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Economic Research Informing Tobacco Control Policy

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Estimating the Economic Costs of Tobacco Use

Introduction

The health risks associated with tobacco use can be substantial and can affect not only smokers but non-smokers as well. Tobacco use accounted for more than seven million deaths in 2015 (around five million men and two million women). Around 80% of tobacco-attributable deaths are occurring in low- and middle-income countries (LMICs).[1] Tobacco use imposes a significant economic burden, including the costs of healthcare to treat the diseases caused by tobacco and the lost productivity resulting from tobacco-attributable morbidity and mortality.[2 3] Tobacco use has been recognized as the single most important preventable risk to non-communicable diseases (NCDs) in the world,[4] a risk whose increasing burden from productivity losses and impoverishment has become a major concern.[5]

Estimates of the economic costs of tobacco use are relevant not only for determining the economic burden and for financial planning, but also to push policymakers to implement effective tobacco control programs. Despite that, reliable cost estimates still do not exist in many countries—especially in LMICs. The available evidence suggests that the healthcare costs associated with tobacco-related illnesses can be very high, reaching even 1.8% of GDP in the US and Switzerland, 2.5% of GDP in Hungary, and 3.4% of GDP in the Philippines.[2] Current levels of tobacco taxes fall short of recovering the true cost of tobacco use to economies, as in most LMICs the collection is below 1% of GDP. Therefore, a significant increase in tobacco taxes can help close the gap between the cost of tobacco use and the revenue generated from tobacco sales.

This technical note presents the various categories of economic costs of tobacco use, explains the approaches to their estimation, and summarizes the existing empirical evidence. The discussion is based on the US NCI and WHO 2016 Monograph, "The Economics of Tobacco and Tobacco Control"[2] and several other published sources.

Defining categories of costs

Various categories of costs have been used in the literature, depending on the applied calculation methodology and the goals of the studies. While there are several categories of costs of tobacco use, the most common classification used in empirical studies distinguishes between direct and indirect costs. Direct costs include the costs of healthcare, while indirect costs represent the value of lost productivity in current and future years due to disability and mortality.

Direct versus indirect costs

Direct costs of tobacco use refer to the monetary value of goods and services consumed as a result of tobacco use and related illness,[6] and consist of healthcare costs (e.g., physician's and other service fees, medical supplies, medicines, etc.) and non-healthcare costs (e.g., transportation, food supplements, etc.). On the other hand, indirect costs include the value of lost productivity and lost lives resulting from tobacco use-related illnesses. It should be noted, to avoid potential confusion, that this terminology has been used inconsistently in the literature, as

some indirect costs are sometimes classified as direct costs. There are two approaches which can be used to estimate the direct costs of tobacco use: the annual cost approach and the lifetime cost approach.

Internal versus external costs

One of the fundamental issues in estimating the costs of tobacco use is that total cost estimates often do not account for external costs. While internal costs are those borne by the smoker (e.g., spending on tobacco purchases, healthcare costs incurred by the smoker), the external costs represent an involuntary burden on others, i.e., negative externalities for which they are not compensated (e.g., healthcare costs as a result of exposure to secondhand smoke (SHS)). Internal and external costs are also sometimes called private and social costs. As involuntary burdens, external costs weigh more in economic analyses. Moreover, for policymaking purposes, external costs are more important than internal costs, even if they may not be as high in magnitude. They provide one of the major rationales for government intervention because, without a negative externality imposed by an individual's action, it is difficult for internal costs alone to justify government action.[7]

Tangible versus intangible costs

Another category of economic costs of tobacco use distinguishes between tangible and intangible costs. Tangible costs are measurable and easy to identify, such as productivity losses due to morbidity and premature mortality caused by tobacco use, and healthcare costs of treating tobacco-related illnesses. When tangible costs are reduced, they release financial resources which can be used for other purposes. On the other hand, intangible costs are far more difficult to quantify, such as the value of lost life, or pain and suffering due to illness. Unlike tangible costs, reducing intangible costs does not release any immediate financial resources for alternative uses, but it increases welfare. Due to the difficulty in quantifying intangible costs, most are underestimated, indicating that the burden on the economy is even higher than estimates may suggest.

