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ORIGINAL ARTICLE

Trends in tobacco consumption in India 1987–2016: impact of the World Health Organization Framework Convention on Tobacco Control

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Abstract

Objectives We describe national and subnational trends in tobacco use over three decades in India, assess the impact of the World Health Organization's Framework Convention on Tobacco Control (FCTC) on them and draw inferences for regional tobacco control policy.

Methods Data from nine cross-sectional surveys conducted between 1987 and 2016 were analysed. Time trends in gender- and state-wise prevalence were derived for different forms of tobacco. To assess Framework Convention's impact, relative changes in tobacco prevalence before and after its implementation were estimated. Progress towards global noncommunicable diseases target was also measured.

Results Post-implementation of the FCTC, smoking and smokeless tobacco use declined by 52.9% and 17.6%, respectively. The tobacco product mix (exclusive smokeless/exclusive smoked/dual) underwent a reversal from 37:52:11 in 1987 to 65:22:13 in 2016. Having achieved 20.5% relative reduction since 2009, India is en route to achieving the global noncommunicable diseases target.

Conclusions Steep declines in tobacco use have followed the implementation of FCTC in India. However, the impact has been unequal on smokeless and smoked forms. Tobacco-control policies in high smokeless burden countries should take cognizance of this pattern and design comprehensive and flexible policies.

Keywords Framework Convention on Tobacco Control · Smokeless tobacco · Tobacco smoking · Trends · Tobacco control · India

Introduction

India is the second largest producer of tobacco in the world with an estimated annual production of 800 million kilograms (Food and Agriculture Organization of the United

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Nations 2003). It is also among the top three highest burden countries in terms of the number of users (GBD 2016 Risk Factors Collaborators 2017). In 2016, the global adult tobacco survey (GATS) estimated the prevalence of smokeless and smoked tobacco use in India among those aged $\geq$ 15 years to be 21.4% and 10.7%, respectively (Ministry of Health and Family Welfare 2017). Consequently, India is one of the four countries that shared more than 50% of the 6.3 million deaths and 155 million disability-adjusted life years (DALY) attributable to smoking, worldwide in 2016 (GBD 2016 Risk Factors Collaborators 2017). Besides smoking, South East Asian (SEA) countries, including India, suffer the additional burden of smokeless tobacco (SLT). SEA is home to more than 80% of the world's smokeless tobacco users (290 million) who outnumber the smokers (National Cancer Institute and Centers for Disease Control and Prevention 2014). Globally, in 2010, 652 494 deaths and 46 million DALYs were attributable to SLT use, of which over 80% was borne by SEA countries (Sinha et al. 2016).

Worldwide, tobacco control efforts have historically focussed most of the attention on cigarette smoking and accorded lesser importance to SLT control due to various reasons (National Cancer Institute and Centers for Disease Control and Prevention 2014). In tandem with the global movement, the earliest attempts at tobacco control in India began in 1975 but were limited in their effectiveness due to fragmented implementation, non-coordination between states and overemphasis on cigarettes (Mehrotra et al. 2010). The Indian Government was active in the World Health Organization's Framework Convention on Tobacco Control (WHO FCTC) negotiations, signed it in September 2003 and ratified it in February 2004 (Reddy and Gupta 2004). While becoming a signatory to the FCTC in 2003, India had also enacted the first recognizable federal law to regulate the supply, production, distribution, advertisement and sale of tobacco products—the Cigarette and Other Tobacco Products Act (COTPA) (Ministry of Law and Justice 2003). COTPA enforced five important regulations in sync with the FCTC recommendations, i.e. prohibition of smoking in public places, ban on tobacco advertising and sponsorship, ban on sale to and by minors and within 100 yards of educational institutions, display of pictorial health-warning labels and content regulation of tobacco products (Reddy et al. 2008, 2010). However, specific SLT control strategies (i.e. ban on sale of *gutka* and *paan masala*) were not incorporated under this law until after 2011, setting up the stage for non-uniform impact on the two major types of tobacco consumption. Although a few studies have tried to assess the impact of this law in the past, they have had a narrow approach, only looking at a few provisions at a time and none have assessed the overall, long-term impact on tobacco prevalence making use of all available data at the national and subnational levels.

The global noncommunicable diseases (NCD)-monitoring framework, which followed the United Nations political declaration on NCDs in 2011, targets a 30% reduction in tobacco use from 2010 levels, before 2025 (World Health Organization 2013). To monitor the progress towards this target, an analysis based on robust and comparable survey data across the evaluation period is essential. Despite the availability of such data in India, previous attempts have been limited in scope. Some studies have considered only two or three time points, while others have examined only smoking trends or specific subsets of the population (Gupta and Sankar 2003; Jhanjee 2011; Goel et al. 2014; Bhan et al. 2016). Further, India is an amalgamation of states with variations in socio-economic, developmental and health indicators. This heterogeneity necessitates examination of the state-level trends as being distinct from the national trend. Such monitoring of trends is also a requirement of the World Health Organization—Monitor, Protect, Offer help, Warn, Enforce and Raise taxes (WHO-MPOWER) strategy (World Health Organization 2008).

