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ORIGINAL ARTICLE

Contextual correlates of intensity of smoking in northeast India

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Abstract
Objectives This study assessed the significance of socio-demographic and contextual factors on the number of daily cigarette and bidi smoking in northeast India.
Methods This study is based on the data from the Global Adult Tobacco Survey-India (2009–2010). Community asset is measured as the totality of all households' durables and community affinity to smoking as the proportion of households which allowed smoking in the house.
Results High daily cigarette and bidi smokers constitute 20 and 30 % of the respective smokers and they smoke 35.8 cigarettes and 14.6 bidis daily, respectively, on the average. The higher is the community affinity to smoking, the higher is the intensity of smoking among the high daily cigarette smokers. Advancing age and educational attainment have significant deterrent effect on the intensity of cigarette and bidi smoking.
Conclusions Contextual factors are found to be important for regional tobacco control programmes. The need for reaching out to communities and the importance of promotion of public–private partnership under the provision of corporate social responsibility for effectiveness of tobacco control programme is recommended.

Keywords Cigarettes · Bidis · Intensity of smoking · Community

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Introduction

The beautiful landscape of the eight tiny states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura in northeast India in the eastern Himalayas of Northeast (NE) India is under the mist when it comes to high prevalence of smoking and use of smokeless tobacco. Initiation of smoking at tender age of 10 years and high prevalence of smoking ranging from 34.5 % in Mizoram to 19.7 % in Assam among students were evident from a study (Sinha et al. 2003). Similar results of initiation of smoking at the tender age of 13.6 years on the average and smoking prevalence of 29.6 % among adolescent students in Kolkata were highlighted (Bagchi et al. 2014). The recent report of Global Adult Tobacco Survey-India (GATS India) 2009–2010 indicates prevalence of daily smokers among adults 15 years and above varying from a high of 35.4 % in Mizoram to a low of 10.7 % in Assam (MoHFW GOI and IIPS 2010). This suggests prevalence of smoking in NE India remains persistently high over time. It is a matter of grave concern that the fight against the use of tobacco in any form by means of tobacco control legislation in India is not yet able to inch towards fulfilment of right to smoke-free air.

Most of the acts in India either relate to statutory warning or prohibition of smoking in public places or restriction on sales to minors (Kaur and Jain 2011). For the first time in 1975 Government of India the Cigarettes Act made it mandatory to put statutory warning on all cigarette packages, cartons and advertisement of cigarettes (GOI 1975). Further statutory warnings were made mandatory for smokeless tobacco under the Prevention of Food Adulteration Act (PFA) (GOI 1990). Ban on use of tobacco in dental products was enforced in 1992 under the Drugs

and Cosmetics Act 1940 (GOI 1992). Cigarettes and Other Tobacco Products Act (COTPA) of 2003 prohibits smoking in public places, prohibits sale of tobacco products to and by minors under 18 years, bans sale of tobacco products within 100 yards of all educational institutions and made it mandatory to display pictorial fatal health warnings on tobacco products packages (GOI 2003). To enforce provisions of COTPA in 2007–2008, the National Tobacco Control Programme (NTCP) was implemented (GOI 2008).

The above-mentioned acts and programmes have contributed in their own right in the fight against tobacco use as far as in public places is concerned. But there is also the need to reach out to communities for their involvement in discouraging use of tobacco products as cultural elements and peer pressure cannot be rule out for any programme to be successful. For instance, in NE India offering hookah (smoking specially made tobacco using water pipe), tobacco paan (pieces of areca nut, lime and tobacco wrapped in betel leaf) and bidis (chopped dried tobacco leaves wrapped in dried leave of special trees) to guests and friends is age-old tradition. A number of studies have contributed to the assessment of prevalence of smoking and chewing (Rani et al. 2003), prevalence of smoking, quit rates and respiratory morbidity (Jindal et al. 2006), association between tobacco use and body mass index (Pednekar et al. 2006), tobacco-associated mortality (Gupta et al. 2005), and profile of smoking and smokeless tobacco users (Gupta et al. 2012).