Avoidable versus unavoidable costs

Total costs of tobacco use are also made up of avoidable and unavoidable costs, depending on the time available for the costs to be reduced or eliminated. Avoidable costs are those which could be reduced or eliminated at any time as a result of behavioral change, that is, reduced tobacco consumption.[7] However, unavoidable costs refer to already existing tobacco-related illnesses and the new cases resulting from past tobacco consumption, as well as continued present consumption, which require a long time period (i.e., generations) and the development and dissemination of new knowledge and policy interventions. Therefore, providing empirical evidence on the impacts of tobacco use and continued and improved policy interventions are a driving force in reducing and eliminating the unavoidable costs, and ultimately, total economic costs of tobacco use.

Cost estimation approaches

Lifetime (longitudinal) versus annual (cross-sectional) approach

When estimating the costs of tobacco use, one of the first decisions is whether the focus should be solely on the costs of current tobacco use or on the costs of all current and past tobacco consumption. With this distinction in mind, there are two approaches used in the literature: lifetime and annual costs.

The lifetime approach compares the costs of current tobacco users relative to never-tobacco users over the entire lifespan. This is also known as a longitudinal approach as it estimates the costs by using the longitudinal data on healthcare costs. Estimating the lifetime cost requires an assumption of life expectancy for

both current tobacco users and never-tobacco users. To obtain lifetime costs, this method discounts future (expected) values of annual healthcare costs for current tobacco users and never-tobacco users to convert them into present values and then sums them to obtain the lifetime costs. Finally, the excess lifetime cost for tobacco users over never-tobacco users represents the lifetime healthcare cost of tobacco-related illnesses.

The annual approach to estimating healthcare costs compares the healthcare cost for both former and current tobacco users with never-tobacco users in a given year. Because the annual approach uses cross-sectional data, it is also referred to as the cross-sectional approach. The annual costs do not adjust for the difference in life expectancy between tobacco users (both current and past) and never-tobacco users but represent the healthcare costs attributed to tobacco use in a given year.

The decision on which approach to use depends on the purpose of the analysis. The lifetime approach is appropriate for conducting a long-term cost-effectiveness analysis of tobacco control policies, while the annual approach is more appropriate for short-term analyses, such as estimating annual cost and budget formulation or for estimating the short-term impact of a certain policy. Given the difficulty of obtaining longitudinal data which tracks healthcare costs over time, the lifetime approach is less commonly used.

Approaches in estimating Smoking-Attributable Fraction (SAF)

One of the most relevant tasks in estimating the economic cost of tobacco use is the estimate of the so-called Smoking-Attributable Fraction (SAF),[6] which represents the proportion of a total outcome (e.g., total healthcare costs) attributable to past and current tobacco use. The SAF considers current smoking prevalence and the relative risk of disease and the mortality and morbidity incurred by smokers in comparison to never-smokers.

Studies estimating SAF commonly use two approaches: the epidemiological approach and the regression (econometric) approach. The epidemiological approach is very popular as it can be used even when no detailed survey data is available, while the regression approach requires relevant, nationally-representative survey data.

The epidemiological approach applies the additive method in estimating the SAF, first determining a share of healthcare costs for each tobacco-related disease of interest using a formula. Specifically, in the case of a tobacco-related illness j, the prevalence of ever-smoking p, and the relative risk of healthcare costs for treating j for ever-smokers relative to never-smokers R_j, the SAF equals[8]

$$SAF_j = \frac{p\,(R_j - 1)}{p\,(R_j - 1) + 1}$$

Once the SAF for each illness is estimated, they are summed to obtain the total healthcare cost of tobacco use.

The regression (econometric) approach applies a subtractive method in estimating the SAF. First, it estimates the total annual healthcare cost of an individual for treating all diseases, related and not related to tobacco use. Then, it estimates the healthcare costs for a hypothetical population with no tobacco use (by setting all tobacco variables to zero) and deducts this estimate from the estimated total healthcare cost to obtain the excess healthcare costs for tobacco consumers. Finally, to calculate the SAF, it divides the estimated healthcare costs for tobacco users with estimated total healthcare costs for all individuals.

It has been argued that since many smoking-related illnesses are also related to other risk factors not related to smoking, cost estimation approaches should be adjusted for these other factors. Some evidence suggests that ever-smokers and never-smokers are different in terms of risk-taking.[9] The adjustment would, however, require additional data, and the appropriate degree of adjustment is debatable as many other factors may influence health

behaviors, such as socioeconomic status, exposure to tobacco industry advertising, peer pressure, etc.