In keeping with the above, we analysed data from nationally representative surveys spanning over three decades to examine the national-level and state-wise trends in the prevalence of different forms of tobacco use among adults (15–49 years) in India, assess the impact of the FCTC and derive important lessons on tobacco control for other countries in the region undergoing a similar tobacco epidemic.

Methods

We performed a trend analysis based on a series of cross-sectional surveys conducted at different time points at the national and state levels.

Data sources

Three main indicators were selected for trend analysis—current use of any smokeless tobacco, any smoked tobacco and any tobacco. We attempted to identify all available surveys, which were conducted at the national level or state level across all available years. The selected surveys provided data for the above-mentioned indicators for at least one gender from a representative sample of the general population. Surveys that did not provide information on sample weighting or the selected indicators and those that did not allow access to raw data sets were excluded. A total of nine surveys (eight national and one subnational), conducted at different time points between 1987 and 2016,

were found eligible for the analysis. These surveys can be categorized into four types—the national sample surveys (NSSO rounds 43, 50 and 52), national family health surveys (NFHS 2, 3 and 4), district-level household and facility survey (DLHS-4) and the global adult tobacco surveys (GATS 1 and 2). All except DLHS-4 provided national-level data. The methodologies of the individual surveys are described in detail elsewhere (International Institute for Population Sciences 2018a, b; Ministry of Statistics and Program Implementation, Government of India 2018; Centres for Disease Control and Prevention 2018). All surveys used a multistage stratified random sampling but differed on the age groups studied. Among these surveys, NFHS 3 and NFHS 4 were different from the rest as majority of their sample consisted of women.

Excluded surveys

We identified seven other major survey reports, which could not be included in the analysis due to lack of publicly available/accessible raw data sets or sample weighting information. These were the special fertility and mortality survey (1998), the national household survey of drug and alcohol abuse (2000), the world health survey (2003), the sample registration system baseline survey (2004), two WHO STEPwise surveys (2004 and 2007) and the baseline annual health survey (2010).

Data availability and management

The common variables required for analysis across different surveys were mapped and their details recorded in a codebook. Questions on the selected tobacco-use indicators across the different surveys were matched in a standardized manner (Table S1). The availability of the original data sets and their main characteristics are summarized in Table S2.

Statistical analysis

Descriptive analyses were performed, and prevalence was calculated, state and gender wise, for each time point. Since the age groups included were different across the nine surveys, the analysis was restricted to the common age group of 15 to 49 years. Smokeless tobacco referred to those tobacco-containing products that are chewed or applied orally, for example, snus, tobacco tooth powders, snuff, *gutkha, khaini, tambaku, qiwam, dohra, kimam,* tobacco powder, *and mawa* among others. Any smoked tobacco included cigarettes, *bidis*, *hookah*, cigars, cheroots, *chuttas* and pipes. All proportions and their 95% confidence intervals were weighted to account for the complex survey design. For NFHS 3 and NFHS 4 surveys, which had sample size imbalances in sex, overall prevalence was adjusted according to state-wise sex proportions obtained from the nearest census data. The state-wise prevalences were represented in a series of heatmaps. Relative percentage change was calculated for two time intervals 1987–2005 and 2005–2016 to assess the impact of the FCTC. To monitor progress towards the fifth global NCD target, relative change was calculated for the time interval 2009–2016. Slopegraphs were used to visualize the ranks and relative percentage change in the states. Analyses were conducted in Stata 11 and QGIS 2.18.20. The codes and codebook of the statistical analysis are available at https://github.com/sarizwan1986/India-tobacco-trends.git.

Description of the surveys

All the included surveys employed a probability proportional to size, multistage, stratified random sampling technique. Trained interviewers collected data from household members by a face-to-face interview using a pretested structured questionnaire, translated into appropriate local languages. Data quality was maintained through standard quality control measures. The global adult tobacco surveys were focused tobacco surveys, whereas the NSSO surveys collected data on household expenditure patterns and the NFHS and the DLHS surveys dealt with maternal and child health issues. Sample sizes were comparable across the surveys; the GATS had the smallest, and the DLHS 4 had the largest sample sizes. All surveys had been conducted under the patronage of the Government of India.