The aforesaid studies, however, have limited scope in assessment of influence of community environments on tobacco use and secondly, have not addressed the factors associated with the high prevalence of smoking in NE India. The importance of environment, particularly geographically based cultural context in structuring lifestyle behavioural pattern of individual had been argued (Skog 1985). Place of residence often drives in lifestyle of an individual (Griffin et al. 2014). Some elements of lifestyle are associated with individual predisposition or socio–economic and some elements with area contextual (Blaxter 1990; Kulik et al. 2014). It is therefore pertinent to consider area-specific contextual factors in explaining high intensity of smoking particularly in NE India. The present study is an attempt to fill the research gap and draw attention on the need for community involvement in tobacco control policy in NE India.

Methods

The Ministry of Health and Family Welfare (MOHFW), Government of India (GOI) in collaboration with WHO South-East Asia Regional Office (SEARO) and Centers for Disease Control and Prevention (CDC) conducted Global Adult Tobacco Survey-India (GATS India, 2009–2010) with International Institute for Population Sciences (IIPS) as the designated nodal agency. The data include tobacco use both smoking and smokeless tobacco, exposure to second-hand smoke, quit attempts, attitudes and perceptions of health effects of tobacco use and exposure to media campaign against tobacco use. It is a national representative cross-sectional survey and was designed to provide estimates of prevalence of smoking and smokeless tobacco at the national and state levels for the persons 15 years and more. Multistage stratified probability proportional to size (PPS), three stages for urban sampling and two stages for rural sampling was adopted in GATS India. Data for this study are for 15,259 individuals of the eight northeastern (NE) states of India from GATS India (2009–2010) (MOHFW GOI and IIPS 2010).

The intensity of smoking by individuals in this study is measured by the number of cigarettes smoked per day by individuals aged 15 and above for cigarette smokers, while it is the number of bidis (dried chopped tobacco wrapped in dried leaves of special trees) for bidi smokers.

The first area-specific contextual factors considered in the analysis is cultural and social approval of smoking in the community measured by the proportion of households in the sampled primary sampling unit (PSU), a village or portion of a village in rural and census enumeration block (CEB) in urban, where smoking inside the house is allowed. A community is then classified as low, medium and high cultural and social affinity to smoking on the basis of three equal partition of the total proportion of households where smoking is allowed. The intensity of smoking by individuals is expected to be positively associated with community affinity to smoking. The second contextual factor is the level of economic well-being of the community. GATS India (2009–2010) collects data on household assets. For measuring asset or economic well-being of the community, the total score of assets of all households of sampled PSU is obtained assigning 1 for possession of a particular asset, otherwise 0. Community, that is sampled PSU is then categorized into poor, moderate and rich on the basis of three equal partitions of the total score of assets. There is no evidence of magnitude and direction of influence of community economic well-being or asset on lifestyle, such as, smoking of cigarettes or bidis. However, economically better-off community individuals are more likely to have a decent lifestyle.

The other individual predisposition or socio-demographic factors considered in the analysis are age, sex, residence, educational attainment and awareness of ill effect of smoking. Lifestyle and outlook of individual changes with stages of life as individual ages, age is also a factor which enables individual to wade through peer

pressure. Gender not only captures biological differences, but also differences in lifestyle and attitudes towards socially approved behaviour. Education increases awareness and can act as a factor that helps individual to stay away from health risk lifestyle. Residence background can have multiplicity effect on lifestyle of individuals. Urban residents are likely to be more informed about the health risks of smoking while rural residents are likely to have more community bonding. Awareness about fatal health effect of smoking can be a deterrent factor to smoking and it is included in explaining intensity of smoking in terms of awareness that smoking causes cancer.

Statistical analysis

Descriptive statistics and bivariate analysis are used for description of intensity of smoking in terms of number cigarettes smoked per day and number of bidis smoked per day and its association with socio-demographic and area-specific contextual factors. Finite mixture modelling is use for multivariate analysis.

For the choice of model for multivariate analysis, we take note of the unobserved heterogeneity in the population can result in inconsistent parameter estimates (Santos-Silva 2003). It is to reiterate that stratification is the conventional means for accounting heterogeneity of population and mixture modelling or latent class techniques are widely used for classification of individuals into subpopulations based on heterogeneity (McLachlan and Peel 2000; Muthen 2002). Advantage of mixture modelling for count data referred as finite mixture model (FMM) is extensively discussed (Deb and Trivedi 2002; Wedel et al. 1993). When applying FMM to empirical data, the number of strata accounting for heterogeneity is unknown and estimated from the data itself. For count data the specification for the distribution of mixture commonly considered are Poisson, negative binomial I (NBI) and negative binomial II (NBII) (Deb and Trivedi 1997; Deb and Holmes 2000). Bayesian information criterion (BIC) and consistent Akaike information criterion (AIC) are used for selection of one of these distributions.

