Journal of Public Health: From Theory to Practice (2019) 27:453–459
https://doi.org/10.1007/s10389-018-0973-x

ORIGINAL ARTICLE

Classification of nicotine-dependent users in India: a decision-tree approach

Akansha Singh [1] · Himanshu Katyan [2]

Received: 1 June 2018 / Accepted: 20 August 2018 / Published online: 5 September 2018

Abstract

Aim India has been predicted to have the fastest increase in deaths attributable to tobacco in the first 2 decades of the twenty-first century. Consequently, it is imperative to examine the extent of nicotine dependency among adults in India. The main objective of the present article is to characterize nicotine dependency related to smoking and smokeless tobacco among adults according to age, education level, duration of use and other socioeconomic characteristics.

Subjects and methods We analyzed Global Adult Tobacco Survey (GATS) 2010 data for 9190 smokers and 13,357 smokeless tobacco users who were 15 years of age or older. Time to first tobacco use of the day was used as a measure of nicotine dependence. We employed a decision tree algorithm from SAS Enterprise Miner to conduct classification analysis to establish the relationship among nicotine dependency for smoking, smokeless tobacco use, and its predictors.

Results More than 65% of smokers and 54.3% of smokeless tobacco users were nicotine dependent. The decision tree results showed that the most important explanatory variable for the prediction of smoking dependency was duration of smoking followed by education, gender and region. For smokeless tobacco use, duration of smokeless tobacco use was also the most important explanatory variable followed by education, occupation and age.

Conclusions Smoking and smokeless tobacco use dependencies are driven by different sets of demographic and socioeconomic predictors. Suitable plans for tobacco cessation need to be implemented based on the type of tobacco and particularly duration of use, which was found to be the most important determinant of quitting.

Keywords Tobacco · Smoking · Decision tree · Nicotine dependency · Smokeless tobacco

Introduction

The burden of the tobacco epidemic hinders society and economic progress as the combined costs of tobacco-related deaths and related productivity losses drain the global economy each year (Shafey et al. 2009). A substantial proportion of current global tobacco users reside in developing countries such as India. India is also one of the few countries in the world where prevalences of both smoking and smokeless tobacco use are high (Reddy and Gupta 2004). Tobacco use is the causal risk factors for many types of cancers and other diseases. According to the World Health Organization, nearly 6 million deaths occur every year because of tobacco use in India, a figure that will rise to 8 million deaths by 2030 (World Health Organization 2008). In a nationally representative study, it was estimated that smoking caused about 930,000 adult deaths in India in 2010, with 70% of these deaths occurring in the 30–69-year age group (Jha et al. 2008). Smokeless tobacco use is related to oral cancer and cancer of the head, neck, oesophagus and pancreas (World Health Organization 2008). The Government of India has enhanced their involvement in tackling India's tobacco problem. The Cigarettes and Other Tobacco Products Act (COTPA) of 2003 prohibits smoking in public places, forbids sale of tobacco products to and by minors under 18 years of age, bans the sale of tobacco products within 100 yards of all educational institutions and makes pictorial health warnings on tobacco products packages mandatory (Government of India 2003). The National Tobacco Control Programme (NTCP) was implemented in 2007–2008 (Government of India 2008) to enforce the

✉ Akansha Singh
akanshasinghiips@gmail.com

[1] Centre de recherche en démographie, Université Catholique de Louvain, Place Montesquieu, 1 bte L2.08.03-1348, Louvain-la-Neuve, Belgium

[2] Syneos Health, Zaventem, Belgium

COTPA provisions. The above-mentioned acts and various other programmes have contributed towards the fight against tobacco use in public places.

