

The burden of cancer cases attributable to tobacco in India: case of Kerala and Bihar states

Abstract

Background: For effective planning and administrative purpose, a precise estimate of burden due to tobacco and projection figure is essential. There were some studies in India, reporting tobacco-related cancers. However, there is no observable study in India, especially for these backward and forward state, attempting to assess cancers due to tobacco for measuring the geographical variations. Hence, this study tried to highlights geographic variation between one from developed state is as Kerala, and another one is from not so well-developed state as Bihar in India.

Materials and methods: Tobacco prevalence, the relative risk of cancer due to tobacco, incidence rates of tobacco-related cancers, and population were obtained respectively from recent five rounds of Nation Sample Survey, our recently published study, reports of Population-Based Cancer Registries, and projections of Registrar General of India. Prasad and Dhar published generalised Population Attributable Risk method (2018) was used to assess cancer due to tobacco and regression method for prediction.

Results: The burden of cancer cases due to tobacco was found highest in the state of Bihar (23,679), while in Kerala, it was 5,981 in the year 2015 and increased to 42,244 and 6,646 by 2025 in Bihar and Kerala respectively. Lung cancer is the leading cancer sites followed by mouth and tongue cancers. In Kerala, the proportion of smoking is found to be high and lead to the higher proportions of larynx cancers (61percent) followed by oropharynx (59 percent) and lung cancer (58 percent) and are likely to increase from 2015 to 2025 slightly. In Bihar, around three fourth of mouth cancers cases being due to chewing followed by oesophagus (59 percent), tongue (54 percent) and so on.

Conclusion: Present study reports the absolute burden of cancer due to tobacco, Tobacco-Related Cancer as well as a percent change of it for Kerala and Bihar till 2025. It might be helpful to policy planners and administrators in decision making relating to anti-tobacco measures.

Keywords: cancer-related with tobacco, projections, cancer attributable to tobacco

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Introduction

A current study on the global burden of cancers shows that their incidence has been increasing steadily, and this increase has been steeper in low and middle-income countries.¹ To fulfil the Non-Communicable Diseases (NCD), Global Monitoring Framework's 25 by 25 strategy, i.e., reduction of NCD mortality by 25percent by 2025. We need to expedite the identification of significant causes of cancer which is one of the main NCDs and target our efforts to control or eliminate them. Cancers of the mouth, which are strongly associated with smokeless tobacco use, are one of the top six causes of Cancer in India.^{2,3}

A case study of Myanmar indicated a clear association between oral cancer and betelquidchewing.⁴ Usage of tobacco with lime was identified as a risk factor for oral cancer. In India, two extensive hospital-based case-control studies reported two-fold increases in the risk of Oral Cancer. One Indian study based on oral cancer said that current users of nasal snuff had a 3.9 relative risk for cancer of the gingival.⁵ Smoking sets a much higher chance of larynx cancer. However, one of the case-control Indian studies showed the highly significant relative risk for laryngeal cancer because of occasional pan-tobacco chewing.⁶

In India, particularly oral cancer bears a direct association with an increase in consumption of a broad range of tobacco products.⁷ Moreover, most of the studies highlighted that the use of smokeless tobacco causes oral cancer, oesophageal cancer (if chewed with betel quid) and conduces to cardiovascular diseases.⁸⁻¹⁰ Pharyngeal and oral cancers have a high incidence even among women in Southeast Asia.¹¹ The oral use of smokeless tobacco in this area is considered the predominant risk factor, particularly for oral cancer.¹¹

Lung, oropharyngeal and oral cavity cancers are the most common cancer sites observed by Indian registries, and Prasad and Dhar.^{2,12,13} These cancer sites are causally related to the use of tobacco in different forms.¹⁴ In India, the use of tobacco is common in the way of chewing and smoking of bid is and cigarettes.¹⁵⁻¹⁷ This study has done for the states of India, where NCRP reports are silent on an actual number of cancer cases due to tobacco. This is mainly owing to i) different forms of tobacco, and ii) varying degrees of association of tobacco with different types of cancers. Thus, this study has taken into account tobacco and shown that the actual burden of Cancer in Bihar and Kerala states at different points in time. Further, forms of tobacco consumption are significantly varying by geographically.³ Hence, this study tries to highlights geographical differences by taking one developed state (Kerala) and another not so well-developed state (Bihar).

