Smoking-related deaths averted due to three years of policy progress

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Objective To evaluate the global impact of adopting highest-level MPOWER tobacco control policies in different countries and territories from 2007 to 2010.

Methods Policy effect sizes based on previously-validated SimSmoke models were applied to determine the reduction in the number of smokers as a result of policy adoption during this period. Based on previous research suggesting that half of all smokers die from smoking, we also derived the estimated smoking-attributable deaths (SADs) averted due to MPOWER policy implementation. The results from use of this simple yet powerful method are consistent with those predicted by using previously validated SimSmoke models.

Findings In total, 41 countries adopted at least one highest-level MPOWER policy between 2007 and 2010. As a result of all policies adopted during this period, the number of smokers is estimated to have dropped by 14.8 million, with a total of 7.4 million SADs averted. The largest number of SADs was averted as a result of increased cigarette taxes (3.5 million), smoke-free air laws (2.5 million), health warnings (700 000), cessation treatments (380 000), and bans on tobacco marketing (306 000).

Conclusion From 2007 to 2010, 41 countries and territories took action that will collectively prevent nearly 7.5 million smoking-related deaths globally. These findings demonstrate the magnitude of the actions already taken by countries and underscore the potential for millions of additional lives to be saved with continued adoption of MPOWER policies.

Abstracts in عربي, 中文, Français, Русский and Español at the end of each article.

Introduction

The World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC) has been one of the most rapidly embraced treaties in the history of the United Nations. To assist countries with implementing FCTC obligations, in 2008 WHO introduced the MPOWER package of evidence-based tobacco control measures. The MPOWER package includes: monitoring tobacco use and tobacco control policies; protecting people from the dangers of tobacco smoke; offering help to quit tobacco; warning the public about the dangers of tobacco; enforcing bans on tobacco advertising, promotion and sponsorship; and raising tobacco taxes. These measures are supported by substantial evidence of their impact for reducing smoking.[1–4]

Since their introduction, countries have steadily implemented recommended MPOWER policies. Early leaders in adopting rigorous MPOWER measures include Brazil,[5] Ireland[6] and Thailand.[7] As the movement to adopt MPOWER policies gains momentum, more countries have passed laws and many others have put advocacy efforts in place to support legislation. This progress has also been aided by significant support from private donors.

In 2008, WHO began systematically gathering information about MPOWER measures in every Member State to assess progress with the adoption of legislation, motivate further change and provide examples of excellence. In 2008, 2009 and 2011 WHO published reports that provide information about MPOWER implementation.[8–10] Findings of the most recent report, which includes data from 2010, showed that 3.8 billion people were covered by at least one MPOWER category globally and demonstrated progress in every MPOWER category.

The goal of the MPOWER package is to reduce smoking-attributable deaths (SADs), which are projected to rise to 8.3 million annually by 2030.[11] The purpose of this study is to determine the number of SADs averted as a result of the implementation of MPOWER policies. By capitalizing on the previously-validated SimSmoke model[5–7,12–20] to estimate the impact of MPOWER policies for reducing SADs, we employ a simple but powerful method to estimate the long-term impact of MPOWER policy implementation in the first three years.

Methods

Assessment of incremental policy change

The WHO reports[8–10] show the status of each MPOWER policy, by country or territory, for 2007, 2008 and 2010 using a five-level categorization. The highest level comprises the MPOWER measures that WHO placed in the highest category in terms of the completeness of the legislation. For example, WHO categorizes smoke-free laws at the highest level as those calling for "all public places smoke-free or ≥ 90% of the population covered by subnational smoke-free legislation".

Using these criteria, we created a list of countries and territories that had adopted a highest-level policy after 2007, commensurate with the timing of WHO reports. We also used WHO corrigenda to clarify or correct policy status based on additional knowledge gained after publication of the reports.[21] The list of countries and territories adopting highest-level policies was confirmed by representatives of the WHO Tobacco Free Initiative.

We compared 2010 data for the POWER (monitoring is excluded from this report) categories to 2007 data to determine which countries not in the highest-level category in 2007 had progressed to the highest level by 2010. For each country that had adopted a highest-level policy by 2010, policy data from earlier reports were used to determine incremental policy changes because the effect of a policy change depends upon the initial policy level (e.g. the incremental effect of a complete

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ban is less if a partial ban was in place than if no policy existed).

