

Economic burden of tobacco use in Pakistan

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ABSTRACT

Background The lack of reliable tobacco healthcare and economic cost estimates leaves the tobacco industry undertaxed and thriving in Pakistan and makes the country as one of the top tobacco-consuming nations. To facilitate effective tobacco tax policymaking, this study estimates the economic cost of smoking-attributable diseases and deaths in Pakistan.

Methods A nationally representative sample survey of 13 000 households was administered to gather the data required to estimate different cost components of smoking-attributable diseases through the prevalence-based approach.

Findings The total smoking-attributable economic cost of all diseases and deaths in Pakistan in the year 2018–2019 for persons aged 35 years or older is 615.07 billion (\$3.85 billion). Similarly, three major diseases, namely cancer, cardiovascular disease and respiratory disease, along with associated deaths, cost the nation PKR437.8 billion (\$2.7 billion) of which 77% is the indirect cost. The three major diseases make 71% of the total estimated cost, nearly two-thirds of which is borne by rural residents, nine-tenth by males and more than four-fifths by the citizens in the 35–64 years age group.

Conclusion The total annual economic costs of all smoking-attributable diseases and deaths and those of the three major diseases equal 1.6% and 1.15% of Pakistan's gross domestic product, respectively. The tax contribution of tobacco sector is merely 20% of the total estimated cost. The finding of huge economic and health costs of smoking makes a convincing case for policymakers to realise the true value of the industry's contribution and raise tobacco taxes to the level of full cost recovery.

INTRODUCTION

Tobacco use defies all economics, public health and welfare sense and yet the illusion of its sizeable tax contribution is too attractive to be ignored by policymakers in many developing countries.^{1–4} Tobacco use also defies our optimism with public health awareness, as despite most Pakistani adults understand the consequences of tobacco use, nearly two-fifths of the household and 11.6% of the citizens in Pakistan report tobacco use.⁵ These paradoxes may be explained by policymakers' inadequate understanding of the economic cost of tobacco use that helps the undertaxed tobacco industry thrive under the shadow of governments' ignorance.

This necessitates the monetised estimation of the full economic cost of smoking-attributable fraction (SAF) of cancer, cardiovascular disease (CVD) and respiratory disease, along with complications associated with tobacco use. These costs include the direct costs (medical+patient care costs) and indirect costs

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Pakistan is one of the top tobacco-consuming nations and the tobacco industry is thriving in the country while claiming to make a significant contribution in the country's yearly tax revenue. The earlier attempt to estimate the health and economic cost of tobacco has used patient-level data and suffers from a selection bias and underestimations.

WHAT THIS STUDY ADDS

⇒ This paper provides the first reliable estimates of the cost of tobacco use in Pakistan. The tax contribution of the tobacco sector is found to be merely 20% of the total economic and health cost and is not sufficient to repair the damage that it causes, let alone any economic gain.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The finding of huge economic and health cost of smoking-attributable diseases and the fact that this cost is 3.65 times higher than the overall tax collected from the tobacco industry help bust the myth that this industry is a 'huge' tax contributor. This can help the policymakers realise the true value of tobacco taxation and power them to raise taxes to WHO's recommended threshold.

(morbidity+mortality).⁶ Usually, the full cost of tobacco consumption falls between 0.5% and 2% of the national gross domestic product (GDP)—which often outweighs the economic contribution of tobacco tax revenues—and the indirect costs usually make up a larger portion of the total cost estimates.^{2 4 7–13} The theory of change suggests that when equipped with 'reliable' monetised estimates of smoking-attributable costs, policymakers will opt for a set of tax policies that can bring simultaneous improvements in tax revenues and public health outcomes.

The demand for reliable cost estimates of smoking-attributable disease burden in Pakistan is clearly increasing but remains largely unfulfilled. Saqib *et al*¹⁴ recently calculated this cost to be ~60% higher than the tobacco tax revenue or equals to 0.4% of the country's GDP. Relying on a sample of hospital patients, this study, however, suffers from sample selection bias and ends up with underestimation of the cost of smoking-attributable disease burden as it does not consider the cost of outpatient visits or those who die unattended. Furthermore, when asked for regional, provincial, gender and age



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group-level disaggregation of the cost of tobacco-attributable disease burden,¹⁵ none of the existing studies help.