Approaches in measuring the value of lost life

One of the main challenges with estimating some types of economic costs of tobacco use, such as indirect costs, is measuring the value of lost life due to premature death attributed to tobacco use since life does not have a market value. Four approaches in estimation are commonly recommended: the value of production (or human capital) approach; the demographic approach; the value of a statistical life (VSL) approach; and the willingness to pay (WTP) approach. The human capital and demographic approaches are based on the estimated market value of losses, while the value of statistical life and willingness to pay approaches rely on a subjective value of effort to prevent premature death. The decision on which approach to apply in estimating the economic costs of tobacco use depends on the policy question asked.

The main difference between the human capital approach and the demographic approach is in the way they treat the costs of premature morbidity and mortality. These two approaches are, in fact, quite complementary as they look at the same issue from two different angles and by answering two different questions. While the human capital approach estimates the potential cost savings assuming tobacco use ceases to exist, the demographic approach starts with the question: "What if tobacco use never existed in the first place?" The human capital approach estimates the present and the (discounted) future costs of tobacco-related mortality in the current year, while the demographic approach estimates the present costs of tobacco-related mortality in past and present years by comparing the size and structure of the actual population with a hypothetical population where there are no tobacco-related premature deaths.

The advantage of the human capital and demographic approaches is that their estimates are relatively easy to quantify; their limitation is that they may undervalue the costs in LMICs relative to high-income countries (HICs), as wages and fringe benefits are relatively lower. In addition, as these approaches examine the market value of the lost production, they may undervalue the lives of people who are out of work for reasons other than smoking, such as young children, youth enrolled in school, the elderly, the disabled, caregivers, etc.

The VSL and WTP approaches try to address the limitations of the production-based estimation approaches in undervaluing the lives of certain individuals by measuring the subjective value a person puts on their life. While the VSL approach assesses ex-post reduction in mortality risk, i.e., after the health has been impaired due to tobacco use,[10] the WTP is an ex-ante approach that measures an individual's willingness to pay for prevention of an impaired health condition and a reduction in mortality risk. Both the VSL and WTP approaches rely on self-reported valuations, and the estimates can vary widely, being on average around 120 times a country's GDP per capita.[11] While VSL and WTP estimates are much higher than those of the production-based approaches, they also vary by income and therefore can be much higher in HICs than in LMICs.

Types of costs analysis

In addition to the cost categories, the type of cost analysis can vary according to the policy question asked. Three types of cost analysis are commonly used: economic cost-benefit analysis (ECBA), GDP-based social cost analysis (GSCA), and expenditure-based cost analysis (EXBA).[12]

ECBA is most commonly used to evaluate the economic impact of a policy on the welfare of society as a whole. Unlike the other types of analysis which consider only costs with monetary values, ECBA considers both direct and indirect, and tangible and intangible costs of tobacco use. However, ECBA also excludes some types of costs. For example, ECBA includes only the unexpected costs of smoking, given that a smoker is assumed to have accounted for the

expected costs when deciding whether to smoke or not[12] and tobacco users tend to underestimate the health impact of tobacco use.[13]

GSCA is used to answer questions regarding the impact of tobacco use on forgone production, most commonly the impact on GDP, either from an aspect of the whole economy or of selected sectors within an economy or government. Unlike ECBA, GSCA includes both expected and unexpected costs but does not include intangible costs such as losses which are not reflected in market transactions.

EXBA is usually used to evaluate the impact of tobacco use on a budget, by defining costs as monetary expenditures and revenues as benefits. This analysis does not include the intangible costs and the economic value of lost lives.

Development impact of smoking

Tobacco consumption can impact the development of a society directly by imposing healthcare costs, and indirectly by reducing productivity and working years of life due to morbidity and mortality. Moreover, part of the economic costs and the development impact of tobacco use is also reflected in decreased human capital investments caused by the crowding out of spending on health, nutrition, and education for children.