Effect size parameters

Effect sizes for incremental policy change were derived from the SimSmoke tobacco control policy model.[2,22,23] The SimSmoke model has been validated for four states of the United States of America and more than 20 countries.[5–7,12–20,23,24] Table 1 summarizes policies and effect sizes based on expert panels and published literature reviews.[23] We provide upper and lower bounds for effect sizes based on variability estimates from our previous work.[14]

To determine policy effect size, we used the per cent reductions (in relative terms) in smoking prevalence resulting from a particular policy. The policy effect size is classified as being either short-term or long-term: (i) a short-term effect size is defined as the percentage change in smoking prevalence in the first three years of policy implementation; (ii) a long-term effect size is the percentage change in smoking prevalence after 40 years of implementation. In SimSmoke models, a short-term effect size is based on the change in policy by 2010 from its 2007 level, and a long-term effect size is derived by multiplying the short-term effect by a long-term multiplier and by adjustment factors for health knowledge, urbanization and enforcement. In previously-developed versions of SimSmoke, the long-term multiplier is estimated for each policy (LT-MULT_p) as the ratio of the relative change in prevalence after 40 years to the relative change in short-term prevalence in the first year.

Except for tax policies, effect sizes are based primarily on policy evaluation studies from high-income countries or territories (HICs) due to the lack of studies for low- and middle-income countries or territories (LMICs). Accordingly, for LMICs, the effect size is adjusted by a health knowledge variable ($\text{AWARE}_p > 1$ in LMICs, and 1 in HICs), reflecting the ability to affect health awareness from policy p (excluding price policies) in LMICs (e.g. Blecher et al.[26] found that advertising bans have larger effects in LMICs). Some policies are also subject to the percentage of urban population in country i, URBAN_i, measured as (1 minus the percentage employed in agriculture).[27] The urban adjustment incorporates the ability to reach and influence the population and those not covered by smoke-free-air laws (i.e. those not working indoors).

For smoke-free air (SFA) effects and impact of smoke-free air laws, we posit that half of the effects will occur automatically through passage of the law (e.g. due to a change in norms), while the remaining half of the effects will depend on enforcement (ENF, $0 \leq \text{ENF} \leq 1$, using the MPOWER index = 1,…10 divided by 10), and a publicity index based on tobacco control spending (PUB = 0.5 if low [< 0.05 United States dollars (US$) per capita], = 0.75 if medium [≥ US$ 0.05 and < US$ 0.50 per capita], and = 1 if high [≥ $US 0.50 per capita]). Letting ST-SFA be the short-term effect size for a HIC with high enforcement and publicity (PUB), the long-term SFA effect (LT-SFA_i) for country i is:

$$\text{LT-SFA}_i = \text{ST-SFA}_i \times \text{LT-MULT}_{\text{SFA}} \times \text{AWARE}_{i,\text{SFA}} \times \text{URBAN}_i \times \left[0.5\left(1 + ENF_{i,\text{SFA}} \times \text{PUB}_i\right)\right] \quad (1)$$

where ST-SFA_i is country i's short-term effect size from the change in policy if it were a HIC.

The marketing restrictions (MR) equation omits the URBAN and PUB effect (i.e. URBAN = PUB = 1), so the long-term MR effect for country i is:

$$\text{LT-MR}_i = \text{ST-MR}_i \times \text{LT-MULT}_{\text{MR}} \times \text{AWARE}_{i,\text{MR}} \times 0.5\left(1 + \text{ENF}_{i,\text{MR}}\right) \quad (2)$$

For cessation treatment policies (CTP), the long-term effect (LT-CTP_i) is:

$$\text{LT-CTP}_i = \text{ST-CTP}_i \times \text{LT-MULT}_{\text{CTP}} \times \text{URBAN}_i \times \text{AWARE}_{i,\text{CTP}} \quad (3)$$

where ST-CTP_i is the short-term CTP effect size in a HIC from the change in CTP policy.

For health warnings (HWs), URBAN is set equal to one. The long-term HW effect is:

$$\text{LT-HW}_i = \text{ST-HW}_i \times \text{LT-MULT}_{\text{HW}} \times \text{AWARE}_{i,\text{HW}} \quad (4)$$

The effect for price policies (PRICE) depends on standard economic demand elasticities, which we assume are constant over price changes and are applied to the smoking prevalence. The formula for the prevalence elasticity, E, is defined in terms of the inflation-adjusted price, Pr, and prevalence, PREV. Using an arc elasticity formula, price change is measured as the price change between 2007 and 2010 relative to the average price, i.e. $(P_{2010} - P_{2007})/[0.5(P_{2010} + \text{P}_{2007})]$. The short-term prevalence elasticity is negative and written as:

$$E = \frac{\dfrac{\text{PREV}_{2010} - \text{PREV}_{2007}}{\text{PREV}_{2010} + \text{PREV}_{2007}}}{\dfrac{\text{Pr}_{2010} - \text{Pr}_{2007}}{\text{Pr}_{2010} + \text{Pr}_{2007}}} \quad (5)$$

Since the change in prevalence can be calculated as:

$$E_i \times \frac{(P_{2010} - P_{2007})}{0.5\left(P_{2010} + P_{2007}\right)} \quad (6)$$

and assuming constant price elasticities,[25] the price effect size for country i is calculated as:

$$\text{LT-PRICE}_i = \frac{(P_{2010} - P_{2007})}{0.5\left(P_{2010} + P_{2007}\right)} \times E_i \times \text{LT-MULT}_{\text{PRICE}} \quad (7)$$

Based on previous reviews,[28] overall short-term elasticities were set at −0.15 for HICs, −0.2 for MICs and −0.2 for LICs, with a long-term multiplier of 2.

