Progression in Tobacco use in India: an Application of Survival Function Analysis

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1.1 Introduction

Tobacco appears to be as old as human civilization; the spread of tobacco usage in the sixteenth and seventeenth centuries was part of the global drug convergence resulting from European voyages, discovery, expanded trade and the colonial plantation system. As tobacco gained in popularity, users learned to combine it with more familiar substances, often smoking or chewing them together (Jordan *et. al.* 2005). Tobacco was first introduced in India by Portuguese traders during AD 1600. Soon after its introduction, tobacco became a valuable commodity of exchange. The versatile uses of tobacco made it popular across the globe and enabled its acceptability in various socio-cultural contexts around the world (Reddy *et. al.* 2004). Its use and production proliferated to such an extent that overall, there are 1.1 billion smokers worldwide (Bansal *et. al.* 2005). Today India is the second largest producer of tobacco in the world and the third largest consumer.

The acceptance and rejection of tobacco consumption as a practice must be viewed in the context of the Indian value system, which has traditionally emphasized social hierarchies based on factors such as age, gender, caste, wealth, education, professional standing or celebrity status. Socio-cultural factors are crucial in determining who consume tobacco, when, how, and why. Further, the consumption of tobacco has a symbolic aspect that must be explored in terms of the individual's lifestyle, self image and social relationship. Tobacco use, through perceived as an individual habit, often acquires a ritualistic character involving group behaviour; this is true for India, in both rural and urban settings (Reddy *et. al.* 2004).

As per the Tobacco control in India 2004, the estimated numbers of tobacco users among those aged 10 years and above were recorded as around 250 million. It is approximated that worldwide, five million people are killed annually due to cigarette smoking and use of other forms of tobacco accounts for the death of one in every ten adults. It is estimated that by 2030, this number will increase to over 8 million, that is, one of every six adult deaths. Given the existing trends in mortality, about 500 million people alive today will die prematurely as a result of tobacco use, with 1 billion deaths from tobacco expected during this century (Jha *et. al.* 2006). In the last two decades, the prevalence of smoking has increased mostly in low income and middle income countries, while it has declined in high income countries. Currently, eight out of ten of the world's 1.1 billion smokers live in low and middle income countries. Therefore, it can be concluded that worldwide, the number of tobacco deaths will increase from four million to ten million annually in the next 30 years. Further, the vast majority of these deaths will occur in low income countries (Merete 2001).

Although the prevalence of smoking has fallen in developed countries, it continues to increase in many low and middle income countries, especially among young people and women. An estimated 4.9 million (8.8 percent% of the global total) deaths were attributed to the use of tobacco in 2000, which is 45 percent higher than the number in 1990. This increase was the highest in developing countries, which now accounts for 50 percent of the global mortality and 56 percent of the disease burden. Without additional interventions to reduce the use of tobacco, the health burden will continue to increase, particularly in developing regions. At current levels of consumption, the burden from tobacco related morbidities is estimated to double by 2020 (Kenji *et. al.* 2003). Smoking has been widespread for many decades among men in India, where most adult deaths involve vascular disease, tuberculosis, or other respiratory diseases (Vendhan *et. at,*. 2003). Jha (2010) highlighted that around 15-18 percent of total deaths in India are preventable in nature as a large number of these deaths are due to tobacco related morbidity and lifestyle based diseases.

Tobacco use in the Indian context implies the availability of a diverse range of chewing and smoking forms of tobacco available at different price points, reflecting the varying socio-economic and demographic

patterns of consumption. Tobacco is consumed in both smoking and smokeless forms, for example, *bidi, gutkha, khaini, hookah*, cigarettes and cigars. Tobacco is also part of the socio-cultural setting in various societies, especially in the Eastern, Northern, and North-Eastern parts of the country.

The Global Adult Tobacco Survey (GATS) is one of the components of the Global Tobacco Surveillance System (GTSS). GATS is a standardized household survey that enables countries to collect data on key tobacco control indicators and assist countries in the formulation, tracking and implementation of effective tobacco control interventions and international comparisons as laid out in the MPOWER policy package of the World Health Organization (WHO). The WHO aims to reduce the global burden of disease and death caused by tobacco, thereby protecting present and future generations from the devastating health, social, environment and economic consequences of tobacco consumption and exposure to tobacco smoke. This is expected to be accomplished by providing global policy leadership through promoting the WHO framework convention on tobacco control and MPOWER strategies. The MPOWER approach covers the different domains to reduce the use of tobacco products, which can help protect people from morbidities and mortalities due to tobacco consumption. The MPOWER approach has been explained below:

M: *Monitor tobacco use and prevention policies*
P: *Protect people from second- hand smoke*
O: *Offer help to quite tobacco use*
W: *Warn about the dangers of tobacco*
E: *Enforce bans on tobacco advertising or promotion*
R: *Raise taxes on tobacco*

1.2 Review of literature

This study deals with the progression in tobacco use among smokers and users of smokeless tobacco in India till the onset of the desire and decision to quit using tobacco using the Kaplan Meier survival function analysis as well as the Cox proportional hazard model. The study has been organised into three sections. The first section deals with the prevalence of tobacco use separately for smoking as well as use of smokeless tobacco, the second section deals with the progression in terms of survival of the behaviour by some selected background characteristics. The last section portrays the determinants of quitting tobacco use with the application of Cox proportional hazard model.