Different forms of tobacco use are prevalent in India. Smoking, as well as smokeless tobacco use, is predominant among males, whereas the vast majority of females use smokeless tobacco. Cigarette smoking among females is not widely accepted in India, although it is gaining popularity among the elite in urban areas (Aghi et al. 2001; Kaufman and Nichter 2001). The recent Global Adult Tobacco Survey India (GATS India) data revealed that 35% of adults in India use tobacco. *Bidi* is the most commonly used smoking product followed by the cigarette. Use of smokeless tobacco (often consumed by chewing) is also prevalent. *Khaini* or a tobacco-lime mixture is the most commonly used smokeless tobacco product. The prevalence of smokeless tobacco products, except dentifrice, is higher among males than females (Ministry of Health and Family Welfare, Government of India 2010). Several studies in India provide information about the estimated prevalence of tobacco use along with selected characteristics and factors affecting it (Rani et al. 2003; Subramanian et al. 2004; Singh and Ladusingh 2014). There are also a few studies about patterns of use and age of initiation for tobacco consumption (Manimunda et al. 2012; Singh and Ladusingh 2014). Although tobacco is extremely addictive, few studies have examined the level of tobacco use dependency in India (Chandra et al. 2005; Manimunda et al. 2012; Islam et al. 2014; Parashar et al. 2016). Most of the past research on nicotine dependency was either based on localized studies or limited to specific focus groups in terms of their tobacco habit (Chandra et al. 2005; Islam et al. 2014). In the context of the high prevalence of tobacco use in the country, its extremely addictive nature as well as the associated health hazards, there is an urgent need to measure the rates of tobacco use in India. The GATS is the first large-scale tobacco survey to collect reliable information on tobacco use in India among adults aged 15 years and above. This survey gives us an opportunity to investigate the degree of nicotine dependency and its associated socioeconomic, demographic and knowledge-related factors (Ministry of Health and Family Welfare, Government of India 2010). To assess the effect of socioeconomic, demographic and knowledge-related factors on nicotine dependency and identify the risk subgroups, we used novel statistical techniques to create a framework for measuring nicotine dependency and tested the model to ascertain the contribution and relative importance of each predictor.

Methods

Data source

Data from the GATS India were used for this study. GATS India is the first comprehensive, nationwide, multistage sampling survey to measure tobacco use in India. It was conducted in 2009–2010 as a household survey of adults aged 15 years and above. A total of 69,296 interviews were completed, of which 33,767 and 35,529 were with males and females respectively. The survey design was multistage, with two stages in the rural and three stages in the urban areas. Several questions related to the extent of nicotine dependency were asked. The most important was "How soon after you wake up do you usually smoke for the first time?". A similar set of questions was asked about smokeless tobacco use.

Measuring nicotine dependency

Several measures of nicotine dependency have been reported in the literature. Most of those commonly used in large survey studies assess dimensions such as the extent of tobacco use calculated in terms of frequency of daily use (e.g. number of cigarettes smoked per day) (Sargent et al. 1998) or minutes to first use of tobacco upon awakening (Son et al. 1997). The extent of nicotine dependency in this study was measured using first use of tobacco after waking up, measured in minutes, since it appears to show a pattern of heavy, uninterrupted tobacco use and may be a good single-item measure of nicotine dependence. Daily tobacco users whose first use of a smoking/smokeless tobacco product was within 30 min of waking up were the dependent variable in this study (yes/no).

Independent variables

The independent variables used in this study were age in years (15–24, 25–44, 45+), gender (male/female), place of residence (rural/urban), education (no education, less than primary, primary but less than secondary, secondary and above), occupation (government or non-government employee, self-employed, student, homemaker, retired/unemployed), duration of use of smoking/smokeless tobacco products in years (< 15, 15–24, 25+), knowledge that exposure to smoking/smokeless tobacco causes serious illness (yes/no), smoking allowed in home (yes/no), thought of quitting smoking/smokeless tobacco after seeing warning labels on tobacco products (yes/no), number of household members and geographical region in India.