Lost productivity resulting from absenteeism from work and premature death due to tobacco-related illnesses represents lost earnings for employees and lost revenues for the employers. A few recent studies from HICs suggest these costs are high. For example, the estimated average annual cost of a smoker to an employer in the US is $US 5,816.[14] It is also reported that smokers are absent 6.5 more days per year than non-smokers in the US[15] and 2.7 more days in the UK.[16] In terms of lost productivity, the estimated costs of smokers in the US is around $US 151 billion (0.9% of GDP) (and around $US 6 billion (0.03% of GDP) for non-smokers as a result of SHS exposure),[17] and in Australia around $AU 8 billion (or 0.9% of GDP).[7]

Various other economic costs have been associated with tobacco use and should be, but have rarely been considered when estimating the total costs, such as the costs of fires attributed to smoking, or the environmental waste produced by tobacco farming and manufacturing.[18]

Smoking has been identified in some countries as the leading cause of fire and accounts for 10% of the total global fire death burden; 30% in the US.[19] Moreover, tobacco cultivation eats up large swaths of land which could otherwise support sustainable food production. About 90 percent of commercial tobacco leaf is grown in the southern hemisphere, often in countries where undernourishment and child labor continue to pose challenges. The total cost from these developmental consequences of tobacco use are potentially enormous, and they are expected to be borne by future generations. Tobacco farming is land intensive and frequently uses large amounts of chemical fertilizers, pesticides, growth regulators, and wood for flue-curing. Tobacco crops strip the soil of nutrients such as nitrogen, phosphorus, and potassium to a greater extent and faster than other major food and cash crops. Clearing land for tobacco growing cuts into forest reserves, as do tobacco-related forest fires.

Moreover, tobacco growing and curing are direct causes of deforestation; it has been estimated that 11.4 metric tons of wood are used globally per year only for curing tobacco.[20] Taken together, tobacco production disrupts the ecosystem and leads to soil and land degradation including deforestation. Tobacco control, in particular supporting economic alternatives to tobacco growing, can help restore biodiversity and protect land resources while advancing other important development objectives, like increased food security.

The environmental consequences of tobacco are not limited to tobacco farming. Cigarette butts are the most widely littered product globally, often dumped into oceans, lakes, and other bodies of water. In 2014, 2,248,065 discarded cigarette butts were picked up from beaches and

water edges across 91 countries.[20] Meanwhile, tobacco production is not only water intensive but also disperses chemicals into nearby waterways. Arsenic, lead, nicotine, and ethylphenol are leached from discarded butts into aquatic environments and soil, but the impact of these on the quality of drinking water is not yet specifically defined. Without considering the "environmental lifecycle of tobacco" and its impacts on pollution, hazardous waste disposal, and inefficient water use, efforts to achieve clean water and sanitation will be both less comprehensive and less effective. Even unsmoked filters are toxic to water and life within it. In parts of Nicaragua, where most tobacco farms are close to important rivers, researchers found pesticide contamination in both the superficial aquifer and deep groundwater. Studies in Brazil have found excessive agrochemical residues in waterways near tobacco farming communities.[20]

Analyzing the incidence of external costs of smoking

One of the important questions in analyzing the costs of smoking is who bears the burden of external (or social) costs because these costs can be viewed as a form of tax imposed on different groups in a society. Because intangible costs of smoking, such as the costs of loss of life, cannot be immediately passed on to others, external costs incidence refers to only tangible external cost.

External costs are initially borne by smokers, other individuals, businesses, and governments, who then shift these costs to other groups through different channels.[7] Both smokers and other individuals (through SHS exposure) shift the cost of smoking to their employers (e.g., businesses) through lower productivity. To compensate for these costs, businesses further shift the costs to either employees by lowering wages, or to final consumers through higher prices, or to the government through lower tax payments. To finance the healthcare costs attributed to smoking and to compensate for lower tax revenues, the government either reduces other public spending or imposes higher taxes on either individuals or businesses. This process, however, does not end here, as higher taxes on businesses are likely to be further shifted to employees through lower wages, and to final consumers through higher prices. Ultimately, it is individuals who bear the burden of the external costs of smoking.

Global evidence on economic costs of tobacco use

The existing evidence on the economic costs of tobacco use across countries suggests that, in terms of GDP, the estimates vary widely depending on the quality of data, the method applied, and the scope of analysis. Studies conducted in LMICs mostly rely on more limited data and, therefore apply less sophisticated methods than those in HICs.