Enis *et al.* (2000) found that tobacco use continues to be the leading preventable cause of death and disability among adults in the world today. By the year 2020, tobacco use is expected to cause approximately 8.4 million deaths, 70% of which will occur in developing countries. Aggressive marketing by transnational tobacco companies (TTCs) to expand their markets has resulted in increasing rates of tobacco consumption. Changing social norms in developing countries have made women an additional potential market for tobacco. During 1974-76, 49% of the world's tobacco consumption was in developing countries; by 1984-86 this had risen to 61%. In the year 2000, developing countries are expected to account for 71% of global tobacco consumption.

Rani *et al.,* in their study in 2003 found that 30 percent of the population aged 15 years and above, 47 percent among men and 14 percent among women either smoked or chewed tobacco, which translates to almost 195 million people in India, 154 million men and 41 million women. However, due to the use of household informants, the prevalence may have been underestimated by almost 11 percent among men and 1.5 percent among women for chewing tobacco and 5 percent among men and 0.5 percent among women for smoking. The study also shows that tobacco consumption was significantly higher among the poor, the less educated, Scheduled castes and Scheduled tribe populations. The prevalence of tobacco consumption shows

an increasing trend up to the age of 50 years and thereafter, a levelling or a declining trend. The prevalence of smoking and chewing also varied widely between different states and had a strong association with an individual's socio-cultural characteristics.

The 52nd National Sample Survey (52nd NSS) conducted by the National Sample Survey Organization in 1995–96 was the first nationally representative household survey to collect data on tobacco consumption for a population ten years and older using surrogate household informants. The prevalence rate of tobacco consumption of any form of tobacco consumption was at 51.3% for men and 10.3% for women in the age group, 15 years and older; this which was lower than that estimated by WHO and other small studies based on special population groups in small geographical areas. The review of the prevalence studies also points to the dearth of representative prevalence estimates in India.

The Tobacco Institute of India reports that cigarette sales have increased by 26.5% between 1993-94 and 1997-98, and estimates that cigarette consumption will continue to increase by 5% per year. The increase in tobacco consumption has paralleled the increase in spending on tobacco marketing. In 1998, tobacco advertising spending amounted to $48.8 million, a substantial increase over recent years. The Indian Tobacco Company Ltd (ITC), manufacturer of Gold Flake and Wills cigarettes, doubled its advertising budget between1995 and 1999, becoming the second largest advertiser in the nation. ITC, a British American Tobacco (BAT) affiliate, is the largest cigarette manufacturer with 66% of the market share. Godfrey Phillips India (GPI), a Phillip Morris affiliate, and Vazir Sultan Tobacco (VST), a BAT affiliate, each have 13% of the total market share. Golden Tobacco Company (GTC) has 8% of the market share.

1.3 Need of Study

India is experiencing a rapid health transition, with large and rising burdens of chronic and communicable diseases. The World Health Organization predicts that tobacco deaths in India may exceed 1.5 million annually by 2020. Several studies abroad and many case studies in India have established the causal relation between smoking and tuberculosis. It has been observed that boys at early ages start smoking and using other smokeless tobacco products. Therefore, it is necessary to survey how frequently and at what age people start consuming tobacco. Nationally representative and reliable prevalence data on tobacco consumption are insufficient. Significant research is needed to identify the actual trends. There is need to pay attention to chronic and communicable diseases like tuberculosis and asthma, especially from the point of view of policy making and program implementation.

1.4 Objectives of the study

This study aims to analyse the different dimensions of tobacco use in India .The specific objectives of the present study are

1. To analyze the differentials in prevalence of smoking as well as use of smokeless tobacco.
2. To examine the progression in smoking as well as use of smokeless tobacco.
3. To assess the major determinants of quitting tobacco use among smokers as well as user of smokeless tobacco.