FMM for k subpopulations and distribution of counts $f(y/\theta)$ is of the form

$$f(y/x) = \sum_{j=1}^{k} \pi_j f\left(y/x, \theta_j\right), \tag{1}$$

where $0 < \pi_j < 1$ and $\sum_{j=1}^{k} \pi_j = 1$. In Eq. (1), π_j and θ_j are called mixing proportion and mixing parameter while y is the count covariate and x is the observed covariate. In GATS India (2009–2010), distribution of y is available only for cigarette and bidi smokers due to instruments, therefore truncated distributions

$$f(y/x, \theta_j, y > 0) = \frac{f(y/x, \theta_j)}{1 - F(0/x, \theta_j)},\ y > 0 \tag{2}$$

where $F(.)$ is the distribution of $f(.)$ is used in place of Eq. (1), based on other studies (Grogger and Carson 1991; Gurmu and Trivedi 1992).

Results

The intensity of smoking of cigarettes and bidis in this paper is measured by the number of cigarettes and bidis smoked per day by daily smokers. Figure 1 shows distribution of sampled daily cigarette and bidi smokers by states in NE India. The share for cigarettes is highest for Mizoram and least for Tripura while for bidis highest share is for Assam and the least for Manipur and Meghalaya.

As a background of the paper to this study Table 1 provides percent of daily cigarette and bidi smokers by selected socio-demographic factors. On the whole, 8.4 and 7.2 % in NE India are daily smokers of cigarettes and bidis, respectively, and which varies by socio-demographic factors. Daily smoking of cigarettes is 11.9 % the highest among individuals in 45–64 years and for daily smoking of bidis the highest is 16.8 % among the elderly 65 years and older. The lowest prevalence of daily smoking of cigarettes and bidis are the lowest 4.5 and 2 % among individuals in 15–24 years. The general pattern noted is that with advancing age the daily cigarette and bidi smoking tends to increase. This is evident from the age pattern of prevalence of daily cigarette and bidi smoking together with age distribution is shown in Fig. 2.

When it comes to gender differential as much as 15.4 % of males smoke cigarettes daily, while only 1.1 % of females do so. Daily bidi smoking is noticed among 12.6 % of males and 1.6 % of females. There is rural–urban contrast in the pattern of daily cigarette and bidi smoking, as 11.8 % of urban residents smoke cigarettes daily when 8.1 % of rural residents were daily bidi smokers. A much lower 3.8 % of urban residents smoke bidis daily, but almost an equal proportion of 7.6 % of rural residents smoke cigarettes on daily basis. Cigarette smoking are more of urban phenomenon while bidis and cigarettes are more or less equally preferred in rural areas. There is a clear pattern of association between educational attainment and daily bidi smoking, as against 1.4 % among those educated beyond secondary level 15 % among non-literate smoke bidis daily. That is daily bidi smoking were lesser among the higher educated individuals than among the less educated. In contrast, the more the educational attainment the more is the daily cigarette smoking. Thus daily smoking of bidis is a phenomenon more common among the rural and among the less-educated individuals,

