274). Joaquin Barnoya receives support from the Foundation for Barnes-Jewish Hospital. Rima Nakkash receives funding from the International Development Research Centre, Canada. Ramzi Salloum receives funding from the International Development Research Centre, Canada.

Contributors

All co-authors contributed to the conceptualization of the paper and provided examples to highlight themes identified. Berg led the writing of the manuscript. All co-authors contributed to and approved the final manuscript.

Conflict of interest

The authors declare no conflicts of interest.

Acknowledgements

N/A

References

Abad-Vivero, E. N., Thrasher, J. F., Arillo-Santillan, E., et al. (2016). Recall, appeal and willingness to try cigarettes with flavour capsules: assessing the impact of a tobacco product innovation among early adolescents. *Tobacco Control, 25*(e2), e113–e119.

Agaku, I. T., & Alpert, H. R. (2015). Trends in annual sales and current use of cigarettes, cigars, roll-your-own tobacco, pipes, and smokeless tobacco among US adults, 2002–2012. *Tobacco Control*. https://doi.org/10.1136/tobaccocontrol-2014-052125 (Published Online First: 21 April 2015).

Agaku, I. T., Filippidis, F. T., Vardavas, C. I., et al. (2014). Poly-tobacco use among adults in 44 countries during 2008–2012: evidence for an integrative and comprehensive approach in tobacco control. *Drug and Alcohol Dependendence, 139*, 60–70.

Al Ali, R., Rastam, S., Ibrahim, I., et al. (2015). A comparative study of systemic carcinogen exposure in waterpipe smokers, cigarette smokers and non-smokers. *Tobacco Control, 24*(2), 125–127.

Alderete, E., Kaplan, C. P., Gregorich, S. E., Mejia, R., & Perez-Stable, E. J. (2009). Smoking behavior and ethnicity in Jujuy, Argentina: evidence from a low-income youth sample. *Substance Use & Misuse, 44*(5), 632–646.

Asfar, T., Ward, K. D., Al-Ali, R., & Maziak, W. (2016). Building evidence-based tobacco treatment in the eastern mediterranean region: lessons learned by the syrian center for tobacco studies. *Journal of Smoking Cessation, 11*(2), 116–123.

Asthana, S., Labani, S., Kailash, U., Sinha, D. N., & Mehrotra, R. (2018). Association of Smokeless Tobacco Use and Oral Cancer: A Systematic Global Review and Meta-Analysis. *Nicotine & Tobacco Research*. https://doi.org/10.1093/ntr/nty074 (2018 May 22, Epub ahead of print).

Barnoya, J., Arvizu, M., Jones, M. R., Hernandez, J. C., Breysse, P. N., & Navas-Acien, A. (2011). Secondhand smoke exposure in bars and restaurants in Guatemala City: before and after smoking ban evaluation. *Cancer Causes & Control, 22*(1), 151–156.

Barnoya, J., Jin, L., Hudmon, K. S., & Schootman, M. (2015). Nicotine replacement therapy, tobacco products, and electronic cigarettes in pharmacies in St. Louis, Missouri. *Journal of the American Pharmacists Association, 55*(4), 405–412.

Berg, C. J., Ajay, V. S., Ali, M. K., et al. (2015). A cross-sectional study of the prevalence and correlates of tobacco Use in Chennai, Delhi, and Karachi: data from the CARRS