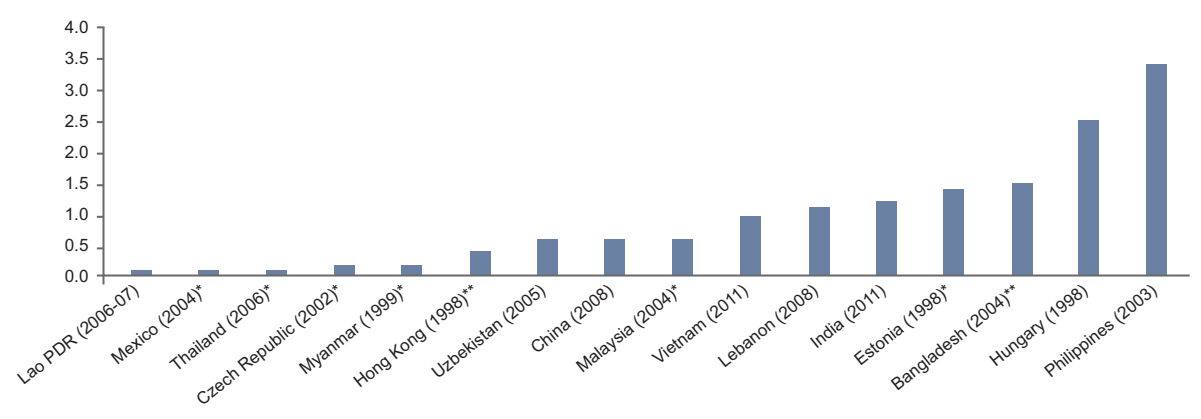
A systematic review of studies conducted in various countries between 1990 and 2011[2] finds that direct and indirect smoking-related costs in LMICs account for between 0.1% of GDP in Lao PDR to 3.4% of GDP in the Philippines, while direct costs alone range from 0.1% of GDP in Mexico to 1.4% of GDP in Estonia (Figure 1). For HICs, the direct and indirect costs account for between 0.3% of GDP and 2% of GDP, while the direct costs range from 0.1% of GDP to 1% of GDP (Figure 2). It should be noted, however, that these estimates are not fully comparable as the studies vary greatly in terms of data used, methodology applied, and types of costs included in the analysis. A few studies have estimated the economic cost of smokeless tobacco; for example, the estimated economic cost of smokeless tobacco-related cancers in Sri Lanka was $US 121.2 million in 2015, (or 0.15% of GDP),[21] while the economic cost of bidi consumption in India in 2017 was estimated at INR 805.5 billion (or 0.48% of GDP).[22]

The estimates of costs associated with SHS exposure are very limited. A 2009 study

estimates the total annual costs of treatment of conditions associated with SHS exposure in the state of North Carolina (NC) to be $US 293.3 million, or 0.07% of NC GDP.[23] A similar estimate for the state of Minnesota (MN) in 2008 was $US 228.7 million (or 0.08% of MN GDP),[24] and in Hong Kong direct medical costs and productivity losses in 1998 were estimated at $US 688 million (or 0.41 % of GDP), while after adding the value of attributable lives lost, the costs were estimated to be $US 9.4 billion (or 5.6% of GDP).[25]

Figure 1

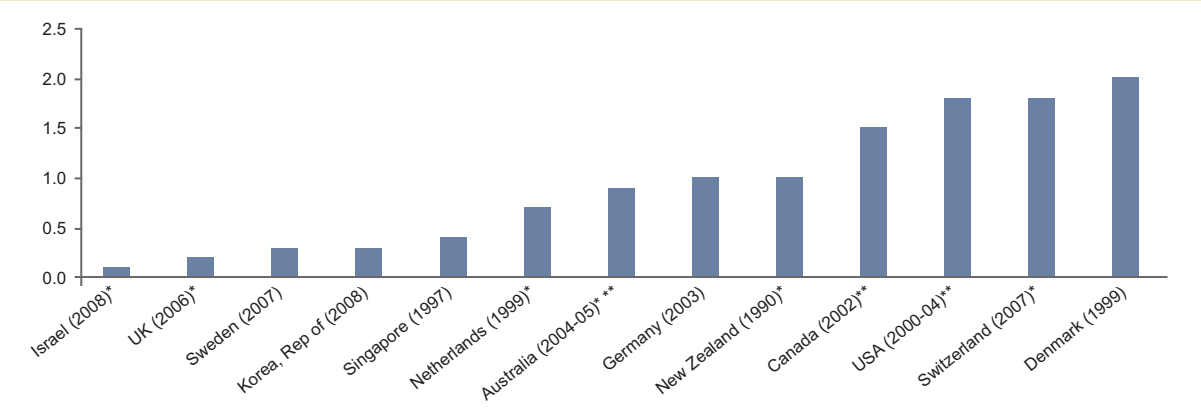
Estimates of direct and indirect costs of smoking in LMICs (% of GDP)