1.5 Data and Methods

This study is based on the data from the Global Adult Tobacco Survey India (GATS India). GATS India was conducted in 2009-10 as a household survey of persons in the age group 15 and above. The data of Global Adult Tobacco Survey India (GATS India) is the global standard for monitoring adult's tobacco use (smoking and smokeless) and tracking key tobacco control indicators. Global Adult Tobacco Survey India was carried out in all 29 states of the country and the two union territories of Chandigarh and Puducherry, covering about 99.9 percent of the total population of India. A national probability survey was used to

provide national and regional estimates by residence and gender and state estimate by gender. The survey was designed to produce internationally comparable data on tobacco use and other tobacco control indicators using a standardized questionnaire, sample design, data collection and management procedures. A total of 69,296 interviews were completed among which 33,767 and 35,529 were of males and females respectively. Details about the contents and coverage of the GATS-India along with the methodology can be obtained from the national report (IIPS and MOHFW, 2009-10).

This paper is an attempt to find the progression of use of tobacco in all the regions of India by using the Kaplan-Meier Survival Analysis and Cox's Proportional Hazards Regression. The Cox proportional-hazards regressions model is broadly applicable and the most widely used method of survival analysis.

Let T represent survival time. We regard T as a random variable with cumulative distribution function

$$P(t) = Pr(T \leq t)$$

and probability density function

$$P(t) = \frac{dP(t)}{dt}$$

The more optimistic survival function S (t) is the complement of the distribution function.

$$S(t) = Pr(T > t) = 1 - P(t).$$

A fourth representation of the distribution of survival times is the hazard function, which assesses the instantaneous risk of demise at time t, conditional on survival to that time:

$$h(t) = \frac{\text{limit}\to 0\ Pr[(t \leq T < t+\Delta t) | T \geq t]}{\Delta t} = \frac{f(t)}{S(t)}$$

Modelling of survival data usually employs the hazard function or the log hazard.

1.5.1 Kaplan-Meier Survival Analysis

Kaplan Meier estimator of survivorship function is also called the product limit estimator. This estimator incorporates information from all the observations available, uncensored and censored, by considering the survival to any point of times as a series of steps by observed survival and censored time. In an analysis of survival time, we estimate the conditional probability of 'successful steps' and then multiply them to obtain an estimate of overall survivorship function.

1.5.2 Cox's Proportional Hazards Regression

There are several reasons for choosing Cox's proportional hazards modelling to explain the effect of covariates on time until the occurrence of event - the relative risk, no parametric assumptions, the use of the partial likelihood function, and the creation of survivor function estimates. Survival analysis typically examines the relationship of the survival distribution to covariates. Most commonly, this examination entails the specification of a linear-like model for the log hazard. For example, a parametric model based on the exponential distribution may be written as

$$\log h_i(t) = \alpha + \beta 1 x_{i1} + \beta 2 x_{ik} + \cdot\ \cdot\ \cdot + \beta k x_{ik}$$

Or, equivalently,

$$h_i(t) = \exp(\alpha + \beta 1 x_{i1} + \beta 2 x_{ik} + \cdot\ \cdot\ \cdot + \beta k x_{ik})$$

That is, as a linear model for the log-hazard or as a multiplicative model for the hazard. Here, i is a subscript for observation, and the 'x's are the covariates. The constant α in this model represents a kind of log-baseline hazard, since log hi (t) = α [or hi (t) = eα] when all of the x's are zero. There are similar parametric

regression models based on other survival distributions. The Cox model, in contrast, leaves the baseline hazard function α (t) = log h0 (t) unspecified:

$$\log hi\ (t) = \alpha\ (t) + \beta 1xi1 + \beta 2xik + \cdot\ \cdot\ \cdot + \beta kxik$$

The survival function in the survival library fits the exponential model and other parametric accelerated failure time models. The Cox model is now used much more frequently than parametric survival regression models,

Or, again equivalently,

$$hi\ (t) = h\ 0(t)\ \exp\ (\beta 1xi1 + \beta 2xik + \cdot\ \cdot\ \cdot + \beta kxik)$$

This model is semi-parametric because while the baseline hazard can take any form, the covariates enter the model linearly. Consider two observations i and i that differ in their x-values, with the corresponding linear predictors

$$\eta i = \beta 1xi1 + \beta 2xik + \cdot\ \cdot\ \cdot + \beta kxik \text{ and}$$
$$\eta i\_ = \beta 1xi\_1 + \beta 2xi\_k + \cdot\ \cdot\ \cdot + \beta kxi\_k$$

The hazard ratio for these two observations,

$$\frac{hi(t)}{hi'(t)} = \frac{h0(t)e^{ni}}{h0(t)e^{ni'}}$$
$$= \frac{e^{ni}}{e^{ni'}}$$

is independent of time t. Consequently, the Cox model is a proportional-hazards model.

Cox proportional hazard regression is done for obtaining cumulative hazard function and hazard ratio after testing the proportionality assumption of hazard throughout.

