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Mexico *SimSmoke*: how changes in tobacco control policies would impact smoking prevalence and smoking attributable deaths in Mexico

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Abstract

We examined the effect of tobacco control policies in Mexico on smoking prevalence and smoking-related deaths using the Mexico *SimSmoke* model. The model is based on the previously developed *SimSmoke* simulation model of tobacco control policy, and uses population size, smoking rates and tobacco control policy data for Mexico. It assesses, individually, and in combination, the effect of six tobacco control policies on smoking prevalence and smoking-related deaths. Policies included: cigarette excise taxes, smoke-free laws, anti-smoking public education campaigns, marketing restrictions, access to tobacco cessation treatments and enforcement against tobacco sales youth. The model estimates that, if Mexico were to adopt strong tobacco control policies compared to current policy levels, smoking prevalence could be reduced by 30% in the next decade and by 50% by 2053; an additional 470,000 smoking-related premature deaths could be averted over the next 40 years. The greatest impact on smoking and smoking-related deaths would be achieved by raising excise taxes on cigarettes from 55% to at least 70% of the retail price, followed by strong youth access enforcement and access to cessation treatments.

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Implementing tobacco control policies in Mexico could reduce smoking prevalence by 50%, and prevent 470,000 smoking-related deaths by 2053.

Keywords

Tobacco control policies; smoking prevalence; smoking-attributable deaths; Mexico

Introduction

In response to the heavy toll of tobacco worldwide (Mathers & Loncar, 2006), the World Health Organization (WHO) has set out the Framework Convention for Tobacco Control (FCTC) (World Health Organization, 2005), intended to guide tobacco control policy implementation globally. Substantial evidence indicates that higher cigarette taxes, smoke-free indoor air laws, marketing bans, media campaigns and cessation treatment policy can appreciably reduce adult smoking rates, especially when combined as a comprehensive strategy (Levy, Gitchell, & Chaloupka, 2004; U.S. DHHS, 2000). The MPOWER Report (World Health Organization, 2008), which has defined a set of policies consistent with the FCTC, recommends that each nation: impose taxes on cigarettes that constitute at least 70% of the retail price; implement and enforce comprehensive smoke-free indoor air laws; ban tobacco product marketing; require large pictorial health warnings on cigarette packs; provide access to tobacco cessation treatments; implement a well-funded anti-tobacco public education campaign; and adopt and enforce bans on selling tobacco products to youth.

Evaluating the impact of tobacco control policies on smoking prevalence and tobacco-attributable deaths is a priority because of the increasing disease burden from tobacco consumption, including in low- and middle-income countries. Most studies have examined the effect of only one or, at most, two policies (e.g., Farrelly, Pechacek, & Chaloupka, 2003; Hu, Sung, & Keeler, 1995) because the ability to distinguish their effects on smoking rates is limited by the statistical approaches that are often used. Simulation models can combine information from different sources to estimate the effects of public policies on intended outcomes in complex social systems (Levy, Bauer, & Lee, 2006). Simulation models estimating the effect of tobacco control policies have been developed by Mendez and Warner (2004), Mendez, Warner, and Courant (1998), Ahmad and Billimek (2007) and Levy et al. (2006). The *SimSmoke* model of Levy et al. simultaneously considers a broad array of tobacco control policies and has demonstrated that it provides accurate estimates of policy effects in a range of countries (e.g., China, Ireland, the USA) (Currie, Blackman, Clancy, & Levy, 2013; Levy, Blackman, Fong, & Chaloupka, in press; Levy, Huang, Currie, & Clancy, 2013; Levy, Rodriguez-Buno, Hu, & Moran, 2014), including middle-income countries (e.g., Brazil, Thailand) (Levy, de Almeida, & Szklo, 2012; Levy, Benjakul, Ross, & Ritthiphakdee, 2008; Levy et al., 2010).

Mexico ratified the FCTC in June 2004. Since 2004, Mexico has adopted stronger advertising restrictions and smoke-free laws in some areas, implemented graphic health warnings covering 30% of the front and 100% of the back of the package, started a quitline and increased cessation treatment coverage, and raised cigarette taxes. However, much

remains to be done in order to meet the FCTC requirements, and evaluating the impact of these potential policies will provide critical information to inform policy development and advocacy efforts. Legal challenges have been initiated by the tobacco industry (Ibáñez Hernández, 2013), and it will be important to show the effects of stronger policies on public health.