This paper communicates Pakistan's first ever estimate of the economic cost of smoking-attributable cancer, CVD and respiratory disease from a nationally representative survey of smokers and non-smokers in the country for the year 2019. It is an analysis of the direct and indirect costs of smoking-attributable disease and death burden disaggregated by gender, region, age group and type of service (inpatient or outpatient). Moreover, we use the relative risk (RR) of all-cause mortality from smoking to come up with the total economic costs from all smoking-attributable diseases and deaths in Pakistan and hope that more informed and effective tobacco taxation policies will emerge from this.

METHODS

Study approach

This study used the cost of illness (COI) approach to estimate the annual macroeconomic consequences of tobacco consumption. COI is a well-received approach to estimate the economic and health costs of tobacco consumption and is considered as a monetised proxy of the tobacco-attributable disease burden. It considers the direct and indirect costs of smoking across all citizens to come up with an overall cost tag that informs public policymaking on the cost of tobacco consumption. Computationally, it takes the excess cost that all smokers incur when treating smoking-induced diseases or deaths (current, past or ever) during a year compared with the never smokers. To preempt the frequently raised queries by policymakers, researchers often calculate COI across regions (eg, rural/urban), individuals (ever users and never users), healthcare types (eg, inpatient and outpatient), age categories (eg, 35 and 65+), genders (eg, male and female), cost types (eg, direct and indirect or morbidity and mortality) and illnesses (eg, cancer, cardiovascular and respiratory). This normally requires a nationally representative data set.

Sampling and data collection

None of the available micro data sets for Pakistan provide individual specific information that is a prerequisite for the computation of COI at the required level of disaggregation. Hence, a nationally representative sample survey of nearly 13 000 households was conducted. This includes 702 households as replacement in case of refusals. The sample was drawn from the latest sampling frame (2017) with the help of Pakistan Bureau of Statistics (see online supplemental table I for the details of sampling framework and parameters fixed to draw the sample size).

The provincial distribution of sample was proportional to their share in Pakistan's population: Punjab 53.1%, Sindh 26.6%, Khyber Pakhtunkhwa (KP) 11.9%, Balochistan 5.5%, Federally Administered Tribal Areas 1.7% and Islamabad 1% (see online supplemental table II). Similarly, the rural sample was slightly more than 51% and the rest were urban. The survey was conducted in late 2019 and early 2020 through 15 teams (organising 75 trained enumerators and 15 infield supervisors).

The survey tool was designed based on WHO's *Economics of Tobacco Toolkit*⁶ and was pretested before administered for data collection. Sampling weights were applied to derive the smoking-attributable aggregates of all healthcare expenditures for the entire population.

For estimation of indirect morbidity and mortality cost, the study also used various secondary data sources. These include employment rates from the Pakistan Economic Survey¹⁶ and annual earnings of the target age groups (converted into daily

earnings) from the Labour Force Survey (LFS).¹⁷ Data on real interest rate were taken from the World Development Indicators and life expectancy data were taken from WHO¹⁸ life tables.

Data description

The selected household sample size rendered information of 82 889 individuals of which some 27% qualified the '35-years or older age' criterion that was required for the estimation of economic costs of smoking.⁴ The distribution of the qualified sample was such that 51% were from the urban regions and 52% were males. Age wise, 86% belonged to the 35–64 years age group while the rest were older, whereas their average age was 49.5 years. Average educational attainment was 8 years and 43% of them were employed—a slightly higher percentage than the overall sample average. Online supplemental table III provides further details on descriptive statistics of the sample.

Tobacco prevalence in our sample was 19.1% and smoking prevalence was 8.8% which were almost the same and slightly higher when compared with the respective figures from Global Adult Tobacco Survey.¹⁹ Balochistan had the highest smoking prevalence (14.4%) among all provinces and the 65 years and older age group had a slightly higher smoking prevalence (15.9%) than the 35–64 years age group (15.1%). The CVDs (a year prior to the interview) were the most prevalent illness nationally in the urban regions, across both genders and in the Punjab and KP provinces, and were followed by cancer. The prevalence of CVD (during the last 15 days prior to the interview) was also the highest across regions, genders and in the Punjab and Sindh provinces (see online supplemental tables IV and V).

