HHS Public Access

Author manuscript

Tob Control. Author manuscript; available in PMC 2018 May 24.

Published in final edited form as:

Tob Control. 2018 January ; 27(1): 50–57. doi:10.1136/tobaccocontrol-2016-053381.

Seven years of progress in tobacco control: an evaluation of the effect of nations meeting the highest level MPOWER measures between 2007 and 2014

David T Levy, **Zhe Yuan**, **Yuying Luo**, and **Darren Mays**

Department of Oncology, Georgetown University Medical Center, Cancer Prevention & Control Program, Lombardi Comprehensive Cancer Center, Washington, DC, USA

Abstract

Objective—Since WHO released the package of six MPOWER measures to assist nations with implementing the WHO Framework Convention for Tobacco Control (FCTC), 88 countries adopted at least one highest level MPOWER measure. We estimated the subsequent reduction in smoking-related deaths from all new highest level measures adopted between 2007 and 2014.

Methods—Policy effect sizes based on previously validated *SimSmoke* models were applied to the number of smokers in each nation to determine the reduction in the number of smokers from policy adoption. On the basis of research that half of all smokers die from smoking, we derived the smoking-attributable deaths (SADs) averted of those smokers alive today.

Findings—In total, 88 countries adopted at least one highest level MPOWER policy between 2007 and 2014, resulting in almost 22 million fewer projected SADs. The largest number of future SADs averted was due to increased cigarette taxes (7.0 million), followed by comprehensive smoke-free laws (5.4 million), large graphic health warnings (4.1 million), comprehensive marketing bans (3.8 million) and comprehensive cessation interventions (1.5 million).

Conclusions—These findings demonstrate the immense public health impact of tobacco control policies adopted globally since the WHO-FCTC and highlight the importance of more countries adopting highest level MPOWER measures to reduce the global burden of tobacco use. Substantial additional progress could be made, especially if heavily populated nations with high smoking prevalence were to reach highest level MPOWER measures.

Correspondence to Dr David T Levy, Department of Oncology, Georgetown University Medical Center, Cancer Prevention & Control Program, Lombardi Comprehensive Cancer Center, 3300 Whitehaven Street NW, Suite 4100, Washington, DC 20007, USA; dl777@georgetown.edu.

Twitter Follow Darren Mays @darren_mays

Collaborators Jennifer Ellis, Bloomberg Philanthropies.

Contributors DTL conceived of the idea, managed the study, wrote the initial draft and revisions. ZY and YL collected the data, conducted the analysis and helped to revise the paper. DM helped to write and revise the paper.

Disclaimer The content is solely the responsibility of the authors and does not necessarily represent the official views of the funders.

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement We will share the data and programmes used in the article.

INTRODUCTION

Smoking-attributable deaths (SADs) are projected to rise to eight million deaths annually worldwide by 2030,[1] due primarily to growth in smoking in low and medium income countries (LMICs). The WHO Framework Convention on Tobacco Control (FCTC) is the first international global health treaty and seeks to reduce this burden by providing countries with a legally binding instrument to guide impactful tobacco control policy measures. To assist nations with implementing WHO-FCTC obligations, WHO released the MPOWER package of six evidence-based WHO-FCTC tobacco control measures in 2008. The MPOWER package includes: Monitoring tobacco use and tobacco control measures; Protecting people from tobacco smoke; Offering help (eg, treatments) to quit tobacco; Warning people about the dangers of tobacco; Enforcing bans on tobacco advertising, promotion and sponsorship and Raising tobacco taxes.

While the WHO-FCTC came into force in 2005, global tobacco control efforts have been accelerated since WHO first introduced the MPOWER package in 2008. Financial support from the Bloomberg Philanthropies beginning in 2007[2] and the Bill and Melinda Gates Foundation beginning in 2008[3] have supported MPOWER-based tobacco control efforts in more than 100 LMICs. As part of the Bloomberg Initiative to Reduce Tobacco Use, the WHO published five reports[4–8] documenting the status of the MPOWER measures worldwide.

A previous study[9] estimated that over seven million deaths were averted globally as a result of countries adopting ≥1 MPOWER measures between 2007 and 2010. This paper uses newly released data to update the prior analysis to estimate SADs averted as a result of country progress from 2007 to 2014. Although the evidence base establishing the effectiveness of tobacco control policies is vast, no previous studies have systematically estimated the impact of recent progress in tobacco control on population health using SADs averted as a marker of policy impact. Such an estimate is critical, as it allows countries that have not yet put life-saving tobacco control measures in place to better understand the potential benefits for population health.

METHODS

Assessment of incremental policy change

The WHO reports[4–8] provide the status of each nation's tobacco control policy for 2007, 2008, 2010, 2012 and 2014. From these reports, a list of nations that had adopted a highest level policy (ie, placed in a highest level P, O, W or E category or meeting the R requirement that tax is >75% of price, with M providing current smoking prevalence) between 2007 and 2014 was created. To ensure accuracy, we had the list of nations adopting highest level measures confirmed by representatives of the WHO Tobacco Free Initiative. In our previous study,[9] we developed a list of nations that met the highest level policy by 2010. In this study, we reviewed 2007 data for any corrections in classifications (as indicated in the online 2015 MPOWER Report) and compared most recently available data (for the year 2014 from the MPOWER 2015 Report) to the corrected 2007 data.