The goal of this paper is to examine the effect of tobacco control policies in Mexico using the Mexico *SimSmoke* model. In order to examine the potential effect of tobacco control policies on future smoking prevalence and tobacco-attributable deaths in Mexico, we developed a modified version of *SimSmoke*. Using data from Mexico on population size, birth rates, death rates and smoking, we developed an initial model to predict smoking prevalence and smoking-attributable deaths for the whole population, as well as by age and gender, from 2013 to 2053, in the absence of tobacco control policies. We then predicted future trends until 2053 in smoking prevalence and smoking-attributable deaths to estimate the effect of an additional set of policies consistent with FCTC/MPOWER recommendations.

Materials and methods

Basic model

We employed a discrete time, first-order Markov process to project future population growth through births and deaths, and smoking rates through smoking initiation, cessation and relapse rates, by age and gender, from the base year to future years. Smoking prevalence is allowed to shift due to changes in tobacco control policies. Smoking-attributable deaths are estimated using smoking rates and mortality risks of smokers and ex-smokers relative to never smokers, similar to standard attribution measures (CDC, 2000). *SimSmoke* Mexico is described further in a longer report (Levy, Reynales-Shigematsu, Fleischer, Thrasher, & Cumming, 2014).

The base year for the Mexico model is 2002, which precedes the 2004 adoption of FCTC and the implementation of most major tobacco control policies. In addition, smoking prevalence data are available from the Encuesta Nacional de Adicciones (ENA) for 2002 (Kuri-Morales, Gonzalez-Roldan, Hoy, & Cortes-Ramirez, 2006); prevalence had been relatively stable prior to that year (Waters, Saenz de Miera, Ross, & Reynales Shigematsu, 2010). Population and fertility and mortality rates by gender and age were obtained from the Instituto Nacional de Estadística y Geografía (Instituto Nacional de Estadística y Geografía. Censo de Población y Vivienda, 2013).

Smoking prevalence and initiation, cessation and relapse rates

Current, former and never smoking prevalence data for the baseline year were obtained from the 2002 ENA, a nationally representative survey of the Mexican population between 12 and 65 years old (Kuri-Morales et al., 2006). A current smoker was defined as someone who had smoked 100 cigarettes in his/her lifetime and had smoked in the past 30 days. A former smoker had smoked 100 cigarettes in his/her lifetime, but had not smoked in the past 30 days. Former smokers were also distinguished by the number of years since they had quit.

Because the 2002 ENA did not contain information on smokers above age 65, we used an estimate of the current smoking prevalence of the population aged 65 and above from the nationally representative Encuesta Nacional de Salud y Nutricion (ENSANUT) for the year 2000, adjusted by comparing smoking prevalence from ENA and ENSANUT in earlier years. We used data from the US 1993 Current Population Survey-Tobacco Use Survey (U.S. Bureau of the Census, 2001) to distinguish the per cent of former smokers into each of the years quit categories for age 65 and above. Data were also used from the Mexican administration of the International Tobacco Control Policy Evaluation Survey (ITC Mexico) on policy implementation and cessation rates (Swayampakala et al., 2013).

Due to empirical challenges in measuring initiation and cessation, and in order to insure stability and internal consistency of the model, initiation rates at each age were measured as the difference between the baseline smoking rate at that age and the baseline smoking rate at the previous age. Based on smoking prevalence data and data on stated age of initiation in the ENA sample, we allowed for initiation through age 24.

Using the 2002 ENA, the cessation rate during the past year was calculated as people who were former smokers and had quit in the last year but not the last 30 days/(current smokers + those who had not smoked in the last year, including those who had not smoked in the last 30 days). Cessation and relapse data from the ITC Surveys (Swayampakala et al., 2013) yielded average cessation rates across both males and females of about 7.8% over the period 2007 through 2012. Allowing for the effect of policies since 2002, the 2002 ENA yielded similar cessation rates to the ITC estimates.

Because the cessation rate does not allow for relapse of those who quit less than one year ago, for both genders, a 50% relapse rate (Hughes, Keely, & Naud, 2004) was applied to that measure up through age 44, but no relapse after age 45, which is based on the higher success rates of those at later ages when a smoker often quits for health reasons.