Results

Time trends in tobacco use

Prevalence of any smokeless tobacco use increased from 15% in 1987 to 24.2% in 2009 and thereafter, declined to 19.3% in 2016. A similar pattern was observed among males and females—but in males the decline began earlier than the females (2005 vs. 2009). Despite this, the 2016 prevalence among females was 10% points lower than their baseline, while in males it was 47% higher than their baseline. On the other hand, prevalence of any smoked tobacco declined from 19.8% in 1987 to 8.6% in 2016; the prevalence among males ranged between 36% and 16%, while among females it never went over 3%. Prevalence of any tobacco use showed a declining trend initially, from 1987 (31.3%) to 1998 (25.9%), after which it briefly peaked to 34.7% in 2005 before falling to 24.6% in 2016. Males and females exhibited similar trends except that the changes in females were lagging behind males; the peaking

Table 1 Trends and relative change in the prevalence of tobacco consumption among adults (15–49 years) in India, 1987–2016

Type of tobacco product	Prevalence (95% confidence intervals)								% Change (2005–2016)
	1987	1993	1995	1998	2005	2009	2015	2016	
Any smokeless tobacco use									
Total	15.0	13.2	14.1	17.2	23.4	24.2	17.6	19.3	− 17.6
	(14.9, 15.2)	(13.1, 13.4)	(13.8, 14.3)	(17.1, 17.4)	(23.1, 23.8)	(23.6, 24.8)	(17.4, 17.9)	(18.7, 19.8)	
Male	19.5	18.4	21.4	25.7	36.9	32.7	29.0	28.7	− 22.2
	(19.2, 19.7)	(18.2, 18.7)	(21.0, 21.8)	(25.4, 26.0)	(36.3, 37.4)	(31.8, 33.7)	(28.6, 29.4)	(27.8, 29.6)	
Female	10.5	7.7	6.3	8.8	9.0	14.9	5.6	9.4	4.3
	(10.3, 10.7)	(7.6, 7.9)	(6.1, 6.5)	(8.6, 9.0)	(8.8, 9.2)	(14.3, 15.6)	(5.5, 5.7)	(8.9, 9.9)	
Any smoked tobacco use									
Total	19.8	17.2	17.6	13.7	18.3	11.9	12.5	8.6	− 52.9
	(19.6, 20.0)	(17.0, 17.4)	(17.4, 17.9)	(13.6, 13.9)	(18.0, 18.6)	(11.5, 12.4)	(12.3, 12.7)	(8.3, 9.0)	
Male	36.3	31.7	32.8	25.9	33.3	21.4	23.5	15.8	− 52.5
	(36.0, 36.6)	(31.4, 32.0)	(32.4, 33.2)	(25.6, 26.2)	(32.9, 33.8)	(20.6, 22.3)	(23.1, 23.9)	(15.2, 16.5)	
Female	2.8	1.9	1.7	1.6	2.2	1.6	0.8	1.0	− 53.8
	(2.7, 2.9)	(1.8, 2.0)	(1.6, 1.8)	(1.5, 1.7)	(2.1, 2.3)	(1.4, 1.9)	(0.7, 0.8)	(0.9, 1.2)	
Any tobacco use									
Total	31.3	27.2	27.9	25.9	34.7	31.0	25.8	24.6	− 29.0
	(31.1, 31.5)	(27.0, 27.4)	(27.6, 28.2)	(25.7, 26.1)	(34.3, 35.1)	(30.4, 31.7)	(25.5, 26.1)	(24.0, 25.2)	
Male	49.2	44.2	47.1	41.8	57.0	45.0	44.3	38.4	− 32.6
	(48.9, 49.5)	(43.9, 44.6)	(46.7, 47.6)	(41.5, 42.1)	(56.5, 57.5)	(43.9, 46)	(43.8, 44.7)	(37.4, 39.4)	
Female	12.8	9.3	7.7	10.0	10.8	15.9	6.2	10.1	− 6.6
	(12.6, 13.1)	(9.1, 9.5)	(7.5, 8.0)	(9.8, 10.2)	(10.6, 11.1)	(15.3, 16.6)	(6.2, 6.3)	(9.6, 10.7)	

2005–2016 refers to the period after the implementation of Framework Convention on Tobacco Control provisions. State-wise, product-wise and gender-wise data are presented in Table S3A-C

happened in 1995 and 2005 in males but in females they occurred in 1998 and 2009 (Table 1, Figure S1).

Impact of the FCTC regulations

In the period following the implementation of the national anti-tobacco law as per FCTC obligations (2005–2016), all forms of tobacco use declined. The highest decline of 52.9% was seen in smoked tobacco use, whereas smokeless tobacco use declined by 17.6% and any tobacco use declined by 29%. Since smokeless tobacco use in females had a delayed peak in 2009, a sight increase of 4.3% was seen, but it had actually reduced by 35% in the interval 2009–2016 (Table 1).

