THE ECONOMIC COST OF TOBACCO-INDUCED DISEASES IN PAKISTAN

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Executive Summary

Pakistan with 24 million active tobacco users is among the world's top tobacco-consuming countries. Tobacco use is associated with many adverse health effects, but the tax revenue it generates cause tobacco tax policy inertia in Pakistan and other countries. Despite evidence that higher tobacco taxation discourages tobacco consumption, Pakistan's tax policy is among the weakest action areas in the country's fight against tobacco. One explanation could be that the policymakers, who consider the tobacco industry a major contributor to government coffers, are reluctant to raise taxes fearing the revenue loss.

However, when the government abolished the third tax tier in 2019 which effectively reduced the tobacco industry's maneuvering space to sell cheaper cigarettes by avoiding taxes, the tax contribution of the industry actually increased to 120 billion Pakistani rupees (Rs) compared to Rs 92 billion in 2016. This raised the tobacco industry's share of total tax collection to 3 percent from 2.15 percent in FY16.The government's reluctance to change tobacco tax policy is partly due to its failure to fully appreciate the smoking-attributable fraction (SAF) of health and social costs. This makes its benefit-cost analysis of tax revenue faulty and compromised over e health outcomes.

In reality, tobacco use incurs huge direct and indirect cost to its subjects. Direct costs include in- and out-patient hospital expenses, whereas, the indirect cost include the caregiving costs, opportunity cost of the lost workdays of the patients and their caregivers. By using the cost of illness (COI) approach, this study estimates the economic burden of three major smoking-induced diseases (cancer, cardiovascular, and respiratory) in Pakistan, based on a nationally representative sample of 12,298 households and their smoking members. The study also estimates total economic costs from all smoking-attributable diseases and deaths in Pakistan in 2019.

The survey results show that smoking prevalence in Pakistan is 8.8 percent. Prevalence is highest in Balochistan (14.43 percent) and in the age category of 65 and older (15.90 percent), though the 35–64 age group is not far behind (15.07 percent). Nationally, cardiovascular diseases are the most prevalent in the year 2019. Cardiovascular diseases are also most prevalent, followed by cancer, in urban regions, across both genders, and in Punjab and Khyber Pakhtunkhwa (KP) provinces.

The total smoking-attributable fraction of the direct cost of three diseases is Rs 100.3 billion ($0.63 billion) of which the medical cost is 96 percent (Rs 96.24 billion or US$ 0.60 billion) and non-medical cost is four percent (Rs. 4.06 billion US$0.03 billion. Smoking-attributable indirect morbidity cost is Rs 56.32 billion ($0.35 billion). The morbidity cost is 56 percent of the smoking-attributable medical and non-medical expenses. Mortality due to smoking, on the other hand, costs Rs 281.1 billion ($1.76 billion), with rural areas contributing 59 percent to the total morbidity cost. At the disease level, cancer has the highest share (56 percent) of the mortality cost. The mortality cost for males is higher than females in both age groups and also within and across regions. Overall, the mortality cost for males is Rs 259 billion ($1.62 billion), which is 92 percent of the total.

Following are the sobering insights and messages from this study:

- The total costs attributable to all smoking-related diseases and deaths in Pakistan for 2019 are Rs 615.07 billion ($3.85 billion), and the indirect costs (morbidity and mortality) make up 70 percent of the total cost. Rural residents bear 61 percent, males bear 77 percent and 35–64 age group bears 86% of the total cost. The total tax contribution of tobacco industry (120 billion in 2019) is only around 20 percent of the total cost of smoking.
- Smoking-attributable total direct and indirect cost of cancer, cardiovascular and respiratory diseases amount to a total of Rs 437.76 billion (US$ 2.74 billion) which is 3.65 times higher than the overall tax revenue from the tobacco industry (120 billion in 2019). Of this, the direct cost is 23 percent and indirect mortality cost is 64 percent. Rural residents bear 65 percent, males bear 87 percent and 35–64 years age group bears 82 percent of this cost.
- The major share (71 percent) of the smoking-induced costs come from cancer, cardiovascular and respiratory diseases. The total smoking-attributable costs are 1.6 percent of the GDP, whereas the smoking-attributable costs of cancer, cardiovascular and respiratory diseases are 1.15 percent of the GDP.
- The share of morbidity and mortality costs for females is underestimated because of their lower rates of labor force participation and difficulties in putting monitory value on their informal contribution to household production.
- The smoking-attributable direct cost is 8.3 percent of the total health expenditures, which is very high.

Keeping in mind the tax elasticity of cigarette demand and the enormous economic and health costs of smoking, more effective use of taxation policy is recommended to reduce tobacco consumption in the interest of public health. The taxes should be increased at least to the level that meets the World Health Organization's recommended threshold or to the level that covers the health and economic costs due to smoking-induced diseases and deaths. In the short run, the rates of the two existing tax tiers on cigarettes should be increased with a higher increase for the second tier in order to narrow the gap between them. In the long run, however, the two-tier system should be abolished to have a single-tier system for tobacco taxation. This would help to bring the poor out of the vicious cycle of poverty in addition to reducing the smoking-related disease burden.

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Acronyms

COI	Cost of Illness
FATA	Federally Administered Tribal Areas
GATS	Global Adult Tobacco Survey
GDP	Gross Domestic Product
HIES	Household Integrated Economic Survey
HIICS	Household Integrated Income and Consumption Survey
KP	Khyber Pakhtunkhwa
LFS	Labour Force Survey
PBS	Pakistan Bureau of Statistics
PIDE	Pakistan Institute of Development Economics
PSLM	Pakistan Social and Living Measurement
RME	Relative Margin of Error
RR	Relative Risk
Rs	Pakistani Rupees
SAE	Smoking-attributable Expenditures
SAF	Smoking-attributable Fraction
WDI	World Development Indicators
WHO	World Health Organization

1 Introduction

The success of the tobacco industry hinges on the ignorance of real economics at work behind the scenes. Though tobacco use is associated with many adverse health effects (Saha et al., 2007), increased health costs (John et al., 2020; Sung et al., 2006), and overburdened health systems (Amin et al., 2017), the tax revenues it generates often encourage policy inertia in poor economies such as Pakistan.

As a country of 24 million active tobacco users, Pakistan stands as the one of the world's top tobacco-consuming countries. Although 86 percent of its adult population know that tobacco use damages human health (GATS, 2014), some 45 percent households report tobacco use. Smoking prevalence varies across gender (male 32.4 percent, female 5.7 percent), region (rural 13.9 percent, urban ten percent), and age group (adults 19.1 percent, adolescents 6–14 percent).

This situation requires the government to make corrective policies to nudge public behavior in the greater interest of society. One way to alter public behavior is through taxation policies. Increasing tobacco taxes has been found to reduce tobacco consumption, including in Pakistan (Nayab et al., 2018). Despite empirical evidence that tax policy is effective in reducing tobacco consumption and improving public health outcomes, the country's taxation policy is among the weakest action areas in its fight against tobacco.

One potential reason for this could be that the government considers tobacco industry as major tax contributor and is therefore reluctant to increase taxes for fear of revenue losses. The first part of this argument is correct: the tobacco industry contributes considerably to the national exchequer. In fiscal year 2015–16, its contribution to the total tax collection was around 2.15 percent. The second part of the argument, however, does not carry weight. Nayab et al. (2018) projected that abolishing the third tobacco tax tier and increasing taxes would raise the tax revenue, which is indeed what happened. In fiscal year 2018–19 when tax policy was simplified along the lines suggested by Nayab et al. (2018), the tax revenue increased to Rs 120 billion from the baseline revenue of Rs 92 billion in 2016.

Another reason for the government's reluctance to use tax policy effectively to curb tobacco consumption could be the absence of a reliable estimate of the true economic costs of smoking. Both government and the general public are aware that smoking causes various diseases such as cancer, cardiovascular problems, and respiratory complications, among others. What is unknown, however, are the costs that smoking-induced diseases impose on society. In other words, the absence of a monetized value of smoking-attributable costs makes it difficult for the government to account for the tax-induced improvements in public health outcomes. These costs consist of direct medical and non-medical expenditures as well as indirect morbidity and mortality costs.