Smoking-attributable deaths

Smoking-attributable deaths (SADs) were determined by the excess mortality risk of current and former smokers compared to never smokers as applied to the number of current and former smokers at each age. Death rates were calculated by age, gender and smoking status (never, current and the former smoker groups) using the data on death rates and 2002 smoking rates, and relative mortality risks. Because risks for Mexico (Reynales-Shigematsu et al., 2006) are likely lower than USA risks due to the lower quantity of cigarettes smoked, we use relative risks of 1.6 for males and 1.5 for females, consistent with risks from other middle-income nations earlier in the tobacco epidemic (Jee, Lee, & Kim, 2006; Wen, Tsai, Chen, & Cheng, 2002). A sensitivity analysis was conducted using USA relative risks of 2.2 for males and 2.0 for females (Burns, Garfinkel, & Samet, 1997).

Policy effects

The policy parameters in the model used to generate the predicted effects are based on thorough reviews of the literature (Levy et al., 2004) and the advice of an expert panel. As a middle-income nation, the effects for Mexico were determined primarily from studies for that nation and high-income nations, but were adjusted to reflect characteristics of a middle-

income nation, such as the urban/rural mix and level of income. Policy effect sizes were defined in terms of percentage reductions in smoking prevalence, and initiation and cessation rates. Reductions were applied to the smoking prevalence in the year in which the policy was implemented and, unless otherwise specified, applied to initiation and cessation rates in future years if the policy was sustained. Policies and potential effect sizes are summarised in the Appendix.

For Mexico, we tracked policy levels from the date that the model begins in 2002 until 2013. The level of a policy was based on information MPOWER reports (World Health Organization, 2013), the Tobacco Control Report for the Region of the Americas 2013 (Organización Panamericana de la Salud, 2013) and members of the Mexico National Institute of Public Health. Specific policy levels are detailed in a technical report (Levy, Reynales-Shigematsu et al., 2014) and policy effect sizes are shown in the Appendix. Below, we briefly state the policy levels in Mexico for 2013.

Cigarette excise taxes—Since demand studies for Mexico (Saenz de Miera, Thrasher, Reynales-Shigematsu, Hernández-Ávila, & Chaloupka, 2014; Waters et al., 2010) were consistent with those of the USA, we adopted the age-specific prevalence elasticities (i.e., the percentage change in prevalence for a 1% increase in price) used in the USA *SimSmoke*. For the years 2002–2009, we used inflation-adjusted price data from Waters et al. (2010). For 2008 through 2012, we used data from the ITC (Saenz de Miera et al., 2014). With the addition of a fixed 7 peso tax in 2011, excise tax rate increased to 54% by 2012. We consider increasing the cigarette excise tax to 70% of the retail price, which leads to further price increase due to 13.8% value-added tax (Saenz de Miera et al., 2014).

Smoke-free indoor air laws—A national law in 2008 allowed smoking only in designated areas for worksites, restaurants and other public places. In 2008, Mexico City and Tabasco adopted comprehensive smoke-free policies. Similar bans were put into place in other states between 2011 and 2013, covering 40% of the population. The enforcement level was set to 5 on a 10-point scale based on compliance data from GATS (Instituto Nacional de Salud Pública, 2009) and ITC (Thrasher, Boado, Sebrie, & Bianco, 2009; Thrasher, Nayeli Abad-Vivero, et al., 2012; Thrasher et al., 2010). In compliance with the FCTC, we consider the implementation of complete smoke-free air laws for worksites, bars and restaurants with strong enforcement.

Marketing restrictions—In 2009, advertising was banned on all television, radio, and billboards and some types of sponsorship, but was allowed in magazines that primarily target adults, in adult-only venues and points of sale, and through the mail (Perez-Hernandez, Thrasher, Rodriguez-Bolanos, Barrientos-Gutierrez, & Ibanez-Hernandez, 2012). Promotional discounts, branding and advertising at sponsored events were also banned. Mexico is denoted as having marketing restrictions at 75% of moderate level (3rd level) and 25% low (2nd level) since 2009, with enforcement at 5 of 10. In compliance with the FCTC, we consider the effect of a complete marketing ban, which would include the addition of a ban of advertisements at all points of sale, in all magazines and by mail.

Health warnings—In Mexico, the 2002 law required minimal health warnings, considered weak. The warnings increased to 50% of the back of the pack in 2004, considered moderate, and increased in 2011 to 30% of the pack front with an image and 100% of the back with only text, considered as already strong, and are not further considered.

Tobacco control/media campaigns—Media campaigns have been sporadic and are considered to be at a low level since 2002 (Thrasher, Huang, et al., 2011; Thrasher et al., 2013a; World Health Organization, 2013). We consider the effect of implementing media campaigns at a high level (publicised heavily on TV at least two months of the year and at least some other media).