For smoke-free laws, cessation interventions, health warnings and marketing bans, the classifications are based directly on the MPOWER evaluations. For raising taxes, cigarette prices from the MPOWER reports for 2008, 2010, 2012, 2014 and 2015 are adjusted for inflation and translated into effect sizes via an equation dependent on price elasticities. [10]

Effect size parameters

To examine the impact of highest level MPOWER measures implemented, we applied effect sizes derived from the *SimSmoke* tobacco control model, which are based on the advice of expert panels and published literature reviews. Since effect sizes are based primarily on policy evaluation studies from HICs, the effects sizes are adjusted by an 'urban adjustment' factor (measured in term of per cent urban [911]) that captures the ability to reach the population (through smoke-free and cessation policies), and an 'awareness' factor (measured in term of whether a low-income, medium-income or high-income nation in 2007)[911] that reflects the potential to affect attitudes at earlier stages in the tobacco epidemic. A parameter based on tobacco control expenditures per capita is also used to calculate publicity effects for smoke-free and cessation interventions. The effect sizes are measured in relative terms as the absolute reduction in smoking prevalence relative to its initial level. We also provided credible ranges for the effect sizes based on a previous review[12] and as applied in previous SimSmoke analyses.[1113] Policies and effect sizes are shown in table 1 and described in greater detail in our previous paper.[9]

Effect sizes used account for differing levels of incremental change in policy between 2007 and 2014 (as indicated in the 2015 MPOWER Report), such that countries improving to highest level measures from previously low-level measures show a greater effect size than countries improving from medium-level measures.

The reduction in smokers and smoking-attributable deaths

Smoking prevalence (crude) rates by gender were obtained from WHO reports, measured as smoking (every day and someday) of any tobacco product (including kreteks and bidis). Prevalence estimates were chosen covering a broad age group (preferably ≥age 15) and from surveys closest to 2007 for policies implemented in 2007–2010, for 2010 for policies implemented in 2010–2012 and for 2012 for policies implemented in 2012–2014. Similarly, population estimates (ages 15 and above) are for 2007, 2010 and 2012 for the three groups. [14] The smoking rate was multiplied by the population to obtain the number of smokers.

Applying the policy long-term effect size to the number of smokers, we calculated the reduction in the number of smokers. The number of SADs of smokers alive prior to the policy being implemented was calculated by applying an algorithm based on Doll *et al*[15] and confirmed by later US studies[1617] suggesting that half of all cigarette smokers die prematurely from smoking. However, this method does not correct for the higher mortality rate of former relative to never smokers at higher ages. Using US data,[18] the ratio of the former smoker mortality rate to the current smoker mortality rate by age and gender was weighted by the number of smokers by age and gender and then summed over ages. This method yielded a former smoker correction factor of an 18% reduction.

Since the number of smokers is measured using the population and the smoking prevalence for the closest available year prior to policy implementation, the number of SADs averted as a result of policy implementation represents the reduction in future SADs of those smokers alive in 2007 for policies implemented in 2007–2010, in 2010 for policies implemented in 2010–2012 and in 2012 for policies implemented in 2012–2014.

RESULTS

For the countries adopting highest level MPOWER measures between 2007 and 2014, table 2 presents year of change, nation income status, initial smoking prevalence by gender, total number of smokers affected, effect sizes and the effects on the number of smokers and SADs averted. Table 3 contains results aggregated by policy from 2007 through 2014. Overall, 88 countries newly adopted a highest level MPOWER policy by 2014, of which 19 are HICs, 51 are MICs and 18 are LICs.

Between 2007 and 2014, 40 nations (6 HICs, 28 MICs, 6 LICs) adopted highest level smoke-free measures. Effect sizes range from −0.4% in Pakistan (due to low enforcement, but worksites and public places laws already in place) to −12.3% in Chile (with few restrictions in 2007 and high enforcement). Of the total 13 198 178 smokers alive in all countries before the policies were implemented, 5 411 253 fewer premature SADs are projected in future years as a result of countries reaching the highest level for smoke-free air, with 2 353 142 fewer SADs due to policies implemented in 2012–2014, 1 749 572 fewer SADs due to 2010–2012 policies and 1 308 539 fewer SADs due to 2007–2010 policies.

Fourteen nations (nine HICs, five MICs) adopted highest level cessation interventions (including quitlines, availability of pharmacotherapies and healthcare provider treatments in all places) from 2007 to 2014. Effect sizes range from −1.8% in Malta to −6.3% in Turkey. A total of 1 495 737 fewer future SADs are projected, with most due to policies between 2007– 2010 and 2010–2012.

Thirty-three nations (3 HICs, 24 MICs, 6 LICs) adopted highest level health warning (bold and graphic, and covering at least 50% the package) measures. Effect sizes range from about −2.0% in Canada and Singapore (with strong warnings in 2007) to −8.0% in Sri Lanka, Namibia, Philippines, Turkmenistan, Fiji, Samoa, Solomon Island, Vanuatu and Costa Rica. A total of 4 141 918 fewer future SADs are projected.

Twenty-two nations (3 HICs, 14 MICs, 5 LICs) adopted highest level tobacco advertising bans (on all direct and indirect advertising) with enforcement from 2007 to 2014. Effect sizes range from −1.7% in Guinea (having already had strong laws in 2007) to −13.0% in Turkey. In total, 3 766 340 fewer SADs are projected, of which 2 058 906 deaths are projected due to 2012–2014 policies and 1 504 970 due to 2010–2012 policies.

From 2007 to 2014, 20 nations (6 HICs, 12 MICs, 2 LICs) raised cigarette taxes to 75% of price. The effect size is as high as −40.6% (Latvia), but Cuba, although reaching the 75% goal, increased the tax rate less than the amount needed to compensate for price inflation. In total, 6 976 676 fewer future SADs are projected, of which 4 384 644 deaths are projected from 2012 to 2014 policies.

