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Ministry of Health & Family Welfare
Government of India

Economic Burden of Tobacco Related Diseases in India

The report on the, "Economic Burden of Tobacco Related Diseases in India" has been developed by the Public Health Foundation of India, with support from the Ministry of Health & Family Welfare, Government of India and the WHO Country Office for India.

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LIST OF CONTRIBUTORS

Expert Group members

1. Dr Prakash C. Gupta
   Director
   Healis - Sekhsaria Institute for Public Health Mumbai

2. Dr D.K. Shukla
   Scientist F & Head, NCD Divison
   Indian Council of Medical Research
   New Delhi

3. Dr S.K. Jindal
   Retired Professor
   Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh

4. Dr. G.K Rath
   Chief, B.R.A.
   Institute Rotary Cancer Hospital (IRCH)
   All India Institute of Medical Sciences New Delhi

5. Mr Amal Pusp
   Director
   Ministry of Health and Family Welfare

6. Ms Vineet Gill Munish
   National Professional Officer
   WHO Country Office for India

Authors

1. Dr Rijo M John
   Assistant Professor
   Indian Institute of Technology Jodhpur

2. Dr Sarit Kumar Rout
   Associate Professor
   Indian Institute of Public Health Bhubaneswar

3. Dr B Ravi Kumar
   Consultant and Adjunct Assistant Professor
   Public Health Foundation of India

4. Dr Monika Arora
   Director
   Health Promotion
   Public Health Foundation of India

Peer reviewers

1. Mr Amit Yadav
   Legal Consultant
   Public Health Foundation of India

2. Dr Gaurang Nazar
   Doctoral Scholar
   Public Health Foundation of India

3. Dr Bidyut Sarkar
   Associate Professor
   (Senior Scientist)
   Public Health Foundation of India

4. Mr Praveen Sinha
   National Consultant (Policy), NTCP
   Ministry of Health & Family Welfare

5. Dr A. V. Rinkoo
   National Consultant, NTCP
   Ministry of Health & Family Welfare

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ABBREVIATIONS

AP	Andhra Pradesh
COTPA	Cigarette and Other Tobacco Products Act, 2003
CPI	Consumer Price Index
CPI-IW	CPI for Industrial Workers
CPI-RL	CPI for Rural Labourers
CVD	Cardiovascular Disease
DALY	Disability-Adjusted Life Year
DE	Direct Health-care Expenditures
FCTC	Framework Convention on Tobacco Control
GATS	Global Adult Tobacco Survey
GDP	Gross Domestic Product
GoI	Government of India
IEC	Information, Education and Communication
IC	Indirect Morbidity Costs
LFPR	Labour Force Participation Rate
LMIC	Low- and Middle-income Country
MoHFW	Ministry of Health and Family Welfare
NCD	Noncommunicable Disease
NFHS	National Family Health Survey
NSS	National Sample Survey
NSSO	National Sample Survey Office
PVLE	Present Value of Foregone Lifetime Earnings
RR	Relative Risk
SAF	Smoking -Attributable Fraction
SHS	Secondhand Smoke
TB	Tuberculosis
TDE	Tobacco-attributable Direct Health-care Expenditure
TIC	Tobacco-attributable Indirect Morbidity Costs
TN	Tamil Nadu
UP	Uttar Pradesh
WB	West Bengal
WHO	World Health Organization

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EXECUTIVE SUMMARY

Non-communicable diseases (NCDs) are the leading cause of death globally. In India, they account for 60% of all deaths. Additionally, communicable diseases (including maternal, perinatal and nutritional conditions) still account for 37% of all deaths in India, forcing the country to grapple with a double burden of disease. Given that the public spending on health in India is a mere 1.04% of its gross domestic product, the financial burden of tackling both communicable diseases and NCDs is likely to pose a massive economic burden on the country's economy. More than 80% of all NCD related deaths in India are attributed to four major diseases – cardiovascular diseases, cancers, chronic respiratory diseases and diabetes and tobacco consumption is the largest preventable risk factor for these NCDs.

The National Action Plan and Monitoring Framework for Prevention and Control of NCDs in India developed by the Ministry of Health and Family Welfare seeks to achieve a reduction in the prevalence of current tobacco use by 15% by 2020 and 30% by 2025. The regulatory policy actions by the Government of India to reduce production, sale and use of tobacco have in the past been fiercely contested by arguments related to the revenue benefits from tobacco sales. However, such arguments ignore several economic and social costs attributable to the rising burden of tobacco use. This includes pushing millions of people who are unable to bear the costs of treating tobacco related diseases into poverty. In this context, this report describes the health cost of tobacco use and estimates the economic burden arising from tobacco use in India.

Methods and Data

This study considered three major categories of costs to estimate the total economic burden attributable to tobacco: (1) direct medical cost of treating tobacco related diseases; (2) indirect morbidity costs; and (3) indirect mortality costs of premature deaths due to tobacco use. In all the three components, only the portion of the cost that can be attributed to tobacco use is estimated in the study. A prevalence-based attributable-risk approach was used for estimating the direct medical costs and the indirect morbidity costs. To estimate the costs of premature mortality, the study used a human capital approach and estimated the expected value of lost future productivity caused by tobacco attributable premature deaths. All the three components of the costs were estimated separately for males and females aged 35-69 by type of tobacco use, namely, smoked and smokeless tobacco. Apart from estimating the costs at the national level, the study also estimated the costs in thirteen major states of India that accounted for 86 percent of the country's population. These states were selected based on sample size criteria of having at least 2000 households with complete data on morbidity, health care and condition of the aged. Data were taken from a variety of sources, the primary data for estimating the costs of diseases was the unit level data from the 60th round of the National Sample Survey (NSS-2004), namely, "Morbidity, Health Care and the Condition of the Aged". Data for tobacco use prevalence were obtained from the Global Adult Tobacco Survey (GATS 2009-10). The costs were estimated for 2004 and updated for the year 2011 by using consumer price index.

Major Findings

1. The total economic costs attributable to tobacco use from all diseases in India in the year 2011 for persons aged 35-69 amounted to Rs. 1,04,500 crores (US$ 22.4 billion), of which 16 % was direct cost and 84 % was indirect cost.
2. Direct medical costs of hospital care and treatment of tobacco attributable diseases amounted to Rs.16,800 crore (US$ 3.6 billion), and associated indirect morbidity cost amounted to Rs. 14,700 crore (US$ 3.1 billion). The cost from premature mortality was Rs. 73,000 crores (US$ 15.6 billion).
3. Males contributed 91 % of the total economic burden while females accounted for the rest. However, the contribution from females was much higher (29 %) for smokeless tobacco. If one considers only the direct medical costs, the female share in costs attributable to smokeless tobacco increases substantially (66 %). The huge difference in premature mortality costs between males and females is on account of lower annual average earnings and the lower present value of lifetime earnings for females in India compared to their male counterparts.
4. Cardiovascular diseases (CVDs) shared the highest burden (Rs. 3,600 crores) of direct medical and indirect morbidity costs on account of tobacco use, followed by respiratory diseases (Rs. 2,800 crores), tuberculosis (Rs. 2,300 crores) and cancers (Rs.1,400 crores).
5. Among the four diseases associated with tobacco use, female share in the economic burden of disease was highest for cancers (38 %), followed by CVD (18 %), tuberculosis (17 %) and respiratory diseases (1.4 %).
6. The cost of premature mortality was highest in the age group 40-44 years for both males (Rs. 20,300 crores) and females (Rs. 1,000 crores).
7. The total economic burden of direct medical and indirect morbidity costs related to tobacco use was variable among the thirteen states in the study. Uttar Pradesh (UP) contributed to highest (28 %) of the estimated burden followed by West Bengal (WB), 13% and Andhra Pradesh (AP) 12 percent.
8. Four states (WB, Maharashtra, AP and UP) together contributed 60 % of the disease burden from tobacco attributable CVD. Three states, Tamil Nadu (TN), UP and WB predominantly shared 52 % of the burden due to tobacco attributable cancers. UP and WB together contributed 47 % of the burden from respiratory diseases. Thirty one percent of the tobacco attributable tuberculosis burden was in UP alone.
9. UP shared 34 % of the tobacco attributable cancer burden among males and WB shared 25 % of the tobacco attributable cancer burden among females. UP alone has 38 % of the tobacco attributable respiratory diseases burden among females.
10. To put the estimated costs of tobacco in perspective, the report also compares it with a few important macroeconomic indicators from India. The estimated Rs. 1,04,500 Crores (US$ 22.4 billion) economic cost of tobacco was found to be 1.16 percent of the GDP and was 12 % more than the combined state and central government expenditures on health in 2011-12. The total central excise revenue from all tobacco products combined in the year 2011-12 amounted to only 17 % of the estimated economic costs of tobacco.

Recommendations

The enormous economic burden and resulting losses to the nation could be prevented by strengthening the tobacco control efforts to reduce the burden of Non-communicable Diseases (NCDs) in India.

Comprehensive Tobacco Control Policy: The study recommends the need to have a comprehensive tobacco control policy with health in all policies approach. This would ensure a whole-of-a-government approach for tobacco control, thereby aligning the policies of the other Departments for public health.

Tobacco Taxation Policy: Develop a comprehensive tax policy for all tobacco products so that they are taxed at similar rates taking into account the need to increase 'real prices' , keeping in mind both price elasticity and income elasticity of demand, as well as inflation and changes in household income.

Treatment for tobacco dependence: The government should provide accessible and affordable cessation services including access to a Tobacco Cessation Quit-line to all tobacco users who wish to quit. Tobacco dependence treatment should be mainstreamed into the existing health care delivery systems.

Prohibit sale and manufacture of all forms of smokeless tobacco products (SLT)/chewing tobacco: This study strongly supports the Government's efforts to prohibit the manufacture and sale of all forms of SLT/chewing tobacco.

Enhancing Public Awareness: Increased support for high visibility public awareness campaigns using a variety of media to reach different set of audiences. In addition, strong and prominent graphic health warnings must be displayed on both sides of tobacco products which must be rotated at regular intervals.

Implementation of WHO Framework Convention on Tobacco Control and Cigarettes and other tobacco Products Act, 2003 (COTPA) The study recommends strengthening the implementation of the Cigarettes and other tobacco Products Act, 2003 (COTPA) and the Rules framed thereunder at national and sub-national levels.

This report, “Economic Burden of Tobacco Related Diseases in India” uses an analytical and evidence based approach to highlight the need to prioritise control of tobacco use in India. From the estimates, it is evident that tobacco use and the associated costs are creating an enormous burden for the nation. Tobacco is a preventable risk factor for major diseases and the resultant economic consequences. If urgent action is not taken, the financial burden due to direct and indirect costs of tobacco-attributable diseases will continue to push families of millions of tobacco users towards poverty and steadily decelerate the economic growth of the country. Besides increased resources and budget allocations for NCD prevention and control, full implementation of the WHO Framework Convention on Tobacco Control and the tobacco control laws will go a long way in preventing the onset of tobacco attributable NCDs in the country.