Estimation procedure

Though this study estimates the health and economic cost of all smoking-attributable diseases and deaths, it particularly focuses on three broader categories of diseases, namely cancer, CVD and respiratory disease, to offer deeper insights on the cost burden of tobacco consumption. The three main diseases—cancer, CVD and respiratory disease—were comprehensively covered. For instance, the CVD includes ischaemic heart disease, cerebrovascular disease (stroke), atherosclerosis, aortic aneurysm, peripheral vascular disease, arterial embolism, thrombosis, etc. Similarly, respiratory diseases include chronic bronchitis, emphysema, chronic airway obstruction, asthma, pneumonia, etc. Likewise, cancers include lip, oral cavity, pharynx, oesophagus, stomach (gastric), liver, pancreas, larynx, trachea, lung, bronchus, cervix, uteri, kidney and renal pelvis, urinary bladder, acute myeloid leukaemia, colon, rectum, etc. Economic burden of any smoking-induced diseases usually comprises a direct cost component (that includes both medical and caregiving expenses consisting of payments to formal caregivers, transportation and food costs, as well as forgone income of informal caregiver for accompanying an ill family member to healthcare facility), a morbidity cost component (that accounts for productivity loss due to sickness or disability caused by smoking) and a mortality cost component (that estimates the value of effects on labour from death caused by smoking). While the latter two are considered as indirect components of the economic cost of smoking, the medical expenses which are a direct cost can be categorised further into inpatient and outpatient costs of treating the smoking-induced diseases.

Following the best practice in the relevant tobacco research,⁴ the economic cost of smoking has been estimated for ever 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.^{20 21} For estimating the cost of premature deaths attributable to smoking, the present value of lost earnings is estimated by employing the human capital approach.^{22 23}

Smoking-attributable fraction

People may develop a smoking-related disease with or without consuming tobacco. Having an estimate of SAF of the risk to develop a disease is a prerequisite to estimate any direct medical and non-medical costs as well as indirect morbidity and mortality costs. This study follows Rice *et al*²¹ and uses epidemiological approach to estimate SAF⁶ through the following equation:

$$SAF_{jgr} = \frac{PE_{jgr} (RR_{jgr} - 1)}{PE_{jgr} (RR_{jgr} - 1) + 1} \quad (1)$$

where SAF_{jgr} denotes SAF for disease j , gender g , region r and age group a . PE is the smoking prevalence for ever smokers. RR is the relative risk of premature death compared with non-smokers (mortality ratio) or work loss of employed smokers due to illness/disease relative to employed non-smokers.⁶

Absence of the disease, gender, age and region-disaggregated RRs for Pakistan made the calculation of SAFs particularly challenging. In such situations, researchers either use SAFs from countries with similar socioeconomic conditions and smoking prevalence rates or estimate RRs if data permit. Opting for the latter, RRs were estimated through the mortality ratio approach. Though this is the least preferred over the other available approaches to estimate SAFs, it was opted as it was the one that permitted the estimation of usable disaggregated SAFs with the data in hand.

Direct cost of smoking

Following equation 2, the total direct cost attributable to smoking is estimated for both inpatient hospitalisation and outpatient visits.

$$SAEXP_{jgr} = TDHEXP_{jgr} \times SAF_{jgr} = [DMEXP_{jgr} + DNMEXP_{jgr}] \times SAF_{jgr} + (EXPH_{jgr} \times NH_{jgr} + EXPO_{jgr} \times NO_{jgr} \times 26) + (EXPHI_{jgr} \times NH_{jgr} + EXPOI_{jgr} \times NO_{jgr} \times 26) \times POP_{jgr} \times SAF_{jgr} \quad (2)$$

In the above equation, $SAEXP_{jgr}$ is the smoking-attributable health expenditures for disease j , gender g , region r and age group a ; $TDHEXP$ is the total health expenditures. Total 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 hospitalisation, and NH is the average number of hospitalisations 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 2 weeks before the date of the interview. $EXPHI$ and $EXPOI$ are the average expenditures on transportation and food of informal caregivers and payments to formal caregivers per hospitalisation 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 hospitalisation and outpatient visits include 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).