1.5.3 Hazard Function: Another important qualitative term considered in survival is the hazard function, denoted by H (t). In contrast to the survival function, "the hazard function summarises the survival data by focusing on failures, the hazard function gives the instantaneous potential per unit time for an occurrence" given that individuals have survived up to time t; while the survival function is an expression for a survival probability, hazard function is an expression for a failure rate. The mathematical formula for the hazard function is

$$h\ (t) = \lim_{dt \to 0} \frac{\Pr[(t \le T < t+\Delta t) | T \ge t]}{dt} = \frac{f\ (t)}{S(t)}$$

The expression defines h (t) as the limit as the time interval delta t approaches zero of the ration of two quantities.

The probability is that the event will occur between time t and t+Δt, given that the survival time T is greater than or equal to t , and to the time interval Δt. Sometimes called the conditional failure rate, the hazard function gives the conditional probability of failure per unit time. For any specified value of t, h (t) is always nonnegative and has no upper bound. The hazard function is of particular interest because the mathematical model used to describe survival data is usually written in terms of hazards function. The hazard and survival functions are related such that if the form of h (t) is known, S (t) can be derived, and vice versa, the relationship between h (t) and S (t) can be shown in two mathematical formulae.

$$S(t) = \exp\left[-\int_0^t h(t)\, du\right]$$

$$h(t) = -\frac{1}{S(t)}\frac{ds(t)}{dt}$$

The formulae indicate that for a given values of t, a high S (t) corresponds to a small h (t) and low S (t) corresponds to a high h (t).

1.6 Results and Discussion

1.6.1 Prevalence of Tobacco Use

Like other countries in the world where GATS survey has been conducted, India has also made systematic efforts to generate evidence based on different dimensions of tobacco use by taking a representative sample of all adults aged 15 years and above. As per the 2001 census, there have been 795.5 million residents aged 15 and above, living in their primary residence prior to the survey. GATS India used a nationally representative sample with potential to provide national as well as state level estimates separately for males and female and urban-rural residence. Accordingly, a total of 79,690 households were identified and 69,296 individuals aged 15 and above were interviewed with a standard set of questionnaires. The national level household survey produced an overall response rate of 91.8 percent with very little variation across the States/Union Territories. In view of the overall prevalence of tobacco use of 35 percent, India has a total of 275 million tobacco users, where approximately 111 millions are tobacco smokers and about 206 million are users of smokeless tobacco. This means that almost 42 million adults have the dual habit of smoking as well as use of smokeless tobacco.

The overall prevalence of tobacco (smoking as well as use of smokeless tobacco) reflects the complete scenario. In India, around 35 percent of the population use tobacco, whereas out of them 84 percent (29.4%) use it daily, which highlights their nicotine dependency and the severity of the problem. On the other hand, the prevalence of smoking is around 9 percent and the prevalence of use of smokeless tobacco is 21 percent, while 5 percent of the adult population in the country use tobacco in both the forms, smoking as well as use of smokeless tobacco. Thus, the absolute prevalence of smoking is 14 percent and use of smokeless is 26 percent. However, the level of tobacco use is not uniform across the different states in the country. There is a profound variation in the overall use of tobacco as well as smoking tobacco and use of smokeless tobacco across different states.

Figure 1(a) portrays the prevalence of the overall use of tobacco in India and its variation across different states. The prevalence of tobacco use is the highest in Mizoram (63%) followed by four other states from the North-Eastern region, that is, Nagaland (57%), Tripura (56%), Meghalaya (55%) and Manipur (54%). The overall prevalence is considerably higher in the Empowered Action Group (EAG) states, which have already been the focus of maternal and child health programs and interventions centrally launched by the Government of India. The prevalence is high in Bihar (54%), Chhattisgarh (53%), and Jharkhand (50%). On the other hand, the lowest prevalence of tobacco is reported in Goa (9 %), Punjab (12 %), Chandigarh (14 %), Puducherry (15 %) and Tamil Nadu (16 %).

1(a) Prevalence of Tobacco Users (GATS 2009-10)