study. *BMC Public Health, 15*.
Berg, C. J., Solomon, M., Bailey, E., et al. (2016). Former southeastern state legislators' views on public smoke-free policies. *Health Behavior and Policy Review, 3*(4), 304–314.
Berg, C. J., Solomon, M., Barkley, A., Bailey, E., Goodwin, S., & Kegler, M. C. (2015). Tobacco Taxes in the Southeastern U.S. States: Views from Former Legislators. *Health Behavior and Policy Review, 2*(5), 333–342.
Blanco-Marquizo, A., Goja, B., Peruga, A., et al. (2010). Reduction of secondhand tobacco smoke in public places following national smoke-free legislation in Uruguay. *Tobacco Control, 19*(3), 231–234.
Blanke, D. D., & da Costa e Silva, V. (2004). *Tobacco control legislation: An introductory guide* (2nd ed.). Geneva: World Health Organization. Retrieved from https://books.google.com/books?id=0LAVl_j1ny4C&pg=PT175&lpg=PT175&dq=brazil+light+low+tar&source=bl&ots=m3afH1sXQv&sig=J7vPll0J7I1j7jocCHdPUmyCY4g&hl=en&sa=X&ved=CC0Q6AEwAmoVChMImprEunqxwIV04uSCh1vxQdN#v=onepage&q=brazil%20light%20low%20tar&f=false.
Blecher, E. H., & van Walbeek, C. P. (2004). An international analysis of cigarette affordability. *Tobacco Control, 13*(4), 339–346.
Borland, R., Wilson, N., Fong, G. T., et al. (2009). Impact of graphic and text warnings on cigarette packs: findings from four countries over five years. *Tobacco Control, 18*(5), 358–364.
Borrelli, B., Hayes, R. B., Dunsiger, S., & Fava, J. L. (2010). Risk perception and smoking behavior in medically ill smokers: a prospective study. *Addiction, 105*(6), 1100–1108.
Chaloupka, F. J., Straif, K., & Leon, M. E. (2011). Working Group IAfRoC. Effectiveness of tax and price policies in tobacco control. *Tobacco Control, 20*(3), 235–238.
Chaloupka, F. J., Yurekli, A., & Fong, G. T. (2012). Tobacco taxes as a tobacco control strategy. *Tobacco Control, 21*(2), 172–180.
Cohen, J. E., Washington, C., Ferguson, J., Brown, J., Kroart, L., & Smith, K. (2016, March). *Cigarette flavors in 13 low- and middle-income countries: Are tobacco companies experimenting with how to circumvent bans on "characterizing" flavors?. Poster presentation at the 22nd annual meeting of the society for research on nicotine and tobacco.* (Chicago, Illinois).
Cohen, J. E., Yang, J., & Donaldson, E. A. (2014). Impact of the removal of light and mild descriptors from cigarette packages in Ontario, Canada: switching to "light replacement" brand variants. *Preventive Medicine, 69*, 120–125.
Drope, J., Bialous, S. A., & Glantz, S. A. (2004). Tobacco industry efforts to present ventilation as an alternative to smoke-free environments in North America. *Tobacco Control, 13*, 41–47.
Drope J, Li Q, Araujo E, et al. The economics of tobacco farming in indonesia. indonesia tobacco employment studies. Washington DC: World Bank. 2017, October.
Drope, J., Liber, A. C., Cahn, Z., Stoklosa, M., Kennedy, R., Douglas, C. E., ... Drope, J. (2018). Who's still smoking? Disparities in adult cigarette smoking prevalence in the United States. *Cancer: A Cancer Journal for Clinicians, 68*(2), 106–115.
Fong, G. T., Cummings, K. M., Borland, R., et al. (2006). The conceptual framework of the International Tobacco Control (ITC) Policy Evaluation Project. *Tobacco Control, 15*(Suppl 3), iii3–11.
Fooks, G. J., Peeters, S., & Evans-Reeves, K. (2014). Illicit trade, tobacco industry-funded studies and policy influence in the EU and UK. *Tobacco Control, 23*(1), 81–83.
Gilmore, A. B., Rowell, A., Gallus, S., Lugo, A., Joossens, L., & Sims, M. (2014). Towards a greater understanding of the illicit tobacco trade in Europe: a review of the PMI funded 'Project Star' report. *Tobacco Control, 23*(E1), E51–E61.
Glass, R. I. (2013). What the United States Has to Gain From Global Health Research. *Journal of the American Medical Association, 310*(9), 903–904.
Goma, F., Drope, J., Zulu, R., Li, Q., & Banda, J. (2017). *The economics of tobacco farming in Zambia (Revised version)*. Lusaka: University of Zambia School of Medicine and Atlanta: American Cancer Society.