Statistical analysis

Bi- and multivariate analyses were carried out to assess the effect of socioeconomic, demographic and knowledge-related factors on nicotine dependency and identify the risk subgroups. Bivariate analysis was performed using SAS 9.4. Decision tree analysis was used to predict the likelihood of nicotine dependency and examine the significance of different predictors in the multivariate analysis. Decision tree methodology is a commonly used data mining method for

establishing classification systems based on multiple covariates or for developing prediction algorithms for a target-dependent variable. It classifies a population into branches that construct an inverted tree with a root node, internal nodes and leaf nodes. Decision trees involve splitting the data into groups by successively dividing the data into subgroups based on empirically derived associations between the response (target) and one or more predictor variables. A decision tree incorporates both a stepwise forward procedure that adds model terms and a backward procedure for pruning and conducts variable selection by only including useful and significant variables in the model. All observations are first sorted into bins based on the predictor value(s). Criteria are established for each predictor to determine which observations go into which bins in such a way as to maximize the association with the response. Then, the predictors that have the best association with the target variable are divided in a particular subgroup. The decision tree algorithm is non-parametric and can efficiently deal with complex data sets without imposing a complicated parametric structure. The study sample was divided into training (60%) and validation (40%) data sets. The training data set was used to build a decision tree model, and the validation dataset was used to select the appropriate tree size to achieve the optimal final model. This study used the decision tree dialogue box in SAS Enterprise Miner 9.4.

Results

Table 1 shows the percentage of daily tobacco users consuming first tobacco within 30 min of waking up according to the variables selected for the decision tree model. This proportion was 53% in the 15–24-year age -group and increased to 67% in the 45-year + age group. Similarly, among smokeless tobacco users, the figures varied from 41% in the 15–24-year age group to 59% in the 45-year+ age group. More male daily smokers (66.7%) than female smokers (59.6%) smoked for the first time within 30 min after waking up; no significant gender variation was found for the smokeless tobacco users. Among current users of tobacco, the consumption of tobacco products within 30 min after waking up decreased sharply the higher the educational attainment level. The prevalence among smokers with no education was 69.2% and among secondary and above educated smokers was 56.7%. Similarly, the consumption of smokeless products also showed a decreasing pattern from 58.9 to 49.6% in similar subgroups. Dependency on the consumption of tobacco increased with duration of use among daily tobacco users. A positive relationship was observed between duration of use and first tobacco consumption of the day. A higher proportion of daily smokers (71.3%) who had been smoking for more than 25 years smoked their first smoking product within 30 min of waking up compared with 57% of those who had been smoking for less than 15 years. Similarly, 63.3% of smokeless tobacco users with more than 25 years of use took tobacco within 30 min of waking up. Overall, dependency was higher among smokers than smokeless tobacco users. Significant regional variation in the first tobacco use pattern was observed. The proportion among smokers varied from 57.1% in the North to 70.7% in the South. Similarly, among smokeless tobacco users, the figures varied from 42.4% in the Northeast to 57.6% in the West. Knowledge of the associated health hazards was negatively related with first tobacco use within 30 min. The proportion among smokers who were not aware of its associated health hazard was 67.6%, compared with 65.6% of those smokers who were aware of its associated health hazard. Similarly, the consumption among smokeless tobacco users who were not aware of its associated health hazard was 57.7% compared with 53.8% among users who were aware of the smokeless tobacco use health hazard.

Decision tree models were used to predict nicotine dependency for smokers and smokeless tobacco users in India. To establish the predictive ability of the decision tree models, their misclassification rates and other fit statistics were estimated. Table 2 shows the fit statistics of the decision tree models for smoking and smokeless tobacco dependency. The misclassification rate for the smoking model was 0.34 and 0.43 for the smokeless tobacco use model. This shows that the decision tree models classified two-thirds of the nicotine dependency outcomes for smoking and smokeless tobacco correctly.

Figures 1 and 2 show the results of the decision tree models for smoking and smokeless tobacco dependency. The top-level (root) node of the smoking dependency decision tree model (Fig. 1) shows that of the 9190 respondents to the survey, 65.7% were classified as smokers with higher nicotine dependency (coded as 1), while 34.3% were classified as less dependent smokers (coded with 0) in the training and validation data set. Under the root node, duration of smoking, gender, education and regional variables satisfied the minimum criteria based on logworth values (at $p < 0.05$) selected in the machine-learning based decision tree modelling. Duration of smoking further characterized the smoking dependency outcome. Long-term smokers are more dependent and constitute the most significant predictor in the decision tree. Of the long-term smokers (more than 15 years), 70% were more addicted to tobacco consumption compared with 57.5% of short-duration smokers (< 15 years). Short-duration smokers could be further categorized based on educational attainment. Education played a significant role in classifying the dependent users and was statistically proven at the 5% level of significance. The less well educated short-duration smokers (< 15 years) were more addicted (60.4%) than the higher educated (49.5%). Low-educated, short-duration smokers were further classified based on gender, showing higher dependency among

