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Original Investigation

Reducing the Burden of Disease Through Tobacco Taxes in Mongolia: A Health Impact Analysis Using a Dynamic Public Health Model

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Abstract

Background/Objectives: Smoking is the leading risk factor for many chronic diseases. The quantitative analysis of potential health gains from reduced smoking is important for establishing priorities in Mongolia's health policy. This study quantifies the effect of tobacco-tax increases on future smoking prevalence and the associated smoking-related burden of disease in Mongolia.
Methods: The dynamic model for health impact assessment (DYNAMO-HIA) tool was used. The most recent data were used as input for evaluating tobacco-taxation scenarios. Demographic data were taken from the Mongolian Statistical Information Services. Smoking data came from a representative population-based STEPS survey, and smoking-related disease data were obtained from the health-information database of Mongolia's National Health Center. Simulation was used to evaluate various levels of one-time price increases on tobacco products (25% and 75%) in Mongolia. Conservative interpretation suggests that the population will eventually adjust to the higher tobacco price and return to baseline smoking behaviors.
Results: Over a three-year period, smoking prevalence would be reduced by 1.2% points, corresponding to almost 40 thousand smokers at the population level for a price increase of 75%, compared to the baseline scenario. Projected health benefits of this scenario suggest that more than 137 thousand quality adjusted of life years would be gained by avoiding smoking-related diseases within a population of three million over a 30-year period.
Discussion: Prevention through effective tobacco-control policy could yield considerable gains in population health in Mongolia. Compared to current policy, tax increases must be higher to have a significant effect on population health.
Implications: Tobacco taxation is an effective policy for reducing the harm of tobacco smoking, while benefiting population health in countries where the tobacco epidemic is still in an early stage. Smoking prevalence and smoking behaviors in these countries differ from those in Western countries. Reducing the uptake of smoking among young people could be a particularly worthwhile benefit of tobacco-tax increases.

Introduction

Globally, tobacco accounts for over 7.2 million deaths every year. Currently, around 80% of the world's smokers live in low-middle-income countries (i.e., the growth market for tobacco companies). Despite the proposal and implementation of a range of tobacco-control interventions aimed at reducing tobacco consumption in these countries, the tobacco-related disease burden remains high.[1]

Tobacco taxation is regarded as the most effective intervention for reducing tobacco use, relative to other interventions.[2] Increases in tobacco taxes typically lead to increases in the price of cigarettes.[3] As a result, cigarette consumption decreases. A 10% increase in the price of tobacco decreases tobacco consumption by about 4% in high-income countries (HICs) and about 8% in low-middle income countries (LMICs).[4,5] Although price and tax measures are effective means of reducing the demand for tobacco, tobacco-tax levels differ widely across countries.

Tobacco taxes are very low in many LMICs. The World Health Organization recommends that excise tobacco taxes should account for at least 70% of the retail price for tobacco products.[6] Previous evidence has shown that, on average, excise taxes amount to about 40% of the retail price for a pack of cigarettes in LMICs—much lower than the average rate in HICs (67%).[5]

Mongolia is an example of a LMIC with a high rate of tobacco smoking. The prevalence of smoking has not changed in the past decade, with 27% of people 15 years of age and older being smokers. In terms of gender, almost one in every two men smoke.[7] The country's population of approximately 3.2 million is relatively young, with about 60% being younger than 35 years of age.[8] Although the average life expectancy has increased recently (70 years in 2018), men live almost nine years shorter than women do: 67 years versus 76 years.[9]

Mongolia launched an active tobacco control policy in 1993, and the Tobacco control Law has been revised four times in the past decade. This law regulated a range of tobacco control measures including smoke-free public places, restrictions on the sale of tobacco within 500 m from schools, mass media campaigns, advertising bans and tobacco taxation. A comprehensive national tobacco-control program aimed at reducing smoking prevalence from 27% in 2013 to 22% by 2021.[10] This program calls for increasing the level of excise taxes in the retail price of cigarettes from 25% in 2017 to at least 60% by 2021. As a first step, the excise tax law was adjusted to increase excise taxes on tobacco by 10% in 2018, followed by three annual increases of 5%. This policy resulted in the level of excise taxes for about 38% of the total retail price. In 2018, the WHO assessed the Mongolian tobacco control policy and many tobacco measures were rated as 'Complete policy,' however tax levels were considered too low.[11]