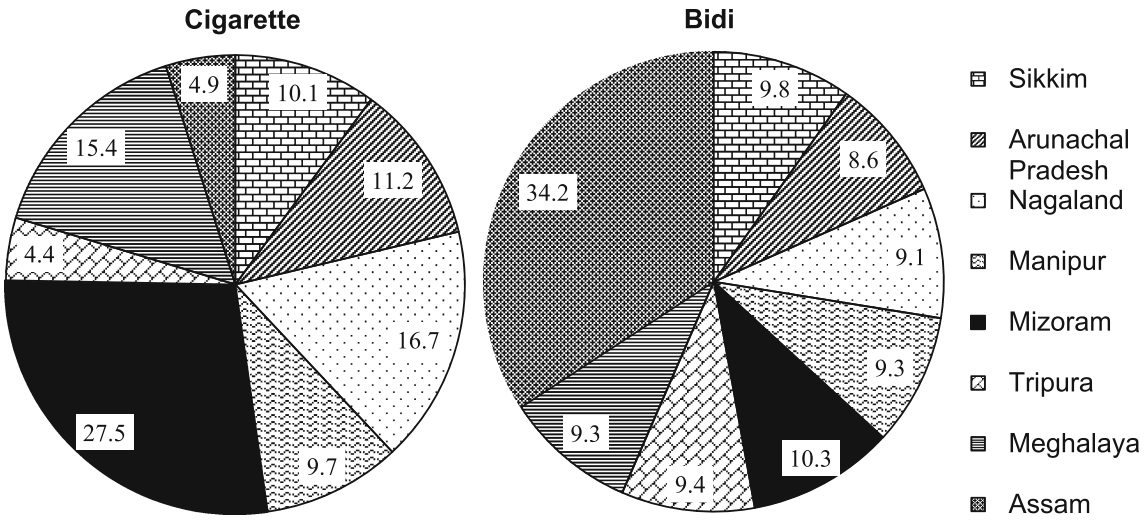

Fig. 1 Percentage distribution of daily cigarette and bidi smokers by states in northeast India, Global Adult Tobacco Survey-India, 2009–2010

Table 1 Percentage of daily cigarette and bidi smokers by background characteristics in northeast India, Global Adult Tobacco Survey-India, 2009–2010

Background characteristics	Cigarette	Bidi	*N*
Overall	8.4	7.2	15,259
Age			
15–24	4.5	2.0	3,216
25–44	9.3	6.9	8,117
45–64	11.9	13.0	3,320
65+	9.4	16.8	606
Sex			
Male	15.4	12.6	7,430
Female	1.1	1.6	7,829
Residence			
Rural	7.6	8.1	12,116
Urban	11.8	3.8	3,143
Education			
No education	7.8	15.0	3,089
Up to primary	8.9	10.4	4,338
Up to secondary	7.8	3.5	4,935
More than secondary	9.3	1.4	2,897
Smoking causes lung cancer			
No	10.2	10.4	2,079
Yes	8.2	6.8	13,180
State			
Sikkim	12.1	7.9	1,490
Arunachal Pradesh	13.5	15.2	1,316
Nagaland	20.1	10.5	1,396
Manipur	11.7	7.4	1,419
Mizoram	33.1	4.4	1,573
Tripura	5.3	19.1	1,430
Meghalaya	18.5	14.2	1,417
Assam	5.9	4.7	5,218

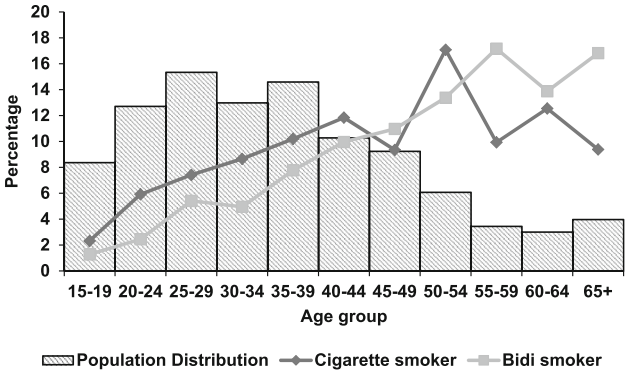

Fig. 2 Prevalence of daily cigarette, bidi smoking and population distribution by age in northeast India, Global Adult Tobacco Survey-India, 2009–2010

while daily cigarette smoking is the associated lifestyle of urban and higher educated individuals. From the point of view of information, education and communication (IEC) of tobacco control programme it is heartening to observe that both daily smoking of cigarettes and bidis were less among the individuals who were aware that smoking causes cancer as the prevalence daily cigarette and bidi smoking among them were 8.2 and 6.7 % as compared to the corresponding figures of 10.2 and 10.4 % among those who were not aware of the fatal association between smoking and cancer. Daily cigarette and bidi smoking differ widely by states in NE India, 33.1 % in Mizoram were daily cigarette smokers the highest in NE India and for daily bidis the highest is 19.1 % in Tripura. Daily cigarette smoking is second highest of 20.1 % in Nagaland. In Meghalaya and Arunachal Pradesh daily smoking of both cigarette and bidi smoking are high, 18.5 and 14.2 % in Meghalaya and 13.5 and 15.2 % in Arunachal Pradesh were reported smoking cigarettes and bidis, respectively, on daily basis. Daily cigarette smoking is predominantly higher in the hilly and colder states of Mizoram, Nagaland, Meghalaya, and Arunachal Pradesh. The state of Tripura where daily bidi smoking is highest is in the international border is a state with many migrant poor labourers.