INTRODUCTION

- Tobacco use is a major cause of NCDs, which account for approximately 60% of deaths in India
- Nearly 35% of adults in India use tobacco in some form according to the Global Adult Tobacco Survey
- India has nearly 275 million tobacco users of which 206 million use smokeless tobacco products while 111 million use smoked tobacco products
- This report estimates the direct and indirect costs from all diseases caused by tobacco use for the adults in India in the age group 35-69 years

1.1 Background

Non-communicable diseases (NCDs) accounted for approximately 68% of deaths worldwide in 2012. Globally, about 80% of the NCD deaths are from the low- and middle-income countries (LMICs), where the burden of NCDs is rising rapidly. Evidence shows that 29% of NCD deaths in LMICs occur below the age of 60 years.[1] Behavioural factors such as tobacco use, alcohol use, unhealthy diet and physical inactivity are some of the major causes of NCDs. Among the risk factors, tobacco consumption is responsible for 9% of global mortality, second only to raised blood pressure.[2]

By 2014, NCDs were responsible for 60% deaths in India. It was further estimated that the probability of dying between the ages of 30 and 70 years from the four major NCDs in 26%. The Global Adult Tobacco Survey India (GATS) found that nearly 35% of adults in India use tobacco in some form. The estimated number of tobacco users in India is 275 million, with 163.7 million using the smokeless forms of tobacco and 69 million using smoked forms of tobacco.[3] It was estimated that in 2010 in India, there would be 930 000 deaths, 580 000 among men and 90 000 among women who smoke, in the age group of 30–69 years.[4] Tobacco-related cancers have been estimated to cause about 42% of cancer deaths among men and 18% of cancer deaths among women.[5] It has been established that tobacco in all forms has a causal role in various NCDs and that the overall mortality rate for smokers is 60% to 80% higher than for non-smokers.[6–8] There is compelling evidence to show that maternal tobacco consumption has a harmful effect on the foetus.[9–11] It can lead to neonatal death,[12] respiratory infection, asthma[13] and sudden infant death syndrome.[14] Epidemiological studies have shown causal association of tobacco consumption with most cancers, cardiovascular diseases, pregnancy-related disorders, infertility and plausible association with worsening of HIV/AIDS and tuberculosis.[9,15–18] Second-hand smoke (SHS) exposure has been shown to be an important cause of several diseases among non-smokers.[19] SHS is one of the most common indoor pollutants worldwide. Globally, it is estimated that 40% of children, 35% of women and 33% of men are regularly exposed to SHS indoors. It has been estimated that SHS caused 603 000 deaths and 10.9 million disability adjusted life years (DALYs) globally in 2004, which corresponds to 1 % of all deaths and 0.7 % of the worldwide disease burden.[20] According to the GATS India Report 2009-10, 52% of adults are exposed to SHS at home.[3]

[1]US$ 1 = INR 46.67 as per average exchange rate for the year 2011 as per World Bank. Available at http://data.worldbank.org/indicator/PA.NUS.FCRF accessed on 23.05.2014.

The morbidity and mortality pattern due to tobacco consumption gives an incomplete picture of the impact of tobacco-related diseases on the welfare of society as a whole. Chronic diseases resulting from tobacco usage culminate in enormous economic and societal costs due to premature deaths, loss of wages for the family and loss of productivity for the society. At an individual level, tobacco-related diseases can lead to loss of income due to absenteeism and also to borrowing.[21] Such households face a lack of savings, investments in children's education, and curtailment of household consumption.[22] At the societal level, poor health of the population could be associated with increased health expenditure, reduced functional capacity, loss of income or productivity, lower savings rate, increased poverty and lower rates of return on capital, all of which could contribute to reduction in economic growth.[23,24] Out-of-pocket expenditure on medical care for tobacco-attributable diseases has been reported to result in higher poverty rates, affecting 0.93 million people in India.[23]

Estimating tobacco-related health- care costs will help to highlight the magnitude of tobacco-related economic loss to the society, which is an important input for informed decision making in any country.

1.2 Rationale

During the post-independence period, India's public health system stressed on communicable diseases and maternal and child health issues, which were pivotal during that period. Tobacco-related diseases and NCDs received comparatively lower priority. Today, with the country undergoing a “health transition”, the ability to combat infant mortality, communicable diseases and malnutrition is being put to the test; while at the same time there are emerging demands for better services and more attention to NCD prevention and control.[25] This is so because chronic diseases resulting from tobacco use may involve enormous societal costs apart from the economic loss to the individual and family.

Measurement of the economic impact of tobacco-attributable diseases will inform decision makers of the extent to which tobacco-attributable diseases or depleted health status disturbs or reduces economic production or consumption opportunities at the household and societal level. The National Action Plan and Monitoring Framework for Prevention and Control of NCDs in India developed by the Ministry of Health and Family Welfare (MoHFW) seeks to achieve a relative reduction in prevalence of current tobacco use by 15% by the year 2020 and 30% by the year 2025. However, tobacco control policies are thwarted by several challenges including the benefit argument. According to this argument, the employment, revenue and foreign exchange earnings generated by the tobacco industry are large and surpass any health-care cost caused due to tobacco-related diseases. However, such arguments ignore the huge economic and social costs incurred due to tobacco-attributable diseases and premature deaths. An estimation of the economic burden due to tobacco use would be useful in countering such an argument. Moreover, an understanding of the actual costs of tobacco use is important for policy makers to make informed decisions about health service provisions. Government-sponsored health insurance schemes for the public will hugely benefit from information like the true cost of tobacco use.

While the cost of illness studies per se will not provide sufficient evidence for allocation of resources, the estimation of the economic losses or costs associated with a particular health condition can help to establish the proportion of government resources that could have been used for other purposes in the absence of these preventable diseases.[26] Cost of illness studies also need to be treated with a degree of caution as they are often based on estimations and assumptions, as the full data set required often does not exist. Also, the cost may only be postponed – humans will still fall sick and die, but at later age – and

pertinently, not during their most productive years of life. It is therefore, prudent to conduct such a study since the objective of the study is to provide evidence on the economic cost of illness and death attributable to tobacco use in India

1.3 Review of the literature

Since the 1990s, studies in the USA have attempted to estimate the costs of smoking and the direct medical cost for detection, treatment and rehabilitation of persons with smoking-attributable clinical diseases have been the primary outcome of the models. These smoking-attributable costs have been consistently estimated at 6–8% of the total annual expenditures for health care, with an estimated upper ceiling as high as 14%.[27] In 1998, smoking-attributable health-care expenditure was estimated at US$ 75.5 billion.[28] During 1997–2001, the estimate for smoking-attributable health-care expenditure rose to US$ 92 billion.[29] Other studies in different parts of the world have estimated the cost of tobacco-related diseases by adopting different methodologies. In the United Kingdom, the cost of smoking estimated for the National Health Service was between 1.4 billion to 1.7 billion pounds sterling in 1991, 5.2 billion pounds sterling in 2005–06[30] and 3.3 billion pounds sterling in 2006–07.[31,32] In Hong Kong, for a population of 6.5 million in 1998, the annual value of direct medical cost, long-term care and productivity loss was estimated at US$ 532 million for active smoking and US$ 156 million for passive smoking.[33] In Taiwan, smoking-attributable medical expenditure for people aged 35 years and above was found to be US$ 397.6 million, which accounted for 6.8% of the total medical expenditure of people in that age group.[34] The mean annual medical expenditure per smoker in Taiwan was US$ 70 more than that of a non-smoker.

There have been relatively fewer studies on the global healthcare cost on secondhand (SHS) or passive smoking. Also, the impact of SHS on the healthcare cost is less understood. The 2006 US Surgeon General's Report studied the medical treatment cost of SHS by gathering, evaluating and synthesizing available epidemiologic evidence on the relationship between SHS exposure and a wide variety of medical conditions. Studies in the USA have estimated the cost of illnesses attributable to SHS (among both children and adults) to be around US$ 17 million to US$ 270 million in different regions during different periods in the 2000s.[35–37]

There is limited evidence available regarding the economic cost of tobacco use in India. One study by Rath & Chaudhry in India was based on estimates of the burden of management of the three main tobacco-related diseases, namely cancer, coronary artery disease and chronic obstructive pulmonary disease.[38] This study was done in two hospitals in Delhi and Chandigarh with 195 and 500 patients respectively. Data was collected on treatment expenditures (both medical and non-medical), institutional expenditures and loss of wages during treatment for 1990–1992, until death or recovery. They estimated the total direct and indirect cost due to the three major tobacco-related diseases in India to be INR 277.61 billion, 83.7% of which was due to premature deaths. The same methodology was adopted in 2002–03 with costs pertaining to that year and the total cost of all the three major tobacco-related diseases was found to be INR 308.33 billion.[8]

Latest estimates for India were calculated in 2009, based on the National Family Health Survey-2 (NFHS-2) data on the prevalence of tobacco consumption. The National Sample Survey Organization (NSSO) Sixtieth round data was used for estimating health-care expenditure. It used data from the Mumbai cohort for determining the relative risks of smoked and smokeless forms of tobacco and from the US Census Bureau for population estimates. In this study, all major NCDs: cardiovascular diseases, respiratory diseases,

cancer and tuberculosis were taken into consideration. The direct cost of treating tobacco-related diseases was estimated to be US$ 907 million for the smoked variety and US$ 285 million for the smokeless tobacco. The indirect cost of tobacco use was estimated to be US$ 398 million and US$ 104 million, respectively for smoked and smokeless products.[39]

Making comprehensive national and sub-national level estimates on the economic burden of tobacco use in the country is a complex task that requires huge monetary resources and several years of effort by experts. Lack of reliable data is a major hindrance for such studies in the short term. However, estimates utilizing widely accepted methods can be made for immediate use without huge financial resources. Several developments have taken place since the last study in terms of tobacco consumption, disease pattern and presentation of disease, association of newer diseases to tobacco consumption, changes in access to healthcare for tobacco-related diseases and a growing population with diverse socio-economic characteristics. More information is now available from the Global Adult Tobacco Survey on the consumption patterns of different types of tobacco products across the country as well as the latest census providing population estimates of the country. Any study in the current scenario will provide more robust and updated estimates for the tobacco-attributable burden for India. As the prevalence of tobacco usage varies across states, estimation of the economic burden of tobacco use warrants attention at the sub-national level. Apart from recent information on the prevalence patterns and population, the present study will answer questions on the impact of the tobacco-related illness on household income and how much the household pays for a particular tobacco-attributable disease.