Cigarettes are the most used type of tobacco product in Mongolia. According to the national survey, more than 95% of current smokers smoked manufactured cigarettes. In Mongolia, a value-added tax (VAT) of 9.1% is levied, and an import duty tax (5%) on imported cigarettes. Additionally, a uniform excise tax (ET) has been imposed for all cigarette products in Mongolia, which has slowly been increasing over the period 2018–2021.[11] Hence the current study focused on increases in excise taxes, which have the largest expected direct impact on smoking behavior.[12]

Previous studies have shown that excise-tax increases can lead to significant reductions in smoking prevalence and smoking-related disease burden.[13] It is important to note, however, that most modeling studies apply a static modeling approach based on the conservative assumption that half of all current smokers will eventually die from smoking-related diseases. These static models thus do not reflect increased morbidity. They also fail to discount intervention effects over time. In contrast, a dynamic modeling approach tracks the reduction of smoking prevalence over time, based on changes in demographic patterns and smoking behavior over time.[14,15] Several previously published simulation models allow such a dynamic modeling approach.[16] Within the context of Mongolia, as in other Asian countries, meaningful application requires a model-based evaluation that properly reflects local smoking-behavior patterns, particularly with regard to tracking differences between men and women.

The current study aims to provide evidence that can be used by policymakers to support local tobacco-control policies. To do so, this study quantified the effect of a one-time tobacco-tax increase on future smoking prevalence and the associated smoking-related disease burden in Mongolia, based on a dynamic health impact model.

Methods

The DYNAMO-HIA tool, a population-based public health model with a state-transition structure, was used to project the future level of smoking prevalence associated with various tax-increase scenarios and to simulate smoking-related disease burden over time.[17] The model was populated with factual local input data, to provide a proper reflection of the situation in Mongolia for the case year, 2018. The conceptual framework of the model is presented in Figure 1.

Sources for input parameters are summarized in the supplementary Table S1. Overall, the model combines three sets of input parameters: demographic data, smoking-prevalence data, and epidemiological data. All of the data applied are stratified by gender and age (based on one-year age categories up to the age of 95 years). The population is further divided into three categories based on smoking behavior: never smokers, current smokers, and former smokers. The epidemiological causal pathway implies that smoking prevalence is linked through the relative risk (RR) of the incidence of smoking-related diseases, followed by its effects on mortality. The DYNAMO-HIA model is publicly available from https://www.dynamo-hia.eu/en, more details on the model structure and calculations can be found in publicly available user manuals.[18]

To study the effects of tobacco tax increases five consecutive calculation steps were followed (see supplement S2 for more details): first, baseline smoking transition rates, including initiation, quit and relapse, were estimated from observed smoking prevalence, to identify the reference smoking behaviour among the total population, by age and gender specific. Second, one-year effects of price changes on smoking prevalence, induced by one-time taxes increases, were calculated from published estimates of the price elasticity of demand for cigarettes and information on how this affects smoking behaviour for different levels of tax increase scenarios. Third, multiplication factors were estimated, to adjust baseline transition rates, until new transition rates fit the one-year reduction in smoking prevalence from step 2. These multiplication factors varied among youth and adults, as it is expected that the reduction in current smoking originates from less starters among youth and more quitters among adults. Fourth, the overall effects of tobacco tax increases were calculated over a 3-year time horizon, resulting in smoking prevalence estimates by age and gender, using DYNAMO-HIA and the adjustment factors. After three years, the effect of the price increase was set to zero, meaning that after three years, people are assumed to have become