The international evidence suggests that smoking-related illnesses impose enormous costs on society. Various studies have found these costs to be in the range of 0.5 to 2 percent of the respective country's gross domestic product (GDP). Studies that estimate the economic costs of smoking-induced disease burden have been conducted for America (Warner et al., 1999), Germany (Welte et al., 2000), India (John et al., 2009; John, 2019; John et al., 2020), China (Sung et al., 2006; Yang et al., 2016), Vietnam (Ross et al., 2007), and Sri Lanka (Amarasinghe et al., 2018). In all these studies, indirect costs (morbidity and mortality) constitute the major shares. Moreover, in all these studies the costs of smoking outweigh the tax contribution of the tobacco industry.

Keeping in mind the evidence from multiple countries as well as the government's hesitation to use tax policy more aggressively to curb tobacco consumption, there is a need to explore the true economic cost of smoking-induced diseases in Pakistan. To the best of the authors' knowledge, there is only one study that attempted an estimation of the economic cost of smoking in Pakistan (Saqib et al., 2020). The study found the smoking-attributable economic costs to be Rs 192 billion, or 0.4 percent of the country's GDP. However, the study uses a sample of hospital patients and, therefore, suffers from sample selection bias. It excludes those patients who visit as outpatients or who might have died at home. Moreover, the study does not provide estimates at any level of disaggregation such as by region, province, gender and age groups.

To fill the gap identified above, the current study estimates the true cost of three major smoking-induced diseases (cancer, cardiovascular, and respiratory) in Pakistan by conducting a nationally representative survey of smokers in the country. This study provides estimates not only across diseases but also by gender, region, age group, and type of service (inpatient or outpatient). Furthermore, both direct (medical and non-medical) and indirect (morbidity and mortality) costs are estimated. In addition, this study also estimates total economic costs from all smoking-attributable diseases and deaths in Pakistan in the year 2019 using relative risk of all-cause mortality from smoking. These estimates provide a broader view of smoking-induced illnesses for the government and facilitate the development of more informed tobacco taxation policies.

2 Data Needs and Sources

2.1 Approach

This study uses the annual cost of illness (COI) approach to estimate tobacco consumption's economic and health costs to Pakistan's economy. The COI essentially aggregates smoking's impact across all economic agents to determine the annual macroeconomic consequences of tobacco consumption. This approach totals the excess costs of smoking-induced diseases and deaths suffered by smokers (current, past, or ever) compared to never smokers during a year.

Although these costs are incurred at selected points in time during the cure of smoking-related illnesses, these costs, in fact, accumulate over the years of exposure to tobacco. Hence, this approach is also termed as a prevalence-based approach. This approach is used to calculate the economic costs of smoking of those who (i) are recently diagnosed with or (ii) are in advanced stages of smoking-induced illness, and (iii) those who die of such illnesses in a particular year, irrespective of their smoking initiation or cessation date. Normally a nationally representative sample is required to estimate the cost of tobacco use at various levels of disaggregation, as shown in Figure 1.

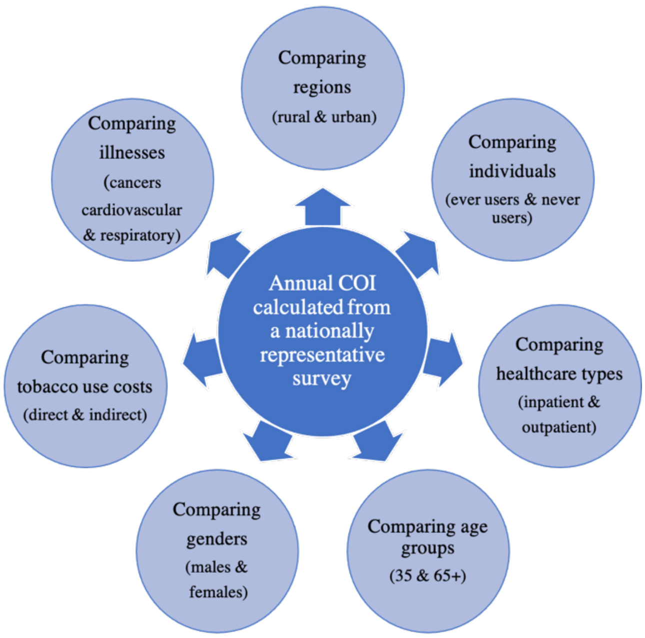

Figure 1. Cost of illness approach

2.2 Data

There is no existing data set that satisfies the requirements of COI to estimate the economic costs of smoking at the required levels of disaggregation. Of the two most relevant national data sets, Pakistan Social and Living Standards Measurements (PSLM)/ Household Integrated Economic Survey (HIES)/ Household Integrated Income and Consumption Survey (HIICS) provide information aggregated at the household level instead of at the level of individual smokers; while the National Health Accounts ignore some very important tobacco-related illnesses. This situation demands primary data collection through a nationally representative survey of smokers that could cover relevant details for the estimation of smoking-attributable costs at national and disaggregated levels. This study used the World Health Organization's *Economics of Tobacco Toolkit* (WHO, 2011) as a guide to design a comprehensive questionnaire. Figure 2 summarizes the scheme and content of the sample survey questionnaire. To rationalize the field costs, the authors broadened the survey scope and included another module obtaining the information required for another planned study (Figure 2, Section D4).

2.3 Sampling and data collection

This study uses the National Sampling Frame 2017, the latest edition available from the Pakistan Bureau of Statistics (PBS). Being the official statistics arm of the government, PBS was engaged to help with the sampling exercise. The authors' previous work exhibited significant variations in smoking behavior across rural and urban regions (Nayab et al., 2018). Besides using the region as a primary sampling consideration, the sampling was performed based on the following parameters: the predicted value of the indicator (r), design effect, relative margin of error (RME), the base population in total population according to the census conducted in 2017, average household size, and response rate. The resulting sample size of 12,298 households from 615 blocks was determined based on the cluster sampling technique (Table A1 in Appendix A). The authors also expected some refusals to participate in the survey, which is addressed through a replacement sample of 702 households (about 6 percent of the sample size); the sample size and replacement sample add up to 13,000 households.

To ensure true representativeness, the sample was distributed across all administrative units in proportion to their share in the country's population. Table A2 presents these proportions. Punjab and Sindh account for slightly more than half and slightly more than one-fourth of the sample, respectively. The remaining one-fifth adds up as Khyber Pakhtunkhwa (KP) 12 percent, Balochistan 5.5 percent, Islamabad one percent, and Federally Administered Tribal Areas (FATA) 1.7 percent.

The survey was conducted from October 2019 to March 2020. Out of the sampled 615 blocks, the survey teams were able to cover 607 blocks. The remaining eight blocks could not be surveyed due to extreme weather conditions, non-permission in security-sensitive areas, and lockdown due to COVID-19. Fortunately, the response rate from households in the surveyed blocks was 100 percent. The 607 surveyed blocks covered 12,140 households. In rural areas, data from 312 blocks (6,240 households) were collected, whereas 295 blocks (5,900 households) were surveyed in urban regions. The provincial distribution of households was as follows: Punjab (5,240 households), Sindh (3,420 households), Khyber Pakhtunkhwa (1,980 households), and Balochistan (1,500 households).

Since the sample provided by the PBS is nationally representative at the rural-urban level, it came with sampling weights, which allows the estimates to be generalized for the entire country with a certain degree of confidence. With sampling weights, the sum of health care expenditures for all diseases in the study sample should ideally derive the total health care expenditures for all non-institutionalized populations in Pakistan. Further description of field activities is provided in Appendix B.