Reduction in smokers and smoking-attributable deaths

Adjusted smoking prevalence for those 15 years of age or older, by sex, for 2007 or a previous year were obtained

Table 1. **Specific policies and corresponding effect sizes**

Policy type	Description from MPOWER reports	Short-term effect size[a] (%)	Lower and upper bounds	Long-term multiplier	Awareness adjustor[b]	Urban adjustor[c]
Protect: smoke-free policies[d]						
Indoor workplaces: smoke-free	Ban in all indoor workplaces	6	(−50%, +50%)	1.4	1.5	Yes
Restaurants: smoke-free	Ban in all indoor restaurants	2	(−50%, +50%)	1.4	1.5	Yes
Pubs and bars: smoke-free	Ban in all indoor restaurants	1	(−50%, +50%)	1.4	1.5	Yes
Enforcement	Ranking out of 10 converted to per cent	25% of the effect, by type, depends on enforcement level.	NA	NA	NA	NA
Publicity	Based on level of tobacco control funding in MPOWER. 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.	NA	NA	NA	NA
Offer: cessation treatment[d]						
Availability of NRT and bupropion	1 if NRT is provided by either general store or pharmacy with prescription; 2 If NRT is provided by general store or pharmacy (no prescription required). 1 if bupropion is provided by either general store or pharmacy with prescription	1 if score of 3	(−50%, +100%)	2.5	1.5	Yes
Provision of treatments	Types of facilities distinguished, specified as primary care facilities, hospitals, offices of health professionals. Community and other. MPOWER: 0 if none, 0.1 if yes in some, 0.2 if yes in most	2.25 if indicator ≥ 1 and programme is well publicized	(−50%, +100%)	2.5	1.5	Yes
Quitline	Operating active quitline	0.50	(−50%, +100%)	2.5	1.5	Yes
Warn: health warnings on cigarette packages[e]						
Strong health warnings	Bold and graphic, and covers at least 50% of the package, score = 4	1.0	(−50%, +50%)	3	2	No
Moderate health warnings	Warning cover at least one-third of the package, but not graphic, score = 3	0.5	(−50%, +50%)	3	2	No
Weak health warnings	Non-graphic warning, covers less than one-third of the package, score = 2	0.1	(−50%, +50%)	3	2	No
No warnings	None	0	NA	NA	NA	NA
Enforce: marketing bans[f]						
Ban on direct and indirect marketing	Ban on all direct and indirect advertising, score = 4	5	(−50%, +50%)	1.3	2	No
Ban on advertising	Ban on all direct advertising, score = 3	3	(−50%, +50%)	1.3	2	No
Partial ban on advertising	Ban on some direct or indirect advertising, score = 2	1	(−50%, +50%)	1.3	2	No
No restrictions		No effect				
Enforcement	Ranking out of 10 converted to per cent	50% of the effects depends on enforcement level.	NA	NA	NA	NA

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Policy type	Description from MPOWER reports	Short-term effect size[a] (%)	Lower and upper bounds	Long-term multiplier	Awareness adjustor[b]	Urban adjustor[c]
Raise cigarette taxes						
Increase in retail price of cigarettes due to taxes	Cigarette price in local currency, adjusted for inflation using inflation rates in www.theodora.com. Prevalence elasticity is applied to percentage change in inflation-adjusted price using an arc elasticity formula	Based on country-specific price elasticities, −0.15 for HICs, −0.2 for MICs, and −0.25 for LICs[g]	(−25%, +25%)	2	No	No

HIC, high-income country; LIC, low-income country; MIC, middle-income country; NA, not applicable; NRT, nicotine replacement therapy.
[a] Short-term effect size is defined as the relative percentage change in smoking prevalence in the first three years of policy implementation. The initial effect size is the short-term-effect multiplied by the long-term multiplier, with adjustments for rural status and awareness as specified in the table.
[b] The awareness adjustor is multiplied by the effect size for low- and middle-income countries.
[c] The urban adjustor reduces the effect to reflect the percentage of the rural population not affected by the policies indicated.
[d] Effects are additive over policies.
[e] Mutually exclusive categories.
[f] First four categories are mutually exclusive.
[g] See Levy et al. (2000) for description of calculations.[25]

from the 2011 WHO report for all countries except Colombia, whose adjusted prevalence was obtained from InfoBase. Prevalence reported is for "current smoking" and includes people who smoke cigarettes and other tobacco products, such as kreteks and bidis, every day and some days. The number of smokers of each sex was obtained by multiplying the respective smoking prevalence by population data for sex from the *World population prospects*, 2008 revision.[17] The number of smokers, by sex, for country i is obtained as:

$$\text{SMOKERS}_i = \text{PREV}_{m,i} \times \text{Pop}_{m,i} + \text{PREV}_{f,i} \times \text{Pop}_{f,i} \quad (8)$$

where PREV is smoking prevalence and Pop is populations (ages 15+), both distinguished by male (m) and female (f).