Table 3 presents the effect on the number of smokers and SADs of countries adopting the highest level POWER measures individually and combined across all 88 countries, and sensitivity analysis of policy effect sizes for SADs. From 2007 to 2010, 31 of the 88 countries implemented at least one highest level measure (22% implemented >1 policy) reducing SADs by 5 336 580. Smoke-free policies and taxes played a prominent role. Between 2010 and 2012, 46 countries implemented highest level measures (17% implemented >1 policy) reducing SADs by 5 365 602 SADs. Smoke-free laws and marketing bans played a particularly large role. Between 2012 and 2014, 32 countries implemented highest level measures (16% implemented >1 policy) reducing SADs by 11 089 741 SADs. Much of the increase in SADs averted from 2012 to 2014 was due to the implementation of highest level measures in four large countries with high smoking rates: Bangladesh (warnings, taxes), Philippines (warnings), Russian Federation (smoke-free air, advertising) and Vietnam (warnings). For all highest level measures implemented between 2007 and 2014, the model projects 53 151 033 (range 30 829 587–75 472 479) fewer smokers, averting an estimated 21 791 924 SAD (range 12 640 131–30 943 716) future deaths among smokers alive before the policies were implemented.

DISCUSSION

As a result of the highest level MPOWER measures adopted between 2007 and 2014, the number of smokers worldwide is projected to decline by about 53 million, translating to almost 22 million premature SADs averted. This reflects an estimated 16 million additional SADs averted due to policy adoption from our previous analysis spanning 2007–2010.[9] The most SADs were averted, due to adoption of increased cigarette taxes, closely followed by comprehensive smoke-free laws, marketing bans, health warnings and cessation treatment programmes. Cessation treatment programmes had the fewest number of countries meeting the highest level policy criteria between 2007 and 2014. Three countries, Brazil, Thailand and Turkey, all MICs, stand out for their efforts in adopting all or nearly all of the highest level MPOWER measures. Of particular note, the number of SADs averted has been increasing over time, with 13 million estimated for 2012–2014. This increase is due primarily to an increased number of countries implementing policies and countries with large populations (eg, the Russian Federation, Viet Nam) implementing policies.

Although 88 countries adopted one or more highest level MPOWER measures between 2007 and 2014, nearly half of the world's population remains uncovered by even a single MPOWER policy. We developed models for the three largest MICs, China, India and Indonesia. We found that, if those three countries alone adopted the complete set of highest level MPOWER measures, the number of SADs of smokers alive in those countries today would be reduced by about 140 million. In particular, few LMICs have met the tax threshold corresponding with the highest level group (>75% of pack price), where this policy has the potential not only to increase cessation among current smokers, but also to reduce initiation of new smokers.[19]

This model represents a critical step forward in the ability to estimate the public health impact of tobacco control policies. We use data from WHO reports and an extensively validated statistical model[111320–25] to estimate the impact of MPOWER measures—such an

assessment provides important, quantitative evidence demonstrating the magnitude of recent tobacco control policy progress globally. In addition, our comparison of the magnitude of the effects from the abridged model used here yielded results consistent with the complete SimSmoke models for nine countries.[9]

Despite these strengths, the findings should be interpreted in light of the limitations of this work. The estimation method is based on the number of deaths of smokers alive in a particular year and does not incorporate dynamic aspects of the effects of changing demographics and smoking rates and the effects of policies over time. Our estimates exclude smokers who may have initiated after the initial year in the absence of strong measures, thereby potentially underestimating the future effects of policies. However, potentially offsetting these benefits of policy implementation are those smokers who were included and may have quit in future years despite an absence of such policies. In addition, the policy effect sizes have almost exclusively been developed based on policy evaluations directed at cigarettes. Countries with significant use of other tobacco products, such as kreteks, bidis, smokeless tobacco and waterpipe, and weak policies towards the use of these products may experience reduced health benefits through the substitution of these products for cigarettes.

The effects of individual policies are assumed to be independent of each other. This method does not take into account either overlapping or synergistic effects of policies. Knowledge of these effects and how they may depend on the sequence of policy implementation is limited.

The effects of MPOWER policies depend on their specification. The effect sizes for smoke-free and marketing restrictions reflect compliance measures based on enforcement measures, whereas compliance may depend on antitobacco norms reflecting complete implementation of smoke-free and marketing measures as well as other policies. Compliance is not considered for the health warnings and tax (eg, through smuggling) measures. In modelling the effect of tax/price policies, we have taken into account the cost of living. However, as inflation-adjusted incomes rise, some of the effects, especially in low-income and middle-income nations, may be eroded. Finally, the MPOWER measures include only demand-oriented policies, and not supply oriented policies, such as youth access, smuggling and product content regulation.