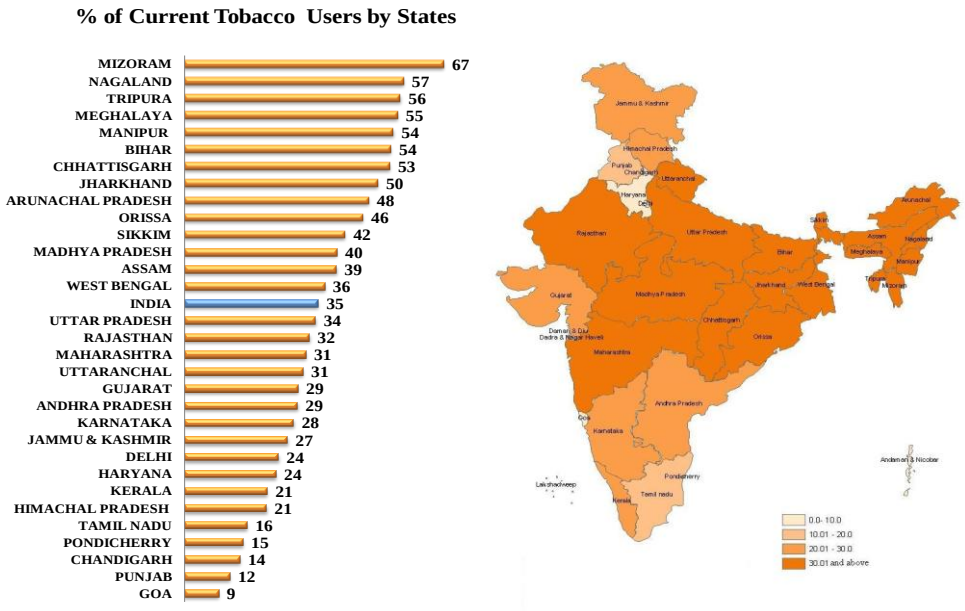


Figure 1(b) presents the percentage distribution of tobacco smokers according to states and UTs. The figure shows that there is a higher concentration of tobacco smoking among different states in the North-Eastern region of the country. Like the overall prevalence in tobacco use, the highest prevalence of tobacco smoking is reported in Mizoram (40%), followed by Meghalaya (36%), Nagaland (32%), and Arunachal Pradesh (29%). Apart from the above states, the other three states from the North-Eastern region also rank very high in the chronology and thus all the seven sister states from the region portray the highest tobacco smoking in the country. Of course, there are many other states where tobacco smoking is higher than the national average. In contrast, the lowest prevalence of tobacco smoking is reported in Goa (5 %), Maharashtra (7%), Punjab (7 %), and Tamil Nadu (10 %), whereas the national prevalence of tobacco smoking use stands at 14 percent. Thus, one can distinguish a profound variation in the prevalence of tobacco smoking across different states/ UTs in India.

1(b) Prevalence of Tobacco Smoking (GATS 2009-10)

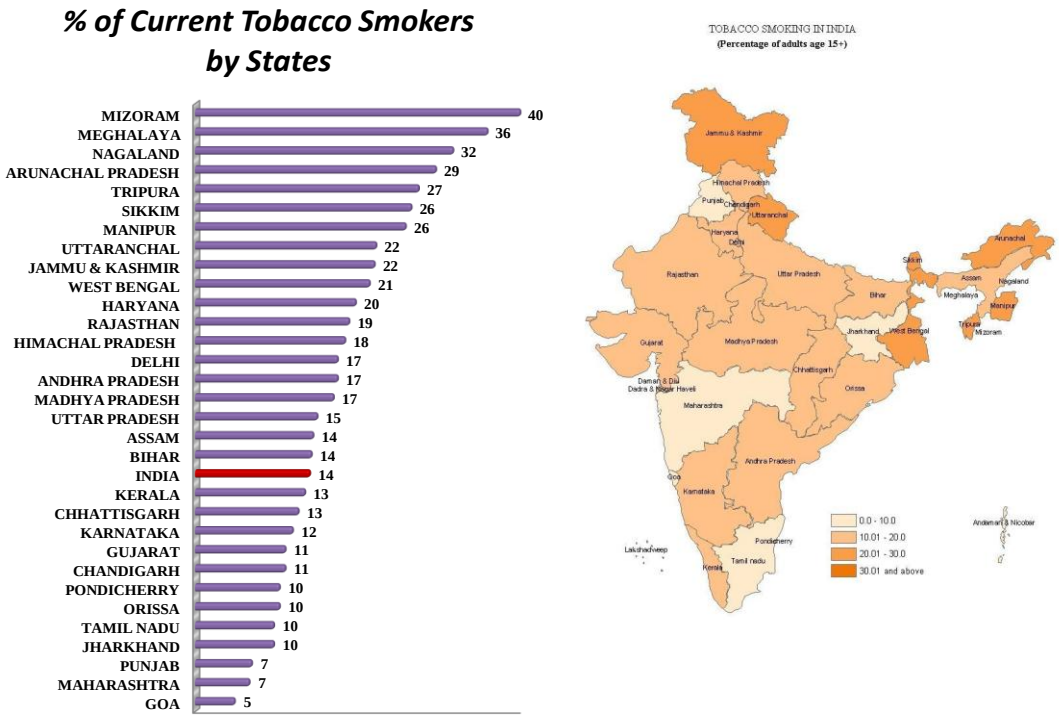
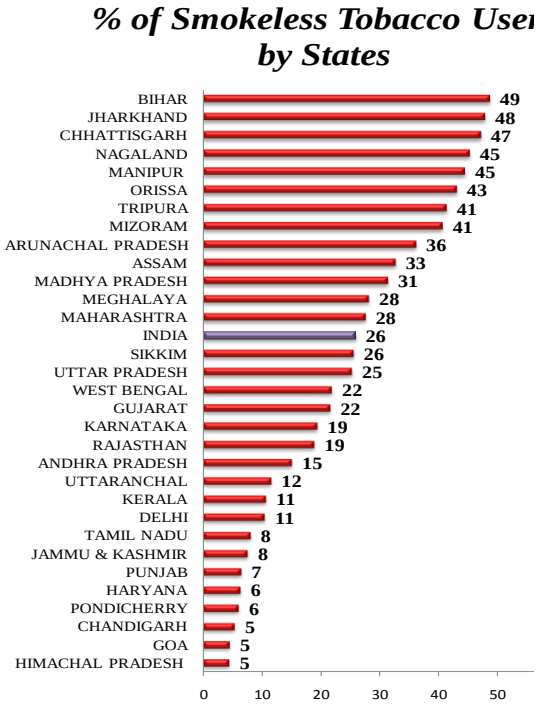
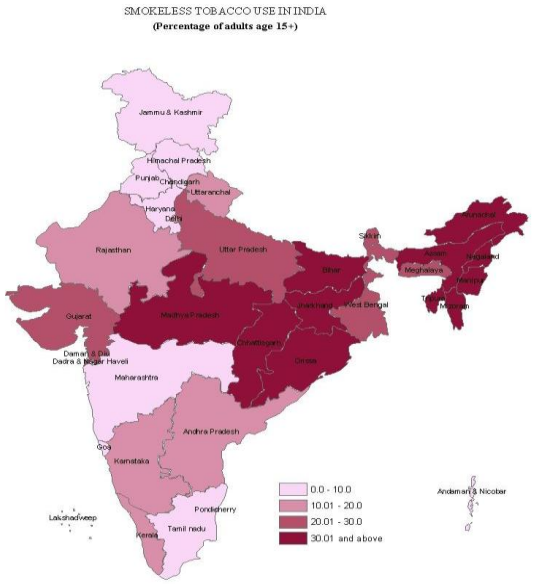