Materials and methods

The state-wise prevalence of smoking, non-smoking and both types of tobacco consumption were obtained from the 61st, 62th, 64th, 66th and 68th rounds of NSSO for Bihar and Kerala states. Further, the Prasad & Dhar³ projected the forms of tobacco under some assumption and methods, which was applied in the present study to project the same for Bihar and Kerala for 2015, 2020, and 2025. Also, Prasad & Dhar² have estimated the cancer incidence for India and its State/Union Territories and projected the same till 2025. Current study has used the same method and assumption to project the number of cancer cases for the period 2015, 2020 and 2025.

Prasad & Dhar¹⁶ described the method descriptively for the estimation of Cancer Due to Tobacco (CDT) in view of multiple forms of exposure. The method is based on and is an extension of the idea of population attributable risk.¹⁶ Further, this method has been used for assessment of CDT in Bihar and Kerala, which required data on cancer incidence, the prevalence of different forms of tobacco use and relative Risk/Odds Ratio. Prasad & Dhar¹⁷ conducted a meta-analysis and stated pooled estimate of Odds Ratio (OR) for different combinations of exposure (forms of tobacco use) and outcome (various cancers associated with tobacco use). The current study applied the required data on OR from this study.

Results

Table 1 depicts the forms of tobacco consumption from 2015 to 2025 in Kerala and Bihar states of India, in which the prevalence of only smoking tobacco consumption was found highest in Kerala. It was around 34 percent in 2015 and increased to nearly 38 percent by 2025. However, only smokeless tobacco was most top in Bihar, which was around 59 percent in 2015 and rose to about 63% by the years 2025.

Table 1 Prevalence of forms of tobacco consumption in Kerala and Bihar, 2015-25

Regions	2015	2020	2025
OST			
Bihar	9.6	11.4	13.3
Kerala	34.4	36.1	37.8
OSLT			
Bihar	59.4	61.3	63.2
Kerala	3.3	3.3	3.3
BSSLT			
Bihar	8.9	10.2	11.6
Kerala	1.7	1.7	1.7

Note OST, only smoking tobacco; OSLT, only smokeless tobacco; BSSLT, both smoking and smokeless tobacco

In Bihar, lung cancer is the leading cancer sites followed by mouth and tongue cancers. Estimates for mouth cancer for the year 2015 is 8009, which will rise to 14541 by the year 2025. The numbers of cancer cases for all the sites for Bihar are 44,944, 58,177 and 71,908 for the years 2015, 2020 and 2025 respectively. The number of cancer cases in most of the sites is increasing throughout the years 2015 to 2025. Further, the estimates of TRCs for Kerala are 13,645, 14,326 and 15,083 for the years 2015, 2020 and 2025 respectively. For the year 2025, leading cancer will be of the lung (5,036), followed by mouth (2,653) and tongue (2,157) cancers, and so on (Table 2).

Table 2 Number of tobacco-related cancers during 2015-25 with percentage change during each 5-year period in Bihar and Kerala, India, 2015-25

Site of Cancer	Bihar					Kerala				
	2015	2020	2025	% change during		2015	2020	2025	% change during	
				2015-20	2020-25				2015-20	2020-25
Lip	374	394	411	5.35	4.31	130	133	138	2.31	3.76
Tongue	5558	7399	9316	33.12	25.91	1854	1976	2157	6.58	9.16
Mouth	8009	11196	14541	39.79	29.88	2401	2512	2653	4.62	5.61
Oropharynx	323	408	496	26.32	21.57	469	482	496	2.77	2.9
Hypopharynx	1359	1431	1489	5.3	4.05	528	543	554	2.84	2.03
Pharynx Unsp.	358	376	391	5.03	3.99	27	29	28	7.41	-3.45
Esophagus	3075	3754	4448	22.08	18.49	1261	1295	1323	2.7	2.16
Larynx	3511	3695	3847	5.24	4.11	1081	1112	1146	2.87	3.06
Lung	19657	26662	33987	35.64	27.47	4776	4908	5036	2.76	2.61
Urinary bladder	2721	2864	2983	5.26	4.16	1117	1337	1552	19.7	16.08
All TRCs	44944	58176	71907	29.44	23.6	13646	14327	15083	4.99	5.28

The contribution of cancer was found high due to smoking tobacco. Among all the sites associated with tobacco, the proportions of larynx cancers (61 percent) were the highest than others followed by oropharynx (59 percent) and lung cancer (58 percent) and are likely to increase from 2015 to 2025. Further, control of tobacco consumption, mainly smoking, will reduce around more than 40 percent cancers of oropharynx, larynx, hypopharynx, oesophagus, and lung in Kerala state (Table 3).