Greenwald, P., & Dunn, B. K. (2009). Landmarks in the history of cancer epidemiology. *Cancer Research, 69*(6), 2151–2162.
Huang, J., Chaloupka, F. J., & Fong, G. T. (2014). Cigarette graphic warning labels and smoking prevalence in Canada: a critical examination and reformulation of the FDA regulatory impact analysis. *Tobacco Control, 23*(Suppl 1), i7–12.
Hyland, A., Barnoya, J., & Corral, J. E. (2012). Smoke-free air policies: past, present and future. *Tobacco Control, 21*, 154–161.
Hyland, A., Cummings, K. M., & Wilson, M. P. (1999). Compliance with the New York city smoke-free air act. *Journal of Public Health Management and Practice, 5*(1), 43–52.
Hyland, A., Travers, M. J., Dresler, C., Higbee, C., & Cummings, K. M. (2008). A 32-country comparison of tobacco smoke derived particle levels in indoor public places. *Tobacco Control, 17*(3), 159–165.
International Agency for Research on Cancer (2009). *Evaluating the Effectiveness of Smoke-free Policies.* Lyon, France: IARC Handbooks of Cancer Prevention.
International Agency for Research on Cancer (2011). Effectiveness of tax and price policies for tobacco control. *IARC Handbook of cancer prevention volume 14*. France: International Agency for Research on Cancer.
Johns Hopkins Bloomberg School of Public Health (2017). Global Tobacco Control: Country Laws Regulating E-cigarettes. http://globaltobaccocontrol.org/e-cigarette/country-laws-regulating-e-cigarettes.
Kaplan, R. C., Bangdiwala, S. I., Barnhart, J. M., et al. (2014). Smoking among U.S. Hispanic/Latino adults: the Hispanic community health study/study of Latinos. *American Journal of Preventive Medicine, 46*(5), 496–506.
Kennedy, R. D., Awopegba, A., De Leon, E., & Cohen, J. E. (2017). Global approaches to regulating electronic cigarettes. *Tobacco Control, 26*(4), 440–445.
King, M. (2014). *Investor Day—Latin American & Canada Region.* Lausanne, Switzerland: Phillip Morris International.
Lencucha, R., Drope, J., & Labonte, R. (2016). Rhetoric and the law, or the law of rhetoric: How countries oppose novel tobacco control measures at the World Trade Organization. *Social Science & Medicine, 164*, 100–107.
Li, V. C., Wang, Q., Xia, N., Tang, S., & Wang, C. C. (2012). Tobacco crop substitution: pilot effort in China. *Americn Journal of Public Health, 102*(9), 1660–1663.
MacGuill, S. (2017, August). *Global tobacco: Key findings part 1 - cigarettes. Euromonitor passport*.
Magati, P., Li, Q., Drope, J., Lencucha, R., & Labonté, R. (2016). *The economics of tobacco farming in Kenya.* Nairobi: International Institute for Legislative Affairs and Atlanta: American Cancer Society.
Makoka, D., Drope, J., Appau, A., et al. (2016). Costs, revenues and profits: An economic analysis of smallholder tobacco farmer livelihoods in Malawi. *Tobacco Control, 26*, 634–640.
Maziak, W. (2017). Cutting collaborations will not put 'America first'. *Nature, 544*(7649), 139.
Maziak, W., Eissenberg, T., & Ward, K. D. (2005). Patterns of waterpipe use and dependence: implications for intervention development. *Pharmacology Biochemistry and Behavior, 80*(1), 173–179.
Maziak, W., Taleb, Z. B., Bahelah, R., et al. (2015). The global epidemiology of waterpipe smoking. *Tobacco Control, 24*(Suppl 1), i3–i12.
McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15*(4), 351–377.
Mejia, R., Perez, A., Pena, L., et al. (2017). Smoking in movies and adolescent smoking initiation: a longitudinal study among argentinian adolescents. *Journal of Pediatrics, 180*, 222–228.
Mejia, R., Perez Stable, E. J., Kaplan, C. P., et al. (2016). Effectiveness of an intervention to teach physicians how to assist patients to quit smoking in argentina. *Nicotine & Tobacco Research, 18*(5), 1101–1109.
Nagelhout, G. E., Osman, A., Yong, H. H., Huang, L. L., Borland, R., & Thrasher, J. F. (2015). Was the media campaign that supported Australia's new pictorial cigarette warning labels and plain packaging policy associated with more attention to and talking about warning labels? *Addictive Behaviors, 49*, 64–67.
