Supplementary appendix

Table of Contents

Supplementary Table 1. Epidemiological and economic key model parameters for each country

Parameter	Argentina	Brazil	Chile	Costa Rica	Colombia	Ecuador	Mexico	Peru
Population 2020 (>= 35 y)	20,404,023	98,134,446	9,771,671	2,299,805	21,977,761	6,335,146	51,796,845	13,390,445
Men	47%	47%	48%	49%	47%	49%	47%	49%
Women	53%	53%	52%	51%	53%	51%	53%	51%
Smoking prevalence (%)								
Men	16%	16%	26%	10%	11%	15%	21%	29%
Women	7%	9%	19%	4%	3%	3%	6%	18%
Overall crude mortality rate per 100,000 (Male/Female)								
Acute myocardial infarction	110·8	135	63·9	72·7	176·9	118·0	185·3	45·5
	(136·6/88·2)	(163·8/109·3)	(79·8/49·3)	(92·8/53·3)	(203·0/154·0)	(137·9/99·4)	(219·3/155·1)	(52·5/38·8)
Ischemic heart disease (non-acute myocardial infarction)	28·1	32·2	20·6	59·5	6·0	5·0	15	5·4
	(35·8/21·3)	(37·7/27·4)	(25·9/15·8)	(71·4/48·0)	(7·3/4·8)	(6·2/3·8)	(17·6/12·7)	(6·5/4·3)
Other cardiovascular disease	187·3	40·0	70·1	57·3	134·1	58·4	41·4	32·8
	(206·6/170·4)	(44·7/37·7)	(65·7/72·2)	(56·8/57·8)	(148·3/121·6)	(56·4/60·3)	(40·7/42·0)	(35·0/30·6)
Cerebrovascular disease	94·5	75·5	84·0	60·3	47·1	67·9	64·0	55·8
	(100·9/88·9)	(80·9/70·6)	(86·0/82·1)	(58·4/62·2)	(46·7/47·3)	(71·5/64·5)	(67·1/61·3)	(55·6/56·1)
Pneumonia / Influenza	148·5	96·6	34·8	35·1	26·2	57·7	48	98·8
	(144·2/152·3)	(99·6/94·0)	(35·2/34·5)	(41·0/29·4)	(29·1/23·6)	(60·2/55·3)	(55·4/41·5)	(101·9/95·9)
Lung cancer	46	36·2	33·3	15·5	24·3	12·2	12·9	20·6
	(65·3/29·0)	(44·0/29·2)	(40·3/26·9)	(20·0/11·2)	(31·2/18·2)	(14·3/10·3)	(16·4/9·8)	(21·2/20·0)
Main direct medical costs 2020 (USD)								
Acute myocardial infarction event	5,783·23	3,761·63	3,986·77	4,329·26	12,405·18	4,825·15	4,673·38	2,848·29
Non-acute myocardial infarction coronary ischaemic event	4,337·42	1,413·23	2,731	1,468·61	7,016·59	5,070·36	3,075·15	1,978·96
Coronary heart disease (Annual follow-up)	1,067·86	307·08	1,459·39	894·3	1,045·74	1,416·87	1,195·74	1,253·01
Stroke event	4,228·33	2,633·14	2,790·74	3,030·48	8,683·63	3,377·61	3,271·37	1,993·8
Stroke (Annual follow-up)	1,264·39	3,234·09	4,478·93	1,520·51	7,145·27	4,198·28	3,970·31	5,411·43
Pneumonia or influenza	429·89	597·96	1538·56	359·42	1579·89	1041·36	628·74	859·07
Mild COPD (annual)	507·84	271·31	237·53	710·75	1871·39	458·61	1262·6	186·25

Moderate COPD (annual)	245·34	520·57	252·83	159·99	213·11	263·68	288·63	156·02
Severe COPD (annual)	540·61	869·49	557·84	288·56	570·69	602·25	863·4	408·57
Lung cancer 1st year	1,655·17	3,624·63	6,199·24	2,011·26	7,864·04	5,364·82	8,902·47	4,667·85
Lung cancer 2nd year	19,301·22	9,226·24	21,961·88	9,231·59	21,961·04	22,449·33	13,294·23	15,065·43
Economic Parameters								
Tobacco tax revenues in 2020 (million USD)	1,353,595,236	1,209,869,879	1,178,712,763	330,069,207	44,733,310	96,871,745	2,031,600,000	476,47
Taxes as a proportion of cigarette price	76·22%	82·97%	82·36%	78·43%	55·11%	69·97%	67·00%	49·00%
GDP in 2020 (million USD)	421,237	1,273,119	240,312	270,842	59,698	100,668	1,051,525	207
GDP per capita in 2020 (USD)	8579	6797	13232	5335	12141	5600	8329	6127
Price elasticity of demand	-0·30 (-0.4 - -0.2)	-0·48 (-0.6 - --0.4)	-0·45 (-0.5 -0.4)	-0·43 (-0.5 - -0.4)	-0·78 (-0.9 - -0.6)	-0·87 (-1.1 - -0.7)	-0·45 (-0.5 - -0.4)	·42 (-0.5 - 0.3)
Total health expenditure· proportion of GDP	9·12%	9·46%	8·98%	7·23%	7·33%	8·26%	5·52%	4·99%