Chewing tobacco consumption is more dangerous in Bihar; around three fourth of mouth cancers cases being due to chewing followed by oesophagus (59 percent), tongue (54 percent) and so on. Overall, 81 percent mouth, 65 percent oesophagus and 63 percent oropharynx cancer cases will come down after combating tobacco consumption (Table 4).

Table 5 reveals the number of cancer cases attributable to tobacco by sites in Kerala and Bihar states of India. Before going for further explanation, there is a need to be clear about two terms used related to tobacco and attributable to tobacco. Related means number of cancers cases exposed to tobacco, while attributable means the actual effect of tobacco on the outcome (Cancer). This table reveals facts due to (attributable to) tobacco during 2015-25 with percentages during each 5-year period in Bihar and Kerala states of India. The burden of cancer cases due to tobacco was found highest in the state of Bihar (23,679), while in Kerala, it was 5,981 in the year 2015 and increased to 42,244 and 6,646 by 2025 in Bihar and Kerala respectively. In both states, lung cancer cases were found highest, followed by mouth cancers throughout the period 2015 to 2025. Percent change decreased from 2015-20 to 2020-25 in all sites of Cancer in Bihar states. However, in Kerala, it decreased in the only lip, hypopharynx, oesophagus, and lung cancer sites.

Table 3 Population attributable risk by sites among tobacco users in Kerala for 2015-25

Sites of cancer	Chewing			Smoking			Both			Overall		
	2015	2020	2025	2015	2020	2025	2015	2020	2025	2015	2020	2025
Lip	0.02	0.02	0.02	0.24	0.25	0.25	0.02	0.02	0.02	0.25	0.26	0.27
Tongue	0.06	0.06	0.06	0.22	0.22	0.23	0.03	0.03	0.03	0.27	0.28	0.29
Mouth	0.16	0.16	0.16	0.21	0.22	0.23	0.09	0.09	0.09	0.36	0.37	0.37
Oropharynx	0.05	0.05	0.05	0.59	0.61	0.62	0.07	0.07	0.07	0.61	0.62	0.63
Hypopharynx	0.05	0.05	0.05	0.45	0.46	0.47	0.04	0.04	0.04	0.48	0.49	0.5
Esophagus	0.07	0.07	0.07	0.37	0.38	0.39	0.04	0.04	0.04	0.41	0.42	0.43
Larynx	0.01	0.01	0.01	0.61	0.62	0.63	0.07	0.07	0.07	0.62	0.63	0.64
Lung	0.01	0.01	0.01	0.58	0.6	0.61	0.06	0.06	0.06	0.6	0.61	0.62

Table 4 Population attributable risk by sites among tobacco users in Bihar for 2015-25

Sites of cancer	Chewing			Smoking			Both			Overall		
	2015	2020	2025	2015	2020	2025	2015	2020	2025	2015	2020	2025
Lip	0.23	0.23	0.24	0.08	0.09	0.11	0.07	0.08	0.09	0.32	0.33	0.35
Tongue	0.54	0.55	0.56	0.07	0.08	0.1	0.15	0.17	0.19	0.59	0.6	0.62
Mouth	0.78	0.78	0.79	0.07	0.08	0.1	0.35	0.38	0.41	0.81	0.81	0.82
Oropharynx	0.47	0.48	0.48	0.29	0.33	0.36	0.27	0.3	0.33	0.63	0.65	0.67
Hypopharynx	0.49	0.49	0.5	0.18	0.21	0.24	0.17	0.19	0.22	0.58	0.6	0.61
Esophagus	0.59	0.6	0.61	0.14	0.16	0.18	0.18	0.2	0.22	0.65	0.66	0.67
Larynx	0.2	0.2	0.21	0.3	0.34	0.37	0.28	0.31	0.34	0.52	0.55	0.58
Lung	0.09	0.09	0.1	0.28	0.32	0.35	0.27	0.29	0.32	0.46	0.5	0.53

Table 5 Number of cancers attributable to tobacco in Bihar and Kerala, India for 2015-25