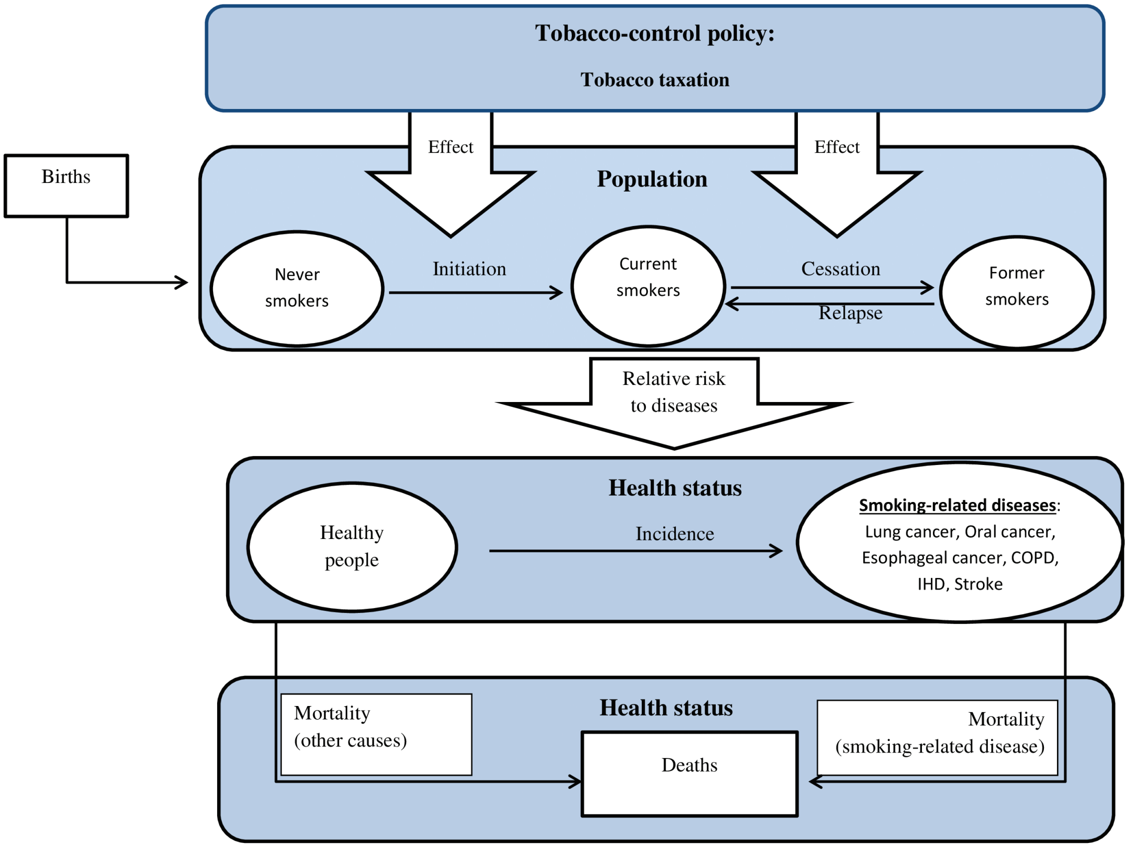

Figure 1. Conceptual framework, model input, and assumptions.

accustomed to the higher price of tobacco smoking and to have returned to their prior smoking behaviors.[5] Finally, these intervention effects in terms of smoking prevalence as obtained from running DYNAMO-HIA for 3 years were used as input to analyze long-term effects on population health, by performing a projection over a 30 years' time horizon using DYNAMO-HIA again with the original transition rates, but starting from the new smoking prevalence. Model simulations involved simulating the future population over a 30 years' time horizon, accounting for birth rates and mortality. These 30 year projections resulted in quality-adjusted life year gains (QALYs) from reduced smoking-related morbidity and mortality. Model outcomes were discounted and summed over the entire time horizon to yield net present values for quality adjusted life years (QALYs) gained in the population. A discount rate of 3% per year was used, in accordance with the guidelines.[19,20] The start year for the 30-year simulation was set to 2018.

Intervention Scenarios

Three scenarios were compared. The first scenario, 'baseline scenario,' assumes that the observed smoking transition rates in the base year would remain stable over time. This scenario thus reflects the tobacco-control policy, as it was implemented up until 2013, which is the date of the most recently available smoking-prevalence data. Consistent with previous studies in Asia, an excise tax increase was assumed to be passed fully onto the consumer price.[12,21] This is reasonable, since manufacturers know the price elasticity is below 1 and usually do not reduce their prices to cushion the excise tax increase. In two tobacco-taxation scenarios, two different levels of price increases of tobacco products were compared: a 25% increase and a 75% increase. Supplementary Table S3 shows what excise taxes are needed to achieve this as a level of retail price. Supplementary Table S4 presents the actual excise tax levels by year in Mongolia. The 25% price increase is linked to an increase in ET from $1.05 (the 2018 level in international dollars) in the model baseline scenario to $1.68, or a rise to nearly 50%, while the 75% price increase is linked to an increase in ET from $1.05 to $2.95, resulting in ET being nearly 61% of the market price.