During the National Consultation on Economics of Tobacco organized by the World Health Organization (WHO) in collaboration with the Ministry of Health and Family Welfare (Government of India) in 2012, an expert working group recommended that a study to estimate the economic burden of tobacco-related diseases at the national and sub-national levels should be undertaken. This study is an outcome of that recommendation and focuses on measuring the economic cost of tobacco-attributable diseases in India. It provides updated estimates about the economic burden caused due to tobacco-attributable diseases and calls for further research in the form of a long-term comprehensive study based on the primary survey.

1.4 Objectives of the study

The objective of this study is to estimate the economic burden of diseases attributable to tobacco use in India and across the states using the latest available evidence. The study estimates the direct and indirect costs from all diseases caused due to tobacco use and specifically respiratory diseases, tuberculosis, cardiovascular diseases and cancers. Considering the substantial variation in both tobacco use prevalence and relative risks, the study intends to present these estimates by type of disease, gender and type of tobacco use (smoked or smokeless).

1.5 Organization of chapters

The section discussed above forms Chapter 1 of the study. Chapter 2 presents the methodology and data sources for estimating the economic burden of diseases at the national and sub-national levels. Chapter 3 discusses the findings of the study and presents the direct and indirect costs of tobacco-attributable diseases, cost of diseases due to smoking and smokeless tobacco use and a gender perspective of the cost at the national and sub-national levels. Chapter 4 presents the conclusions and recommendations from the study.

METHODOLOGY AND DATA SOURCES

- The report estimates (1) direct medical costs of treating tobacco related diseases, (2) indirect morbidity costs, and (3) indirect mortality costs from premature deaths attributable to tobacco use
- Detailed cost estimates are presented for 4 major diseases: cardiovascular diseases, cancers, tuberculosis, and respiratory diseases
- All-cause mortality approach was used to estimate the costs using tobacco use attributable fractions
- Estimates were made separately for smoked and smokeless tobacco and for all major states in India
- National Sample Survey and the Global Adult Tobacco Survey were the major sources of data based on which the estimates were made

This chapter presents the methodology and data sources to estimate the economic burden of tobacco-attributable diseases at the national and sub-national levels. For estimation of costs, the study used secondary data from various sources. Data from the National Sample Survey (NSS)-2004 provided estimates for household expenditure on various diseases and GATS 2009–10 indicated the prevalence of tobacco consumption among different age groups. Using a prevalence-based attributable-risk approach, this study estimated both direct and indirect health costs of tobacco-attributable diseases, both at the national and sub-national levels. The details of methodology, data sources and rationale for selection of states and diseases are explained in this chapter.

2.1 Methods and data

We calculated three major categories of costs to estimate the total economic burden attributable to tobacco: direct medical cost of treating tobacco-related diseases, indirect morbidity costs and indirect mortality costs of premature deaths attributable to tobacco use. A prevalence-based attributable-risk approach applied to tobacco-related costs by Rice et al. was used for estimating the direct medical costs and the indirect morbidity costs.[40] To estimate the costs of premature mortality, we used the human capital approach[41] and estimated the expected value of lost future productivity caused by tobacco-attributable premature deaths. All the three components of the costs were estimated separately for men and women by type of tobacco used, viz., smoked and smokeless tobacco. To estimate the direct medical and indirect morbidity costs attributable to tobacco, we considered four major diseases – cardiovascular diseases, cancers, tuberculosis and respiratory diseases. However, the costs for respiratory disease were not estimated for smokeless tobacco use. Apart from the four diseases mentioned above, we also estimated the tobacco-attributable costs of all diseases together using the all-cause mortality risk from tobacco use. Disease-wise estimates were not obtained for the costs of premature deaths; instead, an all-cause mortality approach was used for this. Direct medical costs and indirect morbidity costs were estimated for 13 major states in India.

We included only persons in the 35–69 years age group in the analysis, since relative risks for the diseases were available for this age group alone. Hence, the estimation of all three

components of costs was restricted to the above age group. The detailed methodology for estimating each of the three components of costs and the data used are described in the subsequent sections.

2.2 Estimation of the tobacco use-attributable fraction

Tobacco use-attributable fraction (SAF) is the proportion of expenditure on personal health services and morbidity costs that can be attributed to smoked and smokeless tobacco use. Persons were classified into three mutually exclusive categories: never smokers—those who have never used any tobacco; smokeless tobacco users—those who have used smokeless tobacco only; and smokers—those who have used smoked tobacco regardless of whether they also used smokeless tobacco. We estimated the SAF separately for smokeless tobacco users and smokers using this epidemiological formula from Lilienfeld[42] for each of the disease categories by state, gender, and tobacco use type:

$$SAF_{tsdg} = \frac{PE_{tsg}(RR_{tdg} - 1)}{PN_{sg} + \Sigma_t PE_{tsg}(RR_{tdg})} \quad (1)$$

where subscripts *t, s, d,* and *g* indicate type of tobacco used, state, disease category and gender, respectively. *PN* and *PEt* denote the percentage of people who never used tobacco and percentage who used tobacco by state and gender where *t* stands for either smokeless or smoked tobacco users. *RR* denotes the relative risk (RR) of mortality separately for smoked and smokeless tobacco users by disease and gender, compared to never smokers. For the purpose of estimating indirect mortality costs of premature deaths attributable to tobacco use, the SAFs were not estimated separately for different diseases but only for all diseases combined using an RR for all-cause mortality. However, these were estimated by gender and 5-year age groupings. The estimated SAFs were later multiplied with each cost measure of interest to arrive at the total smoking-attributable costs.

Estimate of a Tobacco use Attributable Fraction helps to attribute only a portion of the total cost of treating a disease to tobacco

2.3 Data sources

The primary data for estimating the tobacco use-attributable medical and morbidity costs was the report on "Morbidity, Health Care and the Condition of the Aged" from the Sixtieth Round of the NSS carried out during January–June 2004.[43] It was a nationally representative survey conducted by the MoHFW, Government of India (GoI), which provided data on utilization and expenditures with respect to private and public health-care services–inpatient hospitalization during the 365 days prior to the date of interview and outpatient visits during the 15 days prior to interview–from 47,302 rural and 26,566 urban households in India. We used the unit-level data for purposes of estimation. Expenditures from inpatient hospitalization were reported separately for each disease and visit. However, expenditures on outpatient visits were reported as total per person regardless of the number of visits and ailments. In order to calculate the average expenditure per ailment per outpatient visit, we computed the average expenditure on an outpatient visit for each ailment, using only those patients who made one visit. That amount was imputed to the expenditures for the respective ailments of those with multiple visits and ailments. These 15-day averages were later multiplied by 24.33 (365/15) to get annual estimates.

"Morbidity, Health Care and the Condition of the Aged" is a nationally representative household sample survey by the Government of India which provides detailed information on health care expenditures

There is wide variation in the prevalence of smoked and smokeless tobacco across states in India. Prevalence of smokeless tobacco use is much higher among women compared to smoked tobacco

Approximately 41% and 38% of inpatient hospitalization rural and urban areas and 24% and 20% of outpatient visits, also in rural and urban areas were reported to have been serviced by public providers. These included government hospitals, government clinics, government dispensaries, primary health centres, community health centres and central and state government assisted employees' state insurance hospitals and dispensaries. The institutional expenses would not correctly reflect the expenditures that the patients incur at these institutions, as many of these institutions offer either free or highly subsidized treatments. Hence, if the average medical expenditure were to be obtained from these patients, it would severely underestimate the actual costs. To overcome this, we computed the average expenditures on each of the ailments from private providers and imputed these averages to those receiving treatments from public providers. The imputation was undertaken using mean values at disaggregated levels of sex, age group, ailment and state. For example, we would replace the medical expenditures for treating cancers in women aged 35–69 years by public providers in Madhya Pradesh by the average medical expenditures for treating cancers in women of the same age group by private providers in the same state.

Since the health expenditure survey was done in 2004, we used consumer price indices (CPIs) to convert all the expenditure estimates to 2011 prices. For this purpose, we used a weighted average of CPI for industrial workers (CPI-IW) and CPI for rural labourers (CPI-RL) with the weights being the share of the urban and rural population, respectively. The data for CPI was obtained from the Ministry of Labour and Employment, GoI.[44–46]

The RRs of mortality used to estimate the smoking-attributable fraction were obtained from a prospective 1992–99 cohort study of 99,570 Mumbai adults aged 35 or above.[47] It reported the RR adjusted for age and socio-economic status separately for smokeless tobacco users and smokers by gender and disease categories. This is the only study that provides cause-specific RRs separately for smoked and smokeless tobacco by gender and is thus relevant in the Indian context, where wide disparities in tobacco use exist between genders. The RRs used in our analysis are given in Table 2.1. The 5-year age groups and gender specific RRs to be used for the estimation of indirect mortality costs of premature deaths attributable to tobacco use were not published in the above study.

Table 2.1: Relative risks of mortality from tobacco use for the 35 to 69 years age group*

Diseases	Men		Women	
	Smokeless tobacco	Smoked tobacco	Smokeless tobacco	Smoked tobacco
Respiratory	1.50(1.12-2.03)	2.12(1.57-2.87)	1.04(0.82-1.31)	1.15(0.42-3.15)
Tuberculosis	1.55(1.10-2.18)	2.48(1.76-3.50)	1.40(0.99-2.00)	5.92(2.31-15.17)
CVD	1.32(0.94-1.84)	1.54(1.09-2.19)	1.15(0.84-1.59)	1.46(0.35-6.01)
Cancers	1.40(0.96-2.08)	2.60(1.76-3.50)	1.57(1.16-2.13)	1.85(0.45-7.60)
All causes	**1.16(1.03-1.26)**	**1.67(1.49-1.84)**	**1.30(1.18-1.43)**	**1.53(0.97-2.42)**

Source: Mumbai Cohort Study (Gupta et al.);[47] Confidence intervals given in parenthesis

The data source for estimating the prevalence of tobacco use was GATS 2009-10,[3] a representative survey covering 99.9% of the population of India to estimate the prevalence of tobacco use. Prevalence figures used in this study were estimated from the raw data of

GATS. The gender- and state-wise prevalence of smoked and smokeless tobacco in the age group 35–69 years that are used in our analysis are given in Table 2.2. From the 2011 census,[48] age and gender-wise population in India were estimated to be 190 million men and 183 million women between the ages of 35 and 69 years.