Change in product mix

Overall, there was an inversion in the predominant type of tobacco product used across the study period. The relative contribution of exclusive SLT to exclusive smoking to dual use of 37:52:11 in 1987 switched into a 65:22:13 distribution in 2016. A similar inversion was observed for males but not females (Figure S2).

State-wise trends

State-wise prevalence of tobacco use for 1987, 2005 and 2016 is presented in Fig. 1. In 2016, the top three states with the highest smokeless tobacco burden were the north-eastern states of Manipur (49.2%), Tripura (48.3%) and Nagaland (40.6%). Among these, Manipur and Tripura were yet to reverse the rising trend in smokeless tobacco use since 1987. As of 2016, the smokeless tobacco use among males in these states was twice the national average (28.7%) but among their females, it was almost five times the national average (9.4%). In 2016, Himachal Pradesh (2.8%), Kerala (2.9%) and Jammu & Kashmir (3.4%) had the lowest prevalence of SLT usage overall and among males. Among females in the states of Goa, Haryana, Jammu & Kashmir, Chhattisgarh, Kerala, Punjab and

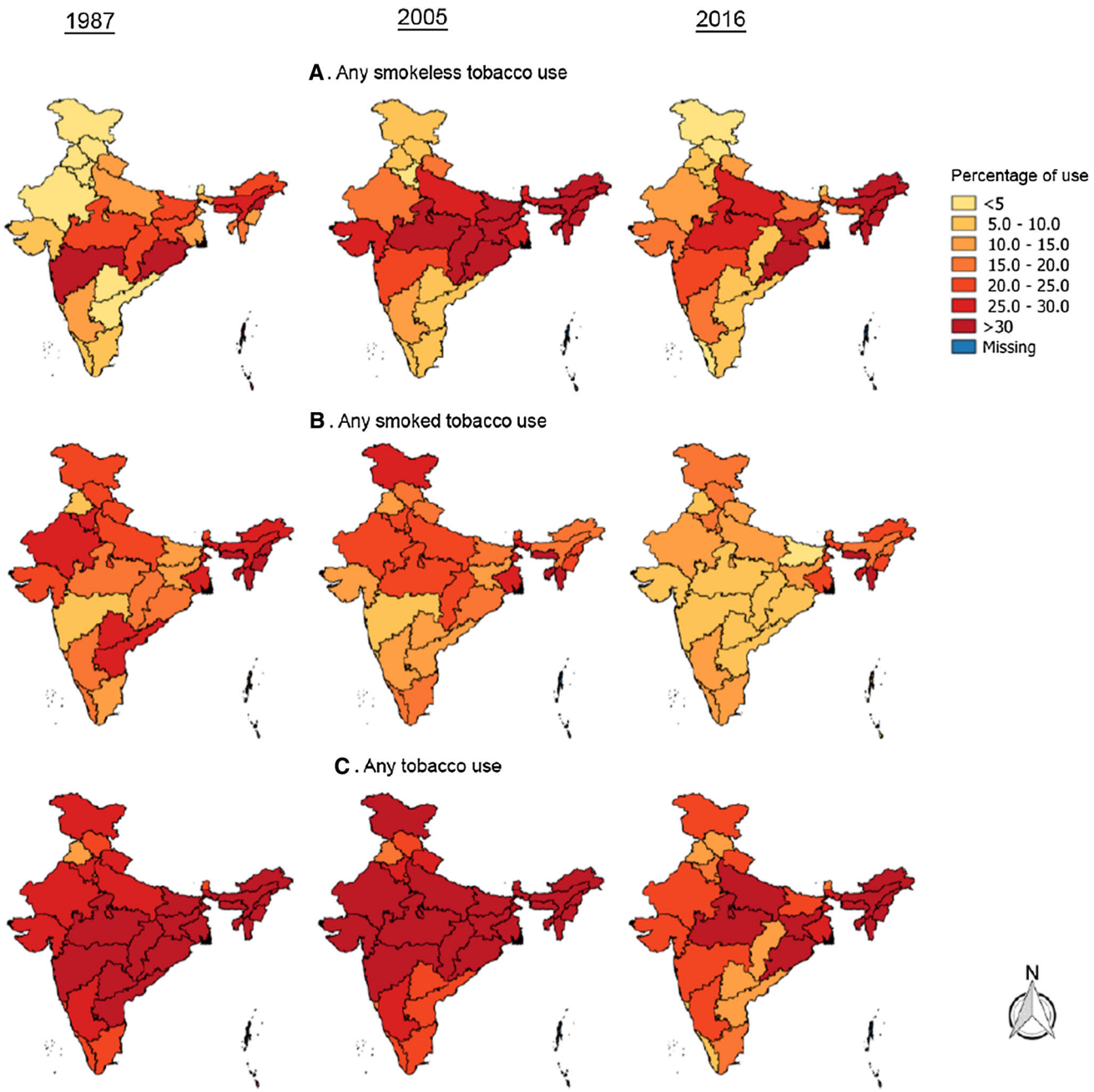

Fig. 1 State-wise trends in the prevalence of tobacco consumption in India, 1987–2016

Himachal Pradesh, prevalence of $\leq 1\%$ was reported. Post-2005, Chhattisgarh (81.1%), Sikkim (67%) and Kerala (65.4%) had achieved the highest relative reductions, whereas Haryana (31.4%) and Karnataka (16.2%) had recorded an increase in SLT use (Figure S3A-C, Table S3A).