Indirect morbidity cost

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.

$$SAIE_{jgr} = INMBC_{jgr} \times SAF_{jgr} = (WDLH_{jgr} \times YH_{jgr} + WDLO_{jgr} \times YO_{jgr} \times 26) \times POP_{jgr} \times SAF_{jgr} \quad (3)$$

In equation 3, $INMBC$ represents indirect morbidity cost and $WDLH$ is the average number of workdays lost in a year per employed individual (including caregivers) due to hospitalisation 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 2 weeks. These average values are annualised 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 (2018–2019). Data on annual earnings for respective groups are obtained from LFS (2017–2018) and are converted into daily earnings.

Indirect mortality cost

Like morbidity, the calculation of mortality from smoking-related diseases also makes use of SAFs to estimate smoking-attributable deaths and subsequently the present discounted value of lifetime earnings (PVLE). The product of these two variables provides the mortality cost attributed to smoking and is estimated through the following equation:

$$SAMC_{jgr} = SAF_{jgr} \times \sum_{k=mink}^{\maxk} (TD_{jgrk} \times PVLE_{jgrk}) \quad (4)$$

where $SAMC$ is the smoking-attributable mortality cost, TD is the total deaths from disease j and $PVLE$ is the present discounted value of lifetime earnings; k denotes 5-year age intervals starting from age 35 years and is not the same as subscript a (that represents the age groups of interest; ie, 35–64 years and 65 years 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.

Estimating equation 4 also requires the $PVLE$ for all 5-year age groups from 35 years and older. This has been estimated through equation 5. Please note that the original formula also requires calculation of average imputed value of household production. However, this study omits that part due to unavailability of data and discusses the consequences of this omission in the Discussion section. The following equation has been used to estimate $PVLE$:

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

where $PVLE$ denotes the present discounted value of lifetime earnings, $surv$ is the probability of survival, y is the average annual earning of employed individuals computed from the survey data, emp is the proportion of the employed population, pro is productivity growth (assumed to be 4.1% based on

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

Region	Disease group	Male					Female				
		35+ (RR)	35–64		65+		35+ (RR)	35–64		65+	
			PE	SAF	PE	SAF		PE	SAF		
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

Authors' calculations are based on the survey data and mortality ratio approach to estimate relative risks (RR). PE, smoking prevalence for ever smokers; SAF, smoking-attributable fraction.

Pakistan's average GDP growth rate between 2000–2001 and 2018–2019), r is discount rate and n is the age at death.

RESULTS

Prevalence, RRs and SAFs

Disease, gender, age and region-disaggregated estimates of RR, smoking prevalence (PE) and SAF are given in table 1. Results suggest that male SAFs across diseases vary considerably but not much between the two age groups in the urban areas. Rural female SAFs for all the diseases but cancer increase significantly as they grow older. Rural females generally show higher SAFs than the urban females such that their 65 years and older age group SAF for respiratory diseases is almost double than that of their urban counterparts. Overall, SAFs vary across diseases, genders, regions and age groups.

Cost estimates of three major diseases

Direct cost

The disaggregated estimates of medical and non-medical costs are given in panels A and B, respectively, in table 2.

Annually, an estimated PKR100.31 billion (\$0.63 billion) is spent on treating smoking-attributable diseases. Of this amount, PKR96.24 billion or about 96% is estimated as direct medical

cost and the remaining is direct non-medical or caregiving cost. Of the total direct medical cost, inpatient hospitalisation cost is about 9% and outpatient treatment cost is 91% (panel A in table 2). In terms of the direct medical cost, cancers appear as the costliest health outcomes of smoking, appropriating PKR47 billion (\$0.29 billion) or 49% of the direct medical cost and are followed by CVD that consumes PKR32.4 billion (\$0.20 billion) or 33% and respiratory disease which costs PKR16.84 billion (\$0.10 billion) or 17%. Smoking by males makes up 85% and smoking in rural areas makes 77% of the total direct medical cost. Surprisingly, the 65 years and older age group is responsible for around one-fifth of the direct medical cost of smoking-attributable diseases.