Source: NCI WHO (2016)[2] and Hoang Anh et al., (2016)[26]
** Estimate includes only direct costs; ** Estimate includes costs attributed to SHS exposure*

Figure 2

Estimates of direct and indirect costs of smoking in HICs (% of GDP)



Source: NCI WHO (2016)
** Estimate includes only direct costs; ** Estimate includes costs attributed to SHS exposure*

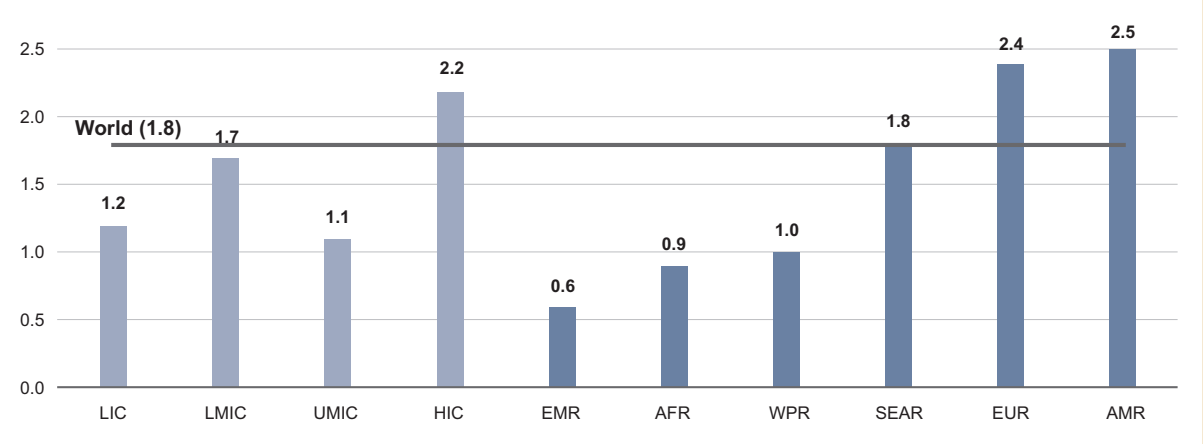
Several studies have estimated the net cost of tobacco use, which considers a possible trade-off between the above average annual healthcare costs for tobacco users and additional annual healthcare costs for never-consumers due to their longer life expectancy.[27, 28, 29, 30] The trade-off refers to the potential savings from the premature death of tobacco users as higher healthcare costs for treating tobacco-related illnesses during a consumer's life could be offset by not-incurred costs in the future had they never used tobacco and lived longer.[31 32 33] Some studies find that although smokers incur higher healthcare costs during their lifetime, the healthcare costs of never-smokers is higher because they live longer.[27, 33, 34, 30] Other studies find the opposite result: the healthcare costs of smokers over their lifetime is higher than the costs of healthcare for never-smokers, despite longer life expectancy of never-tobacco users.[35, 36, 37, 38]

However, it is important to note that never-tobacco users do live longer and therefore contribute relatively more than tobacco-users to the economy and its development, contributing relatively higher returns to education and compensating for the cost of their professional development. As a result, the additional healthcare costs due to the longer life expectancy of never-tobacco users are likely to be more than offset.

Based on data from 152 countries, Goodchild et al. (2018)[32] estimate the total global economic cost of smoking in 2012 at around $US 1.85 trillion (PPP), or around 1.8% of global GDP (PPP) (Figure 3). The direct costs were estimated at around $US 467.3 billion (PPP), which represented around 5.6% of global health expenditures (Figure 4), or 0.5% of global GDP (PPP), while the estimated indirect costs were $US 446.3 billion (PPP) for disability (0.4% of global GDP PPP) and $US 938.6 billion for mortality (0.9% of global GDP PPP). LMICs account for almost 40% of the global costs estimate, with estimated direct costs between 3.8% and 4.0% of total health spending in these countries (Figure 4). Regionally, the Americas and Europe account for almost 70% of the costs, estimated at 6.6% and 6.5% of total spending, respectively (Figure 4). Estimated total economic costs of smoking in LMICs range from 1.1% to 1.7% of GDP (PPP), with the highest costs being estimated in the Americas and Europe at 2.4% and 2.5% of GDP, respectively (Figure 3).