National Cancer Institute and Centers for Disease Control and Prevention (2014). *Smokelesstobacco and public health: A global perspective.* Bethesda, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Institutes of Health, National Cancer Institute. NIH Publication No14–7983.
Nichter, M., Nichter, M., Muramoto, M., & Project Quit Tobacco, I. (2010). Project Quit Tobacco International: laying the groundwork for tobacco cessation in low- and middle-income countries. *Asia-Pacific Journal of Public Health, 22*(3 Suppl), 181S–188S.
Nichter, M., Padmawati, S., & Ng, N. (2016). Introducing smoking cessation to Indonesian males treated for tuberculosis: The challenges of low-moderate level smoking. *Social Science & Medicine, 152*, 70–79.
NIH Fogarty International Center (2017). History of the fogarty international center. https://www.fic.nih.gov/About/Pages/History.aspx.
de Ojeda, A., Barnoya, J., & Thrasher, J. F. (2013). Availability and costs of single cigarettes in Guatemala. *Nicotine & Tobacco Research, 15*(1), 83–87.
Parascandola, M., & Bloch, M. (2016). The global laboratory of tobacco control: research to advance tobacco cessation in LMICs. *Journal of Smoking Cessation, 11*(2), 70–77.
Ross, H., Blecher, E., Yan, L., & Hyland, A. (2011). Do cigarette prices motivate smokers to quit? New evidence from the ITC survey. *Addiction, 106*(3), 609–619.
Saccone, N. L., Emery, L. S., Sofer, T., et al. (2018). Genome-wide association study of smoking heaviness and daily/nondaily smoking in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). *Nicotine & Tobacco Research, 20*(4), 448–457.
Saenz de Miera Juarez, B., Thrasher, J. F., Reynales Shigematsu, L. M., Hernandez Avila, M., & Chaloupka, F. J. (2014). Tax, price and cigarette brand preferences: a longitudinal study of adult smokers from the ITC Mexico Survey. *Tobacco Control, 23*(Suppl 1), i80–i85.
Salloum, R. G., Asfar, T., & Maziak, W. (2016). Toward a Regulatory Framework for the Waterpipe. *American Journal of Public Health, 106*(10), 1773–1777.
Scollo, M., Lal, A., Hyland, A., & Glantz, S. (2003). Review of the quality of studies on the economic effects of smoke-free policies on the hospitality industry. *Tobacco Control, 12*(1), 13–20.
Shihadeh, A., Antonios, C., & Azar, S. (2005). A portable, low-resistance puff topography instrument for pulsating, high-flow smoking devices. *Behavior Research Methods, 37*(1), 186–191.
Smith, K. E., Savell, E., & Gilmore, A. B. (2013). What is known about tobacco industry efforts to influence tobacco tax? A systematic review of empirical studies. *Tobacco Control, 22*(2).
Stanfill, S. B., Connolly, G. N., Zhang, L., et al. (2011). Global surveillance of oral tobacco products: total nicotine, unionised nicotine and tobacco-specific N-nitrosamines. *Tobacco Control, 20*(3), e2.
Stoklosa, M., & Ross, H. (2014). Contrasting academic and tobacco industry estimates of illicit cigarette trade: evidence from Warsaw, Poland. *Tobacco Control, 23*(E1), E30–E34.
Swayampakala, K., Thrasher, J. F., Hammond, D., et al. (2015). Pictorial health warning label content and smokers' understanding of smoking-related risks-a cross-country comparison. *Health Education Research, 30*(1), 35–45.
Thankappan, K. R., Mini, G. K., Hariharan, M., Vijayakumar, G., Sarma, P. S., & Nichter, M. (2014). Smoking Cessation Among Diabetic Patients in Kerala, India: 1-Year Follow-up Results From a Pilot Randomized Controlled Trial. *Diabetes Care, 37*(12), E256–E257.
Thrasher, J. F., Abad-Vivero, E. N., Moodie, C., et al. (2016). Cigarette brands with flavour capsules in the filter: trends in use and brand perceptions among smokers in the USA, Mexico and Australia, 2012–2014. *Tobacco Control, 25*(3), 275–283.
Thrasher, J. F., Besley, J. C., & Gonzalez, W. (2010). Perceived justice and popular support for public health laws: a case study around comprehensive smoke-free legislation in Mexico City. *Social Science & Medicine, 70*(5), 787–793.