The caregiving or direct non-medical cost is PKR4.07 billion (\$0.03 billion) or 4% of the direct cost of smoking-attributable diseases (panel B in table 2). Here, too, the bulk of direct non-medical cost accrues to outpatient visits (86%), males (83%) and rural areas (77%). Unlike medical cost, the contribution of cancer and CVD to the direct non-medical cost is almost equal (ie, 38% each), perhaps because both diseases require frequent outpatient visits. However, the older age group is responsible for 35% of smoking-attributable cost and is understandable as the marginal contribution of caregiving cost would be lower for the

Table 2 Direct cost (billion Rs)

Region	Diseases	Inpatient hospitalisation				Outpatient visits				Disease subtotal
		Male		Female		Male		Female		
		35–64	65+	35–64	65+	35–64	65+	35–64	65+	
A. Medical										
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
	Subtotal	5.58	1.60	0.94	0.54	60.34	14.74	9.18	3.32	96.24
B. Non-medical										
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
	Subtotal	0.32	0.16	0.06	0.05	1.92	0.98	0.33	0.26	4.07
Total direct cost		5.90	1.76	1.00	0.59	62.26	15.72	9.51	3.58	100.31

Table 3 Morbidity cost (billion Rs)

Region	Disease groups	Inpatient hospitalisation				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

Authors' calculations using the survey data.

older age group as they may already require more care regardless of their smoking status.

Indirect morbidity cost

The smoking-attributable annual productivity loss or morbidity due to three disease types costs the nation PKR56.32 billion or \$0.35 billion (table 3). The estimate of this indirect morbidity cost is more than half of the estimated direct medical and non-medical cost of smoking-attributable diseases. Yet, it may be an underestimation as the national RRs have been used for the disaggregated (regional and age groups) estimations of the morbidity cost. Outpatient visits account for 84%, males account for 66% and rural areas account for 72% of the estimated morbidity costs (table 3).

While there is negligible difference in the cost of hospitalisation across regions, outpatient visit cost for rural males is significantly higher than the rural females and urban males. Opposite to the case of direct medical costs, CVDs appear as the costliest from morbidity cost perspective causing 40% of the productivity loss and are followed by the respiratory diseases (31%) and cancer (29%).

Indirect mortality cost

The present value of smoking-attributable premature deaths or indirect mortality cost from the three disease types is estimated at PKR281.1 billion (\$1.76 billion) as reported in table 4. Rural areas bear 59% of the overall cost burden of smoking-attributable deaths mostly in the form of cancers that account for 55% of the rural area share. Mortality cost that accrues to the residents in urban areas is also largely on account of cancers which make 58% of it. Despite higher death rates in 65+ age group, 88% of the mortality cost is borne by 35–64 years age group due to their loss of more productive years and being the most productive

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
Total mortality cost		228.03	31.31	19.39	2.40	281.13

Authors' calculations using the survey data.

period in one's life in Pakistan (see online supplemental table VI for the PVLE). Though the cost of female mortality due to cancer is not estimated due to the absence of their RR coefficient, the overall cost of male mortality attributable to smoking is PKR259 billion (\$1.62 billion) or 92% of the total. For the reason just mentioned and the omission of household production activities, the female mortality cost is underestimated in this study.

Cost estimations for all smoking-attributable diseases

In addition to estimating the economic costs of smoking for the three major diseases in 2019, the study also estimates the total economic costs of all smoking-attributable diseases and deaths in Pakistan for the same year. Due to sampling constraints, RRs for all-cause mortality are calculated only for the two genders and are used to calculate the SAFs for the two regions and age groups (see online supplemental table VII).

The results reveal that the total cost of all smoking-attributable diseases and deaths is PKR615.07 billion (\$3.85 billion) with 70% of it as the indirect morbidity and mortality cost (table 5). A disaggregated look into these results suggests that the rural residents pay about two-thirds, males account for more than three-fourths and those in the 35–64 years age group bear little less than nine-tenth of the total economic cost of all smoking-attributable diseases in Pakistan.

DISCUSSION

Tobacco imposes huge economic health costs in Pakistan such that the three major smoking-attributable diseases, namely cancer, CVD and respiratory disease, have a combined cost tag of PKR437.76 billion or 71% of the total economic and health cost of tobacco. Nearly one-fourth of this is the direct cost, little less than two-thirds is the indirect mortality cost and the remaining one-eighth is the indirect morbidity cost. A disaggregated look at the estimates further reveals that nearly two-thirds of this cost is borne by rural residents, nearly nine-tenth by males and more than four-fifths by the citizens in the 35–64 years age group.