Figure 1(c) presents the percentage distribution of users of smokeless tobacco according to states and UTs in India. It is evident that there is a large variation in the prevalence of use of smokeless tobacco across the different states/UTs. The highest prevalence of the use of smokeless tobacco is reported in some EAG states like Bihar(49 %), Jharkhand (48%), Chhattisgarh (47%) and in the North-Eastern states of Nagaland (45%) and Manipur (45%), while the lowest prevalence is reported by the states of Himachal Pradesh, Goa, Chandigarh (5% in each) and Puducherry and Haryana (6% in each), which is significantly lower than the national level prevalence of use of smokeless tobacco, that is 26 percent.

1(c) Prevalence of Users of Smokeless Tobacco (GATS 2009-10)





1.6.2 Survival Function Analysis

This section contains the survival estimates from Kaplan Meier Survival estimates of smokers and users of smokeless tobacco by selected background characteristics. It gives the survival probability of use of tobacco and displays the trend of continuing use of tobacco. This estimator incorporates information from all the observations available, uncensored and censored, by considering the survival to any point of time as a series of steps by observed survival and censored time. This can also be described in terms of probability of quitting smoking as well as use of smokeless tobacco at different points of time.

Figure 1 reveals that the Kaplan Meier Survival estimate gives the conditional probability of successful steps, here the survival probability of continuing smoking points out the differentials in smoking patterns at different points of time. The male female differentials show that there is little probability of quitting during the first ten years of smoking. It starts declining with increase in the number of years of smoking. The probability of quitting is high among women compared to men. In the case of rural urban differentials, there is a slight variation in the probability of quitting during the first ten years of smoking among rural as well as urban smokers. The Figure below shows that the probability of quitting is higher in rural areas compared to urban areas.

The probability of quitting varies with the level of educational attainment. Figure 1 shows that the probability of quitting is the lowest among those have no formal schooling and less then primary education. It starts declining after the first ten years of smoking. The probability of quitting is the highest among those who have primary but less then secondary education and secondary and above education. The trend is such that, as education attainment increases, the probability of quitting also increases with time.

There is regional variation in the probability of quitting smoking among smokers. Figure 1 shows that the probability of quitting is the highest in the southern region; it starts declining after a few years of smoking. The Figure shows that the probability of quitting is the lowest in North-Eastern states and the highest in the southern region. While the probability of quitting is the highest in southern region, they continue for more years compared to other regions.