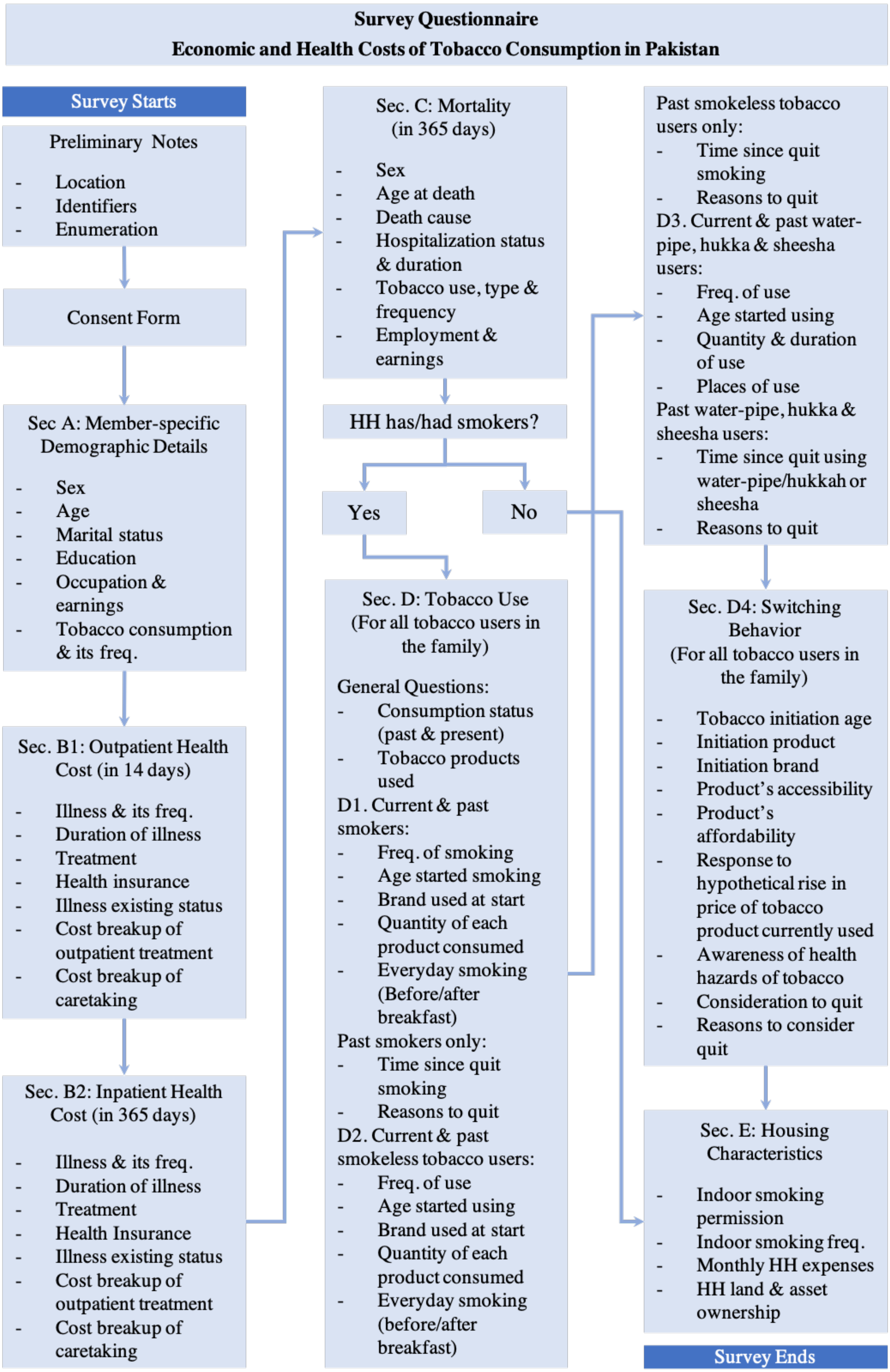

Figure 2. Content and flow chart of the survey questionnaire

2.4 DATA DESCRIPTION

The overall sample size consists of 82,889 individuals. Since estimation of the economic costs of smoking requires restricting the sample to individuals aged 35 years and above (see, for instance, Sung et al., 2006), the relevant sample for the current study consists of 22,823 individuals. Among these, 11,700 are from rural areas and 11,123 are urban residents. Regarding gender distribution, males make up 11,875 of the study sample, or slightly less than half. Similarly, 19,660 individuals belong to the 35–64 age group, and the rest are in the age group of 65 years and older. The descriptive statistics for the sample (overall, 15 and above, and 35 and above) are reported in Table C1 in Appendix C. The average age in the sample of interest is 49.5 years. The proportion of males (52 percent) and average years of education (8 years) are in line with the overall sample. Forty-three percent of the respondents are employed in this sample, which is higher than the overall sample average.

The prevalence of tobacco and smoking across different dimensions (region, gender, province, age group) are reported in Table C2. The table includes the prevalence figures from GATS (2014) for comparison. The tobacco prevalence in the study sample is exactly equal to that of GATS (19.1 percent). The smoking prevalence (8.8 percent) in the study sample is, however, slightly lower than that of GATS. Broadly speaking, the prevalence of tobacco and smoking are relatively similar in the two surveys. Smoking prevalence is highest in Balochistan (14.43 percent) and in the age category of 65 and older (15.90 percent), although the 35–64 age group is not far behind (15.07 percent).

In terms of disease prevalence in the year prior to the interview, cardiovascular diseases are the most prevalent nationally, in urban regions, across both genders, and in the Punjab and Khyber Pakhtunkhwa (KP) provinces (Table C3). The second most prevalent disease is cancer. Prevalence was also highest for cardiovascular diseases during the last 15 days prior to the interview across regions, genders, and in Punjab and Sindh. Overall, the prevalence of these chronic diseases is high across all dimensions.

3 ESTIMATION METHODS

Calculating the economic costs of tobacco consumption requires estimation of three components. The first component is direct cost, consisting of direct medical expenditures incurred by individuals for treating smoking-related diseases and direct non-medical expenses, such as transportation charges and caregiving expenses. The second component is morbidity cost, also called cost in the form of productivity loss due to sickness or disability caused by smoking. Mortality cost is the third component that is required for estimating the value of lives lost due to premature deaths brought on by smoking. The first component is called the direct cost of smoking, whereas the last two components (morbidity and mortality) constitute the indirect costs.

Following Sung et al. (2006), the economic cost of smoking is estimated forever smokers, two age groups (35–64 and 65 and older), two regions (rural and urban), two service types (inpatient and outpatient), and two genders (male and female). The direct costs and the indirect morbidity and mortality costs are estimated by employing a prevalence-based attributable-risk approach (Rice et al., 1985; Rice et al., 1986). For estimating the cost of premature deaths attributable to smoking, the present value of lost earnings is estimated by employing the human capital approach (Rice & Cooper, 1967; Max et al., 2004). This study considers three broader categories of diseases, namely cancer, cardiovascular diseases, and respiratory diseases.[1]

3.1 SMOKING-ATTRIBUTABLE FRACTION (SAF)

SAF is the proportion of health care utilization, health care expenditures, productivity loss, deaths, and other health outcomes attributable to smoking. Each component of smoking-attributable cost requires an estimation of its SAF. This study uses the epidemiological approach to estimate SAF (WHO, 2011). Hence, following Rice et al. (1986), SAF is estimated through the following formula:

$$SAF_{jgra} = \frac{PE_{jgra}(RR_{jgra} - 1)}{PE_{jgra}(RR_{jgra} - 1) + 1} \qquad (1)$$

Where SAF_{jgra} is the smoking-attributable fraction for diseases j, gender g, region r, and age group a. PE is the prevalence of smoking for ever-smokers. RR is the relative risk of premature death compared to non-smokers (mortality ratio) or work loss of employed smokers due to illness/disease relative to employed non-smokers (WHO, 2011).

One of the challenges for estimating SAFs in Pakistan is the absence of estimates for RR for different diseases, especially at the required levels of disaggregation such as gender, region,

[1] Cancer includes lip, oral cavity, pharynx, esophagus, stomach (gastric), pancreas, larynx, trachea, lung, bronchus, cervix, uteri, kidney and renal pelvis, urinary bladder, acute myeloid leukemia, liver, colon, rectum. Cardiovascular diseases include ischemic heart disease, cerebrovascular disease (stroke), atherosclerosis, aortic aneurysm, peripheral vascular disease, arterial embolism and thrombosis. Respiratory diseases include chronic bronchitis, emphysema, chronic airways obstruction, asthma, and pneumonia.

and age group. One method to address this lack of data is to use estimated RRs for other countries with similar economic environments and tobacco use patterns as proxies. These, however, may not reflect the actual relative risks as there are several other factors, including some that are unobservable, that differ across countries. Another option is to estimate RRs for a country when the data permits. In this study's survey, the information required to estimate RRs was collected.

There are four approaches to estimate RR, which are: (i) the medical cost ratio approach, (ii) the utilization ratio approach, (iii) the disease incidence ratio approach, and (iv) the mortality ratio approach. The methods are listed from the most preferred method to the least preferred. However, this study uses the mortality ratio approach because of two issues with the first three methods.