Effect of Price Changes on Smoking Prevalence

The effect of price changes on tobacco consumption was modeled using the price elasticity of demand. Based on published evidence, for developing countries, the total price elasticity of tobacco is −0.8, meaning that a 10% increase in price leads to a 8% reduction in consumption.[4,5,22] The reduction in consumption can be due to a reduction in the number of cigarettes smoked per day, or it could be the result of either complete smoking cessation or reduced initiation. To evaluate the potential impact of price increases on health, the assumptions listed in supplementary Table S5 were applied. The smoking participation price elasticity was −0.4 for adults, and −0.8 for youth. This indicates that a 75% price increase would imply a 60% reduction in the prevalence of smoking among young people between the ages of 15 and 20 years, and a 30% reduction among adults 21 years of age and older. The upper and lower limits of the price elasticity were obtained from the literature. According to global youth tobacco surveys, the price elasticity of smoking participation ranges from −0.56 to −0.96 in developing countries.[23] For adults, the review reports total price elasticity varying from −0.20 to −1.0 for LMICs.[24]

To disentangle overall reductions in smoking prevalence into those resulting from reduced initiation at young age and those resulting from increased cessation in older age groups, multiplication factors on observed smoking transition rates were calibrated, until they reached the average one-year reduction in smoking prevalence, as was required for the intervention scenarios. Supplementary Table S6 shows the estimated multiplication factors for each gender, age group, and scenario. By assumption, relapse should not be affected by higher tobacco prices.

Sensitivity Analysis

First, we performed a range of univariate sensitivity analyses to test the robustness of the model projections. Uncertainty around key parameters was based on the literature. Input parameter values and their sources, as used in the sensitivity analyses, are presented in Supplementary Table S1. We varied the price elasticity and smoking prevalence across age groups.

Second, we performed a partial probabilistic sensitivity analysis to estimate the combined effect of uncertainty around the key parameters. For the prevalence of current smokers, never smokers, and former smokers, we used a Dirichlet distribution to reflect the uncertainty around these smoking-prevalence values, considering total population size for each specific age-gender category, and randomly drew $n = 1000$ values. Finally, extraction of the 2.5 and 97.5 percentiles allowed us to establish 95% uncertainty ranges (UR) for our long-term projections.

Results

Effect of Price Increases on Future Smoking Prevalence

The effects of the price increase scenarios at three years after the intervention are displayed in Table 1. As a result of adjusted smoking habits, the prevalence of current smoking could be expected to decrease in each of the scenarios, as compared to the baseline scenario which indicates the continuation of observed trends in demography, smoking uptake and cessation. However, the effect of the 25% price-increase scenario appeared relatively small at the population level. A 75% price-increase scenario could be expected to reduce current smoking prevalence by 1.2% points at the population level, corresponding to a reduction of more than 36 thousand smokers. The greatest effect is likely to occur among the male population, given that almost seven times more future male smokers were prevented than female smokers. The percentage of former smokers increased as a result of current smokers who quit smoking in response to the price increases. Based on these findings only the 75% price-increase scenario was evaluated over a 30-year time horizon.

The effects of a one-time price increase of 75% and 25% on the age pattern of current smoking, taking into account the actual population structure over a three-year time horizon, are presented in Figure 2. The distance between the lines indicates the magnitude of intervention effects across different age groups. It highlights that these differ by age and are smaller for the 25% than for the 75% scenario. Clearly, fewer youths initiated smoking, while the effects of additional cessation for adults varied by age.