Cessation treatment policies—Mexico has had NRT and Bupropion available since 2002. By 2012, a national programme to support addictions treatment provided cognitive behavioral therapy for individuals and groups. In 2010, a quitline was established and promoted through new pictorial warnings (Thrasher et al., 2013b; Thrasher, Pérez-Hernández, Arillo-Santillán, & Barrientos-Gutierrez, 2012). Based on the ITC (Borland et al., 2012) and GATS (Instituto Nacional de Salud Pública, 2009), the brief intervention index was set to a level of 20%. We consider the effect of providing cessation treatments at no cost and active intervention through the health care providers, hospitals, community centres and other health facilities.

Youth access policy—According to the Global Youth Tobacco Surveys (Reynales-Shigematsu, Rodríguez-Bolaños, & Ortega-Ceballos, 2011; Valdes-Salgado, Reynales-Shigematsu, Lazcano-Ponce, & Hernandez-Avila, 2007), over 60% of youth were not refused cigarette purchases at stores in 2003 and 2011. Youth access enforcement is considered at a low level. We evaluate the effect of increasing enforcement to high levels that ensure compliance with the minimum purchase age laws.

Calibration, validation and projection

The model was first calibrated by adjusting the initiation and cessation rates to insure smooth, slightly declining smoking rates by age and gender groups in the absence of policy change. The model was then validated by comparing smoking rates predicted by the model to the 2011 ENA, the 2012 ENSANUT and the 2009 Encuesta Global de Tabaquismo en Adultos (GATS). The model generally validated well by gender and age groups (results not shown).

The model is programmed to project the Mexican population by age and gender, smoking prevalence by age and gender, and smoking-attributable deaths for people aged 15 years and older for 2014 through 2053 with and without policies implemented. We first established the status quo case, where tobacco control policies are maintained at their 2013 level. We then considered the potential effect of future policies that may be implemented consistent with the FCTC-based MPOWER requirements, which are implemented in 2014 and maintained over time through 2053. We first examined the policies in isolation and then together, since research has shown that the most effective tobacco control campaigns use a comprehensive set of policy measures (Jha & Chaloupka, 2000). By comparing the effect of policies to the

status quo, we focused on the relative change in smoking prevalence over time (i.e., the change in smoking prevalence from the status quo to the future policy scenario divided by the status quo smoking prevalence). For SADs, deaths averted are calculated as the difference between the number of smoking-related deaths under the new policy and the number of deaths under the status quo. For SADs, we summed the deaths over the period 2014 through 2053 to obtain an approximate cumulative estimate of the total smoking deaths of those who were current or former smokers in 2014.

Results

The effect of stronger FCTC policies on smoking prevalence

First, we present the status quo scenario, in which tobacco control policies remained unchanged from their 2013 levels. In the status quo scenario, male adult smoking is projected to decrease from 21% to 18% between 2013 and 2023, and to 13% over a 40-year projection to 2053 (Table 1). The status quo female smoking prevalence is estimated at 7% in 2013, decreasing to 6% by 2023 and 4% by 2053 (Table 2).

We then considered a series of policy changes, and their impact on smoking prevalence relative to the status quo for all policy domains (Tables 1 and 2). Because health warnings fully met FCTC requirements in Mexico in 2013, they yielded no additional effect and are not included. If excise taxes were increased to 70% of the retail price, smoking prevalence is projected to decline by 12% relative to the status quo scenario by 2023 and 16% relative to the status quo scenario by 2053. A comprehensive, well-enforced smoke-free ban is predicted to reduce smoking prevalence by 4% relative to the status quo scenario by 2023, increasing to about 5% by the year 2053. A comprehensive, well-enforced marketing ban is predicted to yield a 7% reduction in prevalence by 2023, increasing to a 10% reduction by 2053. For a well-funded and publicised campaign, the model predicts an 8% reduction in smoking prevalence by 2023, increasing to 10% by 2053. Comprehensive smoking cessation treatment policies are projected to reduce smoking prevalence by about 6% by 2023 relative to the status quo, with an approximately 9% reduction by 2053. The effects grow rapidly over time because of their relatively large impact on cessation rates. With the enforcement of youth access laws, the model predicts a 5% relative reduction in smoking rates by 2023 increasing to 12% by 2053. Because youth access laws only affect those under 18 years of age, they have small immediate effects, but their effects increase over time as a larger and larger share of the population is affected by policies preventing youth tobacco sales. The final scenario projected the effect for a combination of all the policies above, including where excise taxes were increased to 70% of retail price. If a comprehensive set of policies is put into place, the smoking prevalence is projected to drop by 41% relative to status quo by 2023, and by almost 50% by 2053.