First, there are several sub-categories with no observations on the relevant variables due to multilevel disaggregation, which prevents the calculation of RR and consequently SAF. Second, several of the RRs calculated using medical cost ratio or utilization ratio approaches have a value of less than one, thereby resulting in zero SAF. Therefore, RRs are estimated by using the mortality ratio approach, which is then used to estimate the SAFs. These SAFs are utilized in the calculation of direct medical (and non-medical) costs as well as indirect morbidity and mortality costs, multiplied by direct/indirect health expenditures for obtaining direct/indirect health care costs. The details on these methods are provided in the WHO toolkit (WHO, 2011).

3.2 Direct cost of smoking

Following Equation 2, total direct medical cost attributable to smoking is estimated for both inpatient hospitalization and outpatient visits.

$$\begin{aligned} SAEXP_{jgra} &= TDHEXP_{jgra} * SAF_{jgra} \\ &= \left[DMEXP_{jgra} + DNMEXP_{jgra}\right] * SAF_{jgra} \\ &= \left[\left(EXPH_{jgra} * NH_{jgra} + EXPO_{jgra} * NO_{jgra} * 26\right) + \right. \\ &\quad \left.\left(EXPHI_{jgra} * NH_{jgra} + EXPOI_{jgra} * NO_{jgra} * 26\right)\right] * POP_{jgra} * SAF_{jgra} \end{aligned} \quad \textbf{(2)}$$

In the above equation, $SAEXP_{jgra}$ is smoking-attributable health expenditures for disease j, gender g, region r, and age group a; $TDHEXP$ is total health expenditures. Total health expenditures are the sum of two subtotals: a) direct medical expenditures incurred by the patients $DMEXP$ and b) direct non-medical expenditures on informal or formal caregivers $DNMEXP$. $EXPH$ is the mean expenditures per hospitalization, and NH is the average number of hospitalizations per person during the last 365 days. Similarly, $EXPO$ is the average of out-of-pocket expenditures per outpatient visit, and NO is the average number of outpatient visits per person for two weeks before the date of the interview. $EXPHI$ and $EXPOI$ are the average expenditures on transportation and food of formal/informal caregivers per hospitalization and per outpatient visit, respectively. Finally, POP is the total population in the age groups of 35–64 and 65 and older in 2019 for the respective gender and region.

Expenditures on inpatient hospitalization and outpatient visits include insurance, doctor/consultation fee, cost of medicine, surgery and laboratory tests, transport charges, admission fee, and food expenditures. Average expenditures on outpatient visits are converted into annual average expenditures by multiplying them by 26 (fortnights).

3.3 INDIRECT MORBIDITY COSTS

The smoking-attributable indirect morbidity cost is estimated by multiplying the indirect cost of lost productivity due to smoking-related specific diseases with the SAF as in Equation 3.

$$SAIE_{jgra} = INMBC_{jgra} * SAF_{jgra} = (WDLH_{jgra} * YH_{jgra} + WDLO_{jgra} * YO_{jgra} * 26) * POP_{jgra} * SAF_{jgra} \quad \textbf{(3)}$$

In Equation 3, $INMBC$ represents indirect morbidity cost and $WDLH$ is the average number of workdays lost in a year per employed individual due to hospitalization caused by smoking-induced diseases. YH is the average daily earnings of the respective population group. Similarly, $WDLO$ is the average number of lost workdays per employed individual in the last two weeks. These average values are annualized as described in the previous section. YO is the mean daily earnings of the relevant population group. Data on employment rates are obtained from the Pakistan Economic Survey (2018–19). Data on annual earnings for respective groups are obtained from the Labour Force Survey (LFS, 2017–18) and are converted into daily earnings.

3.4 INDIRECT MORTALITY COST

The smoking-attributable mortality cost requires the estimation of smoking-attributable deaths and the present discounted value of lifetime earnings. The product of these two variables provides the smoking-attributable mortality cost.

$$SAMC_{jgra} = SAF_{jgrk} * \sum_{k=mink}^{maxk} (TD_{jgrk} * PVLE_{jgrk}) \quad \textbf{(4)}$$

In Equation 4, $SAMC$ is the smoking-attributable mortality cost, TD is the total number of deaths from disease j, and PVLE is the present discounted value of lifetime earnings. It should be noted that k represents 5-year age intervals starting from age 35. k is different from subscript a, which represents the two age groups (35–64, 65 and older). The total number of deaths is obtained by multiplying the death rate with the total population in the respective category of gender and region. For estimating the death rate, the ratio of total deaths due to specific disease to the total number of respondents (including smokers and non-smokers) is applied to the respective 5-year age interval. The estimation of the discounted present value of lifetime earnings requires life expectancy for different age groups (or probability of survival until the life expectancy of respective age interval, k) average annual earnings,[2] labor productivity, and discount rate (Max et al., 2004).

$$PVLE_{jgra} = \sum_{k=mink}^{maxk} surv_{jgra}(n) * (y_{jgra}(n) * emp_{jgra}(n)) * \frac{(1+pro)^{n-k}}{(1+r)^{n-k}} \quad (5)$$

In Equation 5, $PVLE$ is the present discounted value of lifetime earnings, $surv$ is the probability of survival, y is average annual earning of employed individuals computed from the survey data, emp is the proportion of the employed population obtained from the Labour Force Survey (LFS, 2017–18), pro is productivity growth, r is discount interest rate, and n is the age of the person at death.

Productivity growth accounts for growth in future earnings and is assumed to be 4.1 percent, based on the country's average GDP growth rate between 2000–2001 to 2018–2019. An average value of two percent of the real interest rate for the same time period, taken from World Development Indicators (WDI), is used as a discounting factor for converting a future stream of earning into its present value. The data on life expectancy and probability of survival are taken from the latest life tables of the World Health Organization (2011).

Equation 5 calculates the present discounted value of lifetime earnings for all 5-year age groups from 35 years and older. These are then used in Equation 4 to estimate the indirect mortality cost across diseases, gender, region, and the two age groups (35–64, 65 and older).

[2] The original formula also requires calculation of average imputed value of household production. However, this study omits that part due to unavailability of data.

4 RESULTS AND DISCUSSION

4.1 PREVALENCE, RELATIVE RISKS, AND SAFS

Table 1 provides details of the relative risk for the three major diseases – estimated by mortality ratio approach – along with smoking prevalence (Pe) and their respective smoking-attributable fractions. Information on these variables is provided for the three diseases by gender, age group, and region. Due to sample size limitations, the relative risks are calculated for the three diseases across two genders, and the same relative risks are used in the estimation of SAF for the two age groups (35–64, 65 and older) across the two regions (rural, urban).

Table 1 reveals the relative risk estimates calculated by the mortality ratio approach. These RRs are used in the estimation of direct medical costs (Table 2) and the indirect morbidity and mortality costs (tables 3 and 4). Hence, the estimated SAF, for instance, of rural males in the age group 35–64 suggests that 16 percent of the deaths from cancer in this category are attributable to smoking. These estimates, translated to expenditure terms, suggest that for every Rs 100 spent on treatment of male cancer patients from rural areas, smoking is responsible for Rs 16. In terms of morbidity cost, this would mean that 16 percent of the work lost due to cancer is attributable to smoking. It is worth mentioning here that if the value of an RR is less than 1, its corresponding SAF becomes zero (Sung et al., 2006).

Table 1 further shows that there are considerable variations in the male SAFs across diseases but not much between the two age groups in urban areas. For rural females, SAF increased significantly for all the diseases (except cancer) when they enter the 65 and older age group. This implies that rural females are more vulnerable to diseases due to smoking in their old age. This could be due to the severity of disease owing to the absence of health care facilities in rural regions. Similarly, there are significant SAF differentials across rural and urban regions for females. The trends generally show higher SAFs in the rural region for both age groups. For instance, the SAF for respiratory diseases for rural females in 65 and older age group is almost twice the SAF of their counterparts in urban areas. Overall, smoking-attributable fractions vary across diseases, genders, regions, and age groups. The SAFs are lower for females primarily because of their lower prevalence rates.

Table 1. Relative risks, smoking prevalence, and smoking-attributable fractions

Region	Disease Group	Male					Female				
		35+	35-64		65+		35+	35-64		65+	
		RR	Pe	SAF	Pe	SAF	RR	Pe	SAF	Pe	SAF
Mortality Ratio Approach											
Rural	Cancer	1.68	28.85	16.38	25.72	14.87	1.64	1.31	0.83	1.84	1.16
	Cardiovascular	1.33	28.85	8.76	25.72	7.88	3.72	1.31	3.43	1.84	4.77
	Respiratory	1.86	28.85	19.94	25.72	18.17	3.76	1.31	3.49	1.84	4.85
Urban	Cancer	1.68	27.81	15.88	28.23	16.09	1.64	0.92	0.58	1.06	0.67
	Cardiovascular	1.33	27.81	8.46	28.23	8.58	3.72	0.92	2.43	1.06	2.8
	Respiratory	1.86	27.81	19.36	28.23	19.59	3.76	0.92	3.47	1.06	2.84

Source: Authors' calculations using the survey data
Note: The mortality ratio approaches are used for the calculation of relative risks (RR).