Table 2.2: Prevalence of tobacco use for the 35 to 69 age group (2009–10)

State	Men		Women	
	Smoked Tobacco	Smokeless Tobacco	Smoked Tobacco	Smokeless Tobacco
Rajasthan	47.8%	14.1%	9.5%	7.3%
Uttar Pradesh	39.4%	27.1%	8.9%	19.6%
Bihar	22.5%	59.2%	15.8%	30.2%
Assam	34.9%	25.5%	3.2%	32.1%
West Bengal	47.4%	14.2%	3.5%	27.5%
Orissa	25.0%	41.0%	0.9%	55.1%
Madhya Pradesh	40.9%	29.2%	4.7%	24.5%
Gujarat	35.1%	21.8%	2.7%	15.7%
Maharashtra	18.6%	34.8%	0.1%	29.1%
Andhra Pradesh	44.3%	8.8%	11.5%	22.7%
Karnataka	36.3%	15.6%	0.7%	27.7%
Kerala	34.7%	8.9%	0.0%	12.5%
Tamil Nadu	26.5%	6.3%	0.2%	14.9%
All India	**34.3%**	**25.2%**	**5.4%**	**24.5%**

*Source: Global Adult Tobacco Survey, India 2009–10[3]

2.4 Tobacco use-attributable direct medical costs

Direct medical costs are the direct health-care expenditures for inpatient hospitalization or outpatient visits, including surgeon fees, medicines, diagnostic tests, bed charges, attendant charges, medical appliances, ambulatory services for treating tobacco-related diseases and other such expenditures. Tobacco-attributable direct health-care expenditures (TDE) for each sub-group stratified by type of tobacco use, state, disease category and gender for the age group 35–69 years were estimated by multiplying the SAF with the corresponding direct health-care expenditures (DE) using the formula:

$$TDE_{tsdg} = DE_{sdg} \times SAF_{tsdg}$$

$$= \begin{bmatrix} EIP_{sdg} \times NIP_{sdg} + \\ EOP_{sdg} \times NOP_{sdg} \times 24.33 \end{bmatrix} \times N_{sg} \times SAF_{tsdg} \quad (2)$$

Cost estimates are obtained by state, gender, tobacco use type, and disease from the health expenditures data from NSSO

where subscripts *t, s, d,* and *g* indicate the type of tobacco used, state, disease category and gender, respectively. *EIP* is the average expenditure per inpatient hospitalization, *NIP* is the average number of inpatient hospitalizations per person in 365 days, *EOP* is the average expenditure per outpatient visit, and *NOP* is the average number of outpatient visits per person for 15 days prior to the date of interview. The average number of inpatient hospitalizations or outpatient visits here refers to the average over the entire population over the relevant disease group, age group and gender group under consideration and not just the average of those who had the ailment. *N* is the population aged 35–69 years in 2011. All components in Equation 2 were estimated for the age group 35–69 years.

2.5 Tobacco use-attributable indirect morbidity costs

Tobacco use-attributable indirect morbidity costs comprise of: (i) expenditures incurred for transportation other than ambulance (ii) lodging charges of caregivers, and (ii) loss of household income to the whole household due to inpatient hospitalization or outpatient visits as a proxy for the value of lost productivity. Tobacco-attributable indirect morbidity costs (TIC) for each sub- group stratified by type of tobacco use, state, disease category and gender for the age group 35–69 years was estimated by multiplying the SAF with the corresponding indirect morbidity costs (IC) using the following formula:

$$TIC_{tsdg} = IC_{sdg} \times SAF_{tsdg}$$

$$= \begin{bmatrix} (TIP_{sdg} + YIP_{sdg} \times NIP_{sdg} + \\ (TOP_{sdg} + YOP_{sdg}) \times NOP_{sdg} \times 24.33 \end{bmatrix} \times N_{sg} \times SAF_{tsdg} \quad (3)$$

where subscripts *t, s, d,* and g indicate type of tobacco used, state, disease category and gender, respectively. *TIP* and *TOP* are the average expenditure on transportation and caregivers per inpatient hospitalization and outpatient visit, respectively. *YIP* and *YOP* are the income loss to the whole household due to inpatient hospitalization and outpatient visits. This does not include the cost of treatment, but largely the income lost on account of lost work. *NIP* is the average number of hospitalizations per person in 365 days; *NOP* is the average number of outpatient visits per person for 15 days prior to the date of interview. The average number of inpatient hospitalizations or outpatient visits here refers to the average over the entire population over the relevant disease group, age group and gender group under consideration and not just the average of those who had the ailment. *N* is the population that was aged 35–69 years in 2011. All components in Equation 3 were estimated for the age group 35–69 years.

It must be noted that the reported income lost to household due to hospitalization or outpatient visits might hugely underestimate the true productivity loss as people who are casual labourers/self-employed/unemployed may not report a loss of income during the time of hospitalization. To that extent, the *YIP* and *YOP* will underestimate the true cost of lost productivity during the time of hospitalization or outpatient visit.

Sampling weights were used while estimating the average expenditures in Equations 2 and 3. While computing average expenditures by subgroups (state, disease and gender) we followed a "2 t rule of thumb" to retain only those estimated averages whose standard errors were less than half the value of the estimated average. If for some reason an estimated average did not satisfy this criterion, we replaced it with the corresponding national average. In order to present robust estimates, we decided to include only those states where at least 2000 total households were surveyed so that suitably large samples were available to do a disease-wise analysis. This left us with 13 states in the analysis which, in fact, covered 86% of the population in the age group of 35–69 years.

2.6 Tobacco use-attributable premature mortality costs

A third and important component of the economic cost of tobacco is the cost of premature deaths from tobacco use. To estimate the tobacco use-attributable costs of premature mortality, we usedthe human capital approach and estimated the present expected value of lost future productivity caused by tobacco-attributable premature deaths for the year 2011. It essentially involved two steps – estimating the total number of premature deaths attributable to tobacco use, and estimating the expected present value of future productivity lost for each of those deaths.

Annual average wages are much lower for women compared to men in India and that results in an under estimation of indirect costs due to premature deaths for women

To estimate the total number of premature deaths attributable to tobacco use, all-cause deaths attributable to tobacco use stratified by type of tobacco use, gender and 5-year age groups were estimated by multiplying the SAFs by the corresponding total number of deaths for ages 35 to 69. In order to do this, SAFs were estimated first by 5-year age groups, tobacco use type and gender using the all-cause RR of mortality. These RRs by 5-year age groups, tobacco use type and gender were obtained from the Mumbai cohort study[48] sourced from the primary author. The corresponding age-wise prevalence was estimated from the unit level data of GATS.[3] Data on the total number of deaths in 2011 were collected from the sample registration system.[49] The estimated SAFs were multiplied by the total number of deaths by the respective sub-groups of interest to calculate the number of premature deaths attributable to tobacco use.

To estimate the expected present value of future productivity lost from tobacco use-attributable deaths, we estimated the present value of foregone lifetime earnings (PVLE) for each person at the age of death. The PVLE was estimated by gender and 5-year age groupings based on an approach developed by Max et al.[50] To estimate the PVLE, this approach took into account life expectancy by gender and 5-year age groupings, labour force participation rate, current pattern of earnings at successive ages and a discount rate to convert a stream of future earnings into its present value. The following equation was used to estimate the PVLE:

$$PVLE_{yg} = \sum_{n=y}^{85+} P_{yg}(n)\ [Y_g(n)\ E_g(n)] * \frac{(1+\mathrm{L})^{n-y}}{(1+r)^{n-y}} \quad (4)$$

where $PVLE_{yg}$ is the present discounted value of lifetime earnings for a person of age y and gender *g;* P_{yg} *(*n*)* is the probability that a person of age *y* and gender *g* will survive to age *n* (where *y* is the age of the person at present, *g* is the gender of the individual and *n* is the age up to which the person is expected to survive); Y_g*(*n*)* is the mean annual earning of an employed person of gender g and age *n;* E_g*(*n*)* is the proportion of the population of gender g and age n employed in the labour market (labour force participation rate); *L* is the rate of increase of labour productivity and *r* is the real discount rate. According to Equation 4, lower discount rates and/or higher productivity rates would yield higher PVLE estimates and vice versa.

We used an empirically estimated social discount rate[51] of 5.2% for India for the purpose of economic evaluation of investment projects. In order to account for potential growth on future earnings, we assumed an annual average productivity growth rate of 7.3%, which is the geometric mean of the 10 years of annual gross domestic product (GDP) growth rates between 2002 and 2011 in India. The data on GDP growth rates were obtained from the Handbook Statistics on the Indian Economy.[52] Data for the number of people left alive at age x (lx) and the person-years lived between ages x and x+n (nLx), which were used to compute the probability that a person of age y will survive to age n to be used in the calculation of PVLE, were obtained from gender and 5-year age-specific life tables for India in 2011.[53] Labour force participation rates (LFPRs) and the wage rates of the working population in India were estimated from the unit level data of the Sixty-eight round of the National Sample Survey,[54] a representative large sample household survey on employment and unemployment in India conducted by the Ministry of Statistics and Programme Implementation, GoI 2011–12.

According to the NSS, LFPR is defined as the proportion of persons/person-days in the labour force to the total persons/person-days. To compute the labour force participation rates from the NSS data, we considered the usual principal and subsidiary economic activity together. According to this measure, it was estimated that approximately 93% of men and 37% of women in the age group 35–69 years were part of the labour force. The proportion of men in the age group 35–69 years who were self-employed, regular salaried and casual labour was estimated to be 55%, 18% and 27%, respectively. For women in the same age group, these shares were 57%, 11% and 32%, respectively. NSS data gave daily wage rates for both regular salaried and casual labour. In order to find an average daily wage rate applicable to self employed and unemployed individuals, one needs to use a certain imputation method. We used a "human capital earnings function" known as the Mincer Equation developed by Jacob Mincer[55,56] in order to estimate the average daily wage rate for everyone in the labour force. The following equation predicts the estimated average daily wage rates for all persons in the labour force:

$$Log(Wage) = \beta_o + \beta_1 educ + \beta_2 exper2 + \Theta' Z + \varepsilon \quad (5)$$

where the dependent variable is the natural log of daily wage rates for regular salaried and casual labour, *educ* is the years of education, *exper* is the years of experience which is constructed as age minus five minus years of education, *exper*2 is the square of experience and Z is a vector of economic and demographic variables which include monthly per capita consumption expenditures, household size, gender, place of residence (rural or urban), marital status, religious affiliation and social group. ε is the error term. Equation 5 was estimated using the standard ordinary least squares method with robust standard errors using the econometric software Stata (Version12).[57] This model used only regular salaried and casual labour in work other than public works in the age group 15 to 90. Once the parameters were estimated, we predicted the daily wage rates for all individuals in the labour force above 15 years of age for each sub-group stratified by 5-year age groups and gender. Nevertheless, we used only the age group 35–69 years for the purpose of estimating tobacco use-attributable mortality costs from premature deaths.

Once the average daily wage rates were estimated, we computed the average annual wage earnings for each of the sub-groups by multiplying the average daily wage rates and the number of days worked. In order to calculate the number of days worked in a year, we first estimated the average number of days people were unemployed or seeking jobs, as reported in the NSS data, for each sub-group of interest. We then deducted this estimated figure and an additional 70 days to account for Sundays and holidays in a year from the 365 days available in a year. The estimation of PVLE was carried out using an MS Excel template provided to us by the authors who developed this methodology.