Table 1 Percentage of daily tobacco users whose first use is within 30 min of getting up (India, 2009–2010)

	Smoking	*p* value[a]	Smokeless tobacco	*p* value[a]
Overall	***65.9***		***54.3***	
N	9190		13,357	
Age (in years)				
15–24	53.3	0.000	41.1	0.000
25–44	65.9		55.1	
45+	67.9		59.3	
Gender				
Male	66.7	0.000	54.4	0.003
Female	59.6		54.3	
Residence				
Rural	66.9	0.056	55.5	0.001
Urban	62.5		49.9	
Education level				
No education	69.2	0.000	58.9	0.000
Less than primary	64.5		52.7	
Primary but less than secondary	66.7		51.0	
Secondary and higher	58.1		49.8	
Occupation				
Government/ non-govt employee	67.0	0.000	57.1	0.000
Self-employed	67.2		55.3	
Student	38.3		34.6	
Homemaker	62.0		49.5	
Retired/unemployed	61.6		56.3	
Duration of use (in years)				
< 15	57.3	0.000	46.8	0.000
15–24	68.8		59.4	
25+	71.3		63.3	
Region				
North	57.1	0.000	54.7	0.000
South	70.7		54.4	
East	62.4		54.0	
Northeast	57.6		42.4	
West	60.0		57.6	
Central	69.0		54.6	
Smoking allowed in home				
Yes	67.1	0.000	–	
No	57.8		–	
Awareness that smoking/smokeless tobacco causes serious illness				
No	67.6	0.778	57.7	0.133
Yes	65.6		53.8	
Thought of quitting after seeing warning labels				
No	64.9	0.534	56.0	0.044
Yes	67.6		51.1	

[a] *p* value refers to chi-square test

male smokers. Regarding region, it could be shown that highly educated smokers from the south and west of India had significantly higher levels of nicotine dependency.

The second decision tree classification graph (Fig. 2) represents dependency among smokeless tobacco users. Under the root node, duration of use, education, occupation, age,

Table 2 Fit statistics of decision tree models

	Smoking		Smokeless tobacco	
	Training	Validation	Training	Validation
Sum of frequencies	5512	3678	8013	5344
Misclassification rate	0.34	0.34	0.43	0.42
Minimum absolute error	0.74	0.74	0.71	0.71
Sum of squared error	2428.88	1636.06	3875.09	2593.71
Average squared error	0.22	0.22	0.24	0.24
Root mean squared error	0.47	0.47	0.49	0.49

gender and regional variables satisfied the minimum criteria based on logworth values (at $p < 0.05$) for selection in the machine-learning-based decision tree modelling. The top-level root node of the tree structure depicts that out of the 13,357 respondents to the survey, 54.1% were classified as smokeless tobacco users with higher nicotine dependency, while 45.9% were classified as less dependent users (coded with 0). This was true for both the training and validation data set. This decision tree again shows that the duration of tobacco consumption in its smokeless form plays the most significant role in classifying smokeless tobacco dependent users compared with other independent variables. The smokeless users who had been consuming smokeless tobacco for more than 25 years were more addicted compared with those who had started less than 15 years ago. Educational attainment only played a prominent role in those who had been consuming smokeless tobacco for more than 25 years. Of the long-duration illiterate smokers, 67.6% were addicted compared with 57% of the more highly educated users. Short-duration users were further classified into further significant subgroups by occupational category, age and education. Government and non-government employees, self-employed and the retired or unemployed were more addicted than students and home-makers. Middle-aged adults (25–44 years) working in government/non-government sectors, self-employed and the retired or unemployed had a significantly higher dependency rate than older or young adults.