The effects of the 75% price-increase scenario projected over a 30-year time horizon in terms of the smoking prevalence are displayed in Table 2 and Figure 3. The total population in Mongolia was 2.9 million persons in 2018. The reduction in the smoking prevalence for the 75% price-increase scenario was 4.47 (95% UR 4.27–4.63) percentage points for men and 0.54 (95% UR 0.44–0.67)

Table 1. Reduction in the prevalence of current smoking, expressed in percentage points and reduction in the number of future smokers, by gender, after a three-year time horizon (point estimate, lower and upper limits)

Scenarios	Male	Female	Both
	Mean (lower-upper)	Mean (lower-upper)	Mean (lower-upper)
Baseline prevalence of current smoking in 2018(% of population aged 15+).	49.2(43.4–54.4)	5.3(2.5–8.3)	27.1 (22.8–31.2)
Reduction in the prevalence of current smoking			
75% price increase	2.1 (1.0–2.7)	0.3 (0.1–0.6)	1.2 (0.6–1.6)
25% price increase	0.6 (0.1–1.2)	0.1 (0.0*-0.4)	0.3 (0.1 -0.8)
Baseline number of current smoking among population aged 15+ years in 2018(in thousands)	505.7**	57.3	562.9
Reduction in the number of smokers (in thousands)			
75% price increase	31.63 (15.64–41.28)	4.55 (2.21–9.57)	36.18 (17.85–50.85)
25% price increase	8.79 (2.09–17.96)	2.34 (0.0*-6.60)	11.13 (2.09–24.56)

PE = price elasticity,

* effects too small to be noticeable.

**Census data from National Statistical Office.

percentage points for women, as compared to the baseline scenario. The effect of the intervention declined steadily over time, as a result of the original quit and cessation rates being used, reflecting that behavior returned to baseline smoking habits as the effect of the price increase waned.

Effects on Population Health

The discounted numbers of QALYs gained due to the intervention among the total population over a 30-year time horizon are presented in Table 3. Overall, an increase in tobacco taxes could be expected to yield a gain of more than 137 thousand QALYs, with the majority of the health gains occurring among the male population. The cumulative intervention effect for the 75% price increase scenario in terms of discounted QALY gains is further detailed in supplementary Table S7, stratified by gender, and disease for a 10, 20 and 30 years time horizon. Even after discounting, most of the health gains were obtained in later years, with at 12.9 thousand QALYs being gained in the first 10 years, an additional 44.2 in the next 10 years and 80.6 discounted QALYs in the last 10 years. Most QALY gains were realized by reductions in the prevalence of various smoking-related cancers.

As indicated by the uncertainty analysis, the effect of the intervention was affected by a number of key input parameters. As result of producing significant reductions in the prevalence of current smoking, the imposition of high tax increases reduced future smoking-related disease burden, thereby yielding QALY gains. The QALY gains in the uncertainty analyses ranged from 97 thousand to 150 thousand, reflecting the uncertainty in observed smoking-prevalence and in the estimated smoking-transition rates. The cumulative QALY gains become unrealistic (zero) for women, since the wide uncertainty results in very small (negligible) smoking prevalence among females. Finally, it is important to note that our results present the discounted QALY gains associated with smoking-related diseases over a 30-year time horizon. Much higher values could be presented if these gains had not been discounted.

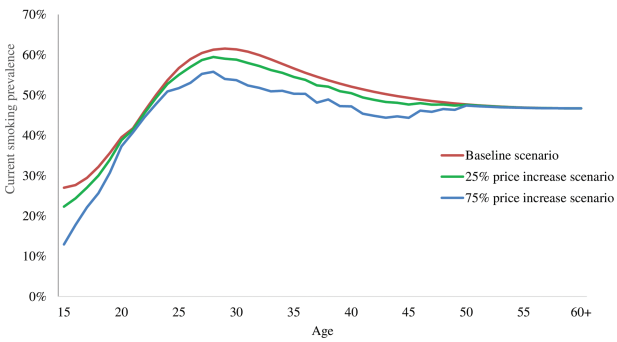

Figure 2. Short-term effects of a tax increase: Percentage of population being current smoker in year 3 by age.