Our analysis depends on estimates of relative risks of mortality based on data for high-income nations. Nevertheless, relative risks in LMICs, especially in many of the larger countries that are approaching high-income status (eg, Brazil, Mexico, Russian Federation and Turkey), are likely to increase as the intensity and duration of smoking increase and non-smoking-related risks decline.[28] If reduced relative risks found in LMICs[2627] are applied, 14 551 472 fewer future SADs (range 8 422 560–20 680 385) are still projected as a result of all countries reaching highest level measures. Furthermore, recent studies for high-income nations[29–32] find that two-thirds, rather than our estimate of half of smokers, die from smoking in the USA, suggesting that our estimates may be conservative for high-income nations. The estimated SADs also assume that those who quit have the risks of never smokers. However, policies will increasingly reduce smoking rates at younger ages, leaving relative risks close to those of never smokers. In addition, the public health implications go beyond the outcomes examined in this study to include improved quality of life and reduced

healthcare costs and productivity loss, harms to the fetus and young children resulting from maternal smoking[33] and the additional deaths to non-smokers from reduced exposure to secondhand smoke.[34] Thus, the estimate of SADs averted captures only one aspect of the potential positive impact of MPOWER policy adoption on population health. In addition, our analysis only considers outcomes and does not consider cost-effectiveness; some (eg, taxes) may be cost-saving, while others (eg, cessation treatments) have costs, but are still cost-effective.[3536]

A final limitation is that our estimates do not include the effect of adopted policies that have stronger components but do not qualify as highest level in the WHO reports. We tabulated cases of countries improving, but not meeting the highest level measure for the time period 2012–2014. We found 64 cases of these improvements averting 5.5 million deaths for that time period, suggesting that our estimates provided above that do not include improvements are conservative.

In conclusion, we found a substantial projected impact on SADs resulting from the adoption of highest level MPOWER measures between 2007 and 2014. With an estimated 22 million SADs averted, our findings show the enormous potential to reduce premature mortality by implementing evidence-based MPOWER tobacco control measures in those countries that have not yet implemented highest level measures.

Acknowledgments

Funding DTL received funding from Bloomberg Philanthropies through the International Union against Tuberculosis and Lung Disease to conduct this study. The funder helped in the collection of data and interpretation of data. DTL had access to all data in the study and had final responsibility for content of the article and the decision to submit for publication. DTL has also received funding from the Cancer Intervention and Surveillance and Modeling Network (CISNET of DCPS, NCI under grant U01-CA97450-020) for general development of the SimSmoke model and from the National Institute on Drug Abuse, under grant R01DA036497 to disseminate results. Preparation of this publication was also supported in part by a grant from the National Institutes of Health (NIH) and the Food and Drug Administration Center for Tobacco Products to DM (K07CA172217).

References

1. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med. 2006; 3:e442. [PubMed: 17132052]
2. [accessed 26 Nov 2016] Bloomberg Philanthropies website press releases (15 April 2013). http://https://www.bloomberg.org/press/releases/page/9/
3. [accessed 30 Aug 2013] Gates Foundation. 2013. http://www.gatesfoundation.org/Media-Center/Press-Releases/2008/07/Michael-Bloomberg-and-Bill-Gates-Join-to-Combat-Global-Tobacco-Epidemic
4. World Health Organization. WHO Report on the Global Tobacco Epidemic, 2008: The MPOWER package. Geneva: World Health Organization; 2008. http://www.who.int/tobacco/global_report/2008/en/index.html [accessed 2 Oct 2013]
5. World Health Organization. WHO Report on the global tobacco epidemic, 2009: implementing smoke-free environments. Geneva: World Health Organization; 2009. http://www.who.int/tobacco/global_report/2009/en/index.html [accessed 2 Oct 2013]
6. World Health Organization. WHO report on the global tobacco epidemic, 2011: warning about the dangers of tobacco. Geneva: World Health Organization; 2011. http://www.who.int/tobacco/global_report/2011/en/index.html [accessed 8/4/11]

7. World Health Organization. WHO report on the global tobacco epidemic, 2013: enforcing bans on tobacco advertising, promotion and sponsorship. Geneva: World Health Organization; 2013. http://www.who.int/tobacco/global_report/2013/en/index.html [accessed 2 Oct 2013]
8. World Health Organization. WHO report on the global tobacco epidemic, 2015: raising taxes on tobacco 2015. Geneva: World Health Organization; http://www.who.int/tobacco/global_report/2015/report/en/ [accessed 12 Mar 2016]
9. Levy DT, Ellis JA, Mays D, et al. Smoking-related deaths averted due to three years of policy progress. Bull World Health Organ. 2013; 91:509–18. [PubMed: 23825878]
10. Levy DT, Cummings KM, Hyland A. Increasing taxes as a strategy to reduce cigarette use and deaths: results of a simulation model. Prev Med. 2000; 31:279–86. [PubMed: 10964642]
11. Levy D, de Almeida LM, Szklo A. The Brazil SimSmoke policy simulation model: the effect of strong tobacco control policies on smoking prevalence and smoking-attributable deaths in a middle income nation. PLoS Med. 2012; 9:e1001336. [PubMed: 23139643]
12. Levy DT, Chaloupka F, Gitchell J. The effects of tobacco control policies on smoking rates: a tobacco control scorecard. J Public Health Manag Pract. 2004; 10:338–53. [PubMed: 15235381]
13. Levy DT, Hyland A, Higbee C, et al. The role of public policies in reducing smoking prevalence in California: results from the California tobacco policy simulation model. Health Policy. 2007; 82:167–85. [PubMed: 17055104]
14. United Nations. World population prospects 2012 revision. New York: Department of Economic And Social Affairs, Population Division; 2013.
15. Doll R, Peto R, Boreham J, et al. Mortality in relation to smoking: 50 years' observations on male British doctors. BMJ. 2004; 328:1519. [PubMed: 15213107]
16. Taylor DH Jr, Hasselblad V, Henley SJ, et al. Benefits of smoking cessation for longevity. Am J Public Health. 2002; 92:990–6. [PubMed: 12036794]
17. Kenfield SA, Stampfer MJ, Rosner BA, et al. Smoking and smoking cessation in relation to mortality in women. JAMA. 2008; 299:2037–47. [PubMed: 18460664]
18. Holford TR, Meza R, Warner KE, et al. Tobacco control and the reduction in smoking-related premature deaths in the United States, 1964–2012. JAMA. 2014; 311:164–71. [PubMed: 24399555]
19. Jha, P., Chaloupka, F., editors. Tobacco control in developing countries. New York: Oxford University Press; 2000.
20. Levy D, Rodríguez-Buño RL, Hu TW, et al. The potential effects of tobacco control in China: projections from the China SimSmoke simulation model. BMJ. 2014; 348:g1134. [PubMed: 24550245]
21. Currie LM, Blackman K, Clancy L, et al. The effect of tobacco control policies on smoking prevalence and smoking-attributable deaths in Ireland using the IrelandSS simulation model. Tob Control. 2013; 22:e25–32. [PubMed: 22634570]
22. Levy DT, Currie L, Clancy L. Tobacco control policy in the UK: blueprint for the rest of Europe? Eur J Public Health. 2013; 23:201–6. [PubMed: 22826505]
23. Levy DT, Cho SI, Kim YM, et al. SimSmoke model evaluation of the effect of tobacco control policies in Korea: the unknown success story. Am J Public Health. 2010; 100:1267–73. [PubMed: 20466968]
24. Levy DT, Benjakul S, Ross H, et al. The role of tobacco control policies in reducing smoking and deaths in a middle income nation: results from the Thailand SimSmoke simulation model. Tob Control. 2008; 17:53–9. [PubMed: 18218810]
25. Levy DT, Blackman K, Currie LM, et al. Germany SimSmoke: the effect of tobacco control policies on future smoking prevalence and smoking-attributable deaths in Germany. Nicotine Tob Res. 2013; 15:465–73. [PubMed: 22855886]
26. Jee SH, Lee JK, Kim IS. Smoking-attributable mortality among Korean adults: 1981–2003. Korean J Epidemiol. 2006; 28:92–99.
27. Wen CP, Tsai SP, Chen CJ, et al. The mortality risks of smokers in Taiwan: Part I: cause-specific mortality. Prev Med. 2004; 39:528–35. [PubMed: 15313092]