To put these cost estimates in perspective, they are compared with various outcome indicators (online supplemental table VIII). The total revenue collected from tobacco (primarily cigarettes) taxation in the fiscal year 2018–2019 was Rs120 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% 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

Table 5 Total cost of all smoking-attributable diseases (billion Rs)

Type of cost	Rural				Urban				Total
	Male		Female		Male		Female		
	35–64	65+	35–64	65+	35–64	65+	35–64	65+	
Medical (inpatient)	5.96	1.27	1.57	0.52	2.49	1.03	0.48	0.22	13.54
Medical (outpatient)	69.19	24.46	18.16	9.99	24.60	7.58	4.71	1.65	160.34
Non-medical (inpatient)	0.40	0.11	0.10	0.05	0.21	0.22	0.04	0.05	1.18
Non-medical (outpatient)	4.43	1.06	1.16	0.45	0.82	0.44	0.16	0.13	8.65
Morbidity (inpatient)	3.49	0.02	3.25	0.21	1.12	0.02	0.95	0.06	9.12
Morbidity (outpatient)	35.65	1.00	47.46	2.02	20.86	0.20	16.37	0.37	123.93
Mortality	110.34	16.88	12.94	3.49	125.52	14.41	14.04	0.70	298.32
Total cost	229.46	44.8	84.64	16.73	175.62	23.9	36.75	3.18	615.08

Authors' calculations using the survey data.

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.

The total cost is nearly 1.6% of the national GDP, whereas the cost of three major diseases equals 1.15% of Pakistan's GDP. An earlier study in Pakistan for the same major diseases came up with a cost estimate of 0.40% of the country's GDP.¹⁴ That study too should be seen as a further underestimation of tobacco-induced health and economic cost primarily because of using a non-representative sample based on limited hospital records.

The often celebrated 'huge' tax contribution is a myth and propaganda against the proposal that advocates for taxing tobacco consumption according to WHO guidelines. Our estimates suggest that tobacco puts a tremendous burden on the country's health infrastructure—especially by increasing the number of patients with cancer, CVD and respiratory disease—and the tobacco industry's tax contribution does not even adequately compensate for it.

These findings also support the arguments made in some recent studies. For example, Nayab *et al*¹⁵ and Saleem and Asif²⁴ reported household tobacco expenses are higher in the rural areas and among the lower income groups and argued that tobacco crowds out investment in human capitals in Pakistan and pushes households into a vicious cycle of poverty. Given that tobacco consumption is highly price elastic, suggesting price increase would reduce demand significantly, taxing tobacco to WHO standards and ensuring tax pass through to consumer prices of cigarettes would simultaneously improve economic and health outcomes.¹⁵

Limitations of the study

Though the study is the first most comprehensive account of the economic and health cost of smoking-attributable diseases, the following few limitations must have resulted in underestimation of the tobacco-attributable cost of diseases and deaths.

First, though the study reports national estimates of tobacco-caused disease burden based on a representative sample survey, the sample size was not adequate to allow the calculation of RRs for the kind of disaggregated analysis carried out in this study. Confronted with the unavailability of RRs in Pakistan, the authors estimated these for age and regions and applied on the related categories. As a result, despite intuitively feeling that the health cost of the 65+ years age group must be higher than the 35–64 years age group, application of the same RR might have resulted in an underestimation of overall health and economic cost.

The second limitation leading to underestimation originates from lack of data on household production activities and female labour force participation. This resulted in authors' inability to calculate the PVLE from these activities and come up with a better estimate for the cost tag. Finally, inability to report an income loss due to inpatient and outpatient medical care by the unemployed and self-employed may have caused further underestimation. Nevertheless, the estimates of health and economic cost should be taken as the best available conservative estimates of smoking-attributable diseases at the national and disaggregated levels.

CONCLUSION

Considering that tobacco industry's tax contribution is highly overclaimed in Pakistan, this nationally representative study was carried out to bring disease, gender, age and region-disaggregated analysis of tobacco-attributable COI. Based on the results reported and discussed in the preceding sections, the following major conclusions may be drawn.