Tobacco use-attributable costs of premature deaths were estimated by multiplying tobacco use- attributable deaths by PVLE for each sub-group stratified by 5-year age groups and gender.

ECONOMIC BURDEN OF DISEASES AT NATIONAL AND SUB- NATIONAL LEVEL

- Total direct and indirect costs of diseases attributable to tobacco use was INR 1,044,816 million in 2011 of which 84% were indirect mortality costs
- Nearly 91% of the costs were attributed to men and the rest to women
- Among the four diseases associated with tobacco use, female share in the economic burden of disease was highest for cancers (38%), followed by CVD (18%), tuberculosis (17%), and respiratory diseases (1.4%)
- Cardiovascular diseases accounted for 36.5% share of the costs followed by respiratory disease (27.8%) and tuberculosis (22.6%)
- Uttar Pradesh, West Bengal, and Andhra Pradesh together accounted for 52% of the costs
- Uttar Pradesh shared 34% of the tobacco attributable cancer burden among males and West Bengal shared 25% of the tobacco attributable cancer burden among females.

This chapter presents both direct and indirect costs of diseases attributable to tobacco use in India and across 13 major states. Besides the aggregate costs, this chapter also presents disease- wise and gender-wise break up and costs on use of smoked and smokeless tobacco. The direct and indirect costs are estimated separately for tobacco-attributable all-cause mortality and four specific diseases – tuberculosis, cardiovascular diseases, cancers and respiratory diseases for the entire country and across states. Using the tobacco use-prevalence rate in the age group of 35–69 years from the GATS 2009-10 survey, relative risk from the Mumbai cohort study and household expenditure from the NSS-2004, this chapter presents the estimates of costs arising from tobacco-attributable diseases at national and sub-national levels.

3.1 Costs at the national level

As presented in Table 3.1, the total direct and indirect cost of diseases attributable to tobacco use was INR 1,044,816 million in 2011. Indirect cost constituted a major proportion, contributing 84% of the total costs. Indirect costs were of two types – morbidity cost and cost of premature mortality. The cost of premature mortality was quite substantial (INR 730,057 million), constituting 70% of the total costs. This shows that families have to bear an enormous economic burden due to loss of wages when a family member is afflicted by a disease, and furthermore, dies at an early age.

Table 3.1: Economic burden of diseases attributable to tobacco use in India (INR million)

	Cost (in INR Million)	% distribution
1. Direct cost[#]	168 035	16.08
2. Indirect cost[®]		
A. Morbidity cost	146 725	14.04
B. Cost of premature mortality	730 057	69.87
Total indirect cost	876 782	83.92
Grand total (1+2)	1 044 816	100

Note: The calculated costs are for all diseases together using all-cause mortality

≠ Direct medical costs are the direct health-care expenditures for inpatient hospitalization or outpatient visits, including surgeon's fees, medicines, diagnostic tests, bed charges, attendant charges, medical appliances, ambulatory services for treating tobacco-related diseases and other such expenditures that are directly related to the inpatient hospitalization or outpatient visit.

®indirect costs are of two types: (i) indirect morbidity costs comprising of expenditures incurred for transportation other than ambulance, lodging charges for caregivers and the loss of household income to the whole household due to inpatient hospitalization or outpatient visits as a proxy for the value of lost productivity; and (ii) indirect mortality cost, which is the cost of premature mortality.

Smoking attributable costs were much higher than the costs incurred due to smokeless tobacco attributable diseases

The cost by type of tobacco used shows that smoking-attributable cost was much higher than the cost incurred from smokeless tobacco use. As presented in Table 3.2, the total smoking attributable cost was INR 811,174.32 million, constituting 78% of the total cost; and the cost of smokeless tobacco was INR 233,642.02 million, constituting 22% of the total cost.

It was further observed that the direct medical cost of smokeless tobacco-attributable diseases for women was higher than for men. Around 66% of the direct medical cost was attributed to the female population in the case of diseases caused by smokeless tobacco use. In spite of higher direct medical cost of smokeless tobacco use by the female population, the total cost for men was higher in this category. This was because the cost of premature mortality for men was much higher than for women, which outweighed the direct medical cost for women.

Table.3.2: Economic burden of diseases attributable to tobacco use by type and sex among adults aged 35–69 years in India (in INR million)

Type of Tobacco	Direct Medical Costs	Indirect Morbidity Costs	Indirect Mortality Costs	Total Costs
Smoked Tobacco				
Men	101 871.81	108290.26	571480.00	781642.07
Women	13 585.55	5463.70	10483.00	29532.25
Sub total	115 457.36	113753.96	581963.00	811174.32
% of total cost®	68.71	77.53	79.71	77.64
Smokeless tobacco				
Men	17 894.84	19 022.30	129 659.00	166 576.14
Women	34 682.60	13 948.29	18 435.00	67 065.89
Sub total	52 577.43	32 970.59	148 094.00	233 642.02
% of total cost®	31.29	22.47	20.29	22.36
Total tobacco				
Men	119 766.64	127 312.56	701 139.00	948 218.21
Women	48 268.15	19 411.99	28 918.00	96 598.13
Grand Total	**168 034.79**	**146 724.55**	**730 057.00**	**1 044 816.34**

Note: The calculated costs are for all diseases together using all-cause mortality
®- Percentage is calculated from total tobacco cost

The gender-wise distribution shows that 90.75% of the total cost was borne by men and 9% by women (Table 3.3). Additionally, the cost of premature mortality among women was lower as compared to men. It was further evident that the cost of smoking- and smokeless tobacco-attributable diseases varied between men and women. The share of women in the cost of smokeless tobacco-attributable diseases was more than their share in the smoking-attributable diseases.

Table 3.3 Male and female distribution of total cost (%)

Type of Tobacco	Direct Medical Cost	Indirect Morbidity Cost	Indirect Mortality Cost	Total Costs
Smoking Tobacco				
Men	88.23	95.2	98.2	96.4
Women	11.77	4.8	1.8	3.6
Smokeless Tobacco				
Men	34.04	57.69	87.55	71.3
Women	65.96	42.31	12.45	28.7
Total Tobacco				
Men	71.27	86.77	96.04	90.75
Women	28.73	13.23	3.96	9.25

3.1.1 Disease-specific costs

In this section, the direct medical and indirect morbidity cost of four specific diseases, viz. Cardiovascular disease (CVD), cancer, respiratory and tuberculosis and cost due to all-cause mortality have been discussed. The cost of premature mortality is not included here due to non-availability of disease-wise age-specific mortality data.

The costs of cardiovascular diseases constituted the largest share of estimated direct costs of tobacco

The cost of cardiovascular diseases was INR 35,589 million, constituting 36.5% of the total cost due to the four diseases (Table 3.4). This was followed by respiratory diseases at 27.83%. One of the reasons for the low cost on account of cancer could be low reporting by the households in the NSS survey, which was used for estimating the cost of diseases in this study. The distribution by gender shows that men had a higher share in the cost of all the four diseases.

Table 3.4: Disease-wise distribution of cost® in India (INR million)

Type of Disease	Men	Women	Total (%)
Cardiovascular	29 321.70	6268.03	35 589.73 (36.50)
Cancer	8739.83	5367.84	14 107.67 (14.07)
Tuberculosis	18 797.31	4950.03	23 747.34 (22.59)
Respiratory diseases	27 522.54	465.56	27 902.97 (27.83)
Total (all four diseases)	**84 382.37**	**17 051.89**	**101 434.3 (100)**

® includes direct medical cost and indirect morbidity cost
Figures in parenthesis indicate % of total direct and indirect morbidity costs of four diseases

3.1.2 Tobacco use-attributable premature mortality costs

One of the most productive age group, 35-44 years, bore the highest costs due to premature mortality from tobacco use

Premature mortality is the death of a person at an earlier age than he or she is expected to die. Tobacco use-attributable premature mortality cost estimates the present expected value of lost future productivity caused by tobacco-attributable premature death. The present expected values were estimated for the year 2011. The total cost of premature mortality due to tobacco usage across all age groups was INR 730,057 million (Table 3.5). Men had a higher premature mortality cost compared to women. In the product-wise analysis, smoked forms of tobacco had a higher cost (INR 581,963 million) compared to the smokeless forms. For both men and women, the highest cost due to premature mortality was found in the age group of 35–44 years, which is considered to be the most productive period of life.

Table 3.5: Attributable costs of premature mortality by tobacco use types in India (INR million)

	Smoked tobacco			Smokeless tobacco			Any tobacco		
Age (yrs)	Men	Women	Total	Men	Women	Total	Men	Women	Total
35–39	148 832	0	148 832	48 887	2642	51 529 719	197	2642	200 361
40–44	175 182	5997	181 179	28 180	4370	32 550 363	203	10 366	213 729
45–49	114 673	0	114 673	19 675	3144	22 819 348	134	3144	137 492
50–54	64 920	2496	67 416	18 502	1477	19 979 421	83	3973	87 394
55–59	30 417	728	31 145	1185	2716	3901 601	31	3444	35 045
60–64	21 375	90	21 465	7847	2655	10 502 221	29	2744	31 965
65–69	16 081	1172	17 253	5384	1433	6817 465	21	2605	24 070
Total	571 480	10 483	581 963	129 659	18 435	148 094 139	701	28 918	730 057
Distribution of total cost by men and women	**98.2%**	**1.8%**	**100%**	**87.55%**	**12.45%**	**100%**	**96.04%**	**3.96%**	**100%**

3.2 Cost at the sub-national level

Thirteen states across India, covering 86% of the country's total population, were included in this study. This section presents only the direct medical cost and indirect morbidity cost without the cost of premature mortality. The cost of the four designated diseases and all-cause mortality are estimated separately and are presented in Table 3.6.

Among the states, Uttar Pradesh accounted for highest cost due to all-cause mortality and the four specific diseases attributable to tobacco use – INR 73,354 million for all-cause mortality and INR 19,912 million for the four diseases. Assam had the least cost due to all causes, whereas Odisha had the least cost for the four specific diseases. Uttar Pradesh, West Bengal and Andhra Pradesh together accounted for 49% of the costs due to four specific diseases and 52% due to all-cause mortality. It was also observed that the share of costs due to men was more than that of women for all-cause mortality as well as for the four diseases.