The north-eastern states of Mizoram (33.8%), Meghalaya (30.3%) and Tripura (25.5%) were the top three states with the highest prevalence of tobacco smoking since 2005, despite recording a consistent reduction in the prevalence between 1987 and 2016. Arunachal Pradesh was the only state that registered a relative increase in smoking (22.1%) from 2005 to 2016. Karnataka (67.9%), Andhra Pradesh (172.7%) and Meghalaya (338.6%) reported a relative increase in female smoking between 2005 and 2016. During this period, Goa (2.9%), Bihar (2.9%) and Maharashtra (2.6%) had the lowest prevalence and they also registered a relative decline of $> 60\%$ since 2005. In 2016, Kerala, Odisha, Tamil Nadu and Goa reported zero prevalence of female smoking (Figure S3D-F, Table S3B).

Tripura (62.2%), Mizoram (57.2%) and Manipur (53.9%) had the highest burden of any tobacco use in 2016.

Goa (7.8%), Kerala (9.1%) and Himachal Pradesh (11.9%) had the least burden of any tobacco usage. Post-2005, all states have reported a reduction in any tobacco usage ranging from 0.4% (Tripura) to 52.3% (Goa). Among the states with tobacco-use prevalence higher than the national average, the north-eastern states recorded lesser gender gap (< 17%) compared to the other states where wider gender gap (> 25%) was the norm (Fig. 2, S3G-H, Table S3C).

Progress towards global NCD target number five

India is en route (20.5% reduction since 2009) to achieve the global monitoring framework for NCDs target that requires a 30% reduction in tobacco prevalence since 2010, before 2025, among population aged 15 years and over. At the national level, the target has been achieved only for females (36.5%), while among males (14.6%) the progress is just half way through. Out of the 29 states considered, only seven, namely Chhattisgarh (74.8%), Bihar (58.8%), Sikkim (54.7%), Kerala (47.9%), Andhra Pradesh (36.3%),