The effects of stronger FCTC policies on smoking-attributable deaths

We also investigated the impact on SADs over the 40-year time period under both the status quo scenario and under implementation of stronger tobacco control policies. Under the status quo scenario, the number of SADs is estimated at nearly 57,000 in 2013 for the whole population (Table 3), with more than 47,000 SADs for men and 9000 SADs for women

(Figure 1). SADs are projected to increase to 68,000 in the year 2053 for the whole population. A total of 2.7 million SADs are predicted over the period of 2013–2053.

For the different policy scenarios, we first considered increasing excise taxes to 70% of the current price, allowing for further effects through the value-added tax. With 70% excise tax, a total of 118,000 premature deaths are averted by 2053. The effects of taxes on deaths are delayed because the effects of cessation on death rates are relatively slow to develop and because the largest tax effects are on youth prevalence.

In terms of other policies, a comprehensive, well-enforced smoke-free ban is predicted to save 59,000 lives over the years 2014–2053. A well-funded, publicised campaign would avert 115,400 premature deaths during the same time period, while a comprehensive, well-enforced marketing ban would avert premature 138,000 deaths. With comprehensive smoking cessation treatment policies, the model projects a total of 130,000 premature deaths averted by 2053. Youth access policies reduce SADs by only 1400 in the year 2053, because the effects of smoking on health occur largely after the age of 40. Between 2014 and 2053, youth access laws are projected to prevent 14,500 total premature deaths. The final modelling scenario, which includes a combination of all policies with excise taxes increased to 70%, projects 19,100 (15,400 males and 3700 females, see Figure 1) fewer annual SADs in the year 2053. The cumulative premature deaths averted between 2014 and 2053 would be 381,000 male and 90,000 female deaths, for a total of 471,000 deaths. Using USA relative risks as a sensitivity analysis, the model projects that 759,000 premature deaths would be averted by 2053 under the combination of all policies with a 70% excise tax.

Discussion

The *SimSmoke* model estimates that if Mexico were to adopt stronger tobacco control policies as recommended by the FCTC now, smoking prevalence could be reduced by 30% in the next decade and by 50% by 2053. Because of the time delay in tobacco-related deaths, such as cancer, early reductions in smoking prevalence have a relatively small impact on the number of SADs in the short term compared to the potential impact after 40 years. By 2053, approximately 20,000 premature deaths can be averted in that year alone with comprehensive tobacco control policies. Without the FCTC-mandated policies, an additional 470,000 lives and will be lost due to smoking by the year 2053.

Of particular note is the potential role of increasing excise taxes to 70% of the price, which alone can reduce smoking prevalence by 16%. Currently, the excise taxes have an ad valorem component (160% of the price to the retailer) and a specific component (0.35 pesos per cigarette or per 0.75 g), which together account for approximately 54% of the consumer price (Reynales Shigematsu, Thrasher, Lazcano, & Hernández, 2013). We recommend a specific tax on cigarettes, which is most likely to be passed on to consumers (Chaloupka, Straif, & Leon, 2011). As a revenue-generating function for government, tax increases may be one of the more politically feasible policies. Another policy which may be politically feasible is stronger advertising restrictions, particularly at point of sale. With Marlboro as the brand purchased by more than 50% of smokers (Instituto Nacional de Salud Pública,

2009), stronger point of sales restriction have the potential to reduce the share of this USA brand in favour of a Mexican brand.

We classified Mexico as having strong warning label policies, even though its policy is weaker than recommended in FCTC implementation guidelines (World Health Organization Headquarters, 2008). These guidelines recommend that warnings cover 50% of the front and back of packages, but only 30% of the front is covered in Mexico. Furthermore, the warning on the back of the pack in Mexico only contains text, whereas pictorial imagery is recommended for primary package surfaces. As countries increasingly implement warnings that meet and go beyond FCTC recommendations (Canadian Cancer Society, 2014), data on any additional impact will inform the further refinement of *SimSmoke* model specifications.

In general, *SimSmoke* produced reasonably consistent estimates of smoking prevalence when compared to the 2011 ENA, the 2012 ENSANUT and the 2009 GATS surveys. However, we recommend interpreting the results of this study in a conservative manner for several reasons. First, the model's results depend on the reliability of the data, and the estimated parameters and assumptions used in the models. In addition, the projections do not include the additional premature deaths averted due to reductions in second-hand smoke exposure, or the effects of maternal smoking on the foetus. Another limitation is that the model assumes no effect of income on smoking rates, since past studies yield conflicting effects on the role of income (Fleischer et al., 2015; Jha & Chaloupka, 2000).