Discussion

Previous studies based on diverse small- or large-scale surveys on nicotine dependency in India have exhibited a high degree of variability in study design, location, population characteristics and outcomes. GATS India data are the first representative and reliable survey of India to provide comprehensive information about tobacco dependency in the form of first use of tobacco in a day. Understanding tobacco use dependency has implications for tobacco cessation programmes in India. Tobacco control needs in India are large and complex because of the high number of tobacco users in the country. Evaluation of use and dependency outcomes to date has been limited in India. This study provides useful insights into the significant predictors of nicotine dependency in India using a decision tree model approach. Unlike other regression models, decision trees present data in a visual format. For health policy-makers, decision trees more readily allow greater transparency in the interpretation of the factors that result in more or less health equity (Bierman et al. 2015). Furthermore, they make it possible to identify the combinations of factors that constitute the highest (or lowest) risk for a condition of interest—in our case, nicotine dependency. Studies on the subject have mainly identified a number of main effect predictors. However, there is little information about how these variables

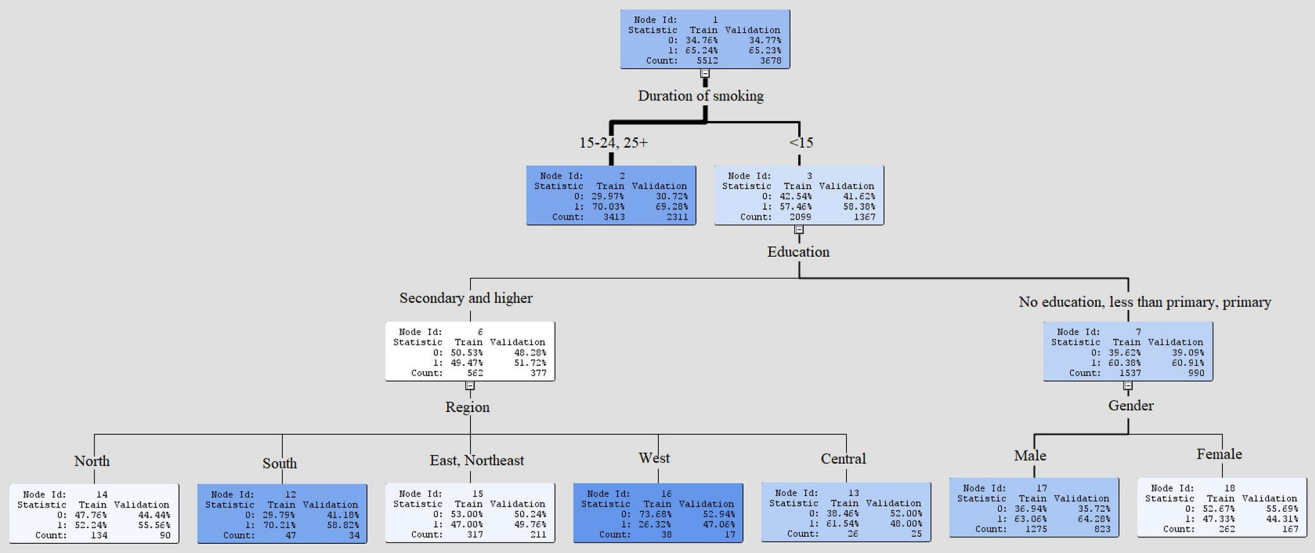

Fig. 1 Decision tree model results for smoking dependency

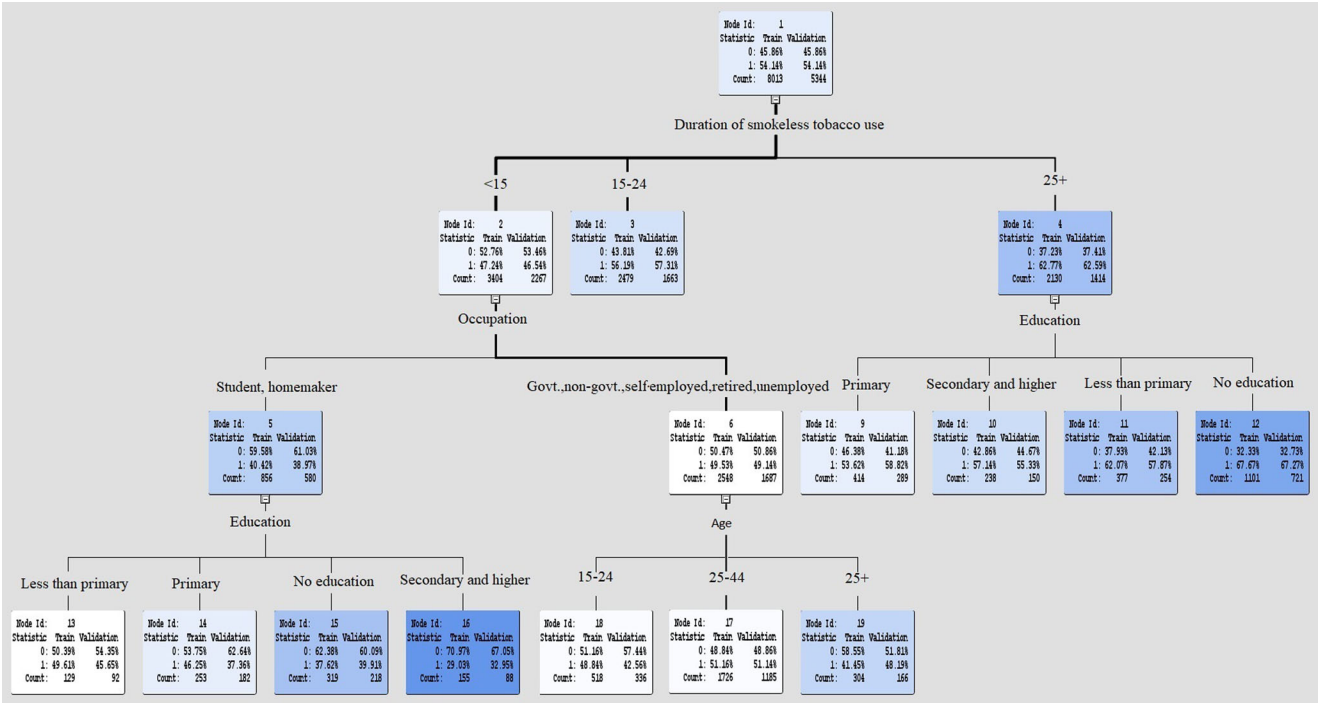

Fig. 2 Decision tree model results for smokeless tobacco use dependency

interact with one another to produce multiplicative patterns of risk or identification of subgroups of tobacco users who might have a higher risk for tobacco dependency. The decision tree method, on the other hand, can identify and demarcate cases by each factor having a legitimate impact on nicotine dependency and can ascertain the potential effect of the interaction of different risk factors. This statistical modelling technique is thus ideally suited to examine the complex interplay of these factors. To our knowledge, ours is the first study to use the decision tree modelling approach to study nicotine dependency among the adult population in India.