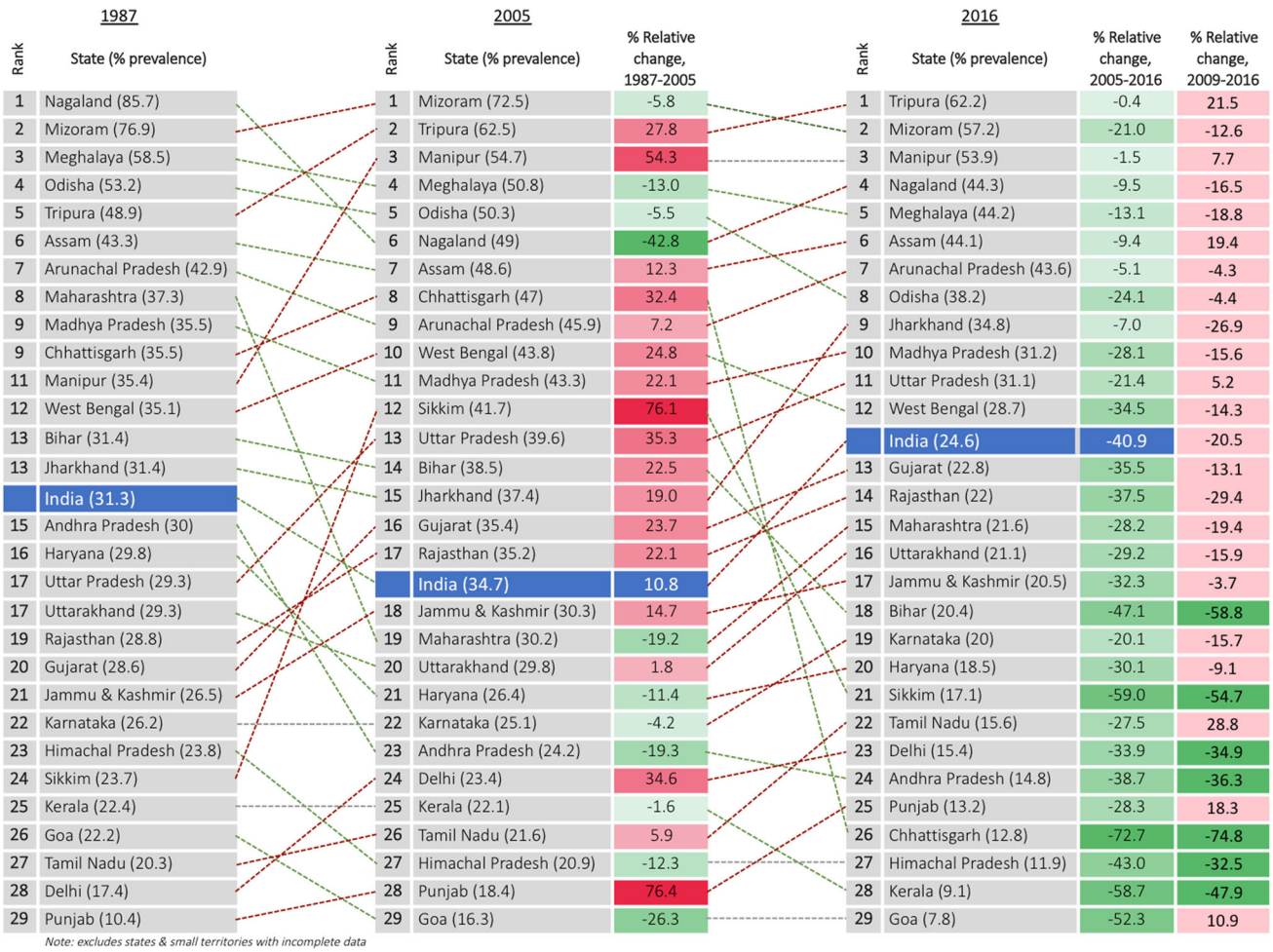

Fig. 2 Trend in state-wise ranks and relative change in the prevalence of any tobacco use in India, 1987–2016. *Note* In each column, the states are arranged in descending order of prevalence. The change in rank of a state between two time points is tracked by dashed lines (maroon for worsening and green for improvement). The 1987–2005 column refers to the period before and the 2005–2016 column refers to the period after the implementation of the Framework Convention on Tobacco Control. In the columns presenting relative change, a relative increase in prevalence is coloured in shades of red and a relative decline is coloured in shades of green (intensity of colour is proportional to the magnitude of change). The last column, 2009–2016 relative change, depicts achievement of global tobacco control target (green for target achieved and pink for not). For example, let us take the state of Tamil Nadu. Its rank was no. 27 in 1987. It worsened to rank 26 in 2005 (dashed maroon line) with a relative increase in prevalence of 5.9%. It again worsened to rank 22 in 2016 (dashed maroon line), in spite of a relative decline of 27.5% in prevalence. Although the prevalence of tobacco use declined by 27.5% between 2005 and 2016, the rank of Tamil Nadu worsened because there were other states (Delhi, Andhra Pradesh, Punjab, Chhattisgarh, Himachal Pradesh, Kerala, Goa) that performed much better than Tamil Nadu. Finally, it can be seen from the final column that Tamil Nadu has not achieved the NCD target (relative increase of 28.8% from 2009 to 2016, coloured pink) (Colour figure online)

Delhi (34.9%) and Himachal Pradesh (32.5%), have achieved the target. Jharkhand (62.2%), Rajasthan (32.8%), Jammu & Kashmir (35.9%), Karnataka (37.1%) and Andhra Pradesh (45.9%) have achieved the target only for females (Fig. 2, Figure S3G-H, Table S4).

Discussion

We analysed data from nine national/subnational cross-sectional surveys to assess tobacco trends among adults in India. Availability of data across three decades enabled an ecological evaluation of the impact of the FCTC implementation in India. Between 1987 and 2016, smoked tobacco use showed a steeper decline compared to SLT use. There has been a radical switch in the predominant type of tobacco product used after 1995, with chewers outnumbering the smokers. After the implementation of FCTC provisions, all forms of tobacco use declined and India is on track to achieve the global tobacco control target by 2025 but with constituent state at varying levels of achievement.

Tobacco trends in India: Interplay between smoked and smokeless tobacco use

Globally, current smoking has declined by 6.7% since 2000 and by 4.1% since FCTC implementation (World Health Organization 2018). This fall has been observed everywhere except for some countries in the African and Eastern Mediterranean regions (Ng et al. 2014; Bilano et al. 2015; Brathwaite et al. 2015; World Health Organization 2015). Even in China, the nation with the highest number of smokers, current smoking had declined sharply between 1993 and 2003 (Qian et al. 2010). Our analysis demonstrating the decline in smoking in India was in line with the findings of the global burden of disease study and the World Bank (Institute for Health Metrics and Evaluation 2018; The World Bank 2018). Presently, high- and low-income countries find themselves at different phases of the four-stage smoking epidemic (Thun et al. 2012). India, which now lies in stage three may not pass through stage four, when female smoking exceeds male smoking prevalence, because of the marked differences in the epidemic drivers between India and other developed nations.