Uttar Pradesh, West Bengal, and Andhra Pradesh together accounted for more than half of the total costs from tobacco attributable diseases

Table 3.6: Attributable costs* of diseases by states (smoking + smokeless) (INR million)

State	4 Diseases			Rank	All Causes		
	Male	Female	Total		Male	Female	Total
Rajasthan	4512.47	535.66	5048.12	7	9624.77	1971.13	11595.9
Uttar Pradesh	16545.70	3367.10	19912.80	13	59674.5	13679.6	73354.1
Bihar	3457.63	1262.59	4720.21	6	8864.77	4540.66	13405.4
Assam	1395.64	182.43	1578.07	2	3799.36	1612.75	5412.11
West Bengal	11485.72	1835.93	13321.65	12	27700.6	6699.44	34400
Odisha	1095.43	227.32	1322.75	1	7689.95	2189.06	9879.01
Madhya Pradesh	4390.10	768.24	5158.34	8	11098.9	2640.12	13739
Gujarat	4237.14	417.31	4654.46	4	11157.6	1429.77	12587.3
Maharashtra	6391.06	1303.03	7694.09	10	16779.5	6119.22	22898.8
Andhra Pradesh	6157.82	2659.10	8816.92	11	24132.9	7046.76	31179.6
Karnataka	2748.44	398.51	3146.95	3	7643.03	2188.15	9831.19
Kerala	5189.54	264.41	5453.96	9	13302	1835.27	15137.3
Tamil Nadu	3714.47	956.25	4670.73	5	9206.66	2506.34	11713
All India	**84381.38**	**17051.46**	**101432.84**		**247079**	**67680.1**	**314759**

*Includes direct medical cost and indirect morbidity cost only.
Costs of indirect mortality were not computed by diseases

The distribution of costs followed a skewed pattern across the states (Table 3.7), with three to four states bearing a significant proportion of the total cost. For instance, 60% of the CVD cost was borne by four states, namely Andhra Pradesh, Uttar Pradesh, Maharashtra and West Bengal. Three states – Uttar Pradesh, Tamil Nadu and West Bengal – accounted for 52% of the total cancer costs. Uttar Pradesh singly accounted for 31% of the TB cost.

Table 3.7: Distribution of costs of disease by states (smoking + smokeless) (%)

States	CVD	Cancer	Tuberculosis	Respiratory	All causes
Rajasthan	4.4	6.4	6.4	7.1	4.4
Uttar Pradesh	13.2	24.8	31.1	28.5	27.7
Bihar	5.3	5.0	8.9	3.3	5.1
Assam	1.6	5.1	0.4	1.7	2.0
West Bengal	17.0	14.5	10.4	18.5	13.0
Orissa	1.0	2.3	2.9	0.8	3.7
Madhya Pradesh	5.3	3.4	9.9	5.0	5.2
Gujarat	4.6	4.5	5.7	6.7	4.7
Maharashtra	15.1	5.9	5.0	6.3	8.6
Andhra Pradesh	14.4	6.5	10.9	6.7	11.8
Karnataka	4.6	4.2	2.7	3.1	3.7
Kerala	7.6	4.8	3.3	8.1	5.7
Tamil Nadu	6.0	12.5	2.3	4.1	4.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: Includes only direct medical and indirect morbidity costs

3.2.1 Direct medical cost of diseases attributable to smoking and smokeless tobacco

This section discusses the disease-wise direct medical cost by type of tobacco used (smoked and smokeless), type and distribution of costs between the male and female populations across states. The variations in costs for the four diseases and all-cause mortality are presented here.

3.2.1.1 Smoking-attributable direct cost

CVD and respiratory diseases accounted for 33% and 34% of total direct medical cost, respectively (Table 3.8). These two diseases had the highest share in the direct medical costs, followed by tuberculosis. In contrast to the all-India pattern, the disease-wise direct medical cost showed different trends across states. For CVD, West Bengal accounted for highest direct cost (INR 2285 million) and the least was Odisha (INR 67 million). For cancer, TB and respiratory diseases, Uttar Pradesh had the highest direct medical costs among the 13 states.

Table 3.8: Smoking-attributable direct cost across states (INR million)

States	CVD	Cancer	Tuberculosis	Respiratory	Total	All causes
Rajasthan	926	409	738	1136	3208	7297
Uttar Pradesh	1724	1147	2943	2643	8457	23275
Bihar	491	152	375	380	1398	3573
Assam	114	243	38	184	580	1550
West Bengal	2285	397	766	2599	6046	14096
Odisha	67	88	178	139	471	2044
Madhya Pradesh	768	135	698	540	2140	5583
Gujarat	502	213	389	1102	2205	6570
Maharashtra	1204	116	124	774	2219	6654
Andhra Pradesh	2180	248	1346	985	4758	13892
Karnataka	653	183	239	612	1687	5023
Kerala	1235	176	333	780	2524	6096
Tamil Nadu	1176	542	146	485	2349	6772
All India	15318	5258	9982	15839	46398	115457
% distribution all India	**33**	**11**	**22**	**34**	**100**	

3.2.1.2 Smoking-attributable direct medical cost by gender

This section discusses the direct medical cost of diseases caused due to smoking by gender across states. Across states, men accounted for the highest direct cost for all the diseases that were attributed to smoking (Table 3.9). This was due to the very low prevalence of smoking among women throughout the country. Among men, the direct cost was highest for CVD and respiratory diseases in West Bengal and for cancer and TB in Uttar Pradesh. Among women, Uttar Pradesh accounted for the highest direct cost for CVD, TB and respiratory diseases and West Bengal for cancer at INR 147 million.

Men accounted for the highest share of direct costs due to smoking due to the relatively high smoking prevalence among them

Table 3.9: Smoking-attributable direct costs by state and gender (INR million)

State	CVD		Cancer		Tuberculosis		Respiratory		All causes	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Rajasthan	878	48	347	62	621	117	1097	39	6264	1033
Uttar Pradesh	1162	563	1059	88	1862	1082	2557	85	19 631	3644
Bihar	312	179	16	136	251	125	326	55	2402	1171
Assam	103	11	240	3	28	10	184	1	1416	134
West Bengal	2156	129	250	147	703	63	2578	20	13 162	934

Orissa	63	3	87	2	169	9	138	0	2005	39
Madhya Pradesh	724	44	105	30	577	121	527	12	5179	403
Gujarat	463	39	205	8	319	69	1097	5	6323	247
Maharashtra	1202	2	116	1	116	7	774	0	6640	14
Andhra Pradesh	1742	438	173	74	342	1003€	940	44	11 640	2252
Karnataka	648	5	176	7	228	11	611	1	4948	75
Kerala	1235	0	176	0	333	0	780	0	6096	0
Tamil Nadu	1169	7	533	9	142	4	485	1	6733	40
All India	13 349	1970	4313	945	7381	2602	15 511	328	101 872	13586

€ : The discrepancy in expenditure between men and women for tuberculosis in Andhra Pradesh was due to higher average medical expenditure for women taking treatment from private sources caused due to presence of an outlier

3.2.1.3 Smokeless tobacco-attributable direct cost

The direct cost of three diseases due to the use of smokeless tobacco across states is presented in Table 3.10. Respiratory diseases were excluded due to inadequate evidence on smokeless tobacco as a risk factor. Further, exclusive attribution of smokeless tobacco as a risk factor for respiratory diseases is yet inconclusive. At the national level, CVDs accounted for the highest direct cost at INR 8706 million followed by cancer and TB. However, this was different across states. Among the 13 states, Maharashtra incurred the highest cost for CVD (INR 769.47 million). For cancer, West Bengal incurred the highest cost (INR 799 million). In the case of TB, the direct medical cost was highest in Uttar Pradesh (INR 668.60 million). It is seen that the pattern of direct medical cost of smoking and smokeless tobacco varies across states.

Table 3.10 Smokeless tobacco-attributable direct cost across states (INR million)

States	CVD	Cancer	Tuberculosis	Total	All causes
Rajasthan	165.50	57.43	75.39	298.32	891.00
Uttar Pradesh	876.85	311.57	668.60	1857.02	7768.45
Bihar	598.48	185.65	264.92	1049.05	2782.81
Assam	80.18	62.95	15.57	158.71	998.41
West Bengal	715.62	799.11	118.55	1633.29	5137.19
Orissa	121.65	97.22	146.67	365.53	2089.84
Madhya Pradesh	382.21	125.88	204.98	713.08	2086.57
Gujarat	244.23	64.67	106.70	415.60	1756.19
Maharashtra	1769.47	290.89	424.92	2485.29	7680.59
Andhra Pradesh	486.99	107.41	186.58	780.98	3073.59
Karnataka	229.86	195.97	72.53	498.36	2165.59
Kerala	274.30	95.41	42.40	412.12	1755.43
Tamil Nadu	368.33	582.96	39.13	990.42	2461.44
All India	8706.94	3650.55	2968.56	15326.04	52577.43
% distribution for all-India	**56.81**	**23.82**	**19.37**	**100.00**	

3.2.1.4 Smokeless-tobacco attributable direct costs by gender

Smokeless tobacco use prevalence is higher among Indian women compared to smoking and that also meant their share of costs due to smokeless tobacco attributable cancers far exceeded that of men

The smokeless tobacco-attributable direct cost showed variations across states. At the all-India level, the cost for men was highest for all diseases except cancer, where women accounted for the highest cost (Table 3.11). Among the states, the cost for men was higer than that for women for all diseases except cancer. For cancer, women accounted for the highest cost in all states except Assam and Uttar Pradesh. It was further observed that among men, the direct cost for CVD was highest in Maharashtra (INR 1331 million) and cancer and TB in Uttar Pradesh (INR 181and 474 million, respectively). Among women, the direct cost was the highest for CVD and TB in Maharashtra (INR 437 and 343 million, respectively) and cancer in West Bengal (INR 780 million).

Table 3.11: Smokeless tobacco-attributable direct costs by state and gender (INR million)

States	CVD		Cancers		TB		All Causes	
	Men	Women	Men	Women	Men	Women	Men	Women
Rajasthan	153.50	12.00	25.59	31.84	68.08	7.31	442.06	448.95
Uttar Pradesh	472.38	404.47	181.75	129.82	474.78	193.82	3222.14	4546.31
Bihar	486.86	111.63	10.55	175.10	245.53	19.39	1514.03	1268.77
Assam	44.56	35.62	43.77	19.18	7.70	7.87	246.91	751.50
West Bengal	381.99	333.63	18.69	780.42	78.13	40.43	940.95	4196.24
Orissa	61.62	60.03	35.50	61.72	103.09	43.58	786.55	1303.29
Madhya Pradesh	306.78	75.43	18.75	107.13	153.35	51.64	886.13	1200.44
Gujarat	171.04	73.18	31.86	32.81	73.88	32.82	941.69	814.50
Maharashtra	1331.57	437.90	54.07	236.82	80.93	343.99	2968.75	4711.84
Andhra Pradesh	204.26	282.73	8.57	98.84	25.18	161.40	550.89	2522.70
Karnataka	164.76	65.10	18.93	177.04	36.34	36.19	507.81	1657.78
Kerala	187.01	87.29	11.27	84.14	31.60	10.80	372.61	1382.82
Tamil Nadu	163.82	204.52	31.54	551.42	12.50	26.63	380.84	2080.60
All India	5809.98	2896.95	791.90	2858.64	2014.54	954.01	17894.84	34682.60
% distribution all India	**66.73**	**33.27**	**21.69**	**78.31**	**67.86**	**32.14**	**34.03**	**65.97**

3.2.2 Indirect morbidity costs of diseases attributable to smoking and smokeless tobacco

3.2.2.1 Smoking-attributable indirect morbidity cost

This section presents smoking-attributable indirect morbidity costs, defined as indirect cost of diseases. Consideration of the indirect morbidity cost will help in understanding the extent of expenses incurred on transportation to avail of services (excluding ambulance) and loss of household income due to inpatient hospitalization or outpatient visits as a proxy value for the loss of productivity. At the all-India level, respiratory diseases accounted for the highest indirect morbidity cost at INR 12, 149 million, followed by TB (Table 3.12). Around 38% of the total indirect morbidity cost was due to respiratory diseases at the national level. Across states, West Bengal accounted for highest indirect cost of INR 1672 million for CVD while the lowest was recorded in Odisha. In the case of cancer, TB and respiratory diseases, the cost in Uttar Pradesh was highest and least in Odisha, with the exception of TB where Assam had the least cost.