Another limitation is that we did not have relative risk estimates specific to Mexico. The estimated relative risks for total mortality of smokers are based on studies from middle-income nations; although later in the smoking epidemic than most middle-income countries, Mexican smokers smoke fewer cigarettes per day, and background risks are likely lower than most high-income nations. With about 50% of smokers who smoke non-daily, and daily smokers smoking 9.4 cigarettes per day (men: 9.7 (8.5–11.0) and women: 8.4 (6.1–10.7) (Encuesta Global de Tabaquismo en Adultos, 2010), we may overestimate the smoking risk. However, the relative risks may increase over time due to earlier average ages of initiation (Doll, Peto, Boreham, & Sutherland, 2004; Peto, Alan, Jillian, & Thun, 2006). For example, data from the 2000 ENA indicate that the average age of initiation dropped from about 17.5 for men and 23.5 for women from the 1930–1959 birth cohorts to 15.7 for men and 16.3 for women from the 1980–1989 birth cohorts (Reynales-Shigematsu et al., 2015). Similar results were obtained using the 2009 GATS and the 2012 ENSANUT. When we used relative risks from the USA, the estimated number of premature deaths increased by about 50%.

The policy modules depend on underlying assumptions, estimated parameters of the predicted effect on initiation and cessation, and assumptions about the interdependence of policies. Knowledge of the different effects of each policy varies (Levy et al., 2004). For example, many studies, with relatively consistent results, have been conducted on the effects of price/taxes and smoke-free policies. However, these studies have been conducted for high-income nations. Studies on media campaigns, advertising bans, health warnings and cessation treatment policies provide a broad range of estimates. In previous work (Levy et al., 2012; Levy et al., in press), we estimated that the effect size of taxes can vary by about

25% around tax parameters, but by 50% around the parameters for other policies (with an upper limit of 100% variation around cessation treatment and youth access policies). The model includes synergies between media campaigns and cessation treatment and smoke-free indoor air policies, but knowledge about the synergistic effects is limited (Levy et al., 2004).

Finally, *SimSmoke* only considered a limited range of policy options. Additional policies that were not considered may provide targets for future intervention, such as better enforcement of the laws against selling cigarettes as single sticks (Thrasher, Villalobos, Barnoya, Sansores, & O'Connor, 2011; Thrasher, Villalobos, et al., 2009), which is increasingly prevalent in Mexico and may undermine cessation attempts. Some Latin American nations, such as Brazil and Chile, are attempting to ban menthol and other tobacco additives, which could further reduce consumption (Levy et al., 2011). Plain packaging that eliminates brand imagery from cigarette packages has been implemented in Australia and may reduce the appeal of smoking for youth while enhancing warning label impacts. Stronger enforcement of laws against smuggling may be needed if higher cigarettes taxes are imposed. Simulation models that consider these and other additional policy interventions can help shape the future evolution of the FCTC and evaluate its impacts.

In summary, this study demonstrates that nearly a half million premature deaths from smoking could be averted over the next 40 years in Mexico if the government would adopt and actively enforce FCTC-recommended policies. Consistent with similar studies for other countries, we estimate that a large increase in excise taxes alone would substantially reduce the number of lives lost to smoking and is the most efficient way to reduce smoking rates quickly. Tax increases are also likely to increase government revenues (Merriman, Yurekli, & Chaloupka, 2000), part of which can and should be earmarked to implement tobacco cessation treatment, fund anti-tobacco public education campaigns, and enforce and publicise other tobacco control policies.

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Appendix: Policies, description and effect sizes of SimSmoke

Policy	Description	Potential percentage effect ^a
<i>Tax policy</i>		
Actual prices from 2002 to 2012, tax changes after 2010	Cigarette price index adjusted for inflation, taxes measure in absolute terms	For each 10% price increase: 4% reduction ages 15–17, 3% reduction ages 18–24 2% reduction ages 25–34, and 1% reduction ages 35 and above
<i>Smoke-free air policies (first four policies are additive)</i>		
Worksite total ban	Ban in all areas	9.0% reduction