28. Flanders WD, Lally CA, Zhu BP, et al. Lung cancer mortality in relation to age, duration of smoking, and daily cigarette consumption: results from Cancer Prevention Study II. Cancer Res. 2003; 63:6556–62. [PubMed: 14559851]

29. Carter BD, Freedman ND, Jacobs EJ. Smoking and mortality—beyond established causes. N Engl J Med. 2015; 372:2170.

30. Jha P, Ramasundarahettige C, Landsman V, et al. 21st-century hazards of smoking and benefits of cessation in the United States. N Engl J Med. 2013; 368:341–50. [PubMed: 23343063]

31. Pirie K, Peto R, Reeves GK, et al. Million Women Study Collaborators. The 21st century hazards of smoking and benefits of stopping: a prospective study of one million women in the UK. Lancet. 2013; 381:133–41. [PubMed: 23107252]

32. Thun MJ, Carter BD, Feskanich D, et al. 50-year trends in smoking-related mortality in the United States. N Engl J Med. 2013; 368:351–64. [PubMed: 23343064]

33. USDHHS. The health consequences of smoking. Atlanta (GA: Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2004.

34. USDHHS. The health consequences of second-hand smoke: a report of the Surgeon General. Atlanta (GA): 2006.

35. Ekpu VU, Brown AK. The economic impact of smoking and of reducing smoking prevalence: review of evidence. Tob Use Insights. 2015; 8:1–35. [PubMed: 26242225]

36. Kahende JW, Loomis BR, Adhikari B, et al. A review of economic evaluations of tobacco control programs. Int J Environ Res Public Health. 2009; 6:51–68. [PubMed: 19440269]

What this paper adds

- A previous paper estimated that implementing highest level MPOWER policies between 2007 and 2010 averted about seven million premature deaths.
- This paper extends the previous analysis to include 2007 through 2014.
- In total, 88 countries adopted at least one highest level MPOWER policy, resulting in almost 22 million fewer premature deaths. The largest number of deaths averted was due to increased cigarette taxes (7.0 million), followed by comprehensive smoke-free laws (5.4 million), large graphic health warnings (4.1 million), comprehensive marketing bans (3.8 million) and comprehensive cessation interventions (1.5 million).

Tob Control. Author manuscript; available in PMC 2018 May 24.