Figure 3

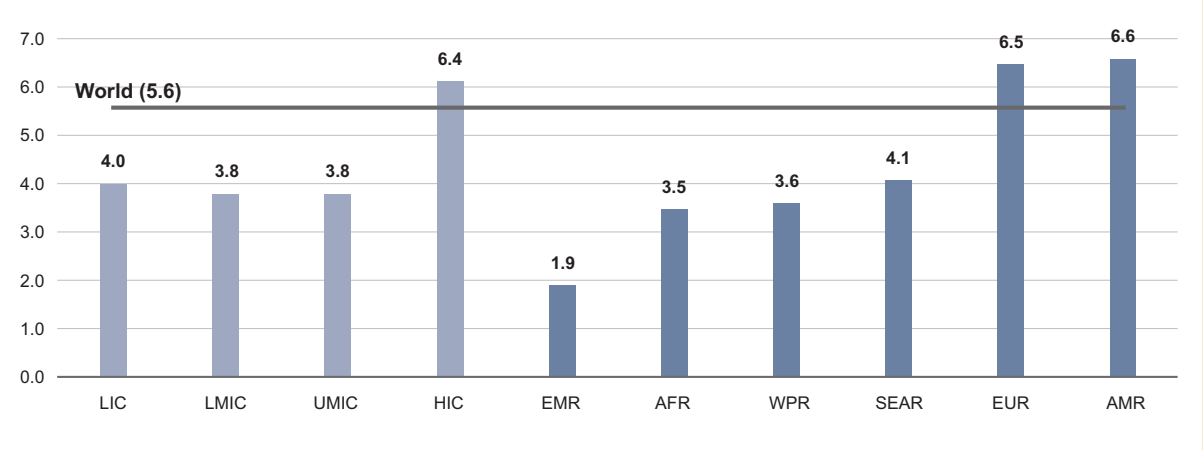
Economic costs of smoking by country-income group and WHO region, 2012 (% of GDP)



Source: Goodchild et al., (2018)

Figure 4

Smoking-attributable direct health-care spending by country-income group and WHO region, 2012 (% of total health-care spending)



Source: Goodchild et al., (2018)

Conclusions

There are limited estimates globally on the economic costs of tobacco use and in many countries (especially LMICs) reliable estimates do not exist due to data limitations, although the last two decades have seen some progress in this regard. The available empirical evidence suggests that the economic costs of tobacco use are very high. In the case of direct costs, the evidence suggests similar estimates between LMICs and HICs. However, the direct costs in LMICs are likely to be underestimated because the quality and access to healthcare are limited and patients cannot receive adequate healthcare treatment. As the indirect costs are much more difficult to estimate, they may be much higher than the existing evidence suggests, especially in LMICs where data is of lower quality. Moreover, the existing estimates often do not include certain very important types of costs, such as costs attributable to SHS exposure, costs of maternal tobacco use during pregnancy, costs resulting from crowding out spending due to smoking, costs of fires caused by smoking, etc., emphasizing the urgent need for further research.

Reliable estimates of costs are important for various reasons, mostly to support arguments for more effective tobacco control policies, including increases in tobacco taxes. Current levels of tobacco taxes fall short of recovering the true cost of tobacco use to the world's economies. A significant increase in tobacco taxes can help close the gap between the cost of tobacco use and the revenue generated from tobacco sales.

Economic costs of tobacco use are especially harmful in LMICs where the need for development spending is very high. Past and current trends in tobacco use, together with improvements in healthcare systems and access to healthcare, suggest that the economic costs of tobacco use in LMICs are likely to increase considerably in the coming years.[2]

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About Tobacconomics

Tobacconomics is a collaboration of leading researchers who have been studying the economics of tobacco control policy for nearly 30 years. The team is dedicated to helping researchers, advocates and policymakers access the latest and best research about what's working—or not working—to curb tobacco consumption and the impact it has on our economy. As a program of the University of Illinois at Chicago, Tobacconomics is not affiliated with any tobacco manufacturer.
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