Policy	Description	Potential percentage effect ^a
Restaurant total ban	Ban in all indoor restaurants in all areas	3.0% reduction
Bar and pubs ban	Ban in all indoor areas of bars and pubs	1.5% reduction
Other places total ban	Ban in 3 of 4 (malls, retail stores, public transportation and elevators)	1.0% reduction
Enforcement and publicity	Government agency is designated to enforce and publicise the laws	Effects weakened by as much as 50% if 0 enforcement and publicity
<i>Mass media campaigns (policies are mutually exclusive)</i>		
Highly publicised campaign	Campaign publicised heavily on TV (at least two months of the year) and at least some other media	9.75% reduction
Moderately publicised campaign	Campaign publicised sporadically on TV and in at least some other media, and a local program	5.25% reduction
Low publicity campaign	Campaign publicised only sporadically in newspaper, billboard or some other media.	1.5% reduction
<i>Marketing bans (first three policies are mutually exclusive)</i>		
Comprehensive marketing ban	Ban is applied television, radio, print, billboard, in-store displays, sponsorships and free samples	10.0% reduction in prevalence, 12.0% reduction in initiation, 6.0% increase in cessation
Moderate ban	Ban is applied all media television, radio, print, billboard	6.0% reduction in prevalence, 8.0% reduction in initiation, 4.0% increase in cessation
Weak ban	Ban is applied some of television, radio, print, billboard	2.0% reduction in prevalence and initiation only
Enforcement and publicity	Government agency is designated to enforce the laws	Effects weakened by as much as 50% if 0 enforcement
<i>Warning labels (policies are mutually exclusive)</i>		
Strong	Labels are large, bold and graphic	4.0% reduction in prevalence And in initiation, 10.0% increase in cessation
Weak	Laws cover less than 1/3 of package, not bold or graphic	1.0% reduction in prevalence & initiation rates, 2.0% increase in cessation rates
<i>Cessation treatment policy</i>		
Complete availability and reimbursement of pharmaco- and behavioural treatments, quit lines, and brief interventions	NRT provided in stores w/out Rx, Bupropion provided by Rx, provision of treatments in all health facilities, quit line, 100% smoker brief interventions with follow-up	6.75% reduction in prevalence, 55% increase in cessation
<i>Youth access restrictions (policies are mutually exclusive)</i>		
Strongly enforced and publicised	Compliance checks are conducted regularly, penalties are heavy, and with publicity is strong, vending machine and self-service bans	30.0% reduction for age <16 in prevalence and initiation only, 20.0% reduction for ages 16–17 in prevalence and initiation only
Moderately enforced	Compliance checks are conducted sporadically, penalties are potent, and little publicity	21.0% reduction for age <16 in prevalence and initiation only, 14.0% reduction for ages 16–17 in prevalence and initiation only
Low enforcement	Compliance checks are not conducted, penalties are weak, and no publicity	3% reduction for age <16 in prevalence and initiation only, 2% reduction for ages 16–17 in

Policy	Description	Potential percentage effect ^a
		prevalence and initiation only

^aUnless otherwise specified, the same percentage effect is applied as a percentage reduction in the prevalence in the initial year and as a percentage reduction in the initiation rate and a percentage increase in the cessation rate in future years. The effect sizes are shown relative to the absence of any policy. They are based on literature reviews, advice of an expert panel and model validation.

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Figure 1. Estimated SADs for men and women aged 15 years and older under status quo and policy change scenarios, Mexico, 2013–2053.

Table 1

Estimated smoking prevalence for men aged 15 years and older under status quo and policy change scenarios, Mexico, 2013–2053.

	Year					
	2013	2014	2023	2033	2043	2053
<i>Policies</i>						
Status Quo Policies	21.3%	20.9%	18.0%	15.5%	13.7%	12.8%
Excise Tax to 70% of Retail Price (VAT at fixed %)	21.3%	18.7%	15.7%	13.3%	11.7%	10.7%
Complete Smoke Free & Enforcement	21.3%	20.2%	17.2%	14.8%	13.1%	12.1%
Comprehensive Marketing Ban & Enforcement	21.3%	19.6%	16.6%	14.2%	12.5%	11.5%
High Intensity Tobacco Control Campaign	21.3%	19.7%	16.6%	14.1%	12.5%	11.6%
Cessation Treatment Policies	21.3%	20.5%	16.9%	14.3%	12.6%	11.7%
Strong Youth Access Enforcement	21.3%	20.7%	17.1%	14.3%	12.4%	11.3%
All of the above	21.3%	15.4%	11.3%	8.7%	7.3%	6.5%
<i>% change in smoking prevalence from status quo</i>						
Excise Tax to 70% of Retail Price (VAT at fixed %)	–	–10.5%	–12.4%	–14.0%	–15.2%	–16.0%
Complete Smoke Free & Enforcement	–	–3.4%	–4.1%	–4.5%	–4.8%	–5.0%
Comprehensive Marketing Ban & Enforcement	–	–6.2%	–7.3%	–8.3%	–9.0%	–9.5%
High Intensity Tobacco Control Campaign	–	–5.7%	–7.5%	–8.6%	–9.2%	–9.5%
Cessation Treatment Policies	–	–1.9%	–5.8%	–7.8%	–8.5%	–8.5%
Strong Youth Access Enforcement	–	–1.1%	–5.0%	–7.7%	–10.0%	–11.7%
All of the above	–	–26.1%	–37.1%	–43.5%	–47.2%	–49.1%