Discussion

A one-time increase of 75% in current retail prices for tobacco would reduce the prevalence of current smoking by 1.2 percentage points at the population level, corresponding to more than 36 thousand less smokers (prevented from starting or quit) in Mongolia after 3 years. As a consequence, in a population of around three million people, more than 137 thousand quality-adjusted life years would be gained from reductions in six smoking-related diseases over a 30-year time horizon. We used a previously validated model and populated it with local data, based on nationwide surveys. We used a 3-year time period for evaluating the direct effects of a tax increase on smoking prevalence and then applied a 30-year time horizon to capture the full health effects of a tax increase. The DYNAMO-HIA public health model was applied for the projections of health impacts. Importantly, we have demonstrated that modest price increases are likely to have too little impact on the reduction of current smoking due to the increasing number of current smokers in Mongolia. To reach the national goals, and the level of excise tax as recommended by the WHO, large tax increases resulting in price increases of nearly 75% would be needed. Overall, more benefits were seen for men than for women, simply because the prevalence of smoking among men was 10 times higher than it was among women.

Our study was based on conservative assumptions. For example, it was assumed that, after three years, the effect of a one-time tax increase has disappeared and that people would have returned to their baseline smoking behavior, as they became accustomed to the higher price. In addition, we explicitly modelled former smokers as still being at a greater health risk than never smokers. For some diseases, the long-term benefits may seem relatively modest. This can be explained by the risks for former smoker (e.g., of developing several cancers) being nearly equal to those of current smokers. The greatest health benefits were associated with the prevention of smoking (i.e., reduced initiation rates) among young people.

The 25% price-increase scenario had small effects on smoking prevalence over a three-year time horizon, while the price increase

Table 2. Reduction in the prevalence of current smoking in the 75% price increases scenario as compared to reference scenario in percentage points over 30-year time horizon.

Year	Population size** (in thousand)	Male		Female	
		Mean	95% UR	Mean	95% UR
2018*	2,987	4.47	(4.27–4.63)	0.54	(0.44–0.67)
2019	3,032	4.15	(4.00–4.31)	0.53	(0.45–0.69)
2020	3,075	3.95	(3.84–4.12)	0.52	(0.44–0.68)
2025	3,267	2.97	(2.92–3.11)	0.42	(0.40–0.51)
2030	3,438	2.27	(2.16–2.33)	0.36	(0.23–0.42)
2035	3,614	1.94	(1.84–2.09)	0.28	(0.17–0.28)
2040	3,802	1.58	(1.53–1.77)	0.28	(0.17–0.34)
2048	4,008	1.07	(1.02–1.24)	0.21	(0.10–0.27)

*Base year.

**Simulated population over a 30 years time horizon. UR: Uncertainty range.

of 75% resulted in a more substantial reduction in the prevalence of current smoking. The reduction was particularly dependent on the age structure of the population. Since effects of the 25% price increase scenario were reaching zero for women and showed to be too small overall, this scenario was not used in the 30-year time horizon projections. Our finding that the effects of the intervention are likely to disappear over time is also due to the projected rapid population growth over the next 30 years. Preventing young people from initiating smoking would require repeated interventions (e.g., new tax increases).

Young people tend to be less addicted to smoking, due to their short history of smoking. Moreover, they are more responsive to price than adults are. Consistent with previous studies, our analyses applied a price elasticity of −0.4 for adults and −0.8 for young people. In young people, this would translate to a lower initiation rate, rather than an increased quit rate. As a result, the intervention effect among young people was substantially larger than in adults. When considering the total price elasticity of demand, tobacco use could even be reduced by as much as 22% among young people in LMICs.[25] Demonstrating this, however, would require a different analytic approach. Our results still indicate that tobacco taxes are highly effective among young people and result in large health gains.