Tobacco use in India is clearly a big burden in terms of its magnitude and different forms (Singh and Ladusingh 2014). This study also indicated that nicotine dependency in India is significantly high. More than 65% of smokers and 54% of smokeless tobacco users consume tobacco within 30 min after waking up. These figures are close to those previously reported for nicotine dependency among adults in India (Chandra et al. 2005; Manimunda et al. 2012) and clearly indicate a large dependency on tobacco use in India. People with higher dependency are also less likely to quit tobacco products (Islam et al. 2014).

The decision tree model used in this study shows that the duration of tobacco use is the most important risk factor for nicotine dependency in India, i.e. higher duration of tobacco use leads to higher dependency on smoking or smokeless tobacco. This finding is in line with earlier studies that also showed that the longer the duration of tobacco use, the higher the dependency among tobacco users and that the duration of tobacco use is an important predictor of nicotine dependency (Branstetter et al. 2015). Poorly educated, long-duration male smokers are another high-risk category with significantly higher smoking dependency. This finding indicates that education up to a certain level is necessary to reduce nicotine dependency among smokers in India. We also found that increases at each level of education have a negative relation with nicotine dependency among smokeless tobacco users. Illiterate long-duration (25 years+) users are the highest risk group for smokeless dependency. Previous studies conducted among rural users and institutionalized populations also indicate that low levels of education are related to higher dependency on tobacco use (Chandra et al. 2005; Jayakrishnan et al. 2012). A recent study in India shows that there is inadequate knowledge of the hazards associated with smokeless tobacco among both smokeless tobacco users and health care providers (Murthy et al. 2018).