Table 2

Estimated smoking prevalence for women aged 15 years and older under status quo and policy change scenarios, Mexico, 2013–2053.

	Year					
	2013	2014	2023	2033	2043	2053
<i>Policies</i>						
Status Quo Policies	7.3%	7.1%	5.9%	4.9%	4.2%	3.8%
Excise Tax to 70% of Retail Price (VAT at fixed %)	7.3%	6.4%	5.2%	4.2%	3.6%	3.2%
Complete Smoke Free & Enforcement	7.3%	6.9%	5.6%	4.7%	4.0%	3.6%
Comprehensive Marketing Ban & Enforcement	7.3%	6.7%	5.5%	4.5%	3.9%	3.5%
High Intensity Tobacco Control Campaign	7.3%	6.7%	5.4%	4.5%	3.8%	3.4%
Cessation Treatment Policies	7.3%	7.0%	5.5%	4.5%	3.8%	3.5%
Strong Youth Access Enforcement	7.3%	7.0%	5.6%	4.6%	3.8%	3.4%
All of the above	7.3%	5.3%	3.7%	2.7%	2.2%	1.9%
<i>% change in smoking prevalence from status quo</i>						
Excise Tax to 70% of Retail Price (VAT at fixed %)	–	–10.4%	–12.2%	–13.7%	–15.0%	–16.0%
Complete Smoke Free & Enforcement	–	–3.4%	–4.1%	–4.7%	–5.0%	–5.2%
Comprehensive Marketing Ban & Enforcement	–	–6.2%	–7.3%	–8.3%	–9.0%	–9.6%
High Intensity Tobacco Control Campaign	–	–5.7%	–7.7%	–9.0%	–9.7%	–10.0%
Cessation Treatment Policies	–	–1.9%	–6.7%	–9.1%	–9.8%	–9.8%
Strong Youth Access Enforcement	–	–0.9%	–4.8%	–7.5%	–9.8%	–11.6%
All of the above	–	–25.9%	–37.7%	–44.2%	–47.8%	–49.9%

Table 3

Estimated SADs for the whole population aged 15 years and older under status quo and policy change scenarios, Mexico, 2013–2053.

	Year				
	2013	2023	2033	2053	2013–2053
<i>Policies</i>					
Status Quo Policies	56,763	61,024	67,131	68,109	2,695,151
Excise Tax to 70% of Retail Price (VAT at fixed %)	56,763	59,945	63,715	62,911	2,577,327
Complete Smoke Free & Enforcement	56,763	60,389	65,324	65,880	2,636,496
Comprehensive Marketing Ban & Enforcement	56,763	59,967	64,225	64,558	2,601,590
High Intensity Tobacco Control Campaign	56,763	59,895	63,703	63,550	2,579,748
Cessation Treatment Policies	56,763	59,984	63,468	62,631	2,565,020
Strong Youth Access Enforcement	56,763	61,024	67,045	66,719	2,680,702
All of the above	56,763	56,462	53,186	49,044	2,797,719
<i>Absolute change in attributable deaths from status quo</i>					
Excise Tax to 70% of Retail Price (VAT at fixed %)	–	1079	3416	5198	117,824
Complete Smoke Free & Enforcement	–	635	1808	2229	58,655
Comprehensive Marketing Ban & Enforcement	–	1057	2906	3551	93,561
High Intensity Tobacco Control Campaign	–	1129	3429	4559	115,403
Cessation Treatment Policies	–	1040	3663	5478	130,131
Strong Youth Access Enforcement	–	0	87	1390	14,449
All of the above	–	4562	13,946	19,065	471,460