4.2 COST ESTIMATIONS FOR THREE MAJOR DISEASES

4.2.1 Direct cost

Using the SAFs reported in the previous section, the smoking-attributable expenditures (SAEs) for inpatient hospitalizations and outpatient visits are estimated for different genders, regions, age groups, and disease categories (Table 2). These consist of medical costs (Panel A: Table 1) and non-medical or caregivers' expenses (Panel B: Table 2). The sum of these two, or total direct medical cost, is Rs 96.24 billion (US$ 0.60 billion). The estimated outpatient visit cost is Rs 87.58 ($0.54 billion), or 91 percent of the total medical expenses. Among the disease categories, cancer accounts for the highest treatment cost estimated at Rs 47 billion ($0.29), followed by cardiovascular diseases with an estimate of Rs 32.4 billion ($0.20 billion). Males account for 85 percent of the total direct medical costs, and rural areas account for 77 percent or Rs 74 billion. Counterintuitively, the age group of 65 and older accounts for only 21 percent of the medical costs.

Household expenditures on tobacco (and smoking) are higher in rural areas and among the lower-income groups (Nayab et al., 2018), due to their concentration in rural areas. Spending on tobacco also crowds out health and education expenditures in Pakistan, especially among the lower-income groups (Saleem & Iqbal, 2020). Moreover, smoking prevalence is higher in rural areas, and so are their SAFs. Therefore, it is logical to hypothesize that smoking traps households into a vicious cycle of poverty.

Table 2. Direct cost (billion Rs)

Region	Diseases	Inpatient Hospitalization				Outpatient visits				Total
		Male		Female		Male		Female		
		35-64	65+	35-64	65+	35-64	65+	35-64	65+	
Panel A. Medical Expenditures										
Rural	Cancer	2.42	0.56	0.12	0.04	30.33	4.21	1.53	0.33	39.56
	Cardiovascular	1.37	0.18	0.54	0.11	12.52	1.85	4.91	1.12	22.60
	Respiratory	0.50	0.21	0.09	0.06	6.79	2.45	1.19	0.65	11.94
Urban	Cancer	0.65	0.14	0.02	0.01	4.17	2.17	0.15	0.09	7.40
	Cardiovascular	0.53	0.49	0.15	0.16	3.54	2.97	1.02	0.97	9.83
	Respiratory	0.11	0.02	0.01	0.16	2.98	1.08	0.38	0.16	4.90
Both	Total	5.58	1.60	0.94	0.54	60.34	14.74	9.18	3.32	96.24
Panel B. Non-Medical Expenditures										
Rural	Cancer	0.11	0.01	0.01	0.00	0.84	0.17	0.04	0.01	1.19
	Cardiovascular	0.09	0.03	0.04	0.02	0.52	0.17	0.20	0.10	1.16
	Respiratory	0.05	0.03	0.01	0.01	0.30	0.27	0.05	0.07	0.79
Urban	Cancer	0.04	0.03	0.00	0.00	0.13	0.12	0.00	0.01	0.34
	Cardiovascular	0.03	0.05	0.01	0.02	0.06	0.17	0.02	0.06	0.41
	Respiratory	0.00	0.00	0.00	0.00	0.08	0.07	0.01	0.01	0.18
Both	Total	0.32	0.16	0.06	0.05	1.92	0.98	0.33	0.26	4.07
Source:	Authors' calculations using the survey data									

The non-medical expenditures (Panel B) are Rs 4.07 billion. Once again, the majority of this part of the direct cost is for outpatient visits (86 percent), males (83 percent), and rural areas (77 percent). Unlike with the medical cost, cancer and cardiovascular diseases contribute equally (38 percent each) to direct non-medical expenses. This is likely due to the fact that the treatment of these two diseases requires more frequent outpatient visits. However, the older age group has a lower share (35 percent) in the non-medical expenses mostly because care is given by the younger people.

The total direct smoking-attributable expenditures are Rs 100.3 billion ($0.63 billion), of which the share of non-medical expenses is only four percent. That is, for every Rs 96 in medical spending on treatment, Rs 4 are caregiver expenses. Hence, smoking also increases out-of-pocket expenditures on non-medical activities.

4.2.2 Indirect morbidity cost

The smoking-attributable indirect morbidity cost comes to Rs 56.32 billion ($0.35 billion) (Table 3). The morbidity cost is 56 percent of the smoking-attributable medical and non-medical expenses. One plausible reason for this relatively lower morbidity cost could be the use of national RRs for the disaggregated (regional and age groups) analysis of the cost. It is pertinent to reiterate here that the RRs used in the calculation of morbidity cost are also the ones estimated through the mortality ratio approach.

Table 3. Morbidity cost (billion Rs)

Region	Disease groups	Inpatient hospitalization				Outpatient visits				Total
		Male		Female		Male		Female		
		35-64	65+	35-64	65+	35-64	65+	35-64	65+	
Rural	Cancer	3.34	0.03	0.11	0.04	3.82	3.83	0.50	1.21	12.88
	Cardiovascular	0.54	0.01	1.61	0.50	5.10	0.88	1.86	5.24	15.73
	Respiratory	0.21	0.05	0.18	0.70	5.62	2.97	0.51	2.05	12.29
Urban	Cancer	0.19	0.18	0.03	0.02	1.89	0.69	0.07	0.14	3.20
	Cardiovascular	0.22	0.14	0.42	0.23	1.87	1.31	0.93	1.87	7.01
	Respiratory	0.03	0.01	0.04	0.04	3.65	0.45	0.29	0.70	5.20
Both	Total	4.54	0.42	2.40	1.52	21.96	10.12	4.15	11.21	56.32
Source:	Authors' calculations using the survey data									

The share of indirect morbidity cost is higher in rural areas (72 percent) and for outpatient visits (84 percent). Two points demand attention here. First, the nature of jobs in rural areas is vulnerable, as most people make their living as daily-wagers which implies that making an outpatient visit would results in the loss of their income for that day. Second, the lack of local health care facilities forces rural patients to seek health care in urban areas, making their outpatient visits costlier in terms of expenses, time, and loss of income.

Similarly, the morbidity cost for males is Rs 41.6 billion ($0.23 billion), which is 66 percent of the total estimated morbidity cost. The lower share of morbidity cost for females is due to their lower labor force participation rates compared to their male counterparts. Nonetheless, the authors believe that the female morbidity cost is severely understated. The inclusion of household production activities in the cost estimation would have significantly increased female shares and thus the overall costs. The absence of data on these activities, however, restricts researchers from estimating the value of household production.

Table 3 further reveals that the cost of outpatient visits for rural males (Rs 22.2 billion) is significantly higher than outpatient visit cost not only for rural females (Rs11.4 billion) but also for their counterparts in urban regions (Rs 9.8 billion). However, the costs of inpatient hospitalizations remain almost the same in both regions. Cancer has the highest share of morbidity cost (40 percent) in disease category, followed by respiratory diseases (17.5 percent).

4.2.3 Indirect mortality cost

Table 4 provides the estimates for indirect mortality costs, which amount to Rs 281.1 billion ($1.76 billion). Rural areas contribute 59 percent to the total mortality cost. Cancer has the highest share (55 percent) of the cost in the rural areas, and it also tops the list in the urban region with 58 percent share. Overall, however, cancer diseases have the highest share (56 percent) of the mortality cost.

Unlike direct cost and indirect morbidity cost, the mortality cost cannot be estimated by service types. The mortality cost for female cancer patients is zero because the value for RR for this category is less than one. The mortality cost for males is higher than for females in both age groups, both within and across the regions. Overall, the mortality cost for males is Rs 259 billion ($1.62 billion), which is 92 percent of the total. Again, the reason for the lower share of female mortality cost is the exclusion of household production activities from cost estimations.