Applying the relevant policy long-term effect size to the number of smokers, we calculated the reduction in smokers in country i as a result of policy p, $\Delta\text{SMOKERS}_{i,p}$, as:

$$\Delta\text{SMOKERS}_{i,P} = \text{SMOKERS}_i \times \text{LT-EFFECT SIZE}_{i,p} \quad (9)$$

where $\text{LT-EFFECT SIZE}_{i,p}$ is the long-term policy effect size of a specific policy p in country i.

The number of SADs averted was calculated by applying an algorithm based on Doll et al.,[29,30] who concluded that "half of all regular cigarette smokers will eventually be killed by their habit". Similar results have been obtained in studies in the United States.[31,32] We applied the 50% figure to smokers who quit as a result of the policy to estimate the deaths averted, ΔSMOKERS DEATHS, as:

$$\Delta\text{SMOKERS DEATHS}_{i,p} = \Delta\text{SMOKERS}_{i,p} \times 0.5 \quad (10)$$

Results

Study population

Table 2 presents national income status, initial smoking prevalence by sex, policy effect size, estimated reduction in the number of smokers between 2007 and 2010, and reduction in SADs by policy and country. In total, 41 countries implemented a highest-level MPOWER policy; 8 implemented more than one highest-level policy. Smoking prevalence estimates varied from < 1.0% for females in Egypt to > 50% for males in Malaysia and Turkey.

Smoke-free air policies

Of the 20 countries implementing complete SFA policies, three are classified as LICs, 12 as MICs, and five as HICs. SFA laws were already in use at worksites in Spain in 2007; restaurants and bars were added by 2010. For other countries (e.g. Turkey), SFA policies were implemented for most locations between 2007 and 2010. Countries such as Burkina Faso and Chad have large rural sectors leading to small effects, whereas Colombia, Nauru, Peru, Seychelles and Turkey have a smaller agricultural sector and hence show larger effects. Owing to their large populations, Pakistan, Thailand and Turkey had the greatest number of SADs averted. In total, 5 032 629 individuals who were smoking in 2007 quit smoking as a result of SFA policies. Consequently, an estimated 2 516 314 SADs are averted (range: 1 258 157–3 774 472).

Cessation treatment policies

Two HICs and two MICs adopted highest-level cessation policies. Effect sizes vary from −1.8% for Turkey to −5.4% for Israel depending on the country's income status and the policies in place in 2007. Collectively, changes in cessation policies are estimated to lead to 759 150 fewer smokers and 379 575 averted SADs (range 189 768 to 759 150).

Health warnings

Seven countries adopted highest-level pack warning policies. All were MICs except for Djibouti. Since most countries were middle-income and their health warnings changed from weak to strong, their long-term effect sizes were −3.0%. For other countries, changes in the warnings or a change to HIC status yielded an effect size of −1.5%. These policy changes reduced the number of smokers by 1 379 580 and averted 689 790 SADs (range:344 895–1 034 685).

Advertising policies

Highest-level bans on tobacco advertising and promotions were adopted by

Table 2. **Smoking-attributable deaths averted, by policy and country or territory**