The paper attempts to shed light on the importance of area-specific contextual factors in explaining intensity of smoking, besides the effects of socio-demographic factors. Table 2 shows the association between two important contextual factors, namely, community asset (economic well-being) and community affinity to smoking and mean number of daily cigarettes and bidis smoked by smokers in NE India. It is noticed that community asset has negative association with intensity of cigarette and bidi smoking among daily smokers. In the rich community the mean number of cigarettes and bidis smoked per day are 7.5 cigarettes and 8.5 bidis, respectively, as compared to the corresponding figures of 9.4 cigarettes and 12.4 bidis in the poor community. As noted above in the case of remote isolated indigenous communities of NE India prosperity can have positive effect on lifestyle. Community affinity to smoking on the other hand has positive association with intensity of cigarette and bidi smoking. In communities with high affinity to smoking the mean number of cigarettes smoked per day is 9.8 as against 6.1 in communities with low affinity to smoking. This evidence suggests that individuals are likely to smoke more in communities where smoking is socially approved and cigarette smoking is not considered as taboo. As for bidi smokers there is no significant differential by level of community affinity to smoking.

To continue assessment of intensity of cigarette and bidi smoking, that is, the number of cigarettes and bidis smoked in a day, Table 3 shows percent distribution of number of cigarettes and bidis smoked daily with means and standard errors by selected socio-demographic background of individuals. In NE India about half of the daily cigarette smokers smoked five or less cigarettes a day and about 30 % smoked 6–10 cigarettes a day. The mean number of daily smoked is 8.5 cigarettes. Regardless of age, sex, residence background, educational attainment and awareness that smoking causes cancer at least 40 % of the daily cigarette smokers smoked five or less and at least 25 % smoked 6–10 cigarettes a day. By age mean number of daily cigarettes smoked varies from 10 among 15–24 years

Table 2 Mean and standard error of number of cigarettes and bidis smoked per day by community background characteristics in northeast India, Global Adult Tobacco Survey-India 2009–2010

Background	Cigarette	Bidi	*N*
Community asset			
Poor	9.4 (0.7)	12.4 (0.6)	5,895
Moderate	8.2 (0.6)	9.4 (0.4)	5,006
Rich	7.5 (0.6)	8.5 (0.8)	4,358
Community affinity to smoking			
Low	6.1 (0.6)	12.6 (1.1)	2,889
Medium	8.3 (0.6)	10.6 (0.6)	6,056
High	9.8 (0.6)	11.0 (0.6)	6,314

Table 3 Percent distribution, mean and standard error (SE) of cigarettes, bidis smoked per day by individual background characteristics, northeast India, Global Adult Tobacco Survey-India 2009–2010

Background characteristics	<6	6–10	11–15	16–20	20+	Mean	SE
Overall							
Cigarette	49.6	29.8	7.2	6.7	6.7	8.5	0.4
Bidi	29.4	35.2	12.8	6.1	16.4	11.1	0.4
Age							
15–24							
Cigarette	43.0	32.1	6.2	5.5	13.2	10.0	1.2
Bidi	34.5	27.1	17.7	6.0	14.8	10.6	1.2
25–44							
Cigarette	51.4	31.8	5.9	6.5	4.4	7.8	0.4
Bidi	25.0	36.9	14.1	6.0	17.9	11.9	0.5
45–64							
Cigarette	47.2	25.7	11.0	8.4	7.7	9.4	0.6
Bidi	27.9	33.5	12.6	7.9	18.0	11.4	0.5
65+							
Cigarette	62.3	28.2	3.0	3.6	2.9	6.4	0.6
Bidi	44.2	39.5	6.3	1.7	8.3	7.9	1.1
Sex							
Male							
Cigarette	49.4	29.4	7.3	7.0	6.9	8.6	0.4
Bidi	25.9	36.7	13.0	6.4	18.0	11.4	0.4
Female							
Cigarette	52.4	35.8	6.7	2.1	3.1	7.9	1.3
Bidi	58.2	22.3	11.4	4.3	3.7	7.9	0.9
Residence							
Rural							
Cigarette	49.6	29.8	7.5	6.1	7.0	8.6	0.5
Bidi	28.6	34.2	13.5	6.3	17.4	11.3	0.4
Urban							
Cigarette	49.4	30.1	6.5	8.3	5.7	8.4	0.6
Bidi	36.3	44.0	7.0	4.7	8.1	8.9	0.9
Education							
No education							
Cigarette	45.4	25.1	12.5	7.4	9.6	10.1	0.9
Bidi	34.7	30.2	12.4	6.5	16.2	10.6	0.5
Up to primary							
Cigarette	46.5	33.4	6.7	5.4	8.0	8.2	0.5
Bidi	21.5	42.5	11.9	5.4	18.8	11.7	0.6
Up to secondary							
Cigarette	51.0	28.3	6.7	7.3	6.8	9.0	0.6
Bidi	34.5	27.8	17.4	6.7	13.5	10.9	0.9
More than secondary							
Cigarette	55.0	30.7	4.6	7.2	2.5	7.0	0.6
Bidi	39.0	38.3	8.8	7.9	6.0	9.1	1.0
Smoking causes lung cancer							
No							
Cigarette	46.6	38.4	7.0	4.6	3.5	8.0	0.8
Bidi	38.9	25.2	16.2	3.7	16.0	10.7	0.9
Yes							
Cigarette	50.2	28.8	7.4	6.8	6.8	8.6	0.4
Bidi	28.0	36.6	11.9	7.0	16.5	11.1	0.4