Table 1

Policy specifications and effect sizes

Policy	Description	Short-term effect size (% effect)*	Long-term multiplier	Awareness parameter†	Urban adjustor‡	Lower and upper bounds (%)
Protect: smoke-free policies (additive over policies)						
Indoor workplaces: smoke free	Ban in all indoor workplaces, from MPOWER Reports	6%	1.3	1.5	Yes	(−50, +50)
Restaurants: smoke free	Ban in all indoor restaurants, from MPOWER Reports	2%	1.3	1.5	Yes	(−50, +50)
Pubs and bars: smoke free	Ban in all indoor restaurants, from MPOWER Reports	1%	1.3	1.5	Yes	(−50, +50)
Enforcement	Ranking out of 10 converted to per cent, from MPOWER Reports	25% of effect by type depends on % enforcement				
Publicity	On the basis of the level of tobacco control expenditures from MPOWER Reports. Set at high (0.75), medium (0.5) and low (0.25)	25% of the effect by type depends on publicity from tobacco control campaigns				
Offer: cessation treatment policies (effects are additive over policies)						
Availability of NRT and Bupropion	If NRT is provided by either general store or pharmacy w/ Rx=1 and=2 If NRT is provided by general store or pharmacy (no Rx required). If Bupropion is provided by either general store or pharmacy with Rx=1. From MPOWER Reports	1% if score of 3	2.5	1.5	Yes	(−50, +50)
Provision of treatments	Types of facilities distinguished, specified as primary care facilities, hospitals, offices of health professionals. Community and other. MPOWER: 0=none, yes in some=0.1, yes in most=0.2. From MPOWER Reports	2.25% if indicator ≥1 and programme is well publicised	2.5	1.5	Yes	(−50, +50)
Quit line	Active quit line, from MPOWER Reports	0.50%	2.5	1.5	Yes	(−50, +50)
Warnings about health on cigarette packages (mutually exclusive categories)						
Strong health warnings	Bold and graphic, and covers at least 50% the package, from MPOWER Reports, score=4	1.0%	3	2	No	(−50, +50)
Moderate health warnings	Nongraphic warning covers at least one-third of the package, from MPOWER Reports, score=3	0.5%	3	2	No	(−50, +50)
Weak health warnings	Non-graphic warning covers <one-third of the package. From MPOWER Reports, score=2	0.1%	3	2	No	(−50, +50)
Enforce: marketing bans (mutually exclusive categories)						
Ban on direct and indirect marketing	Ban on all direct and indirect advertising from MPOWER Reports, score=4	5%	1.3	2	No	(−50, +50)
Ban on advertising	Ban on all direct advertising, from MPOWER Rep, score=3	3%	1.3	2	No	(−50, +50)
Partial ban on advertising	Ban on some direct or indirect advertising, from MPOWER Reports, score=2	1%	1.3	2	No	(−50, +50)
Enforcement	Ranking out of 10 converted to per cent, from MPOWER Reports	50% of the effects depends on % enforcement				

Policy	Description	Short-term effect size (% effect)*	Long-term multiplier	Awareness parameter†	Urban adjustor‡	Lower and upper bounds (%)
Raise cigarette taxes						
Increase in retail price of cigarettes due to taxes	Cigarette price in local currency from MPOWER Reports, adjusted for inflation using inflation rates in theodora.com. Prevalence elasticity is applied to the percentage change in the inflation-adjusted price using an arc elasticity formula	On the basis of country-specific price elasticities, −0.15 for HICs, −0.2 for MICs, and −0.25 for LICs§	2	No	No	(−25, +25)

*The initial effect size is the short-term effect that is multiplied by the long-term multiplier with rural and awareness adjustments as specified in the table.

†The awareness parameter is multiplied by the effect size for low-income and middle-income countries.

‡The urban adjustor reduces the effect to reflect the per cent rural for the policies indicated.

§See Levy *et al*[10] for description of calculations.

HIC, high-income country; LIC, low-income country; MIC, middle-income country; NRT, nicotine replacement therapy.

Table 2

The effects of nations reaching the highest level for MPOWER policies*

Country	Year of meeting highest level	Income status	Smoking rate males (%)	Smoking rate females (%)	Total (male and female) number of smokers affected	Long-term effect size (%)	Reduction in the smoking-attributable deaths
Barbados	2010	HIC	14.2	1.6	17 778	−5.3	384.92
Burkina Faso	2010	LIC	23.6	11.1	1 567 539	−0.6	4167
Chad	2010	LIC	17.4	2.9	554 625	−0.8	1793
Colombia	2010	MIC	19.5	7.4	4 360 121	−8.3	148 442
Greece	2010	HIC	48.2	35.1	3 827 004	−3.3	51 315
Guatemala	2010	MIC	23.9	3.4	1 140 209	−2.2	10 054
Honduras	2010	MIC	24.8	2.3	697 460	−4.2	12 119
Libya	2010	MIC	32.0	1.5	759 198	−2.4	7352
Malta	2010	HIC	34.6	20.9	95 293	−0.8	310
Namibia	2010	MIC	20.9	5.3	185 720	−6.0	4586
Nauru	2010	LIC	49.7	56.0	3302	−5.2	70
Pakistan	2010	LIC	32.4	5.7	23 486 870	−0.4	35 014
Panama	2010	MIC	17.3	3.7	259 975	−8.5	9100
Peru	2010	MIC	23.3	7.3	3 158 190	−7.0	91 250
Seychelles	2010	MIC	35.5	7.0	14 990	−9.7	594
Spain	2010	HIC	35.3	23.9	11 696 404	−3.5	168 070
Thailand	2010	MIC	41.7	1.9	11 435 114	−4.1	193 863
Trinidad and Tobago	2010	HIC	36.5	7.3	218 082	−6.2	5502
Turkey	2010	MIC	51.9	17.3	20 042 442	−6.9	564 554
Argentina	2012	MIC	32.4	22.4	8 081 980	−7.7	255 217
Brazil	2012	MIC	21.6	13.1	24 366 963	−10.1	1 005 852
Brunei Darussalam	2012	HIC	31.8	2.9	52 744	−3.6	768
Bulgaria	2012	MIC	50.3	28.2	2 536 885	−7.6	79 015
Congo	2012	MIC	13.0	1.3	164 509	−3.7	2494
Costa Rica	2012	MIC	18.0	8.6	447 159	−5.3	9704
Ecuador	2012	MIC	36.3	8.2	2 085 893	−6.2	52 982
Lebanon	2012	MIC	43.2	33.8	1 147 973	−6.9	32 333