First, the total cost of all smoking-attributable diseases and deaths for persons aged 35 years or older in 2018–2019 amounts to PKR615.07 billion (\$3.85 billion) and 70% of this is the indirect morbidity and mortality cost. Second, the smoking-attributable cost of healthcare and deaths from three major diseases, namely cancer, CVD and respiratory disease, for persons aged 35 years or older in 2018–2019 is estimated at PKR437.8 billion. The indirect cost makes 77% of this figure and it is 71% of the total estimated cost of all smoking-attributable diseases and deaths. Third, men, rural residents and citizens in the 35–64 years age group bear most of the smoking-attributable health cost burden, whereas cancer is the costliest smoking-attributable disease responsible for more than half of the tobacco-induced economic and health cost. Fourth, the total smoking-attributable cost is equal to 1.6% of the GDP, whereas that of the major diseases, namely cancer, CVD and respiratory disease, is 1.15% of the GDP. Finally, the total tax contribution of the tobacco sector is merely 20% of the total economic and health cost of smoking estimated in this study. The estimated cost is even higher than the total public sector spending in Pakistan and cannot be fully recovered even if taxes are raised to WHO's recommended level. These results suggest that tobacco is a net burden on the resource-constrained public health system in the country and must not enjoy any tax holiday in Pakistan.

Together with the finding of previous studies that suggest higher tax elasticity of cigarette demand, the finding of huge economic and health costs of smoking-attributable diseases in

this study clearly urges that Pakistan needs to realise the true value of tobacco taxation and impose higher taxes on cigarettes to curb tobacco consumption in the country. These taxes should be raised enough to ensure full health and economic cost recovery and should not be less than WHO's recommended threshold.

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Contributors DN, MN and JAM conceived the idea, supervised all steps and obtained funding. MN is guarantor of the study. MN designed the study, provided guidelines in statistical analysis and critically reviewed the draft at various stages. JAM drafted the manuscript and incorporated all feedback and made it submission ready. OS and SK took care of field data collection operations. OS proofread the manuscript. SK cleaned all the data and supported the statistical analysis. All authors read and approved the final version. JAM and MN contributed to this study when they were associated with Pakistan Institute of Development Economics (PIDE).

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SUPPLEMENTARY MATERIALS

1 THE ECONOMIC BURDEN OF TOBACCO USE IN PAKISTAN

Table I: Sampling detail

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 \approx 13000		615

Table II. 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

Table III. 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: Author's calculation from the study survey			

Table IV. Prevalence of tobacco and smoking

Panel	Tobacco	Smoking	Tobacco	Smoking
A. Region				
Pakistan	19.14	8.82	19.1	10.5
Rural	19.8	8.87	21.1	11.2
Urban	18.44	8.77	15.9	9.3
B. Gender				
Male	31.74	16.13	31.8	19.4
Female	4.98	0.62	5.8	1
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	15.9	---	---
Source: Author's calculation from the study survey				

Table V. 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: Author's calculation from the study survey			

Table VI. Present discounted value of lifetime earnings (million PKR)

Age groups	Rural		Urban	
	Male	Female	Male	Female
35-39	7.81	4.55	9.3	9.03
40-44	6.9	5.28	8.7	4.3
45-49	6.4	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	1.5	0.83	1.95	6.22
65-69	1.06	0.86	1.51	0.95
70-74	0.71	0.5	0.81	0.41
75-79	0.5	0.1	0.7	0
80-84	0.27	0.23	0.34	0.04
85+	0	0	0	0

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

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

Region	Disease Group	Male					Female				
		35+ RR	35-64		65+		35+ RR	35-64		65+	
			Pe	SAF	Pe	SAF		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
<i>Notes.</i> Authors' calculations using the survey data											

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

Outcome indicator	Unit (PKR)	Value
The total economic cost of smoking from three major diseases (2019)	Billion	437.8
The total direct cost of smoking from three major diseases (2019)	Billion	100.3
Revenue from tobacco (smoking) taxation (2018–19)*	Billion	120
Public sector health expenditure on health	Billion	421.8
Total health expenditures **	Billion	1208.5
GDP at current prices (2018–19)	Billion	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 PKR. 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.		