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Figure 2 presents the Kaplan Meier Survival estimate that gives the conditional probability of successful steps, here the survival probability of continuing use of smokeless tobacco pointed out the differentials in smoking patterns at different points of time. The male female differentials in terms of probability of quitting the use of smokeless tobacco show that there is little probability of quitting during the first ten years of use of smokeless tobacco. It starts declining with increasing years of smoking. The probability of quitting is high among women compared to men. In the case of rural urban differentials, there is a slight variation in the probability of quitting during the first ten years of use of smokeless tobacco among rural as well as urban users of smokeless tobacco. The Figure shows that the probability of quitting is higher in rural areas compared to urban areas.

The probability of quitting varies with the years of smoking among people with different educational attainment. The Figure shows that the probability of quitting is the lowest among those have no formal schooling and less then primary education. It starts declining after the first ten years of use of smokeless tobacco. The probability of quitting is the highest among those have primary but less then secondary education and secondary and above education. It starts declining from the initial years of use of smokeless tobacco. It seems that as education attainment increases, the probability of quitting also increases with time.

There is regional variation in the probability of quitting the use of smokeless tobacco. The Figure shows that the probability of quitting is the highest in the southern region; it starts declining after a few years of smoking. The Figure shows that the probability of quitting is the lowest in the North-Eastern states and the highest in the southern region. It is seen that users of smokeless tobacco belonging to the western region have a chance to quit the use of smokeless in a short time. While the probability of quitting is the highest in the southern region, users of smokeless tobacco belonging to the northern region seem to continue longer compared to those from the other regions.

1.6.3 Determinants of Quitting Tobacco

This section focuses at the determinants of quitting tobacco; we attempt to identify how socio-demographic variables like age, sex, educational attainment, occupation and region influence the use of tobacco in both the forms, that is, smoking as well as use of smokeless tobacco. There are several reasons for choosing Cox's proportional hazards modelling to explain the effect of covariates on time until the occurrence of event, the relative risk, no parametric assumptions, and the use of the partial likelihood function and the creation of survivor function estimates. Here we have intended the hazard ratio from the Cox proportional hazard ratio model to know the hazard of quitting of smoking as well as the use of smokeless tobacco. Results from the Cox proportional hazard model reveals that the hazard probability of quitting tobacco among females was 1.353 times ($p<.01$) higher compared to that among males. Urban people compared with their rural counterparts, had lower hazard probability of quitting tobacco (hazard ratio=0.905). As expected, the hazard of quitting tobacco increases with the level of education. Compared to uneducated persons, those with secondary education and above had 2.429 times higher hazard probability of quitting tobacco. The

probability of quitting tobacco was found to be more among self-employed and retired or unemployed people than with government or non-government employees. As compared with government or non-government employees, students as well as homemakers, were 9.2 percent ($p<.01$) and 10.6 percent ($p<.01$), respectively, less prone to quitting tobacco. The regional variation shows that the probability of quitting tobacco was higher in the southern and central regions (hazard ratio=1.273), followed by the eastern regions (hazard ratio=1.17) and western regions (hazard ratio=1.068) compared to the north. The probability of quitting tobacco was found to be 37.6 percent less among people from the North-East compared to people from the north.

The study documented the sex of the person as a significant determinant of quitting smokeless tobacco. The hazard of quitting smokeless tobacco was high among women compared to men (hazard ratio=1.022, $p<.01$). People living in urban areas had 1.207 times higher chances of quitting smokeless tobacco compared to their rural counterparts. Education shows a significant positive association with quitting smokeless tobacco. Compare to uneducated persons, those with secondary education and above were 1.695 times ($p<.01$) and those with primary but less than secondary education 1.588 times ($p<.01$) more prone to quit smokeless tobacco. Compared with government and non-government employees, the probability of quitting smokeless tobacco was higher among students (hazard ratio=2.499) followed by homemakers (hazard ratio=1.340), the retired or unemployed (hazard ratio=1.254) and the self-employed (hazard ratio=1.176).

Again, region emerged as a significant factor affecting the chances of quitting smokeless tobacco. People from the south were 1.458 times more likely to quit smokeless tobacco followed by the central region (hazard ratio=1.371) and the north. However, the chances of quitting smokeless tobacco were less in the North-East (hazard ratio=0.484), followed by the central (hazard ratio=0.939) and western regions (hazard ratio=0.984) compared with people from the north.

Table 1.1: Cox proportional hazard ratio of quitting tobacco among smokers by selected background characteristics in India, 2009-10

Background characteristics	Hazard ratio of smokers	Standard error
Sex		
Male®		
Female	**1.354*****	**0.001**
Residence		
Rural®		
Urban	**0.905*****	**0.000**
Education		
No formal schooling®		
Less than primary	**1.010*****	**0.000**
Primary but less than secondary	**2.021*****	**0.001**
Secondary and above	**2.429*****	**0.002**
Occupation		
Govt. & non-Govt. employee ®		
Self employed	**1.120*****	**0.000**
Student	**0.908*****	**0.006**
Homemaker	**0.894*****	**0.001**
Retired or unemployed	**1.440*****	**0.001**
Region		
North ®		
Central	**1.237*****	**0.002**
East	**1.170*****	**0.002**
North-East	**0.624*****	**0.002**
West	**1.068*****	**0.002**
South	**1.273*****	**0.002**

Note: - ® Reference category, ***P<0.01.