Similarly, 88 percent of the indirect mortality cost is borne by the age group of 35–64 years. Although death rates are higher in the age group of 65 and older, deaths in the younger age bracket result in the loss of higher forgone future income because of more years of productive life lost (see Table D1 in Appendix D, which contains the present discounted value of lifetime earnings for males and females across two regions). The most productive age group for males in both regions is 35–39. From there onwards, there is a gradual decline in the earnings. The trends are almost similar for females, though their age-group earnings in absolute terms are lower than their male counterparts. The earnings drop significantly for the age group of 65 and older. The high estimated indirect mortality cost shows that smoking related premature deaths have an enormous economic burden on Pakistani families. Though data do not permit the inclusion of household production in the calculation of the present discounted value of lifetime earnings, current estimates may also be an underestimation of the actual indirect mortality costs of tobacco use in Pakistan.

Table 4. Mortality cost (billion Rs)

Region	Disease	Male		Female		Total
		35-64	65+	35-64	65+	
Rural	Cancer	80.38	8.06	2.16	0.21	90.80
	Cardiovascular	47.56	7.04	5.48	1.28	61.36
	Respiratory	6.84	3.71	2.02	0.43	13.01
Urban	Cancer	55.65	6.20	5.10	0.15	67.10
	Cardiovascular	33.86	2.66	4.02	0.19	40.73
	Respiratory	3.73	3.65	0.62	0.14	8.14
Both	Total	228.03	31.31	19.39	2.40	281.13
Source:	Authors' calculations using the survey data					

4.3 CONTEXT AND IMPLICATIONS

The smoking-attributable direct and indirect expenditures amount to a total of Rs 437.76 billion ($2.74 billion) (Figure 3). The direct cost is 23 percent of these expenditures. The indirect mortality cost is the biggest component, with a 64-percent share. Sixty-five percent of the total cost is borne by rural residents, and males account for Rs 382 billion ($2.39 billion) or 87 percent of the overall cost. Lastly, 82 percent of the total cost is accounted for by the 35–64 years age group.

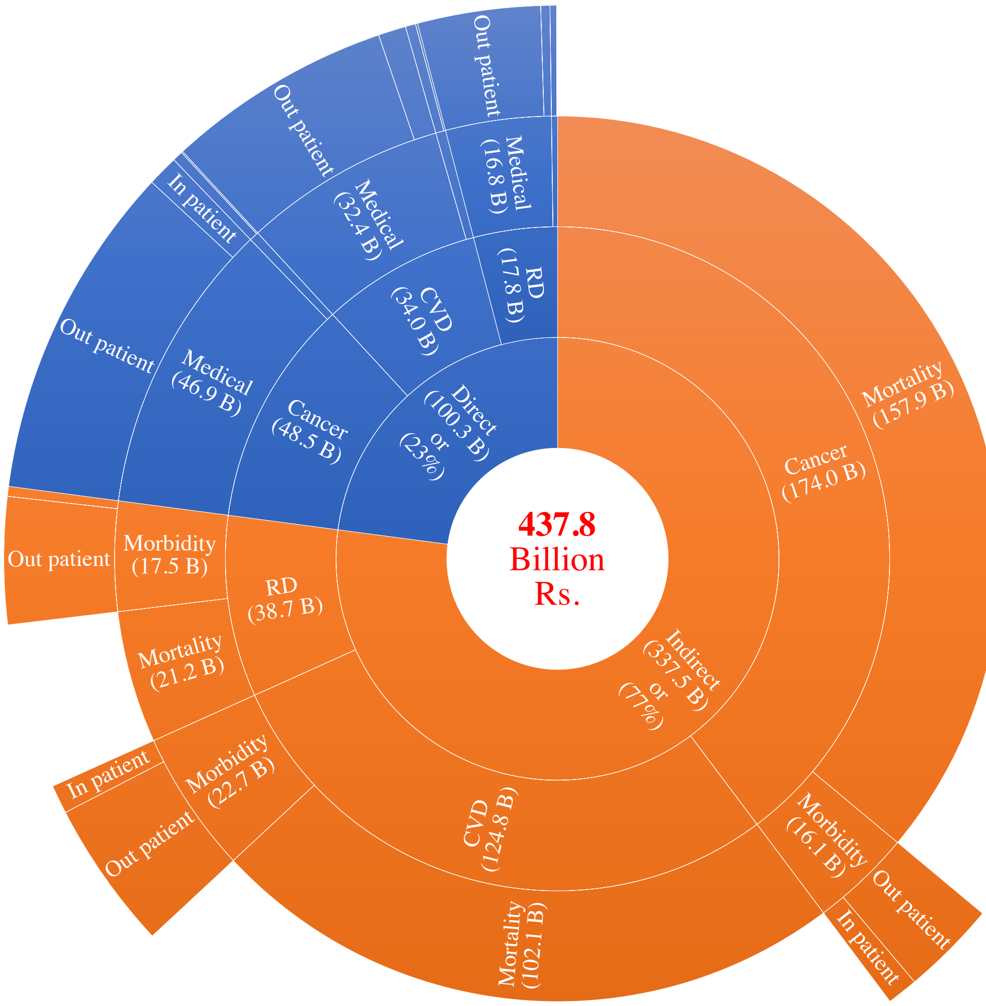

Figure 3. Major components of total cost of tobacco use to Pakistani economy

The question these data provoke is how relatively high this cost is. Is the cost high enough to alarm the policymakers in Pakistan? To put these cost estimates in perspective, they are compared with various outcome indicators (Table 5). The total revenue collected from tobacco (primarily cigarettes) taxation in the fiscal year 2018–19 was Rs 120 billion. Hence, the economic and health cost imposed by smoking on society is 3.65 times higher than the overall tax collected from the tobacco industry.

Similarly, the smoking-attributable direct cost is 8.3 percent of the total health expenditures, which is significantly high. Likewise, the total economic cost of smoking is almost equal (1.03 times) to the public sector health spending (both federal and provincial). Even if it is assumed that the entire tax collection from tobacco goes into the health sector, its contribution to improving the health of society is substantially lower than its attributable damage.

Table 5. Comparison of economic cost of smoking with outcome indicators

Outcome indicator	Unit	Value
- The total economic cost of smoking from three major diseases (2019)	Billion Rs	437.8
- The total direct cost of smoking from three major diseases (2019)	Billion Rs	100.3
- Revenue from tobacco (smoking) taxation (2018–19)*	Billion Rs	120
- Public sector health expenditure on health	Billion Rs	421.8
- Total health expenditures **	Billion Rs	1208.5
- GDP at current prices (2018–19)	Billion Rs	37972
- Cost of smoking (% of GDP)	%	1.15%
- Tobacco revenue (% of the cost of smoking)	%	27%
- Direct cost as (% of total health expenditures)	%	8.3%

Sources: Data sources include Pakistan Economic Survey (2019–20); Pakistan Bureau of Statistics, National Health Accounts (2015–16) and Ministry of Finance, Government of Pakistan.

Notes * The major taxed tobacco product in Pakistan is cigarettes. Hence, the revenue from tobacco taxation primarily comes from cigarette taxation.

** The data for Total Health Expenditure is not officially available for the year 2018–19. The last National Health Account report is available for 2015–16. The Total Health Expenditure according to that report was Rs 908 billion, which was a 20 percent increase (in nominal terms) over the value reported in 2013–14. Assuming the same rate of growth, the authors project the Total Health Expenditure for 2018–19 as reported in the table above.

The economic cost of smoking is 1.15 percent of the country's GDP. This estimated cost is in line with the literature on the disease burden of smoking, which suggests that this cost is in the range of 0.5–2.0 percent. In a country where the public sector health spending historically has remained less than one percent of the GDP, this cost of 1.15 percent should concern not only public health institutions but also the tax authorities whose policies can play a vital role in avoiding this cost.

4.4 Sensitivity analysis

For sensitivity analysis, the estimated RRs are replaced with the ones used for India and China (see Table D2 in Appendix D). The total cost using India's RRs is estimated to be Rs 711.2 billion, which is 1.6 times higher than this study's estimated cost. Using China's RR produces an estimated total cost of Rs 287.2 billion. This is 35 percent less than this study's estimated cost of Rs 438 billion. The probable reason for these differences in costs is coming from the differences in RRs. India's RRs are relatively higher, whereas those of China are lower compared to Pakistan. That is, compared to non-smoking individuals, the probability of death among smokers is higher in India than in China. The lower death ratio in China could either be because of (i) better health care systems or (ii) treatment-seeking (risk-averse) behavior of smokers or both.