The frequency and magnitude of tax increases have been mostly discussed from the public financing perspective, as they generate additional tax revenues, ensure financial sustainability, and create more fiscal space. From a public health perspective, the advantage of relatively large single price increases as opposed to several smaller steps has been highlighted in the literature.[26,27] The benefits of tobacco-tax interventions are not limited to QALY gains resulting from the reduction of smoking-related diseases, as examined in this study. Other benefits could include additional revenue from excise taxes, avoided future healthcare expenditures for tobacco-related diseases, and reduced loss of productivity.[13] Moreover, non-smokers are likely to experience additional health benefits resulting from decreased exposure to second-hand smoke. Previous studies have suggested that increasing tobacco taxes can yield more health and financial gains for the poorest segments of the population than for the most affluent population groups.[26]

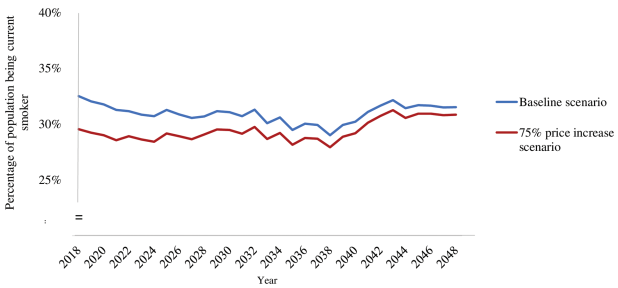

Figure 3. Projected percentage of current smokers per year among total population.

Comparison of our results to those of other modeling studies was challenging, given differences in the modelling approaches applied.[28] Similar dynamic modeling approaches have been used in Vietnam,[14] New Zealand,[15] and Taiwan.[29] In general, these studies corroborate our findings that tobacco-taxation policies can be expected to decrease the smoking prevalence and be beneficial to population health. In contrast to our results, however, these studies used many input parameters from high-income/Western countries. For example, the relative risk of smoking on deaths due to lung cancer was almost 10 times higher than the figure we used in our model. Our relative-risk was taken from a recent pooled analysis of 21 cohort studies in Asia.[30,31] As a result, our estimates could be considered more realistic in an Asian setting. In addition, most other studies lack uncertainty ranges and present only univariate sensitivity analyses.

The DYNAMO-HIA tool is a well-established model for a quantitative health impact assessment that has been used predominately for assessing population-level policies in European countries. Examples include the taxation of alcohol in Western Europe,[32] the taxation of processed meat in Germany,[33] and the comparison of tobacco interventions in the Netherlands.[17] The model has been applied in Korea to compare the effects of a cigarette-pack intervention to those of a tobacco-tax intervention, reporting that a tobacco-tax increase of 100% produced greater health benefits than a package-warning intervention.[34]

The strength of our study involves the use of a dynamic multi-state model with different smoking categories (i.e., never smokers, former smokers, and current smokers). This enabled us to present gains in both life years and quality adjusted life years, while properly discounting the outcomes and being careful to not overestimate health gains from smoking cessation. Moreover, the baseline input parameters in our model were country-specific and taken from nationwide epidemiological registry data on six smoking-related diseases, as well as from the representative STEPS surveys on smoking prevalence. A final strength of our approach is that it includes an elaborate sensitivity analysis to represent the uncertainty in the outcomes, to ensure a proper reflection of the uncertainty introduced by uncertain input parameters and model assumptions.[35]

Nevertheless, it is important to acknowledge several limitations. Although most of the input parameters were country-specific, no local data on the price elasticity of demand for cigarettes were available. We used estimates from global comparison studies, which yielded a mean value of −0.4.[5,22] Given the wide range of cigarette prices in Mongolia, the true level of price elasticity of demand could be different, with smokers switching to cheaper brands rather than

Table 3. Quality-adjusted life year (QALY) gains from the 75% price-increase scenario (in thousands)

		Male	Female	Both
Disease name	ICD-10 code	Mean (95% UR)	Mean (95% UR)	Mean (95% UR)
Oral cancer	C00-C14	18.06 (16.57–19.51)	5.59 (0–6.38)	23.64 (16.57–25.90)
Esophageal cancer	C15	18.08 (16.59–19.54)	5.59 (0–6.39)	23.67 (16.59–25.93)
Lung cancer	C33-C34	17.76 (16.30–19.20)	5.57 (0–6.37)	23.34 (16.30–25.57)
IHD	I20-I25	16.65 (15.24–18.02)	5.08 (0–5.81)	21.73 (15.24–23.83)
Stroke	I60-I69	17.68 (16.21–19.11)	5.56 (0–6.35)	23.24 (16.21–25.46)
COPD	J40-J44	17.87 (16.43–19.23)	4.19 (0–4.78)	22.05 (16.43–24.01)
Total		**106.09 (97.35–114.61)**	**31.59 (0–36.08)**	**137.68 (97.35–150.7)**