to 6.4 among elderly 65 years and older; not much variation among male being 8.6 while among female being 7.9 cigarettes a day on the average; no urban–rural differential at more than 8 cigarettes a day in either place and the same is true with regard to awareness that smoking causes cancer but considerable variation by educational attainment is noted; non-literate and those educated beyond secondary level smokers smoked, respectively, on the average ten and seven cigarettes on daily basis.

Among the daily bidi smokers, 30 % smoked five or less bidis and 35 % smoked 6–10 bidis and mean number of daily intake is 11.1 bidis. Average daily smoking is 10.6 bidis among daily bidi smokers in 15–24 years and 6.4 bidis for those in 65 years and above. The gender gap in average daily bidi smoking is 11.4 among male and 7.9 among female, while differential by place of residence is 11.3 among rural residents as against 8.9 among urban residents. Educational attainment and status of awareness that smoking causes cancer do not have effect on daily bidi smoking.

A number of finite mixture models (FMM) described in the methodology section are implemented for $k = 1$, $k = 2$ and $k = 3$ using STATA 12 to find the most plausible latent subpopulations of daily cigarette and bidi smoking. For the selection suitable distribution of the component densities applicable for the count data, the number of cigarettes and bidis smoked daily, suitability of Poisson, negative binomial I (NBI) and II (NBII) are explored. Separate FMM models are fitted for cigarettes and bidis. LR (likelihood ratio) test indicates $k = 2$, division into two-subpopulation for controlling heterogeneity. Table 4 shows the values of Bayesian information criteria (BIC) and Akaike information criteria (AIC). These statistics suggest two-component NBII for cigarettes and NBI for bidis as the most appropriate FMM.

Table 5 presents the sample average of the estimates of the fitted means by latent classes along with other summary statistics. Low daily cigarette smokers smoked on the average 7.9 cigarettes a day and constitute 80 % of the daily smokers whilst the remaining 20 % high daily smokers on the average smoked 35.8 cigarettes a day. Low daily bidi smokers comprise 70 % and smoke 5.2 bidis daily on the average and the reaming high bidi smokers on the average smoked 14.6 bidis daily.

The parameter estimates, average marginal effects and significant levels for two latent classes FMM for number of daily cigarettes and bidis smoked are shown in Table 6 in two different sets of columns; class I and class II are the low and high daily smokers. Table shows that the coefficients in most socio-demographic variables have the expected sign and most of them are statistically significant, mainly in class II.

Among the high daily cigarette smokers increasing age has negative effect, that is, the number of daily cigarettes smoked among the high smokers decreases with advancing age and is statistically significant when the other factors are controlled. But the effect of age among the low daily cigarette smokers is the other way round, that is, age has positive effect and only that for individuals in 45–64 years are significantly higher than those in 15–24 years at $P < 0.05$. Similar effect of age on low daily bidi smokers is also noted; number of daily bidis smoked by individuals in 25–44 and 45–64 years are more than that by 15–24 years low bidi smokers and is statistically significant at $P < 0.05$. However, age does not show any statistical association with high bidi smokers. The gender effect is negative across latent classes in both the cases of daily cigarette and bidi smoking, AME $= -2.5$ among low daily cigarette smokers and AME $= -11.42$ among high daily bidi smokers. These effects are significant at $P < 0.01$. The covariates representing residence background and awareness that smoking causes cancer do not show any significant effect on daily cigarette and bidi smoking after controlling for other factors in the model. The effect of educational attainment is negative and for beyond secondary educational level AME $= -7.97$ among the high daily cigarette smokers; this means compared to non-literate high cigarette smokers the number of daily cigarette smoking by those educated beyond secondary is less by 7.97 cigarettes and the differential is significant at $P < 0.05$. This same factor is not statistically significant among the infrequent daily cigarette smokers and also among daily bidi smokers regardless of low or high daily smokers.