Policy by country or territory	Income status	2007 smoking rate (%)		Long-term effect size[a]	Reduction in no. of smokers[b]	Reduction in SADs[c]
		Males	Females			
Protect through smoke-free air laws						
Barbados	HI	18.5	3.3	−10.9	2672	1336
Burkina Faso	LI	20.3	8.2	−1.2	14 840	7420
Chad	LI	14.0	2.2	−2.1	9342	4671
Colombia	MI	20.2	9.9	−11.7	574 235	287 117
Greece	HI	48.2	35.1	−5.4	205 925	102 962
Guatemala	MI	24.8	3.9	−5.3	63 526	31 763
Honduras	MI	24.8	3.3	−7.2	52 086	26 043
Libya	MI	32.0	1.5	−6.0	45 234	22 617
Maldives	MI	44.4	9.2	−9.0	8475	4238
Malta	HI	32.0	21.8	−1.7	1581	791
Namibia	MI	31.0	9.3	−9.3	26 674	13 337
Nauru	LI	47.2	53.3	−7.9	248	124
Pakistan	MI	31.7	5.2	−4.0	900 550	450 275
Panama	MI	17.4	4.0	−9.7	25 719	12 860
Peru	MI	29.4	9.4	−9.8	390 685	195 342
Seychelles	MI	35.5	7.0	−11.6	1733	867
Spain	HI	36.0	24.0	−2.4	279 063	139 532
Thailand	MI	39.9	3.4	−5.7	653 498	326 749
Trinidad and Tobago	HI	36.5	7.3	−7.2	15 751	7875
Turkey	MI	53.3	20.5	−8.2	1 760 792	880 396
Offer cessation treatments						
Israel	HI	30.9	17.6	−5.4	70 529	35 264
Romania	MI	45.2	23.6	−4.5	287 825	143 913
Turkey	MI	53.3	20.5	−1.8	381 515	190 757
United Arab Emirates	HI	27.2	2.4	−2.3	19 282	9641
Put warnings on cigarette packages						
Djibouti	LI	41.1	9.2	−1.5	3499	1750
Egypt	MI	41.5	0.6	−1.5	178 598	89 299
IslaMI Republic of Iran	MI	26.2	4.5	−3.0	279 292	139 646
Malaysia	MI	55.5	2.5	−3.0	180 571	90 285
Mauritius	MI	36.2	1.1	−3.0	5658	2829
Mexico	MI	37.6	12.4	−3.1	609 803	304 901
Peru	MI	29.4	9.4	−3.0	122 159	61 080
Enforce marketing restrictions						
Chad	LI	14.0	2.2	−5.9	25 812	12 906
Colombia	MI	20.2	9.9	−10.4	508 760	254 380
Panama	MI	17.4	4.0	−13.0	34 358	17 179
Syrian Arab Republic	MI	42.0	8.9	−1.2	43 716	21 858
Raise cigarette taxes to 75% of price						
Argentina	MI	34.6	24.6	−8.4	775 381	387 691
Czech Republic	HI	34.9	27.4	−1.4	37 697	18 849
Estonia	HI	49.0	25.3	−9.0	35 147	17 574
Finland	HI	30.7	21.0	−1.1	12 493	6246
Greece	HI	48.2	35.1	−1.5	55 875	27 938
Israel	HI	30.9	17.6	−12.2	160 269	80 134
Italy	HI	30.6	16.4	−3.0	370 466	185 233
Latvia	HI	50.6	23.7	−30.5	208 828	104 414
Lithuania	MI	48.4	20.1	−21.4	216 253	108 127
Madagascar	LI	27.3	1.8	−14.1	253 907	126 953
Romania	MI	45.2	23.6	−27.8	1 762 454	881 227
Slovenia	HI	29.6	21.9	−5.8	25 871	12 936
Turkey	MI	53.3	20.5	−14.7	3 141 364	1 570 682
West Bank and Gaza Strip	MI	NA	NA	−8.1	NA	NA

HI, high-income; LI, low-income; MI, middle-income; NA, not available; SAD, smoking-attributable death.

[a] The long-term effect size is defined as the relative percentage change in smoking prevalence after 40 years of implementation.

[b] Based on the smokers alive in 2007.

Table 3. **The effect of meeting targets by 2010 on smokers and smoking-attributable deaths, by policy**

Policy	Total adult smokers in 2007 in countries meeting policies	Reduction in no. of smokers due to policy	Reduction in SADs	Lower and upper bounds
Protect air	85 445 026	5 032 629	2 516 314	(1 258 157, 3 774 472)
Offer cessation treatments	29 846 990	759 150	379 575	(189 788, 759 150)
Warnings on packages	100 633 047	1 379 580	689 790	(344 895, 1 034 685)
Enforced marketing bans	9 333 839	612 646	306 323	(153 162, 459 485)
Raise taxes	62 416 277	7 056 006	3 528 003	(2 646 002, 4 410 004)
Total	**287 675 178**	**14 840 011**	**7 420 006**	**(4 592 004, 10 437 796)**

SAD, smoking-attributable death.

four countries, all of which are MIC except for Chad. Panama adopted a marketing ban without prior restrictions (effect size: –13%), whereas most other countries had several restrictions in place in 2007. Overall, advertising policy changes resulted in 306 323 SADs averted (range: 153 162–459 485).

Price and taxes

Taxes were raised to the MPOWER goal of 75% of the final retail price in 14 countries, including one LIC, five MICs and eight HICs (Table 2). Relative changes in price from 2007 levels varied. Finland had relatively high tax rates in 2007 with increases of less than 5%, as did the Czech Republic and Greece. Other countries had inflation-adjusted price changes of at least 10%: Argentina (21%), Estonia (30%), Israel (41%), Italy (10%), Latvia (102%), Lithuania (53%), Madagascar (28%), Romania (69%), Slovenia (15%) and Turkey (49%). The largest number of deaths was averted in Argentina, Italy, Romania and Turkey, a reflection of the magnitude of the price increase, of initial smoking prevalence and of the size of the total population. Price increases are estimated to lead to a reduction of 7 056 006 smokers and to the aversion of 3 528 003 SADs (range: 2 646 002–4 410 004).