Table 1.2 Log-rank test for equality of survivor functions among the groups of smokers

	Chi-square	d.f.	P value
Sex	**3046.14**	**1**	**0.00**
Residence	**29301.24**	**1**	**0.00**
Education	**1362857.5**	**3**	**0.00**
Occupation	**211780.85**	**4**	**0.00**
Region	**85552.70**	**5**	**0.00**

Table 1.3: Cox proportional hazard ratio of quitting tobacco among users of smokeless tobacco by selected background characteristics in India, 2009-10

Background characteristics	Hazard ratio of Users of Smokeless	Standard error
Sex		
Male®		
Female	**1.023*****	**0.001**
Residence		
Rural®		
Urban	**1.208*****	**0.001**
Education		
No formal schooling®		
Less than primary	**1.066*****	**0.001**
Primary but less than secondary	**1.588*****	**0.001**
Secondary and above	**1.695*****	**0.002**
Occupation		
Govt. & non-Gov employee ®		
Self employed	**1.176*****	**0.001**
Student	**2.499*****	**0.007**
Homemaker	**1.340*****	**0.001**
Retired or unemployed	**1.254*****	**0.001**
Region		
North ®		
Central	**1.371*****	**0.005**
East	**0.939*****	**0.003**
Northeast	**0.484*****	**0.002**
West	**0.984*****	**0.003**
South	**1.458*****	**0.005**

Note: - ® Reference category, ***P<0.01.

Table 1.4 Log-rank test for equality of survivor functions among the groups of users of smokeless tobacco

	Chi-square	d.f.	P value
Sex	**8814.37**	**1**	**0.00**
Residence	**106402.48**	**1**	**0.00**
Education	**374469.13**	**3**	**0.00**
Occupation	**165547.69**	**4**	**0.00**
Region	**244328.12**	**5**	**0.00**

1.7 Summary and Conclusion

The analysis reveals that the overall prevalence of tobacco use as well as prevalence of tobacco smoking is the highest in the North-Eastern states, especially Mizoram and the lowest in Goa. On the other hand, the prevalence of the use of smokeless tobacco is the highest in the EAG states, especially in Bihar and the lowest in Himachal Pradesh. The Kaplan Meier Survival estimates pointed out that the probability of quitting is higher among women than among men and that it is relatively higher in urban areas as compared to rural areas, both for smokers as well as users of smokeless tobacco. Further, educational attainments have a strong negative association with tobacco use as the probability of quitting is the highest among those with secondary education and above than among those with no former schooling. There has been profound regional variation, where the probability of quitting is the highest in the southern states both among smokers as well as users of smokeless tobacco.

Further, the Cox proportion hazard ratio, which portrays the cumulative probability of quitting tobacco use, has been computed for major socioeconomic groups relevant for planning and intervention of tobacco control programs. It has emerged from the analysis that the probability of quitting tobacco among females is 1.35 times ($p<.01$) higher compared to their male counterparts. Urban people compared to their rural counterparts, have a lower probability of quitting tobacco (HR=0.905). The probability of quitting tobacco increases with the level of education. Compared to uneducated persons, those with secondary education and above are 2.43 times more likely to quit the use of tobacco. The regional variation shows that the probability of quitting tobacco is higher in the central and southern regions (HR=1.27), followed by the eastern region (HR=1.17) and western region (HR =1.07) compared with the north. The probability of quitting tobacco is found to be 37.6 percent less among people from the North-East than among people from the northern region. People from the southern region are 1.46 times more likely to quit the use of smokeless tobacco followed by those from the central region (HR=1.37) compared with people from the northern region. However, the chances of quitting the use of smokeless tobacco are less in the North-East (HR=0.48), followed by the central (HR=0.94) and western regions (HR=0.984) compared with people from the north.

In view of the disproportionally high rate of smoking and use of smokeless tobacco in the North-Eastern states along with the progression of the tobacco epidemic, there is an urgent need of innovative strategies to strengthen cessation efforts in North-eastern states. Print as well as electronic media have to play a proactive role in creating awareness among the most vulnerable groups, especially among youth and women, so that they can be convinced to quit and the tobacco related disease burden be minimized. In view of the existing epidemiology transition and significant link between tobacco use and health hazard, the Government should effectively strengthen the MPOWER strategies for tobacco control.

1.8 References

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