To check the robustness of the analysis, RR is estimated at more disaggregated levels (region and age group) and these are used in the cost estimation (see Table D3 in Appendix D). The cost using these RRs is estimated to be Rs 349.5 billion. The reason this is lower than the originally estimated cost is that the values for some of the disaggregated RRs are lower because of zero or fewer observations for smokers. The lower-than-one values of RR turn off the corresponding SAFs and therefore the cost for those categories into zero.[3] Consequently, the total cost estimated using these RRs is approximately 20 percent lower than the original estimated cost. Had some of the SAFs not equaled zero (due to RR<1), the total cost value obtained might have been closer to the originally estimated cost. This suggests that the estimated cost of Rs 438 billion may not be far off the mark.

4.5 TOTAL COST FOR ALL SMOKING-INDUCED DISEASES AND DEATHS

In addition to estimating the economic costs of smoking for the three major diseases in 2019, the study also estimates total economic costs from all smoking-attributable diseases and deaths in Pakistan for the same year using relative risk of all-cause mortality from smoking. Due to sampling constraints, the relative risk for all-cause mortality is calculated only for the two genders. These RRs are then used to calculate the SAFs for the two regions and age groups (see Table E1 in Appendix E for details).

Tables 6–8 show the direct, morbidity, and mortality costs from all smoking-attributable disease and deaths. The total cost amounts to Rs 615.07 billion ($3.85 billion). The indirect cost (morbidity and mortality) constitutes 70 percent of the total cost. Rural residents bear 61 percent (Rs 376 billion) and males account for 77 percent (Rs 474 billion) of the total cost. Moreover, most of this cost (86 percent) is borne by individuals in 35–64 age group. There are differences in the shares of cost across different dimensions between economic burdens from the three major diseases and the total cost from all smoking-attributable diseases and deaths.

Table 6. Direct cost for all smoking-induced diseases and deaths (billion Rs)

Region	Diseases	Inpatient hospitalization				Outpatient visits				Total
		Male		Female		Male		Female		
		35-64	65+	35-64	65+	35-64	65+	35-64	65+	
Panel A. Medical Expenditures										
Rural	All diseases	5.96	1.27	1.57	0.52	69.19	24.46	18.16	9.99	131.12
Urban	All diseases	2.49	1.03	0.48	0.22	24.60	7.58	4.71	1.65	42.76
Both	Total	8.45	2.30	2.05	0.74	93.79	32.04	22.87	11.64	173.88
Panel B. Non-Medical Expenditures										
Rural	All diseases	0.40	0.11	0.10	0.05	4.43	1.06	1.16	0.45	7.76
Urban	All diseases	0.21	0.22	0.04	0.05	0.82	0.44	0.16	0.13	2.07
Both	Total	0.61	0.33	0.14	0.10	5.25	1.50	1.32	0.58	9.83
Source:	Authors' calculations using the survey data									

Table 7. Morbidity cost for all smoking-induced diseases and deaths (billion Rs)

Region	Disease groups	Inpatient hospitalization				Outpatient visits				Total
		Male		Female		Male		Female		
		35-64	65+	35-64	65+	35-64	65+	35-64	65+	
Rural	All diseases	3.49	0.02	3.25	0.21	35.65	1.00	47.46	2.02	93.09
Urban	All diseases	1.12	0.02	0.95	0.06	20.86	0.20	16.37	0.37	39.95
Both	Total	4.61	0.04	4.20	0.27	56.51	1.20	63.83	2.39	133.04
Source:	Authors' calculations using the survey data									

[3] On the other hand, some of the RRs have values as high as 4, which seems unrealistic and therefore pushed the authors to rely on the aggregated RRs for the main analysis.

Table 8. Mortality cost for all smoking-induced diseases and deaths (billion Rs)

Region	Disease	Male		Female		Total
		35-64	65+	35-64	65+	
Rural	All diseases	110.34	16.88	12.94	3.49	143.65
Urban	All diseases	125.52	14.41	14.04	0.70	154.67
Both	Total	235.86	31.29	26.98	4.19	298.32

Source: Authors' calculations using the survey data

It is evident that a major share (71 percent) of the smoking-induced cost comes from the three major diseases analyzed in this study. Making use of the information in Table 5, the total smoking-attributable cost is 1.6 percent of the GDP as compared to 1.15 percent from the three major diseases. Similarly, the total cost is five times higher than the total revenue collected from the tobacco sector and 1.45 times the total public sector health spending. This indicates that smoking puts a tremendous burden on the country's health infrastructure – especially by increasing the number of patients with cancer, cardiovascular, and respiratory diseases – and the tobacco industry's tax contribution does not even adequately compensate for it.

4.6 Limitations of the Study

It is important to note that there are some limitations that may have played a role in making these estimates conservative.

First, the RRs are calculated using the survey data to make them as close to the country's context as possible. The sample size, however, is not large enough for a disaggregated analysis of the RR. Consequently, the authors have to use the estimated RR for both regions and both age groups. This may underestimate the SAF and consequently the cost for some categories. For instance, the RR for the age group of 65 and older may be higher compared to the 35–64 age group. But using the same RR for both age groups could result in lower costs.

Second, the unavailability of data on household production activities prevents the authors from calculating the present discounted values of lifetime earnings from these activities, especially for females. Consequently, the indirect mortality cost is highly underestimated.

Third, the labor force participation rate for females is low in Pakistan. Females are mostly involved in household production activities. Since these activities are not considered a part of the labor market, the indirect morbidity – as well as mortality – costs are underestimated.

Fourth, the reported loss of income due to inpatient hospitalizations or outpatient visits could undervalue the productivity loss because people who are unemployed or self-employed may avoid reporting a loss of income.

Despite these limitations, the current study provides the first comprehensive estimates of smoking-attributable costs at the national and disaggregated levels.

5 CONCLUSIONS AND POLICY IMPLICATIONS

This study estimates the annual economic cost of smoking in Pakistan. For this purpose, a nationally representative survey was conducted. **The combined smoking-attributable cost for cancer, cardiovascular, and respiratory diseases is estimated to be Rs 437.8 billion in 2018–2019**, which is 71 percent of the total cost from all smoking-induced diseases and deaths. Interestingly, the indirect costs are found to constitute the major share (77 percent) of smoking-imposed expenditures. A disaggregated analysis is also conducted by disease category, gender, region, age group, and service type. Men, rural residents, and people in the 35–64 age bracket bear the major share of this cost. Cancer comes out to be the costliest disease (51 percent share) due to tobacco use.

The smoking-induced cost for the three major diseases is 1.15 percent of the GDP. A previous study on Pakistan for the same diseases found this cost to be 0.40 percent of the GDP, which shows the extent of underestimation of the cost using a non-representative sample. The tobacco industry argument that it is one of the major contributors to the public exchequer becomes contestable when the smoking-induced health cost is monetized. The industry opposes increases in tobacco taxes using the argument of illicit trade and subsequent reduction in revenue collection from tobacco taxation. This argument, however, is not valid for the reasons stated below.

First, the tobacco-industry-cited figure of 40 percent[4] for the market share of illicit trade is exaggerated. A recent survey found the size to be 16 percent.[5]

Second, the simulations done by Nayab et al. (2018) show that abolishing the third tobacco tax tier would increase tax revenue and improve public health outcomes. The study further shows that tax on cigarettes is highly elastic (1.06), suggesting that increased taxation reduces tobacco consumption. Combining those projections with the cost estimates of this study, one may suggest that even a tax rate at which the total revenue falls to zero (because of zero consumption) should be acceptable because the economic gains through improvement in public health outcomes of such a rate would outweigh the loss of revenues.[6]

This study reveals that the total revenue collected from the tobacco sector is only around 20 percent of the total cost of smoking. The cost is even higher than the total public sector spending on health in the country. Hence, the revenue collected from the tobacco industry does not even cover the harm it causes to the public health care system. This imbalance forces the government to reallocate resources from other productive sectors to help meet the health care

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[4] https://illicittobacco.oxfordeconomics.com/markets/pakistan/
[5] https://drive.google.com/file/d/1OniBwQyAkmM5SWmUcnSgCxmWIAJAGSz0/view
[6] One can bring in the argument regarding employment generation by tobacco industry. However, the employment share by tobacco sector in the total agricultural employment is only 0.4-0.5 percent in Pakistan. moreover, this loss can simply be outweighed by saving the smoking attributable expenditures from other diseases as we have included only three here.

needs of the nation. Moreover, further burdening a resource-constrained public health sector through increases in the number of patients suffering from cancer, cardiovascular, and respiratory disease could collapse the system.