Among short-duration tobacco users, employed people in government and non-government offices or self-employed in the age group 25–44 years have a significantly higher dependency on smokeless tobacco. It has been established that the majority of users started using smokeless tobacco because of peer pressure (Murthy et al. 2018). These findings support the role of workplace stress in the initiation of smokeless tobacco and higher dependency. In 2008, the Indian government banned smoking in workplaces and other public places to protect people from secondhand smoke (Kaur and Jain 2011). However, there is no specific law to regulate smokeless tobacco use in the workplace. Several factors, including weak

enforcement of tobacco control policy and insufficient information about the harmful effects of tobacco, contribute to higher use of tobacco (Sinha et al. 2011). High dependency on smoking and smokeless tobacco products poses a serious challenge for tobacco cessation programmes in India, which are currently focused on smokers. However, campaigns also need to be directed toward smokeless tobacco use, where the cultural sanctioning and normative attitudes with poor understanding of its harmful effects and potentially addictive nature all encourage the maintenance of smokeless tobacco use in Indian communities.

Funding This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Compliance with ethical standards

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

References

Aghi M, Asma S, Yeong CC, Vaithinathan R (2001) Initiation and maintenance of tobacco use. In: Samet JM, Yoon SY (eds) . Women and the tobacco epidemic. World Health Organization, Geneva, pp 49–68 Available at http://www.who.int/iris/handle/10665/66799. Accessed on 1 May 2018

Bierman AS, Brown AD, Levinton CM (2015) Using decision trees for measuring gender equity in the timing of angiography in patients with acute coronary syndrome: a novel approach to equity analysis. Int J Equity Health 14(155). https://doi.org/10.1186/s12939-015-0280-x

Branstetter SA, Mercincavage M, Muscat JE (2015) Predictors of the nicotine dependence behavior time to the first cigarette in a multiracial cohort. Nicotine Tob Res 17(7):819–824. https://doi.org/10.1093/ntr/ntu236

Chandra PS, Carey MP, Carey KB, Jairam KR, Girish NS, Rudresh HP (2005) Prevalence and correlates of tobacco use and nicotine dependence among psychiatric patients in India. Addict Behav 30(7):1290–1299. https://doi.org/10.1016/j.addbeh.2005.01.002

Government of India (2003) The Cigarettes and Other Tobacco Products (Prohibition of Advertisement and regulation of Trade and Commerce, production, Supply and Distribution) Act, 2003. An act enacted by the Parliament of Republic of India by notification in the official gazette. (Act 32 of 2003). Available at http://mohfw.nic.in/index1.php?lang&level=2&sublinkid=671&lid=662. Accessed on 20 Mar 2018

Government of India (2008) National Tobacco Control Programme 2007–2008. Available at https://www.nhp.gov.in/National-Tobacco-Control-Programme1_pg. Accessed on 15 Mar 2018

Islam K, Saha I, Saha R, Khan SAS, Thakur R, Shivam S (2014) Predictors of quitting behaviour with special reference to nicotine dependence among adult tobacco-users in a slum of Burdwan district, West Bengal. Indian J Med Res 139:638–642 http://www.ijmr.org.in/text.asp?2014/139/4/638/134138

Jayakrishnan R, Mathew A, Lekshmi K, Sebastian P, Finne P, Uutela A (2012) Assessment of nicotine dependence among smokers in a selected rural population in Kerala, India. Asian Pac J Cancer Prev 13:2663–2667. https://doi.org/10.7314/APJCP.2012.13.6.2663

Jha P, Jacob B, Gajalakshmi V, Gupta PC, Dhingra N, Kumar R, Sinha DN, Dikshit RP, Parida DK, Kamadod R, Boreham J, Peto R, RGI-CGHR Investigators (2008) A nationally representative case-control study of smoking and death in India. N Engl J Med 358:1137–1147 http://www.nejm.org/doi/full/10.1056/ NEJMsa0707719