Country	Year of meeting highest level	Income status	Smoking rate males (%)	Smoking rate females (%)	Total (male and female) number of smokers affected	Long-term effect size (%)	Reduction in the smoking-attributable deaths
Mongolia	2012	MIC	48.0	6.9	543 490	−7.1	15 897
Nepal	2012	LIC	35.5	15.9	4 637 859	−2.1	40 450
West Bank Gaza Strip	2012	MIC	37.6	2.6	493 130	−3.5	7016
Papua New Guinea	2012	MIC	60.3	27.0	1 725 386	−1.1	7953
Venezuela	2012	MIC	25.2	13.9	3 849 971	−9.2	145 413
Bhutan	2012	MIC	8.4	4.7	33 898	−0.4	53
Saudi Arabia	2012	MIC	35.0	5.7	4 327 936	−5.3	94 423
Madagascar	2014	LIC	28.5	0.8	1 851 590	−2.5	18 786
Algeria	2014	MIC	27.1	1.7	3 912 141	−7.2	115 496
Russian Federation	2014	MIC	53.3	16.1	40 021 782	−12.0	1 966 933
Jamaica	2014	MIC	22.9	7.5	309 865	−10.0	12 765
Chile	2014	MIC	37.0	31.0	4 653 312	−12.3	234 793
Suriname	2014	MIC	38.4	9.9	91 785	−11.6	4369
Israel	2010	HIC	29.0	17.7	1 260 990	−5.4	27 845
Turkey	2010	MIC	51.9	17.3	20 042 442	−6.3	518 646
United Arab Emirates	2010	HIC	28.1	2.4	869 701	−2.3	8166
Denmark	2012	HIC	24.7	24.0	1 083 898	−2.7	11 961
Kuwait	2012	HIC	38.3	2.3	573 229	−2.2	5262
Panama	2012	MIC	17.3	3.7	256 897	−2.1	2203
USA	2012	HIC	21.5	17.3	47 473 906	−1.9	370 339
Canada	2012	HIC	19.7	13.8	4 762 087	−2.8	54 087
El Salvador	2012	MIC	21.5	2.4	471 241	−3.9	7554
Brunei Darussalam	2014	HIC	32.8	3.7	57 488	−2.4	567
Malta	2014	HIC	31.7	22.2	94 539	−1.8	679
Netherlands	2014	HIC	27.0	25.0	3 612 517	−2.8	40 953
Mexico	2014	MIC	31.0	9.9	17 580 942	−5.4	390 032
Argentina	2014	MIC	29.4	15.6	6 973 994	−2.0	57 442
Egypt	2010	MIC	34.6	0.7	9 830 298	−5.0	201 521
Iran (Islamic Rep of)	2010	MIC	23.2	1.1	7 264 822	−7.5	223 393
Malaysia	2010	MIC	46.5	3.0	5 049 124	−7.5	155 261

Country	Year of meeting highest level	Income status	Smoking rate males (%)	Smoking rate females (%)	Total (male and female) number of smokers affected	Long-term effect size (%)	Reduction in the smoking-attributable deaths
Mauritius	2010	MIC	35.9	5.1	204 946	−7.5	6302
Mexico	2010	MIC	30.4	9.5	15 944 254	−7.5	490 286
Peru	2010	MIC	29.4	9.4	4 005 220	−7.5	123 161
Argentina	2012	MIC	32.4	22.4	8 081 980	−6.0	198 817
Bolivia	2012	MIC	37.4	17.2	1 684 462	−6.0	41 438
Canada	2012	HIC	19.7	13.8	4 607 458	−2.0	37 781
Ecuador	2012	MIC	36.3	8.2	2 085 893	−4.0	34 209
El Salvador	2012	MIC	21.5	2.4	557 739	−6.0	13 720
Madagascar	2012	LIC	28.5	0.8	1 771 575	−4.0	29 054
Mongolia	2012	MIC	48.0	6.9	543 490	−4.0	8913
Nepal	2012	LIC	35.5	15.9	4 637 859	−6.0	114 091
Niger	2012	LIC	8.7	1.0	394 489	−6.0	9704
Seychelles	2012	MIC	37.2	6.3	13 601	−6.0	335
Sri Lanka	2012	MIC	29.9	0.4	2 236 746	−8.0	73 365
Turkey	2012	MIC	47.9	15.2	17 719 227	−4.0	290 595
Ukraine	2012	MIC	50.0	11.3	11 285 109	−6.0	277 614
Singapore	2012	HIC	27.9	5.0	680 766	−2.0	5582
Djibouti	2012	MIC	41.1	9.2	138 205	−6.0	3400
Namibia	2014	MIC	20.9	5.3	182 477	−8.0	5985
Trinidad and Tobago	2014	HIC	33.5	9.4	225 863	−4.0	3704
Philippines	2014	MIC	47.6	9.0	18 249 801	−8.0	598 593
Jamaica	2014	MIC	22.1	7.2	298 645	−6.0	7347
Turkmenistan	2014	MIC	15.5	0.6	289 728	−8.0	9503
Bangladesh	2014	LIC	54.8	1.3	30 198 764	−6.0	742 890
Fiji	2014	MIC	47.0	14.3	191 916	−8.0	6295
Samoa	2014	MIC	34.9	15.3	29 710	−8.0	974
Solomon Islands	2014	LIC	56.1	26.1	134 717	−8.0	4419
Vanuatu	2014	MIC	62.3	20.2	63 517	−8.0	2083
Costa Rica	2014	MIC	18.6	8.5	480 467	−8.0	15 759
Viet Nam	2014	LIC	47.4	1.4	16 496 877	−6.0	405 823