Table 4 Akaike information criterion (AIC) and Bayesian information criterion (BIC) for the possible models of smoking in northeast India, Global Adult Tobacco Survey-India 2009–2010

	Cigarette		Bidi	
	AIC	BIC	AIC	BIC
Poisson	14,748,897.964	14,749,181.661	13,936,106.211	13,936,373.593
Negative binomial I	14,007,554.716	14,007,849.538	13,234,678.464	13,234,956.332
Negative binomial II	13,897,715.773	13,898,010.596	13,345,426.797	13,345,704.666

Table 5 Descriptive statistics of intensity of cigarette and bidi smoking by latent classes, northeast India, Global Adult Tobacco Survey-India 2009–2010

Statistics	Cigarette		Bidi	
	Class I	Class II	Class I	Class II
Mean	7.8	27.6	9.2	20.5
Percentile				
10th	3.8	8.6	6.6	4.4
25th	4.5	11.3	7.7	8.3
50th	5.5	16.5	8.9	19.7
75th	11.9	25.2	10.8	23.7
90th	13.7	45.3	12.2	26.0

Table 6 Regression coefficients (β) average marginal effect (AME) for the number of cigarettes and bidis smoked per day as dependant variable, northeast India, Global Adult Tobacco Survey-India 2009–2010

	Cigarette (negative binomial–II)				Bidi (negative binomial–I)			
	Class I		Class II		Class I		Class II	
	β	AME	β	AME	β	AME	β	AME
Constant	1.80**		4.72**		0.62		3.73**	
π	0.80**		0.20**		0.70*		0.30*	
θ	0.11**		0.27**		3.53**		0.00**	
Age								
15–24[a]								
25–44	0.04	0.29	−0.54**	−10.3	0.21*	1.93	0.05	0.78
45–64	0.19*	1.35	−0.47*	−8.20	0.23*	2.13	0.07	1.08
65+	0.02	0.01	−0.99**	−12.5	−0.05	−0.42	0.01	0.07
Sex								
Male[a]								
Female	−0.37**	−2.50	0.36	6.70	−0.15	−1.31	−0.79**	−11.42
Residence								
Rural[a]								
Urban	0.25	1.73	−0.03	−0.60	0.02	0.18	0.00	0.05
Education								
No education[a]								
Up to primary	−0.06	−0.37	−0.30*	−5.24	−0.01	−0.11	0.05	0.71
Up to secondary	−0.10	−0.67	0.08	1.55	−0.06	−0.56	−0.04	−0.60
More than secondary	−0.03	−0.20	−0.49*	−7.97	−0.13	−1.07	0.28	4.64
Smoking causes lung cancer								
No[a]								
Yes	−0.06	−0.39	0.12	2.09	0.04	0.38	−0.07	−1.02
Community asset								
Poor[a]								
Moderate	0.04	0.31	0.06	1.19	0.26**	2.45	−0.98**	−12.08
Rich	−0.05	−0.37	−0.17	−3.19	0.29**	2.81	−1.25**	−12.85
Community affinity to smoking								
Low[a]								
Medium	0.10	0.71	0.51*	10.61	−0.16	−1.42	0.03	0.48
High	0.10	0.69	0.43*	7.97	−0.12	−1.09	0.00	0.00
Residence × community asset								