In contrast to smoking, the global trends in SLT prevalence are not clearly understood. The SLT problem is prevalent only in some regions of the world such as the SEAR and data on SLT are sparse. Nevertheless, its prevalence has been found to be declining in Bangladesh, India, Indonesia, Myanmar and Nepal according to a WHO report (World Health Organization 2015a, b). In India, unlike the smoking trend that declined consistently from 1987, SLT use was on the rise until 2009, after which it began to decline. One reason for this difference could be the differential impact of early anti-tobacco measures that focused primarily on smoking. After the ratification of FCTC in 2004, India introduced a slew of legal anti-tobacco measures, but initially the measures were focussed on controlling smoking (Arora and Madhu 2012). Some of these measures included ban of sale to minors, point-of-sale advertisements, sale near educational institutions, smoking in public places and implementation of tobacco packaging health warnings. Although some of these regulations (advertisements and educational institutions' embargo) applied to SLT products as well, the law specifically banned the manufacture and sale of *gutka* and *paan masala* (the major SLT products) only in 2013 (Ruhil 2018). However, many other diverse SLT products still continue to be sold and consumed freely. Taxation, one of the most effective tobacco control measures, has been very beneficial in reducing smoking prevalence in India (World Health Organization 2015a, b). However, the SLT market has evaded the tax net for far too long. Taxation on cigarettes and other smoked products have continued to rise between 2008 and 2015, but there was no commensurate increase in taxes on SLT products encouraging their unabated use (The International Tobacco Control Evaluation Project 2018).

Besides the lopsided legal restrictions and taxation policies, inadequate sensitization of the population to the SLT hazards may have influenced their use. While SLT users are aware that it is not harmless, the more explicit depiction of the hazards of smoking can be contrasted with the mellowed-down statements of SLT health risks (Kozlowski and Sweanor 2018). Also, cultural acceptance, religious connections, diverse and unregulated nature of the SLT market, the livelihood of local tobacco farmers and the lower socio-economic status of its users make the control of SLT difficult (Moore et al. 2012; Zaatari and Bazzi 2018).

From smoking to chewing—the product switch

As a result of the differential decline between SLT and smoking, a paradigm shift occurred in the major type of tobacco used post-1995, when the SLT prevalence surpassed smoking by a large margin. A complete understanding of the tobacco landscape in India necessitates the simultaneous consideration of the evolution of SLT use and smoking. Although no strong evidence exists for the complementarity of smoked and smokeless tobacco, it is possible that a substitution of smoked forms by SLT in response to price hikes and legal restrictions on smoked forms could have occurred (2015). After all, smokeless tobacco use has been commonly reported among former

smokers (Richardson et al. 2014). Misleading marketing and promoting SLT as a smoking cessation aid may also explain smokers switching over. The manner in which the complex interplay of legal, political, economic and cultural influences and risk communication will affect the product preferences of new tobacco users should be explored in future studies (Perkins and Neumayer 2014). This knowledge could help us to better predict the future directions of the tobacco epidemic.

Over the years, SLT has been strongly implicated in the causation of several cancers. Worryingly, SLT use and its attributable disease burden, unlike cigarettes, have the distinction of disproportionately affecting the vulnerable sections of the population, propagating health inequities (Thakur et al. 2013). The lack of emphatic evidence on effective SLT cessation interventions deters the provision of credible cessation services for SLT users within the existing healthcare delivery system (Ebbert et al. 2007). The many SLT-related challenges described above require us to further our understanding of its role as a temporary behaviour or as a smoking alternative or as a gateway product among new users. This will inform our preventive efforts.

Interstate variations in tobacco trends

Unsurprisingly, the trends of tobacco use were markedly different across the various states of India. Nonetheless, some policy-relevant generalizations could be made. Northeast India recorded the highest prevalence of any form of tobacco use. There is a distinct chewing belt spanning across central India and a smoking belt that engulfs northern and north-western India. Education, income, caste and other socio-economic variables which are recognized as strong predictors of smoking and smokeless tobacco use may explain this interstate variation (Agrawal et al. 2013). Belonging to a particular state has been observed as an independent predictor of tobacco use implying that distal factors such as tradition, politico-legal climate and geography, operating at a state level, also influence tobacco-use behaviour (Subramanian et al. 2004). Some high prevalence states such as Chhattisgarh, Bihar and Sikkim and some states with a higher development index such as Kerala, Andhra Pradesh and Himachal Pradesh have made remarkable progress in tobacco control. As suggested above, there could be many reasons for interstate variations in tobacco control progress but the extent to which each state has been able to implement the anti-tobacco measures probably played a pivotal role.