Country	Year of meeting highest level	Income status	Smoking rate males (%)	Smoking rate females (%)	Total (male and female) number of smokers affected	Long-term effect size (%)	Reduction in the smoking-attributable deaths
Chad	2010	LIC	17.4	2.9	554 625	−4.6	10 375
Colombia	2010	MIC	19.5	7.4	4 360 121	−10.0	178 765
Panama	2010	MIC	17.3	3.7	259 975	−12.5	13 324
Bahrain	2012	HIC	33.4	7.0	133 668	−5.1	2814
Brazil	2012	MIC	21.6	13.1	24 366 963	−3.4	337 677
Ghana	2012	MIC	8.2	0.4	677 277	−5.2	14 440
Libya	2012	MIC	49.6	0.8	1 189 377	−9.0	43 742
Maldives	2012	MIC	34.7	3.4	43 368	−2.0	347
Mauritius	2012	MIC	40.3	3.7	216 524	−8.5	7501
Spain	2012	HIC	35.3	24.6	11 305 599	−3.0	138 595
Togo	2012	LIC	12.4	1.8	284 880	−6.5	7592
Turkey	2012	MIC	47.9	15.2	17 719 227	−13.0	944 435
Tuvalu	2012	MIC	54.6	22.7	3256	−12.4	165
Vanuatu	2012	MIC	62.3	20.2	60 848	−9.0	2254
Guinea	2012	LIC	23.2	2.0	780 522	−1.7	5408
Suriname	2014	MIC	38.4	9.9	91 785	−9.8	3669
Russian Federation	2014	MIC	53.3	16.1	40 021 782	−10.4	1 706 529
Kiribati	2014	MIC	74.1	43.1	39 692	−9.8	1587
Uruguay	2014	MIC	30.7	19.8	661 202	−9.4	25 374
United Arab Emirates	2014	HIC	28.1	2.4	1 736 395	−2.9	20 361
Yemen	2014	LIC	27.4	10.3	2 748 789	−5.6	63 000
Nepal	2014	LIC	51.9	13.3	5 590 684	−10.4	238 387
Greece	2010	HIC	48.2	35.1	3 827 004	−1.1	17 182
Hungary	2010	MIC	40.5	27.9	2 886 051	−7.1	54 741
Israel	2010	HIC	29.0	17.7	1 260 990	−12.2	63 275
Latvia	2010	MIC	50.6	23.7	685 437	−40.6	74 204
Lithuania	2010	MIC	48.4	20.1	1 012 629	−21.4	57 632
Madagascar	2010	LIC	27.3	1.8	1 795 249	−11.3	54 133
Slovenia	2010	HIC	29.0	21.9	438 439	−4.4	7869
Turkey	2010	MIC	51.9	17.3	20 042 442	−19.6	1 048 028

Country	Year of meeting highest level	Income status	Smoking rate males (%)	Smoking rate females (%)	Total (male and female) number of smokers affected	Long-term effect size (%)	Reduction in the smoking-attributable deaths
Cyprus	2012	HIC	43.9	16.9	211 978	−19.6	17 022
Denmark	2012	HIC	24.7	24.0	1 083 898	−3.5	15 517
Montenegro	2012	MIC	36.7	29.0	158 145	−19.3	8144
West Bank Gaza Strip	2012	MIC	37.6	2.6	493 130	−19.1	25 077
Serbia	2012	MIC	42.1	42.1	3 402 049	−31.4	284 301
Seychelles	2014	MIC	37.2	6.3	16 059	−16.3	696
Bangladesh	2014	LIC	54.8	1.3	30 198 764	−31.7	2 554 257
Romania	2014	MIC	37.4	16.7	4 473 681	−13.3	159 082
Bosnia and Herzegovina	2014	MIC	46.9	34.5	1 332 912	−20.9	74 313
Croatia	2014	MIC	40.9	34.0	1 352 633	−11.7	42 243
New Zealand	2014	HIC	19.4	17.5	649 255	−10.9	29 009
Kiribati	2014	MIC	74.1	43.1	15 302	−14.0	571

*Estimated using the Abridged SimSmoke and data from MPOWER Reports.

HIC, high-income country; LIC, low-income country; MIC, middle-income country.

Table 3

Total effect on smokers and smoking-attributable deaths for 2007–2010, 2010–2012, 2012–2014 and 2007–2014 *

Policy	Reduction in smokers 2007–2010	Reduction in smokers 2010–2012	Reduction in smokers 2012–2014	Reduction in SADs 2007–2010	Reduction in SADs 2010–2012	Reduction in SADs 2012–2014	Total reduction in SADs 2007–2014
Smoke-free air (P)	3 191 558	4 267 248	5 739 371	1 308 539	1 749 572	2 353 142	5 411 253
Cessation (O)	1 352 822	1 100 992	1 194 325	554 657	451 407	489 673	1 495 737
Health warnings (W)	2 926 642	2 777 118	4 398 478	1 199 923	1 138 618	1 803 376	4 141 918
Marketing bans (E)	493 814	3 670 659	5 021 722	202 464	1 504 970	2 058 906	3 766 340
Raising tax (R)	5 051 213	1 270 817	10 694 253	2 070 997	521 035	4 384 644	6 976 676
Total (best estimate)	13 016 050	13 086 834	27 048 149	5 336 580	5 365 602	11 089 741	21 791 924
Lower range of total	7 770 828	6 861 121	16 197 638	3 186 040	2 813 060	6 641 031	12 640 131
Upper range of total	18 261 271	19 312 547	37 898 660	7 487 121	7 918 144	15 538 451	30 943 716

* Estimated using the Abridged SimSmoke and data from MPOWER Reports.

SADs, smoking-attributable deaths.