Table 6 continued

	Cigarette (negative binomial–II)				Bidi (negative binomial–I)			
	Class I		Class II		Class I		Class II	
	β	AME	β	AME	β	AME	β	AME
Urban × medium	−0.34	−2.00	0.35	7.54	−0.15	−1.28	0.18	2.83
Urban × rich	−0.28	−1.71	0.28	5.77	−0.39	−2.92	0.37*	6.40
Residence × community affinity to smoking								
Urban × medium	0.02	0.15	−0.35	−5.69	−0.17	−1.41	−.027	−3.49
Urban × high	0.04	0.26	−0.58	−9.03	−0.28	−2.17	−0.03	−0.47
State								
Sikkim[a]								
Arunachal Pradesh	−0.47**	−2.68	−1.96*	−19.51	0.14	1.28	−2.60**	−19.44
Nagaland	−0.16*	−1.05	−2.25**	−23.06	0.04	0.35	−3.34**	−18.93
Manipur	−0.28	−1.70	−2.02**	−19.41	0.30*	3.07	−2.56**	−16.53
Mizoram	0.90**	7.70	−2.27**	−31.71	0.49**	5.48	−1.72**	−13.20
Tripura	−0.03	−0.17	−1.40**	−15.00	0.28**	2.70	−2.56**	−23.52
Meghalaya	0.65**	5.71	−1.64**	−18.30	0.62**	7.02	−2.57**	−19.20
Assam	−0.15*	−0.99	−2.32**	−24.50	0.34**	3.45	−2.68**	−22.78

** $P < 0.01$, * $P < 0.05$

[a] Reference category

Community asset (economic well-being) is observed to have significant bearing among low and high daily bidi smokers but in opposite directions. On the other hand, community asset does not show any significant effect on daily cigarette smoking invariant of latent classes. Among low daily bidi smokers community asset has positive effect implying that with economic well-being low bidi smokers would increase the number of daily bidi smoking. But the effect of community asset among the high daily bidi smokers is reversed. The two opposite effects of community asset among the low and the high daily bidi smokers are statistically significant at $P < 0.01$. These paradoxical results may be a reflection that the number of daily bidis smoked among low bidi smokers was constrained by economic status, whilst that among high daily bidi smokers it may be capturing way of decent life in the economically better-off community. The emerging message of this finding is that approach for community intervention to control bidi smoking should be different for low and high daily bidi smokers. Community affinity to smoking has been measured in terms of proportion of households which allowed smoking in the house. The more the community affinity to smoking, the more is the daily cigarette smoking among high daily cigarette smokers. This is statistically significant at $P < 0.05$. It is indicative of the need for initiation of community involvement to discourage smoking inside households. The same community factor does not exhibit significant effect among low daily cigarette smokers and daily bidi smokers. To further investigate whether the community asset and community affinity to smoking have the same effect in rural and urban, interaction effects of the two community factors and residence background are considered. Parameters of these interaction factors do not present any statistical significance except the significant positive among high daily bidi smokers in urban areas.

Discussion

The objective of this paper is to appraise the need for extension of tobacco control programme to the community, encourage their involvement and tailor to suit local contexts. The results of the study have provided empirical evidence that socio-demographic and community factors have differential effects on low and high daily cigarette and bidi smoking in NE India which comprises states with the highest prevalence of tobacco smoking and use of smokeless tobacco. Low daily cigarette smokers constitute 80 % of all daily smokers while low daily bidi smokers comprise 70 % of daily bidi smokers. Over-dispersion of intensity of cigarette and bidi smoking on daily basis are evident from the figures of dispersion measure of two latent class finite mixture models. Regardless of daily cigarette or bidi smoking across latent class, educational attainment has deterrent effect on the number of daily smoking. This finding is important as it provides a clue for integrating compulsory primary education programme with tobacco

control programme. The fact that at least a quarter of the daily smokers in any age above 15 years smoked 6–10 cigarettes and bidis daily suggest the need to take tobacco control programme beyond the regulation of banning sales of tobacco products within 200 m of academic institution and ban of sales of tobacco to minors. The tobacco control programme can step up public–private partnership on a larger scale for involving local civil societies for door-to-door campaign and to take the opportunity to educate about the fatal health effect of tobacco use on any social gathering of the community especially in the context of isolated communities of NE India. This follows from the finding that low daily bidi smoking tends to be higher in communities where smoking is allowed in larger proportion of households. However, variation across states in NE India in the intensity of daily cigarette and bidi smoking cannot be fully accounted for by socio-demographic and contextual factors included in this study.

The findings suggest that daily cigarette and bidi smoking intensity is not only determined by predisposing socio-demographic factors, but also by community affinity to smoking and economic well-being of community. Secondly, for a vast country like India, a uniform tobacco control programme and local contextual factors should be taken into account to make it more relevant. Lastly, public programme alone is not sufficient to ward off tobacco use and community's involvement is crucial for making any programme effective.

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