Table.3.12: Smokeless tobacco-attributable indirect morbidity costs by state (INR Million)

States	CVD	Cancer	Tuberculosis	Respiratory	Total	All causes
Rajasthan	185.11	230	415	600	1430.11	3067
Uttar Pradesh	906.47	1093	2063	4340	8402.47	34 072
Bihar	209.72	113	625	419	1366.72	4044
Assam	159.76	235	26	238	658.76	1929
West Bengal	1672.88	324	1048	1941	4985.88	12 976
Orissa	42.51	41	146	66	295.51	3543
Madhya Pradesh	274.01	43	834	684	1835.01	4559
Gujarat	436.09	179	506	542	1663.09	3474
Maharashtra	650.44	139	226	763	1778.44	4960
Andhra Pradesh	1361.45	243	586	662	2852.45	12 474
Karnataka	360.65	49	184	157	750.65	2003
Kerala	628.6	211	259	1203	2301.6	6439
Tamil Nadu	191.59	194	232	508	1125.59	1988
All India	7648.19	3460	8406	12149	31663.19	113754
% Distribution all India	**24.15**	**10.93**	**26.55**	**38.37**	**100**	

3.2.2.2 Smoking-attributable indirect morbidity cost by gender

The indirect cost of smoking-related diseases for men and women across states is presented in Table 3.13. Overall, the indirect morbidity cost was higher for men compared to women. Among men, the indirect morbidity cost was the highest in West Bengal for CVD and in Uttar Pradesh for cancer, TB and respiratory diseases. Among women, the indirect cost was highest in Uttar Pradesh for TB and respiratory diseases and in Andhra Pradesh for CVD and cancer.

Table 3.13 Smoking-attributable indirect morbidity costs by state and gender (INR Million)

States	CVD		Cancer		Tuberculosis		Respiratory		All Cause	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Rajasthan	170.34	14.77	184.04	46.09	300.24	114.63	591.87	8.48	2726.13	341.10
Uttar Pradesh	787.70	118.77	1016.35	76.54	1756.38	306.35	4273.78	66.62	31629.61	2442.26
Bihar	148.56	61.16	27.04	85.75	498.14	127.20	399.17	19.88	3035.44	1008.34
Assam	139.82	19.94	234.20	0.70	23.26	2.98	237.63	0.24	1819.14	110.12
West Bengal	1635.03	37.86	302.28	21.68	1022.73	25.28	1932.79	8.67	12 690.59	285.67
Orissa	41.80	0.71	40.40	0.58	144.65	1.62	65.69	0.29	3518.18	24.52
Madhya Pradesh	254.66	19.34	18.68	24.30	725.68	108.76	675.25	8.74	4298.05	260.60
Gujarat	423.99	12.10	170.19	9.16	455.06	50.53	538.87	2.70	3388.58	85.69
Maharashtra	649.66	0.78	138.69	0.18	224.69	1.14	762.87	0.12	4955.36	4.21
Andhra Pradesh	1219.82	141.63	140.84	102.24	529.69	56.60	642.47	19.39	11 401.99	1071.64
Karnataka	359.05	1.60	47.36	1.72	177.47	6.36	156.58	0.56	1983.66	19.71
Kerala	628.60	0.00	210.77	0.00	259.47	0.00	1203.32	0.00	6439.36	0.00
Tamil Nadu	190.84	0.75	192.12	1.57	228.65	3.59	507.55	0.21	1981.06	7.20
All India	7081.03	567.16	3071.25	388.63	7386.08	1020.17	12 011.63	137.75	108 290.26	5463.70
Percentage	**92.58**	**7.42**	**88.77**	**11.23**	**87.86**	**12.14**	**98.87**	**1.13**		

3.2.2.3 Smokeless tobacco-attributable indirect morbidity costs

Three diseases – CVD, TB and respiratory diseases were included in the estimation of indirect morbidity cost for smokeless tobacco. As presented in Table 3.14, indirect morbidity cost was the highest for CVD followed by TB and cancer at the all-India level. Among the states, the pattern was different. Maharashtra accounted for the highest indirect cost for CVD, Uttar Pradesh for cancer and Bihar for TB. On the other hand, Tamil Nadu had the least cost for CVD, Odisha for cancer and Assam for TB.

In the smokeless category, no one state had the highest cost for more than one disease; Maharashtra had the highest cost for CVD, Uttar Pradesh for cancer and Bihar for TB.

Table 3.14: Smokeless tobacco-attributable indirect morbidity costs by state (INR Million)

States	CVD	Cancer	TB	Total	All Cause
Rajasthan	33.48	37.31	40.08	110.87	340.65
Uttar Pradesh	405.71	287.51	502.83	1196.05	8238.37
Bihar	270.2	127.87	507.7	905.77	3005.77
Assam	124.77	47.35	8.7	180.82	934.17
West Bengal	387.64	138.02	129.93	655.59	2191.05
Orissa	54.42	39.59	95.98	189.99	2202.44
Madhya Pradesh	141.13	89.05	239.43	469.61	1511.21
Gujarat	179.46	62.27	129.24	370.97	787.25
Maharashtra	867.63	134.6	209.91	1212.14	3604.49

Andhra Pradesh	234.44	142.66	48.06	425.16	1740.11
Karnataka	111.67	50.22	48.5	210.39	639.23
Kerala	119.62	65.32	30.54	215.48	846.02
Tamil Nadu	49.54	109.34	47.27	206.15	491.07
All India	3916.12	1739.33	2390.09	8045.54	32970.6
% Distribution All India	**48.67**	**21.62**	**29.71**	**100**	

3.2.2.4 Smokeless tobacco-attributable indirect morbidity cost by gender

Just as for smoking- attributable indirect morbidity cost, a similar exercise was undertaken for estimating the smokeless-attributable indirect morbidity cost. The results are presented in Table 3.15. At the all-India level, the indirect cost for smokeless tobacco was highest among men except in the case of cancer where it was highest for women. In the case of cancer, 68% of the cost was borne by women. Among the study states, the indirect cost was higher among men for CVD (except Assam) and TB (except Tamil Nadu). For cancer, the cost was higher for the women in all states except Uttar Pradesh and Assam. In Uttar Pradesh, the cost for cancer among men was INR 174.38 million in comparison to INR 113.13 million for women. Similarly, in Assam, the cost for cancer was INR 42.68 million among men in comparison to INR 4.66 million among women. It was also observed that among men, the indirect cost was highest for CVD in Maharashtra (INR 719 million), for cancer in Uttar Pradesh (INR 174 million) and for TB in Bihar (INR 487 million). Among women, the indirect cost was the highest for CVD in Maharashtra (INR 147 million), for cancer in West Bengal (INR 115 million) and for TB in Uttar Pradesh (INR 55 million).

Table 3.15: Smokeless tobacco-attributable indirect morbidity costs by state and gender (INR Million)

States	CVD		Cancer		Tuberculosis		All causes	
	Men	Women	Men	Women	Men	Women	Men	Women
Rajasthan	29.78	3.70	13.58	23.74	32.92	7.16	192.38	148.27
Uttar Pradesh	320.34	85.36	174.38	113.13	447.94	54.89	5191.45	3046.92
Bihar	232.03	38.17	17.82	110.05	487.91	19.79	1913.38	1092.39
Assam	60.41	64.36	42.68	4.66	6.30	2.40	317.17	616.99
West Bengal	289.63	98.01	22.59	115.43	113.61	16.32	907.27	1283.78
Orissa	40.62	13.80	16.57	23.02	88.17	7.81	1380.05	822.40
Madhya Pradesh	107.96	33.18	3.34	85.71	192.92	46.51	735.35	775.86
Gujarat	156.47	22.99	26.50	35.78	105.31	23.93	504.69	282.56
Maharashtra	719.73	147.91	64.82	69.78	156.10	53.81	2215.61	1388.88
Andhra Pradesh	143.04	91.40	6.97	135.69	38.95	9.11	539.60	1200.51
Karnataka	91.30	20.37	5.08	45.14	28.30	20.19	203.58	435.65
Kerala	95.19	24.43	13.47	51.86	24.64	5.90	393.57	452.46
Tamil Nadu	26.75	22.79	11.36	97.98	20.10	27.17	112.06	379.01
All India	**3082.00**	**834.12**	**563.94**	**1175.39**	**2016.02**	**374.07**	**19 022.30**	**13948.29**
	78.70%	**21.30%**	**32.42%**	**67.58%**	**84.35%**	**15.65%**		

DISCUSSION AND RECOMMENDATIONS

- The total economic burden was equivalent to 1.16% of the GDP in India in the year 2011-12
- The estimated costs also amounted to 12% more than the combined expenditures on health care incurred by state and central governments in India
- The excise tax on tobacco in the year 2011-12 amounted to only 17% of the total economic costs attributable to tobacco
- Tobacco attributable direct medical cost was around 18% of the national health expenditures in India

4.1 Discussion

Economic burden from tobacco far outweighs the level of public expenditures on health in India

The economic burden of diseases attributable to tobacco use in India was found to be enormous. It was 1.16% of the GDP in 2011–12, which was more than the level of public expenditure on health care (Table 4.1). The total economic burden was 12% more than the combined expenditure on health care incurred by the states and the Central Government. Further, what the government earns from the excise revenue on tobacco products constitutes only 17% of the economic cost of tobacco-attributable diseases. Total direct and indirect tobacco-attributable cost was estimated to be six times more than the excise revenue from all tobacco products. Tobacco-attributable direct medical cost was around 18% of the national health expenditure. This was substantially more than what was evident from an earlier study in India in 2004 where it was estimated to be 4.7%.[39]

Table 4.1: Comparison of costs to macro indicators (INR million)

Indicators	Value
Total direct and indirect cost in 2011 (INR Million)	1,044,816
GDP at market prices in 2011–12 (INR Million)	89 749 470
Total costs as percentage of GDP (%)[1]	1.16%
Excise revenue from tobacco products in 2011–12 (INR Million)[2]	173,694
Excise revenue as percentage of total cost (%)	16.62%
Total State and Central Government expenditure on health in 2011–12 (INR Million)[3]	929,300.00
Total cost as percentage of government health expenditure (%)≠	112.43%
Direct medical cost as percentage of total health expenditure in 2011–12 (%)	18.08%

≠ includes both central and state government expenditure on health

[1]RBI (2013). Handbook of Statistics on Indian Economy 2012–13

[2]Directorate of Data Management, Customs and Central Excise, Ministry of Finance, GoI

[3]Planning Commission (2013). Twelfth Five Year Plan 2012–17, Social Sectors Volume III, GoI

This study updates two earlier studies in terms of methodology and estimation of economic burden. Rath et al.[38] estimated total direct and indirect cost accruing from the three major tobacco-related diseases at INR 277.61 billion in India for the year 1999. Total direct and indirect cost estimated in the present study is almost four times more than the estimate by Rath et al. In the present study, the cost was estimated at a population level using data from a nationally representative household survey. Although the two earlier studies used different definitions of direct and indirect cost, both showed indirect cost to be very high. The present study estimated total indirect cost (for both morbidity and premature mortality cost) to be 84% of the total cost, while the cost of premature deaths was 83.7% as per Rath et al.[38] John et al.[39] estimated the total economic cost at US$ 1.7 billion in 2004.