Total effects

The total estimated impact of each of the five MPOWER policies on the number of current smokers and of deaths prevented is shown in Table 3. The estimated number of smokers will be reduced by 14 840 011 and an estimated 7 420 006 SADs will be averted (range: 4 592 004–10 437 796) among smokers alive in 2007.

Discussion

The highest-level MPOWER policies adopted from 2007 to 2010 will result in 15 million fewer smokers, and 7.4 premature deaths will consequently be averted by 2050. These findings underscore the urgent need for countries to focus on adopting, implementing and enforcing MPOWER policies. Although more than 40 countries adopted one or more MPOWER policies from 2007 to 2010, nearly half of the world population is still not covered by a single MPOWER policy. The policies having the greatest impact – smoke-free air laws and taxation – are alarmingly under-adopted. Only 11% of the world's population is protected by SFA laws and less than 8% resides in countries with the recommended minimum tobacco tax rates.

MPOWER policy implementation is likely to yield additional benefits beyond the nearly 7.5 million estimated SADs averted. The estimates do not include the beneficial effects of adopted policies that have strong components but do not qualify as being of the highest level in the WHO reports. Our estimates also exclude smokers who may have initiated smoking after 2007 in the absence of strong policies. However, smokers who were included in our estimates and who may have quit smoking later despite the absence of such policies potentially offset some of the benefits of policy implementation that were omitted from our analysis.

We used data from WHO reports and an extensively validated statistical model to estimate MPOWER policy impact. This supports the validity of our estimates. Despite these strengths, the findings should be interpreted in light of the limitations of this work. The estimation method does not incorporate dynamic aspects of changing demographics and smoking rates and the effects of policies over time. To explicitly consider the impact of incorporating these dynamic aspects, we applied the SimSmoke simulation model in a separate analysis to nine countries that are reaching MPOWER goals (data not shown). For the nine countries we compared the effects on smoking prevalence and SADs with the effects reported in the previous section and found that they were reasonably close to the reported findings. This suggests that the dynamic aspects of policy change that were not taken into account in our analysis did not substantially bias our findings.

The policy data used for our analysis were reported by WHO, which adheres to a specific set of policies described by the FCTC. To collect the data, WHO reviews actual legislation in its original language and catalogues policy status. The categorization of the policy for inclusion in the report is then reviewed at the regional and national levels by various entities, including each country's health ministry. Although these are the best available data that could be ascertained for our analyses, the characteristics of a policy as implemented in a specific location may not be fully captured by WHO reports. For example, the effects of smoking cessation policies may depend on financial reimbursement and the involvement of health-care workers, but these data are not collected. More specific national-level data may allow for more precise estimation of the impact of FCTC policy on smoking-related morbidity and mortality. Another limitation lies in the ability to model the combined effects of

more than one policy simultaneously. Although there may be synergies, policies may also offset one another. The literature provides little guidance on the potential synergistic or offsetting effects of multiple concurrent policies.

Finally, our analysis depended on estimates of relative risks of death based on data for HICs. Studies indicate that LMICs have lower relative risks: e.g. 1.35 for China[33–35] and 1.6 for the Republic of Korea and Taiwan, China,[36–38] compared with ≥ 2.0 for the United States.[39–41] These differences may reflect initiation at older ages or a higher background risk of premature death from other causes. To consider these effects, we multiplied the SAD estimates for LMICs (using World Bank classifications) by 0.6, based on results from previous SimSmoke models that show 40% fewer deaths in MICs.[7,42] The total estimated number of SADs averted was reduced to 5 130 076 (range: 3 139 571–7243, 484). Of these averted SADs, 2 298 131 resulted from taxes, 1 610 787 from SFA laws, 791 657 from health warnings, 245 707 from cessation treatment and 183 794 from marketing restrictions. However, smoking deaths in LMICs, especially those approaching high-income status (e.g. Mexico and Turkey), may increase as the intensity and duration of smoking increase and risks not related to smoking decline.[43]

Our findings may have implications beyond the outcomes examined in this study. The effect of newly implemented policies could be extended to reductions not only in SADs, but also to benefits in other smoking-related outcomes (e.g. reduced adverse birth outcomes related to maternal smoking, such as low birth weight,[44] better quality of life, lower health-care costs, less productivity loss). Moreover, evidence suggests that additional deaths may be averted among non-smokers because of reductions in exposure to second-hand smoke.[45] Finally, we have not considered the possible effects of the MPOWER policies on reductions in smokeless tobacco prevalence, which would likely bring additional public health benefits.[46,47]