Sites of cancer	Bihar					Kerala				
	2015	2020	2025	% change during		2015	2020	2025	% change during	
				2015-20	2020-25				2015-20	2020-25
Lip	118	131	144	11.02	9.92	33	35	37	6.06	5.71
Tongue	3,281	4,466	5,738	36.12	28.48	505	552	618	9.31	11.96
Mouth	6,450	9,102	11,925	41.12	31.02	868	922	988	6.22	7.16
Oropharynx	202	264	331	30.69	25.38	288	301	315	4.51	4.65
Hypopharynx	788	855	915	8.5	7.02	251	264	275	5.18	4.17
Esophagus	1,991	2,481	2,996	24.61	20.76	518	545	569	5.21	4.4
Larynx	1,817	2,035	2,230	12	9.58	670	700	734	4.48	4.86
Lung	9,032	13,235	17,967	46.53	35.75	2,849	2,981	3,111	4.63	4.36
Total	23,679	32,570	42,244	37.55	29.7	5,981	6,300	6,646	5.33	5.49

Discussion

Smokeless tobacco consumption is significantly higher among poorer, rural and illiterate population compared with wealthier, urban and more educated people.¹⁸ This is likely to begin an epidemic of cancer in the middle of an existing heavy load of NCDs with cancer, which has been already become one of the significant killer diseases among the NCDs. Unlike the developed nations, the developing countries, including India, does not have a national level cancer registry, which makes a calculation of the national burden of cancer tough under the circumstances.

Thought, there have been attempts in the past with different models and approaches to project the burden of cancer-related to tobacco. Some authors have used the age-period-cohort model in the developed countries to predict the burden of cancer at the community level,¹⁹ which is neither feasible nor useful for India due to the lack of data. Therefore, this study has taken the approach, which was adopted by Prasad & Dhar¹⁶ to estimate and project the burden of cancer due to tobacco to see the variation in between one of developed (Kerala) and one of underdeveloped (Bihar) states.

Tobacco-Related Cancers (TRCs) were found to be the highest in Bihar for the selected periods. Among all TRCs, lung cancer was found to be leading cancer, followed by the cancer of the mouth and oesophagus. Tobacco is the cause of around 60, and 46 percent of lung cancer in Kerala and Bihar states respectively, in which smoking plays a significant role. WHO supports this finding and indicates that about 71percent lung cancer is due to smoking, which is higher among men and in the lower-middle-income countries.²⁰

The number of cancer cases due to tobacco consumption in Bihar is about 32.6 thousand for the year 2020, which will rise to around 42.2 thousand by the year 2025, an increase of 29.7 percent. However, in Kerala it is about 6.3 thousand in 2020, which will be increased to nearly 6.7 thousand, an increase of around 6 percent. It may be due to development. Similar, efforts were made earlier by others to study tobacco-related cancer, which shows similar trends.² The increase in cancer incidence is not only due to the rise in population but also due to the rise in life expectancy, modification in lifestyle and ineffective sustained efforts of the Indian Government to control infectious diseases.

Tobacco chewing is more in Bihar than tobacco smoking, which may result in an extra burden of oral cancers in Bihar state as compared to Kerala. Prevalence of chewing tobacco in these states, together with smoking tobacco might lead to a higher number of mouth cancers. Some studies indicate that one-third of all cancers are reported as oral cancer, and 90percent of oral cancer patients are tobacco users.^{21,22} Smoking tobacco is a major cause for oropharynx, larynx and lung cancer. Supported by a study conducted by Prasad & Dhar¹⁷ The highest numbers of cancer cases due to tobacco are found in Bihar. It may be due to a higher number of tobacco consumers. The percentage change in tobacco-related and attribute to tobacco consumption is highest in Bihar and leading to a continuous slightly decrease in the numbers of cancer cases. However, in Kerala, percent change shows decreasing trend only in lip, hypopharynx, oesophagus and lung cancer.

Conclusion

The prevalence of only smoking tobacco consumption was found to be high in Kerala, whereas, only smokeless tobacco was in Bihar. Lung cancer is the leading cancer sites followed by mouth and tongue cancers. In Kerala, the proportion of smoking is found to be high and lead to the higher proportions of larynx cancers (61percent) followed by oropharynx (59 percent) and lung cancer (58 percent) and are likely to increase from 2015 to 2025 slightly. In Bihar, around three fourth of mouth cancers cases being due to chewing followed by oesophagus (59 percent), tongue (54 percent) and so on. Percent change decreased from 2015-20 to 2020-25 in all sites of cancer. However, in Kerala, it slightly decreased in the only lip, hypopharynx, oesophagus, and lung cancer sites. To reduce the cancer cases from the not so well developed (underdeveloped) state, there is need to educate the people and focus on the quality of tobacco manufactured, and conduct region-wise research to specify smallest geographical part for special focus.