Kaufman NJ, Nichter M (2001) The marketing of tobacco to women: global perspectives. In: Samet JM, Yoon SY (eds) . Women and the tobacco epidemic. World Health Organization, Geneva, pp 69–98 Available at http://www.who.int/iris/handle/10665/66799. Accessed on 1 May 2018

Kaur J, Jain DC (2011) Tobacco control policies in India: implementation and challenges. Indian J Public Health 55(3):220–227 http://www.ijph.in/text.asp?2011/55/3/220/89941

Manimunda SP, Benegal V, Sugunan AP, Jeemon P, Balakrishna N, Thennarusu K, Pandian D, Pesala KS (2012) Tobacco use and nicotine dependency in a cross-sectional representative sample of 18,018 individuals in Andaman and Nicobar Islands, India. BMC Public Health 12(515). https://doi.org/10.1186/1471-2458-12-515

Ministry of Health and Family Welfare, Government of India (2010) Global Adult tobacco Survey India 2009–2010. Ministry of Health and Family Welfare, Government of India, Mumbai. Available Online: http://www.searo.who.int/tobacco/documents/2010-pub2.pdf Accessed 20 Apr 2018

Murthy P, Subodh BN, Sinha D, Aghi M, Chaturvedi P (2018) Smokeless tobacco (SLT) use and cessation in India: lessons from user and health care provider perspectives. Asian J Psychiatr 32:137–142. https://doi.org/10.1016/j.ajp.2017.11.009

Parashar M, Agarwalla R, Mallik P, Dwivedi S, Patvagekar B, Pathak R (2016) Prevalence and correlates of nicotine dependence among construction site workers: a cross-sectional study in Delhi. Lung India 33:496–501. https://doi.org/10.4103/0970-2113.188968

Rani M, Bonu S, Jha P, Nguyen SN, Jamjoum L (2003) Tobacco use in India: prevalence and predictors of smoking and chewing in a national cross sectional household survey. Tob Control 12:e4. https://doi.org/10.1136/tc.12.4.e4

Reddy KS, Gupta PC (2004) Report on Tobacco Control in India. Ministry of Health and Family Welfare, Government of India, New Delhi. Available at alwww.who.int/fctc/reporting/Annex6_Report_on_Tobacco_Control_in_India_2004.pdf Accessed on 15 Apr 2018

Sargent JD, Mott LA, Stevens M (1998) Predictors of smoking cessation in adolescents. Arch Pediatr Adolesc Med 152:388–393

Shafey O, Erikson M, Ross H, Mackay J (2009) The Tobacco Atlas. 3rd edition American Cancer Society, Atlanta. 2009. Available at http://www.afro.who.int/publications/tobacco-atlas-3rd-edition Accessed on 20 Apr 2018

Singh A, Ladusingh L (2014) Prevalence and determinants of tobacco use in India: evidence from recent global adult tobacco survey data. PLoS One 9(12):e114073. https://doi.org/10.1371/journal.pone.0114073

Sinha DN, Palipudi KM, Rolle I, Asma S, Rinchen S (2011) Tobacco use among youth and adults in member countries of South-East Asia region: review of findings from surveys under the global tobacco surveillance system. Indian J Public Health 55(3):169–176. https://doi.org/10.4103/0019-557X.89946

Son BK, Markovitz JH, Winders S, Smith D (1997) Smoking, nicotine dependence, and depressive symptoms in the CARDIA study. Effects of educational status. Am J Epidemiol 145:110–116

Subramanian SV, Nandy S, Kelly M, Gordon D, Davey Smith G (2004) Patterns and distribution of tobacco consumption in India: cross sectional multilevel evidence from the 1998–9 National Family Health Survey. BMJ 328(7443):801–806

World Health Organization (2008) WHO report on the global tobacco epidemic, 2008: The MPOWER package. World Health Organization, Geneva. Available at http://www.who.int/tobacco/mpower/2008/en/ Accessed on 20 Apr 2018