Measuring progress towards targets

It has been previously projected that India has more than 95% probability of achieving the fifth target specified under the global NCD control framework by 2025 (Bilano et al. 2015). Our observation also confirms that India is on track to achieve this 30% reduction target. In fact, it has achieved this target for female tobacco users. It was evident that although females were late to adopt tobacco, they also quit or avoided the behaviour before the males did. The lower use and steeper decline observed among females was similar to that seen in China (Chen et al. 2015). Although this success is encouraging, the war against tobacco is far from over. Consistent public health efforts are required to respond to the dynamic tobacco scenario and usher into an era where tobacco ceases to be a public health problem. In addition, the target needs to be achieved by most, if not all, of the states for the control to be considered truly successful.

Strengths and limitations

The major strengths of this study lie in its size and representativeness. Drawing from nine rigorous nationally representative surveys, we are looking at one of the largest data pools ever handled to address the question of tobacco trends and patterns in India. Naturally designed, four out of nine data points lie after the implementation of FCTC provisions and the anti-tobacco law allowing us to assess their impact. We have discussed the tobacco epidemic in its entirety (nationwide, state wise, gender wise, product wise and year wise), providing policymakers with the bigger picture rather than piecemeal hunches. Prior to this, there was only a limited examination of SLT trends, but we have provided an in-depth analysis of the SLT trends in tandem with that of smoked tobacco. This is the first study to offer state-wise estimates and insightful interstate comparisons on tobacco trends. We also provided a measure of progress towards the global NCD target for tobacco—at the national and state levels.

There are a few limitations to consider. Not all surveys conducted between 1987 and 2018 were included for reasons already mentioned in the methodology. The heterogeneity across surveys, in terms of their objectives and methodologies, limited our ability to make absolute comparisons, despite our best efforts to make them as homogenous as possible. Firstly, the widely varying upper age limit in the different surveys was a source of major heterogeneity, which was overcome by restricting the analysis to 15–49 years. Secondly, the placement and wording of tobacco-use questions in the different surveys were not the same but we mapped similar questions across

the surveys and made sure that they matched as much as possible, reducing the possibility of errors. Thirdly, although all the surveys employed representative sampling, the varying sample sizes in each survey introduced varying errors of precision, more so at the state level. This imprecision was quantified by 95% confidence intervals, a close examination of which revealed that, except for a few states with very small sample sizes, the uncertainty was agreeable in general. Fourthly, the social desirability bias that often accompanies surveys of unfavourable personal behaviours is likely to have played a role in this analysis. However, it is inconceivable that this bias would have had differential effects across the different surveys and years. Finally, the notion that these different surveys lack absolute comparability because of their primary intentional differences is invalid in so far as the individual estimates for neighbouring time points did not vary to a large extent.

Conclusions

Over the past three decades, the prevalence of smoking has declined steeply and consistently. But, this has been accompanied by an initial rise and lesser magnitude of decline in SLT prevalence. Post-FCTC, the prevalence of all forms of tobacco use declined, setting India on track to achieve the global tobacco target of 30% reduction before 2025. Nevertheless, the achievements among the states have been unequal. The north-eastern states of India, especially Tripura, Mizoram, Manipur, Meghalaya, Assam and Arunachal Pradesh, reported the highest prevalence in smoked, smokeless and any tobacco use. Besides these, Odisha, Jharkhand, Madhya Pradesh, Maharashtra, Bihar and Uttar Pradesh reported high SLT prevalence, while Jammu and Kashmir, Haryana and West Bengal reported high smoking prevalence.

Policy implications for India and the SEA region

Tobacco-control policies with equal emphasis on strategies for SLT and smoked tobacco are recommended. These policies need to take into consideration the unique factors propelling the SLT epidemic and address them accordingly rather than directly transplanting strategies from the experience of anti-smoking efforts. An equitable approach to tobacco control demands specific policies against SLT with a special focus on the economically disadvantaged. Gender-based tobacco policies are required in lieu of the differences observed between male and female tobacco epidemics (Bandyopadhyay and Irfan 2018). Given the diversity in political commitment and socio-economic indicators across subnational units, it would be wise to renounce the 'one-size-fits-all' approach and weave specific strategies to achieve effective tobacco control.

Author contributions RSA conceived the study and managed the overall enterprise; DNS and PCG identified and extracted the data sources; NA carried out data management; RSA, KJ, RSR and DV performed the analysis; DNS, PCG, NA and SK provided critical feedback on the analysis, results and interpretation; KJ, RSR and RSA wrote the first draft. All authors approved the final manuscript.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interests.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors. The original surveys included in the analysis had obtained ethical approvals from the participating institution's boards. The data sets of these surveys were publicly available or available on request, and all individual identifying information was removed.

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