Data sources:

- Demographic information was obtained through public statistics.[1–6]
- Information on number of deaths for each disease was obtained from public statistics.[7–12]
- Information on smoking prevalence was extracted from country surveys: Argentina,[13] Brazil,[14] Chile,[15] Colombia,[16] Costa Rica,[17] Ecuador,[18] Mexico,[5] and Peru.[19]
- The GLOBOCAN database was used to obtain information on the incidence, prevalence, case fatality rate and mortality rate of cancer diseases.[20]
- The case fatality rates of noncancer diseases were estimated from local hospital discharge databases for Argentina,[11] Brazil,[12] Chile,[10] Colombia,[9,16] Costa Rica,[7] Ecuador,[21] Mexico,[5] and from the Global Burden of Disease data source for Peru.[20]
- The direct medical costs associated with tobacco-related diseases were updated by cumulative inflation rate[22,2324] or estimated following a microcosting approach in which the resources needed for diagnosis, treatment, and follow-up were weighted by their usage rates.
- Average exchange rates of 2020 published by central banks of all countries were used to convert costs in local currency to US dollars.[25–32]
- Macroeconomic parameters were obtained from the data banks of multilateral organizations.[33,34]
- To estimate cost components, labour income of individuals through a Mincer equation[35,36] using representative household surveys in each country,[37–42] and the legal retirement age by sex in each country.[43]
- Information on hours of informal care per day and health conditions was obtained through a literature review.[44–53]
- The parameters needed to estimate the price elasticity of cigarettes for each country were obtained from the literature.[54–60]

Estimation of the effect of the tobacco control measures

The impact of tax increase on revenues was estimated as:

$Vr=\Delta c*(\Delta PpV)$

where Vr is calculated variation in revenues; Δc represents the expected percent variation in consumption due to the price increase; ΔP represents the percent change in cigarette prices; and pV, proportion of price, prior to price increase, represented by taxes.

As explained in the manuscript, the impact of implementing plain tobacco packaging, advertising bans, or smoke-free air was estimated as follows:

$$Prevalence_{post} = Prevalance_{pre} - [(E_m - E_c)/(1 - E_c) * I_p * Prevalence_{pre}]$$

where $Prevalence_{post}$ is the prevalence of smokers after the intervention, $Prevalence_{pre}$ is the prevalence of smokers before the intervention, I_p is the proportion of variation in consumption that affects smoker prevalence, E_m is the expected effectiveness of fully implementing the intervention, and E_c is the effectiveness being achieved (if any) with the current measures (expressed as relative reduction in tobacco consumption).

The expected effectiveness of fully implementing the intervention (E_m) was estimated as follows:

	Plain packaging	**Advertising bans**	**Smoke-free air**
E_m (expected effectiveness of fully implementing the intervention)	12·0% (9·15-21·2%)	9·0% (5·0%-23·5%)	8·4% (4·2%-12·6%) [14·2% (7·2%-20·9%)]*

*Considering the additional reduction in secondhand smoke exposure

Health warnings: Evidence on the effectiveness of health warnings showed that smoking prevalence could be reduced by 0·6% if non-graphic warnings covered less than one third of the pack, 3% if these covered at least one third of the pack, and 6% if covered at least 50%. For the effect of plain packaging, data indicate an additional 3·15% to 15·2%. For the base case, we assumed plain packaging would reach a relative reduction equivalent to the decrease of moving from non-graphic warnings of one third of pack to graphic warnings on at least 50% of the pack (6% reduction). The published range (3·15%-15·2%) was explored in the sensitivity analysis.[61]

Advertising bans: The methodology followed to determine the effectiveness of the intervention is described in greater detail elsewhere.[62] For the evaluation of the impact of this control measure, three levels of implementation were considered. A minimum implementation level: no ban and a ban restricted only to national television, radio or print media. The literature shows that this ban has limited or no effect, so we treat it as the absence of a ban. This level is used as a reference category, with no effectiveness (0%). The intermediate level covers national television, radio or print media, and certain direct and/or indirect forms of advertising. The effect on the relative reduction in per capita consumption ranges from 0% to 13·6%; we chose 1% as the central estimator as it is the most consistent value suggested in the literature and used in a study involving 102 countries.[63,64] The maximum level of implementation was the ban of all forms of advertising, direct and indirect, including product display at POS. In this category associated with legislation, the level of compliance with the ban will clearly determine the effectiveness and the potential impact of taking the measure to the maximum level. The range of reduction in per capita tobacco consumption associated with this level is 5% to 23·5%.[65] As a central estimator, the two best options were: a reduction of cigarette consumption of 7·4% described for 22 resource-rich countries,[64,66,67] and 9% reported in a study of 102 countries; we chose the second option. More details in Bardach et al.[66,67]

Smoke-free Air: The identification of the best estimate of the effectiveness of smoke-free air interventions was carried out after a systematic review that is described in greater detail in Bardach et al 2020.[68] The complete implementation of smoke-free air strategies is estimated to reduce tobacco consumption by 8·4% (range 4·2 to 12·6), a moderate implementation could reduce consumption by 2·8% (range 1·4 to 4·2), whereas a minimal implementation could diminish consumption by 1·4% (range 0·7 to 2·1).[67]

The following table presents the current situation in each country and the effectiveness achieved by current measures adjusted according to the level of compliance (Supplementary Table 2).