Though the methodology used in the present study is similar to that used by John et al., that study did not include the cost of premature mortality, which is an addition in the present study. Another new facet is that the present study estimates costs at the sub-national levels as well, which the previous studies did not provides. Also, the costs estimated in the present study were adjusted for consumer price inflation to arrive at the cost in the most recent year, which was not done in the earlier study. Further, the present study estimates the cost of four specific diseases separately, namely cancers, CVDs, respiratory diseases and tuberculosis; and cost due to all-cause mortality at the national and state levels. This study also presents the cost by smoking and smokeless tobacco use.

Higher prevalence of tobacco use among the poor also means, a higher share of economic costs due to tobacco bourne by them pushing the poor into further poverty

Overall, indirect cost constituted 84% of the total cost, indicating substantial productive losses to the nation. Between men and women, men bear a disproportionately higher burden of the total cost, which is around 90% of the total economic burden due to all-cause mortality. This is mainly due to the higher indirect cost for the male population over that for the female population. This not only shows lower participation of women in the workforce but also indicates lower annual average earnings by them compared with their male counterparts. However, there were major differences when costs due to smoking and smokeless tobacco use were compared. Though the cost due to smoked tobacco was substantially higher than that due to smokeless tobacco use, in the case of smoking, direct medical cost among men was more than that for women while in the case of smokeless tobacco, direct medical cost was higher for women. Further, disease-wise analysis of cost showed that men incurred higher direct medical as well as indirect morbidity costs for all the four diseases due to both smoked and smokeless tobacco use, the exception of cancer for which women were found to incur a higher cost due to smokeless tobacco use. Overall, women incurred higher direct and indirect costs of smokeless tobacco-attributable cancer at the national level. Further, at the all-India level, the total cost was highest for CVDs followed by respiratory diseases and tuberculosis.

Across the 13 study states, 52 % of the costs were borne by three states, namely Uttar Pradesh, West Bengal and Andhra Pradesh due to all-cause mortality and 49% due to the four diseases together. The cost of the four diseases was the highest in Uttar Pradesh.

The disease-wise direct medical costs due to smoking and smokeless tobacco showed variations across states. For smoking-related diseases, Uttar Pradesh incurred the highest medical cost for cancer, TB and respiratory diseases, while in the smokeless category West Bengal incurred the highest cost for cancer and Maharashtra for CVD. Akin to the smokeless tobacco use prevalence pattern, where the percentage of women smokeless users are higher, the direct cost of cancer caused due to smokeless tobacco was higher for women. Particularly in West Bengal, it was the women who incurred almost all the direct

medical cost of cancer caused due to smokeless tobacco. As for the indirect cost, Uttar Pradesh incurred highest cost for smoking related cancer, TB and respiratory diseases, similar to direct cost. However, in the smokeless category, no one state had the highest cost for all three diseases. Maharashtra had the highest cost for CVD, Uttar Pradesh for cancer and Bihar for TB.

It is evident from this study that 78% of the total costs arose due to smoked tobacco whereas 22% was due to smokeless tobacco-related diseases. Studies in India suggest that the poor are more likely to use tobacco.[58,59] It further indicates that the disease burden is disproportionately higher among the poor than the rich, implying that the economic cost would also be higher among the poor, leading to further impoverishment.

The current study has attempted to estimate the economic burden of diseases both at the national and sub-national levels using a prevalence-based relative-risk approach for estimating the cost of diseases. There are several limitations to the study.

First, this study used relative risk of mortality to estimate the relative risk of morbidity. The relative risk of morbidity from the use of tobacco may not be same as the relative risk of mortality. However, due to data limitations, this approach was used in this study. In another study, the relative risk of health-care utilization of smokers was estimated and this was applied to estimate the SAF.[42] It is difficult to apply such approaches in India due to limitations of the data.

Second, this study used relative risk from a Mumbai cohort study, which was based on the population of Mumbai during the 1997–99 follow up and hence it may not be representative.

Third, this study used four specific diseases to estimate direct and indirect cost of diseases, which may underestimate the total cost. However, the presentation of costs by all-cause mortality could to a large extent address such issues.

Fourth, there may be underestimation of indirect morbidity cost due to underreporting of income lost by the households for the unemployed and casual labourers.

Fifth, this study used NSSO-2004 data for estimating the household expenditure for different diseases, which was adjusted using consumer price inflation. However, higher medical inflation than general price inflation may lead to an underestimation of the total economic burden.

Despite these limitations, this study presents a comprehensive estimation of direct and indirect economic burden, especially the cost of premature mortality at the national level.

4.2 Concluding remarks

The main objective of this study was to generate evidence on the economic burden of diseases attributable to tobacco use at the national and sub-national levels in India. This study estimated, for the first time, the cost of diseases attributable to tobacco use at the sub-national level. It also estimated the cost of premature mortality at the all-India level thereby quantifying the losses in productivity due to premature deaths.

This study shows that total cost of tobacco-attributable diseases is substantial and in excess of public expenditure to GDP ratio in India. In 2011–12, the public expenditure to GDP ratio was 1.04% whereas the cost to GDP ratio was 1.16%. Among the various

components of costs, indirect cost, especially the cost of premature mortality, is huge. Around 70% of the costs occurred due to premature mortality (when someone in the family dies at an early age). Estimated loss to the economy is INR 730, 057 million, which is 0.81% of GDP. Thus, the productivity loss to society is enormous. This study produces evidence that men bear a disproportionately higher economic burden – almost 90% of the total cost, in comparison to women. This has a major implication for poor households, leading to further impoverishment, as in India the poor are more likely to use tobacco than the rich.

The economic costs from tobacco attributable diseases is more than 5 times higher than the excise tax revenue from tobacco in India in 2011

Among the 13 states, Uttar Pradesh unequivocally tops the list where the cost of the four diseases (cancer, respiratory, CVD and tuberculosis) is highest followed by West Bengal and Andhra Pradesh. The disease-wise analysis leads to the conclusion that women incur a higher burden of the cost incurred due to smokeless tobacco use. This occurs at the national level as well as in the states included in the analysis except Uttar Pradesh and Assam, where men incur a higher cost.

4.3 Recommendations

The enormous economic burden and resulting losses to the nation could be prevented in wake of stronger tobacco control initiatives by the government and civil society organizations. With a very low public expenditure on health care and the country needing more resources to tackle the double burden of diseases (communicable diseases and NCDs), it makes economic sense to invest in tobacco control efforts to reduce the burden of NCDs in India.

Comprehensive tobacco control policies and programmes

The National Tobacco Control Programme and similar schemes by various government departments including but not limited to health, agriculture, education, consumer affairs, social justice and empowerment, sports and youth affairs, women and child development, legal, urban and rural development and planning, etc. should reflect the various dimensions of the burden of tobacco use while designing their respective strategies and action plans. This will help in reducing tobacco consumption at the national and sub-national levels. It is only through inter-departmental coordination and multi-sectoral action that the burden of tobacco use can be mitigated.

Tobacco taxation policy

This study highlights that revenue earned from tobacco products is just a small fraction of the total cost and therefore the government needs to take steps to increase revenue from tobacco products. This is possible by increasing taxes on all forms of tobacco products to the tune of 70–80% of the retail price of such products. Such increase in tax should be undertaken annually on inflation-adjusted rates.

Uniform and substantial increases in taxes of all tobacco products is the most effective tool for reducing tobacco use

Treatment of tobacco dependence and cessation

Considering the huge burden of tobacco use, governments should allocate resources for treatment of tobacco dependence. It is important that accessible and affordable cessation services and treatments of tobacco dependence, including access to a tobacco cessation

Quitline be provided to tobacco users. Overall, a health promotion approach with community awareness and a proactive health system needs to be established at the grassroots level. For this purpose, support from the National Tobacco Control Programme should reach down to the level of primary health centres.

Prohibit Sale and manufacture of all forms of smokeless tobacco products/chewing tobacco

This study lends its support to the Government's efforts to prohibit the manufacture and sale of smokeless tobacco products, which can help to contain both the direct and indirect cost of cancer, especially among women who are more susceptible to smokeless tobacco use. Since most states and union territories have banned gutkha and other forms of tobacco use, it is critical that this landmark initiative is sustained through strict law enforcement.

Investing in public awareness

Awareness on the hazards of tobacco use and the consequent social, health, environment and economic burden must be generated and tobacco related information must be communicated in local languages to draw public attention to the colossal burden of the epidemic. Funds should be allocated under the National Tobacco Control Programme to ensure development and creation of local information, education and communication (IEC) materials that reach populations with low literacy levels. Considering the alarming burden of tobacco use among women and young people, more gender-specific IEC should be developed. It is also important to impart awareness and skills among youth – not only in schools, but also in colleges, universities, technical and other vocational institutions, besides hostels and residential homes for children – and empower them to stay away from tobacco not only at the individual level, but also advocate for tobacco-free norms in the family and community. In addition, strong and prominent health warnings must be displayed on all tobacco products and rotated at regular intervals.

Implementation of WHO Framework Convention on Tobacco Control and Cigarettes and other tobacco Products Act, 2003 (COTPA)

The study recommends strengthening the implementation of India's tobacco control law - COTPA and the Rules framed thereunder at national and sub-national (state) levels, including landmark efforts like tobacco-free films and television programmes, 85% pictorial health warnings, 100% tobacco-free public places and preventing youth access to tobacco products, particularly within 100 yards of educational institutions.

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