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Conflicts of interest

The authors declare there are no conflicts of interest.

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References

1. Fitzmaurice C, Dicker D, Pain A, et al. The Global Burden of Cancer 2013. *JAMA Oncol.* 2015;1(4):505–527.
2. Prasad JB, Dhar M. Projections of burden of cancers: A new approach for measuring incidence cases for India and its states – Till 2025. *Journal of Cancer Policy.* 2018;16:57–62.
3. Prasad JB, Dhar M. Tobacco use in India and its states: Burden of smoking and smokeless forms of tobacco (2015-25) and its predictors. *Journal of Cancer Policy.* 2017;14:21–26.
4. Sein K, Maung KK, Aung TH. An epidemiologic study of 70 oral cancer cases at the Institute of Dental Medicine, Yangon, Myanmar, 1985-1988. *Odontostomatol Trop.* 1992;15(1):5–8.
5. Sankaranarayanan R, Duffy SW, Day NE, et al. A case-control investigation of cancer of the oral tongue and the floor of the mouth in Southern India. *Int J Cancer.* 1989;44(4):617–621.
6. Rao DN, Sanghvi LD, Desai PB. Epidemiology of esophageal Cancer. *Semin Surg Oncol.* 1989;5(5):351–354.
7. Sankaranarayanan R, Ramadas K, Thomas G, et al. Effect of screening on oral cancer mortality in Kerala, India: A cluster-randomised controlled trial. *Lancet.* 2005;365(9475):1927–1933.
8. Kandpal SD, Sharma M, Aggarwal P. Awareness about tobacco use among medical students of Uttarakhand. *Indian Journal of Community Health.* 2011;23(1):23–25.
9. Gavarasana S, Doddi VP, Prasad GVSNR, et al. A smoking survey of college students in India: implications for designing an antismoking policy. *Jpn J Cancer Res.* 1991;82(2):142–145.
10. World Health Organization. World Health Organization global status report on alcohol. Department of Mental Health and Substance Abuse, Geneva. 2014:472.
11. Moore SR, Johnson NW, Pierce AM, et al. The epidemiology of mouth cancer: A review of global incidence. *Oral Dis.* 2000;6(2):65–74.
12. Prasad JB, Dhar M. Burden of Tobacco-related Cancers in India and its States, 2015-2025. *Social Science Spectrum.* 2018;4(3):147–158.
13. NCDIR-NCRP (Indian Council of Medical Research). Three-Year Report of Population Based Cancer Registries 2012-2014 Incidence, Distribution, Trends in Incidence Rates and Projections of Burden of Cancer (Report of 27 PBCRs in India). 2013:2012-2013.
14. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans VOLUME 83 Tobacco Smoke and Involuntary Smoking. Tobacco Smoke & Involuntary Smoking. 2004:83.
15. Gupta PC, Hamner JE, Murti PR. Control of Tobacco-Related Cancers and Other Diseases : Proceedings of an International Symposium, January 15-19, 1990. Bombay; New York: Oxford University Press; 1992.
16. Prasad JB, Dhar M. A descriptive method for combining the multiple outcomes of multiple exposures and its application with tobacco as exposure and cancer as outcome in a selected state in India. *Archives in Cancer Research.* 2018:145–160.
17. Prasad JB, Dhar M. Risk of major cancers associated with various forms of tobacco use in India : a systematic review and meta-analysis. *Journal of Public Health.* 2019;27:803–813.
18. International Institute for Population Sciences. National Family Health Survey (NFHS-4) 2015-16 India. International Institute for Population Sciences (IIPS) and ICF. 2017:1–192.
19. Olsen AH, Parkin DM, Sasieni P. Cancer mortality in the United Kingdom: Projections to the year 2025. *Br J Cancer.* 2008;99(9):1549–1554.
20. Nathan AJ, Scobell A. Global status report on noncommunicable diseases 2010. *Foreign Affairs.* 2012;91(5):176.
21. Gupta PC. Mouth Cancer in India : A New Epidemic? *J Indian Med Assoc.* 1999;97(9):370–373.
22. Shimkhada R, Peabody JW. Tobacco control in India. *Bull World Health Organ.* 2003;81(1):48–52.