Supplementary Table 2. Current situation of policy intervention in each country

Table 2. Current situation of policy intervention in each country and the effectiveness achieved by current measures (as relative reduction in consumption) adjusted according to the level of compliance in each country (E_c).[69]

Country	Packaging		Advertising		Smoke-free	
	Current Situation	***Effectiveness achieved***	***Current Situation***	***Effectiveness achieved***	***Current Situation***	***Effectiveness achieved***
Argentina	Large warnings with all appropriate characteristics	6·0%	Ban on national television, radio and print media as well as on some but not all other forms of direct and/or indirect advertising	0·9%	All public places completely smoke free	13·24%
Brazil	Large warnings with all appropriate characteristics	6·0%	Bans on all forms of direct and indirect advertising	5·4%	All public places completely smoke free	14·2%
Chile	Large warnings with all appropriate characteristics	6·0%	Ban on national television, radio and print media as well as on some but not all other forms of direct and/or indirect advertising	0·9%	All public places completely smoke free	14·2%
Colombia	Medium size warnings with all appropriate characteristics	3·0%	Bans on all forms of direct and indirect advertising	7·2%	All public places completely smoke free	12·3%
Costa Rica	Large warnings with all appropriate characteristics	6·0%	Ban on national television, radio and print media as well as on some but not all other forms of direct and/or indirect advertising	0·6%	All public places completely smoke free	13·2%
Ecuador	Large warnings with all appropriate characteristics	6·0%	Ban on national television, radio and print media as well as on some but not all other forms of direct and/or indirect advertising	0·6%	All public places completely smoke free	12·3%
Mexico	Large warnings with all appropriate characteristics	6·0%	Complete absence of ban, or ban that does not cover national television, radio and print media	0·0%	Complete absence of ban or up to two public places completely smoke-free	1·2%
Peru	Large warnings with all appropriate characteristics	6·0%	Complete absence of ban, or ban that does not cover national television, radio and print media	0·0%	All public places completely smoke free	10·5%

Methodology used to estimate the cumulative effect over ten years

Three scenarios were considered to estimate impact of reduced consumption: 1) Short-term, conservative: assuming 50% of reduced consumption is a consequence of reduced prevalence (Ip=0·5),[70,71] leading to a larger number of former smokers. 2) Mid-term: adding to previous scenario the potential health benefits associated with reduced number of cigarettes smoked by continuing smokers, assuming this would result in a proportional reduction in 75% of excess risk difference between a smoker and a former-smoker,[72] 3) Long-term: Ip=0·75 and the reduced prevalence resulting in an increased population of individuals who never smoked. We report the accumulated results over ten years, assuming a linear progression from scenarios 1 to 2 over five years and to scenario 3 in years six through ten. Details in in previous publications.[24,73,74] Smoking prevalence was assumed to remain constant in the non-intervention scenario. Interventions were assumed to be implemented in year one and sustained for subsequent years.

Scenarios to estimate the reduction of the tobacco health burden associated with the reduction in cigarette consumption

Summary of parameters by scenario

	Year 1	Year 5	Year 10
Ip (proportion of the variation on cigarette consumption expected to impact on smoking prevalence)	0.5	0.5	0.75
Health benefits associated with the reduction in the number of cigarettes smoked by continuing smokers	No	Yes	Yes
The reduction in prevalence leads to an increase in the number of	Former smokers	Former smokers	Never smokers

The effect of price increases on the prevalence of smoking was calculated as:

$$Prevalence = PrevB + (Ed * \Delta P * I\rho * PrevB)$$

Where PrevB is the baseline prevalence of smoking before price increase; ΔP is the per cent price variation; Ip is proportion of the variation on cigarette consumption expected to impact on smoking prevalence; and *Ed* is the price elasticity of demand of cigarettes. Price elasticity gives the percentage change in quantity demanded for each percent increase in price (e.g. a value of -0.6 means that for every 1% increase in price the demand will fall 0.6%).

Example for a price increase of 50% in a country with a price elasticity of -0.4

	Today	Year 1	Year 5	Year 10
Current smokers	30%	27%	27%	25.5%
Former smokers	25%	28%	28%	25%
Never smokers	45%	45%	45%	49.5%
Health benefits in continuing smokers	No	No	Yes	Yes

The accumulated results over ten years are reported in the manuscript, assuming a linear progression from scenarios one to two over five years and a progression to scenario three in years six through to ten.

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