Thrasher, J. F., Huang, L., Perez-Hernandez, R., Niederdeppe, J., Arillo-Santillan, E., & Alday, J. (2011). Evaluation of a social marketing campaign to support Mexico City's comprehensive smoke-free law. *American Journal of Public Health, 101*(2), 328–335.

Thrasher, J. F., Islam, F., Barnoya, J., Mejia, R., Valenzuela, M. T., & Chaloupka, F. J. (2017). Market share for flavour capsule cigarettes is quickly growing, especially in Latin America. *Tobacco Control, 26*(4), 468–470.

Thrasher, J. F., Osman, A., Abad-Vivero, E. N., et al. (2015). The use of cigarette package inserts to supplement pictorial health warnings: An evaluation of the canadian policy. *Nicotine & Tobacco Research, 17*(7), 870–875.

Thrasher, J. F., Swayampakala, K., Cummings, K. M., et al. (2016). Cigarette package inserts can promote efficacy beliefs and sustained smoking cessation attempts: A longitudinal assessment of an innovative policy in Canada. *Preventive Medicine, 88*, 59–65.

Thrasher, J. F., Villalobos, V., Barnoya, J., Sansores, R., & O'Connor, R. (2011). Consumption of single cigarettes and quitting behavior: a longitudinal analysis of Mexican smokers. *BMC Public Health, 11*, 134.

U.S. Department of Health and Human Services (2014). *The health consequences of smoking—50 years of progress: a report of the surgeon general.* Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

U.S. Food and Drug Administration (2011). Required warnings for cigarette packages and advertisements, Final Rule. June 22, 2011. 21 CFR Part 1141, Federal Register, 2011–15337. Retrieved from http://www.regulations.gov/#!documentDetail.D=FDA-2010-N-0568-0251.

U.S. National Cancer Institute and World Health Organization. Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute; and Geneva, CH: World Health Organization;2016.

Viteri, E., Barnoya, J., Hudmon, K. S., & Solorzano, P. J. (2012). Smoking cessation medications and cigarettes in Guatemala pharmacies. *Tobacco Control, 21*(5), 477–481.

Weber, M. D., Bagwell, D. A., Fielding, J. E., & Glantz, S. A. (2003). Long term compliance with California's Smoke-Free Workplace Law among bars and restaurants in Los Angeles County. *Tobacco Control, 12*(3), 269–273.

World Health Organization (2009). *WHO Framework convention on tobacco control: guidelines for implementation article 5.3; article 8; article 11; article 13.* Geneva, Switzerland: WHO Press.

World Health Organization (2010). *WHO Technical manual on tobacco tax administration.* Geneva, Switzerland: World Health Organization.

World Health Organization (2014). *Systematic review of the link between tobacco and poverty*. Geneva: World Health Organization. Retrieved from http://apps.who.int/iris/bitstream/10665/136001/1/9789241507820_eng.pdf?ua=1&ua=1.

World Health Organization (2015a). World Health Organization Tobacco Fact Sheet. http://www.who.int/mediacentre/factsheets/fs339/en/, Accessed date: 19 May 2015.

World Health Organization (2015b). *Advisory note: waterpipe tobacco smoking: health effects, research needs and recommended actions for regulators* (2nd ed.). Geneva, Switzerland: World Health Organization.

World Health Organization (2018a). Advisory note on waterpipe tobacco smoking: second edition. http://www.emro.who.int/tfi/news/advisory-note-on-waterpipe-tobacco-smoking-second-edition.html.

World Health Organization (2018b). Advisory note: waterpipe tobacco smoking: health effects, research needs and recommended actions by regulators. http://www.who.int/tobacco/publications/prod_regulation/waterpipe/en/.

Yamini, T. R., Nichter, M., Nichter, M., et al. (2015). Developing a fully integrated tobacco curriculum in medical colleges in India. *BMC Medical Education, 15*, 90.

Yong, H. H., Borland, R., Cummings, K. M., et al. (2016). US Smokers' Beliefs, Experiences and Perceptions of Different Cigarette Variants Before and After the FSPTCA Ban on Misleading Descriptors Such as "Light," "Mild," or "Low". *Nicotine & Tobacco Research, 18*(11), 2115–2123.

Yong, H. H., Borland, R., Hammond, D., Thrasher, J. F., Cummings, K. M., & Fong, G. T. (2016). Smokers' reactions to the new larger health warning labels on plain cigarette packs in Australia: findings from the ITC Australia project. *Tobacco Control, 25*(2), 181–187.

Zelnick, J., Campbell, R., Levenstein, C., & Balbach, E. (2008). Clearing the air: the evolution of organized labor's role in tobacco control in the United States. *International Journal of Health Services, 38*(2), 313–331.