quitting. To compensate for this uncertainty, we included a sensitivity analysis using a range of price elasticity of demand values, based on published estimates. Another potential limitation has to do with the small magnitude of the relative risks used in our model, as compared to the original DYNAMO-HIA input data. Our relative risks were taken from studies in Asia, with individual-level data from more than one million participants in 20 Asian cohort studies. As an example, the relative risk of lung cancer was 3.56 for current smokers, whereas the relative risks used in the original DYNAMO-HIA study were almost seven times higher, based on data from European countries.[31,36,37] While the Asian risk figures seem more appropriate, they yield lower estimated health benefits for tobacco-control policies. The low relative-risk levels reflect the comparatively short history of the smoking epidemic in Asia. Over time, therefore, the relative risk for many diseases in Mongolia is likely to increase as individuals who have smoked since their youth grow older. Our projections may thus be too conservative in this respect.

In 2012, the Mongolian government adopted tobacco-control policies to reduce tobacco smoking.[38] While a number of key measures were adopted as part of the tobacco-control law, (e.g., smoke-free workplaces, and a ban on promotions), the level of tobacco taxes has remained the lowest in the region.[11] Although the law does include tax increases, they have been limited to a 10% increase in 2018, followed by annual increases of 5% up until 2021.

Our current study evaluated a scenario of a one time 75% price increase, which leads to a rise in the total tax share (%) on cigarette prices from 38% in the baseline year of 2018 to 61% (23% point). The Mongolian National Tobacco Control Policy targeted a 60% tax share for 2021. The study highlights the health benefits that could be obtained from such an increase. Of note, the WHO recommends a tax share of 70%. Our study shows a larger increase is needed to reach the National and global targets levels for excise tax.

Mongolia has the opportunity to benefit a lot from increases in tobacco taxes, as almost 60% of the population are under the age of 35 years and young people are more responsive to price increases than adults,[3] while not starting to smoke at all results in more health gains than quitting at a later age. For this reason, the government should consider further tobacco-tax increases.[4,5]

In response to an emerging burden of non-communicable diseases (NCDs), Mongolia has adopted a population-based public health approach.[39] Nevertheless, the prevalence of major risk factors—including tobacco smoking—have remained essentially unchanged in the past years..The wide, current gender gap in life expectancy can be explained by differences in lifestyle, and more specifically, the smoking of tobacco.[40] The results of the current study may therefore be used to enhance understanding concerning the effects of tobacco-tax measures, as recommended by global initiatives aimed at curbing the burden of NCDs on population health in Mongolia and similar developing countries.

Conclusion

There is substantial room for tobacco-tax increases in Mongolia. Continuation of the current strategy of annual tobacco-tax increases of 5% up until 2021, as mandated in 2018, is unlikely to achieve Mongolia's national goal of reducing smoking prevalence in the population from 27% in 2013 to 22% by 2021.

A one-time price increase of 75% would reduce the prevalence of current smoking by 1.2% points over a 3-year time horizon, preventing almost 40 thousand future smokers, corresponding to a gain of over 137 thousand QALYs due to the avoidance of disability and death from six smoking-related diseases in 30 years for a population of three million people. Further benefits of such an intervention could include gains in productivity, and savings in healthcare costs due to smoking-related diseases, in addition to the benefits associated with reduced environmental tobacco smoke. Mongolia thus stands to realize substantial benefits from a genuine tobacco-tax intervention.

Supplementary Material

A Contributorship Form detailing each author's specific involvement with this content, as well as any supplementary data, are available online at https://academic.oup.com/ntr.

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Authors' Contribution

AT, TF, and EB designed the study. AT and BP performed the data collection. AT and SK analyzed the data and prepared the manuscript. TF and EB checked the analytic results and provided constructive comments for the revision. All of the authors contributed to the analysis and interpretation of the data, in addition to contributing to the drafting of the manuscript and the critical revision the paper for intellectual content and being involved in the final approval of the version to be published.

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Competing Interest

None declared.

Patient Consent

Not required.

Data Availability

Data available in supplementary material.

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