Similarly, it is known that tobacco spending crowds out expenditure on food and education in lower-income households in Pakistan (Saleem & Iqbal, 2020). It is also a fact that tobacco use is more prevalent among this group of households. Hence, consumers' direct spending on tobacco use and tobacco-induced health care costs will push more people into poverty.

Hence, keeping in mind the tax elasticity of cigarette demand and the enormous economic and health costs of smoking, this study recommends a more effective use of taxation policy to reduce tobacco consumption in the interest of public health. The taxes should be increased at least to meet the WHO's recommended threshold of 70 percent of the retail price or the level required to cover the costs tobacco makes the country incur. In the latter case, the increase would be four to five times what the tax rate is now. In the short-run, the rates on the two tax tiers should be increased with a higher increase for the second tier so that the gap between them is minimized. In the long run, however, the two-tier system should be abolished to have a single-tier system. This would help in bringing the poor out of the vicious cycle of poverty in addition to reducing the smoking-related disease burden.

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7 APPENDICES

APPENDIX A

Table A1. Sampling details

Base	Sampling Parameters						Sample Size		
	r	Design effect	RME	pb	Avg. HH Size	Response Rate	HHs	Clusters	Blocks
Urban	0.124	2	0.05	0.6401	6.2	0.95	5996	20	300
Rural	0.124	2	0.05	0.5721	6.6	0.95	6302	20	315
Pakistan							12298 ≈ 13000		615

Table A2. Population and sample distribution across different administrative units

Administrative Unit	Population (Households)		Sample	
	No. (in thousands)	percent	No.	percent
Punjab	17103.84	53.11	6904	53.11
Khyber Pakhtunkhwa (KP)	3845.17	11.94	1552	11.94
Sindh	8585.61	26.66	3466	26.66
Balochistan	1775.94	5.51	717	5.51
FATA	558.38	1.73	225	1.73
Islamabad	336.18	1.04	136	1.04
Pakistan	32205.11	100	13000	100

APPENDIX B

Field activity for this survey involved the collection of data from a nationally representative sample of households in Pakistan. PIDE itself collected the data. Based on its vast experience of conducting nationally representative surveys, PIDE recruited its own field team. A two-day-long training session was conducted at selected locations throughout Pakistan to orient the field teams with the nature of the survey, survey tools, ethical considerations, and other field issues. They used most of these two days to understand the questionnaire, practice questionnaire filling, and clarifying the questions they had.

Once considered suitably trained, these teams were mobilized in the field. While supervisors managed field teams and operations, the training of the survey and monitoring were performed by the core team of PIDE. The research protocols were approved by the Graduate Research Management Committee (GRMC) of the Pakistan Institute of Development Economics (PIDE).

APPENDIX C

Table C1. Descriptive analysis

Indicator	Overall	15 and above	35 and above
Age	24.54	34.56	49.56
Male (%)	52.72	52.81	51.94
Education (years)	7.01	8.98	8.73
Household size	6.84	4.35	2.13
Employment (%)	31.45	37.01	42.91
Income	18544.81	18611.53	20810.69
Observations	82889	52767	22917
Source:	Authors' calculations from the study survey		

Table C2. Prevalence of tobacco and smoking

Panel	Tobacco (Survey)	Smoking (Survey)	Tobacco (GATS)	Smoking (GATS)
A. Region				
Pakistan	19.14	8.82	19.10	10.50
Rural	19.8	8.87	21.10	11.20
Urban	18.44	8.77	15.90	9.30
B. Gender				
Male	31.74	16.13	31.80	19.40
Female	4.98	0.62	5.80	1.00
C. Province				
Punjab	14.28	8.48		
Sindh	25.59	9.75		
KP	16.98	4.67		
Balochistan	26.02	14.43		
D. Age				
15-34	10.58	3.93		
35-64	29.28	15.07		
65 & above	36.33	15.90		
Source:	Authors' calculations from the study survey			

Table C3. Disease prevalence

Panel	Diseases	Hospitalization (%)	Outpatient visit (%)
A. Region			
Pakistan	Cancer	7.19	5.36
	Cardiovascular diseases	7.34	7.98
	Respiratory diseases	3.75	4.27
Rural	Cancer	7.37	5.62
	Cardiovascular diseases	6.85	7.55
	Respiratory diseases	3.94	4.06
Urban	Cancer	6.97	5.06
	Cardiovascular diseases	7.93	8.46
	Respiratory diseases	3.53	4.51
B. Gender			
Male	Cancer	9.21	5.14
	Cardiovascular diseases	9.21	7.35
	Respiratory diseases	4.48	5.14
Female	Cancer	5.49	5.52
	Cardiovascular diseases	5.77	8.46
	Respiratory diseases	3.14	3.59
C. Province			
Punjab	Cancer	5.84	4.35
	Cardiovascular diseases	13.68	10.73

	Respiratory diseases	4.18	5
Sindh	Cancer	7.41	3.69
	Cardiovascular diseases	6.33	3.9
	Respiratory diseases	2.63	4.32
KP	Cancer	12.94	9.21
	Cardiovascular diseases	14.42	9.14
	Respiratory diseases	3.7	2.58
Balochistan	Cancer	6.57	6.71
	Cardiovascular diseases	3.68	2.03
	Respiratory diseases	3.93	3.92
Source:	Authors' calculations from the study survey		

APPENDIX D

Table D1. Present discounted value of lifetime earnings (million Rs)

Age groups	Rural		Urban	
	Male	Female	Male	Female
35-39	7.81	4.55	9.30	9.03
40-44	6.90	5.28	8.70	4.30
45-49	6.40	4.66	7.76	4.83
50-54	4.79	2.19	6.66	4.55
55-59	4.09	3.95	5.47	4.36
60-64	1.50	0.83	1.95	6.22
65-69	1.06	0.86	1.51	0.95
70-74	0.71	0.50	0.81	0.41
75-79	0.50	0.10	0.70	0.00
80-84	0.27	0.23	0.34	0.04
85+	0.00	0.00	0.00	0.00

Source: Authors' calculations from the study survey, Labour Force Survey (2017–18), and Pakistan Economic Survey (2018–19)

Table D2. Cost estimation using RRs from India and China

Cost	India's RR					China's RR				
	Rural	Urban	Rural	Urban	Total	Rural	Urban	Rural	Urban	Total
	35-64	65+	35-64	65+		35-64	65+	35-64	65+	
Medical Cost	103.90	18.69	20.85	12.48	155.91	40.92	8.26	8.80	4.84	62.82
Non-Medical Cost	3.70	1.36	0.59	0.81	6.47	12.42	8.21	6.29	2.21	29.13
Morbidity Cost	32.24	19.40	15.66	5.86	73.16	1.46	0.65	0.27	0.81	3.19
Mortality Cost	260.34	36.57	161.42	17.41	475.74	91.05	14.25	77.22	9.56	192.1
Total	400.18	76.01	198.52	36.57	711.3	145.8	31.37	92.58	17.42	287.2

Source: Authors' calculations using the survey data and RR from India and China

Table D3. Cost estimation using disaggregated RR for Pakistan from survey data

Cost	Rural	Urban	Rural	Urban	Total
	35-64	65+	35-64	65+	
Direct Medical Cost	40.57	8.04	19.07	10.10	77.79
Direct Non-Medical Cost	1.48	0.70	0.56	0.65	3.38
Morbidity Cost	12.47	9.71	7.05	2.24	31.46
Mortality Cost	95.14	15.07	107.50	19.10	236.82
Total	149.66	33.52	134.18	32.09	349.45

Source: Authors' calculations using the survey data

APPENDIX E

Table E1. RRs, smoking prevalence, and SAF for all-cause mortality

Region	Disease group	Male					Female				
		35+	35-64		65+		35+	35-64		65+	
		RR	Pe	SAF	Pe	SAF	RR	Pe	SAF	Pe	SAF
Panel A. Mortality Ratio Approach											
Rural	All diseases	1.28	28.85	0.07	25.72	0.07	2.53	1.31	0.02	1.84	0.03
Urban	All diseases	1.28	27.81	0.07	28.23	0.07	2.53	0.92	0.01	1.06	0.02
Source:	Authors' calculations using the survey data										

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