In conclusion, we found a substantial projected impact on SADs resulting from the adoption of MPOWER policies from 2007 to 2010. Our main finding – that nearly 7.5 million smoking-related deaths will be averted – shows that evidence-based MPOWER tobacco control measures have an enormous potential to reduce premature smoking-related mortality. The 41 countries that adopted such policies from 2007 to 2010 represent a cumulative population of nearly 1 billion people (one seventh of the 2008 world population of 6.9 billion). If the progress attained by these 41 countries were extended globally, tens of millions of smoking-related deaths could be averted. It is imperative that the public health community continue to advocate for MPOWER policies of the highest level. ■

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ملخص

الوفيات ذات الصلة بالتدخين التي تم تجنبها بفضل ثلاث سنوات من التقدم في السياسة

الغرض تقييم الأثر العالمي لتطبيق سياسات مكافحة التبغ وفق برنامج MPOWER على أعلى مستوى في مختلف البلدان والأقاليم في الفترة من 2007 إلى 2010.

الطريقة تم تطبيق أحجام تأثير السياسة المستندة على نماذج SimSmoke التي تم التحقق منها سابقاً لتحديد الانخفاض في عدد المدخنين كنتيجة لاعتماد السياسة أثناء هذه الفترة. وبناءً على الأبحاث السابقة التي تفيد بأن نصف المدخنين يموتون بسبب التدخين، قمنا كذلك باستخلاص الوفيات المتوقع حدوثها بسبب التدخين التي أمكن تجنبها بفضل تنفيذ سياسة MPOWER. وكانت نتائج استخدام هذا الأسلوب البسيط والقوي متسقة مع تلك التي تم التنبؤ بها من خلال استخدام نماذج SimSmoke التي تم التحقق منها سابقا.

النتائج بشكل إجمالي، اعتمد 41 بلداً سياسة واحدة على الأقل على أعلى مستوى من برنامج MPOWER في الفترة من 2007 إلى 2010. ونتيجة لجميع السياسات التي تم اعتمادها أثناء هذه الفترة، انخفض عدد المدخنين وفق التقديرات بعدد 14.8 مليون شخص مع تجنب ما إجماليه 7.4 مليوناً من حالات الوفيات المتوقع حدوثها بسبب التدخين التي أمكن تجنبها. وتم تفادي أكبر عدد من الوفيات المتوقع حدوثها بسبب التدخين كنتيجة لزيادة الضرائب على السجائر (3.5 مليون) والقوانين المعنية بالهواء الخالي من دخان التبغ (2.5 مليون) والتحذيرات الصحية (700 ألف) وعلاجات الإقلاع عن التدخين (380 ألفاً) والحظر على تسويق التبغ (306 ألفاً).

الاستنتاج في الفترة من 2007 إلى 2010، اتخذ 41 بلداً وإقليماً إجراءات ستمنع في مجموعها 7.5 مليون من الوفيات ذات الصلة بالتدخين على الصعيد العالمي. وتبين هذه النتائج حجم الإجراءات التي اتخذتها البلدان فعلاً وتؤكد على احتمالية إنقاذ ملايين الأحياء الإضافيين عند استمرار اعتماد سياسات برنامج MPOWER.

摘要

三年政策进展对吸烟相关死亡的预防

目的 评估 2007 至 2010 年在不同国家和地区采用最高级别 MPOWER 烟草控制政策对全球的影响。

方法 采用基于先前验证的 SimSmoke 模型的政策效应值，确定该期间由于实施政策吸烟者减少的数量。基于我们提出半数吸烟者死于吸烟的前期研究，我们还提取了因为实施 MPOWER 政策而防止的预计吸烟死亡数（SAD）。使用这一简单而强大的方法得到的结果与使用之前验证的 SimSmoke 方法预计的结果一致。

结果 总体而言，在 2007 至 2010 年之间，有 41 个国家实施至少一个最高级别 MPOWER 政策。由于此期

间实施的各项政策，估计烟民人数减少了 1480 万，总共避免了 740 万例 SAD。提高香烟税避免的 SAD 数量最多（350 万），其他则为：无烟空气法（250 万）、健康警告（70 万）、戒烟治疗（38 万）和烟草营销禁令（30.6 万）。

结论 从 2007 至 2010 年，41 个国家和地区采取行动，总体上预防全球 750 万例吸烟相关的死亡。这些结果表明各国采取行动的幅度，并强调了继续实施 MPOWER 政策另外挽救数以百万计生命的潜力。

Résumé

Des décès liés au tabagisme évités grâce à trois ans d'avancée politique

Objectif Évaluer l'impact global de l'adoption de politiques de lutte antitabac MPOWER du plus haut niveau dans les différents pays et territoires de 2007 à 2010.

Méthodes Les ampleurs des effets des politiques basées sur des modèles SimSmoke préalablement validés ont été appliquées pour déterminer la baisse du nombre de fumeurs à la suite de la mise en place de politiques antitabac au cours de cette période. Sur la base de recherches antérieures suggérant que la moitié des décès de fumeurs sont dus au tabagisme, le nombre de décès attribuables au tabagisme (DAT) évités grâce à l'adoption de politiques MPOWER a pu être évalué. Les résultats de cette méthode simple et performante sont conformes à ceux envisagés par les modèles SimSmoke préalablement validés.

Résultats Au total, 41 pays ont adopté au moins une politique MPOWER du plus haut niveau entre 2007 et 2010. En conséquence de toutes les politiques adoptées au cours de cette période, il a été estimé que le nombre de fumeurs a baissé de 14,8 millions, pour un total de 7,4 millions de DAT évités. La plupart des DAT ont été évités grâce à l'augmentation des taxes sur les cigarettes (3,5 millions), aux lois antitabac (2,5 millions), aux campagnes d'informations sanitaires (700 000), aux traitements de sevrage (380 000) et à l'interdiction de la commercialisation du tabac (306 000).

Conclusion De 2007 à 2010, 41 pays et territoires ont pris des mesures qui ont permis d'éviter près de 7,5 millions de décès liés au tabagisme dans le monde. Ces résultats démontrent l'ampleur des mesures déjà prises par tous les pays et soulignent la possibilité de sauver des millions d'autres vies en poursuivant l'adoption de mesures MPOWER.

Резюме

Предотвращение связанных с курением смертей в результате трех лет прогрессивной политики

Цель Оценить глобальные последствия принятия политики самого высокого уровня MPOWER, направленной на борьбу с табакокурением, в различных странах и территориях с 2007 по 2010 годы.

Методы Для оценки снижения числа курильщиков в результате принятия политики в течение указанного периода применялись коэффициенты эффекта от политики, основанные на ранее проверенных моделях SimSmoke. На основании предыдущих исследований, свидетельствующих, что половина всех курильщиков умирает от курения, мы также рассчитали предполагаемое число случаев смерти от курения (ССК), предотвращенных благодаря реализации политики MPOWER. Результаты, полученные на основе использования этого простого, но мощного метода, согласуются с результатами, спрогнозированными с помощью проверенных ранее моделей SimSmoke.

Результаты В общей сложности 41 страна приняла по крайней мере одну политику высокого уровня MPOWER в период с 2007 по 2010 годы. В результате реализации всех политик, принятых за этот период, число курильщиков, по существующим оценкам, сократилось на 14,8 млн., предотвратив в общей сложности 7,4 млн. ССК. Наибольшее число ССК было предотвращено в результате повышения налогов на сигареты (3,5 млн.), законов о свободном от табачного дыма воздухе (2,5 млн.), предупреждений о вреде курения (700 тыс.), лечения табачной зависимости (380 тыс.), а также запретов на рекламу табачных изделий (306 тыс.).

Вывод С 2007 по 2010 годы 41 страна и территория приняли меры, которые в сумме предотвратили почти 7,5 млн. смертей, связанных с курением. Эти результаты показывают масштаб уже принятых странами мер и подчеркивают потенциал для спасения еще миллионов жизней благодаря продолжению принятия политик MPOWER.

Resumen

Fallecimientos derivados del tabaco evitados gracias al progreso de las medidas de control a lo largo de tres años

Objetivo Evaluar la repercusión global de la adopción de las medidas de control del tabaco de alto nivel MPOWER en diferentes países y territorios desde el año 2007 al 2010.

Métodos A efectos de determinar la reducción del número de fumadores como consecuencia de la adopción de las medidas de control durante ese período, se aplicaron tamaños del efecto del plan de medidas basados en los modelos SimSmoke validados con anterioridad. Con arreglo al anterior estudio, que sugería que la mitad de todos los fumadores fallecían por motivos derivados del tabaco, también colegimos los fallecimientos relacionados con el tabaco evitados gracias a la implementación del plan de medidas MPOWER. Los resultados obtenidos del uso de este método sencillo, pero potente, concuerdan con los previstos utilizando los modelos SimSmoke validados anteriormente.

Resultados En total, 41 países adoptaron al menos una medida de alto nivel MPOWER entre 2007 y 2010. A consecuencia de todas las medidas adoptadas durante este período, se estima que el número de fumadores descendió en 14,8 millones, con un total de 7,4 millones de fallecimientos relacionados con el tabaco evitados. La mayoría de los fallecimientos se evitó gracias al incremento de los impuestos al tabaco (3,5 millones), la legislación antitabaco (2,5 millones), las advertencias sanitarias (700 000), los tratamientos para dejar de fumar (380 000) y las prohibiciones publicitarias (306 000).

Conclusión De 2007 a 2010, 41 países y territorios tomaron medidas que evitaron en conjunto unos 7,5 millones de fallecimientos relacionados con el tabaco. Estos resultados demuestran la magnitud de las acciones ya instauradas por los países y ponen de relieve el potencial de la adopción continuada de las medidas MPOWER para salvar millones de vidas más.

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