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Socio-economic Determinants of Smoking Prevalence and Intensity in Nepal

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Abstract

This study examines the socioeconomic determinants of smoking and smoking intensity in Nepal. Leveraging data from the nationally representative Nepal Multiple Indicator Cluster Survey 2019, a logistic regression is utilized to identify predictors of individual smoking while the study relies on Poisson estimation technique to examine the determinants of smoking quantity. Our results indicate that individual characteristics—particularly age, level of education, history of alcohol use, and consumption of smokeless tobacco—play a significant role in predicting the prevalence of smoking. On the other hand, household factors like wealth scores, household size, and house-specific attributes are only weakly associated with both smoking behavior and intensity. Our results also support that similar set of socio-economic variables influence the likelihood of smoking and the quantity of cigarettes consumed. These findings emphasize the need for demand-side interventions targeted to specific socioeconomic groups, and supplementing the existing supply-side policy and regulatory measures implemented by the Government of Nepal.

Keywords: *Smoking, Smoking Quantity, Socio-economic determinants, Targeted Intervention*
JEL Classification: C21, C25, D31, I14

1. INTRODUCTION

Smoking remains a significant global public health concern, causing premature deaths and a substantial disease burden. In 2019, there were about 1.14 billion active smokers aged 15 or more, and it remains a reason for an estimated 7.69 million deaths annually (Reitsma et al., 2021). Notably, the economic burden associated with smoking also significant. The use of tobacco, for example, results in a loss of USD 229.77 million in Disability Adjusted Life Years (DALYs) (He et al., 2022). Likewise, smoking-related diseases incur significant healthcare expenses. In 2012, for example, healthcare expenses related to smoking-related diseases alone accounted for 5.7% of global health expenditure (Goodchild et al., 2018). When health expenditures and productivity losses are accounted together, the total economic cost of smoking would account for 1.8% of the world's annual gross domestic product (GDP) (Goodchild et al., 2018). In south Asia, smoking is the fourth largest causes of death claiming 1.31 million lives and imposing disease burden equivalent to USD 35.13 million in 2019 alone (Ritchie and Roser, 2017). While smoking is ubiquitous across the globe, WHO (2019) estimates show that nearly 80% of smokers are from developing countries and that these countries need additional efforts to reduce its prevalence and consequent health problems. This indicates that the smoking has a significant economic cost with a disproportionate effect in low-income countries characterized by high smoking prevalence, poor health infrastructure and stark socio-economic disparity.

Available literature suggests that socioeconomic characteristics are important predictors of smoking behavior. In particular, literature suggests education, age, gender, job status, type of employment, income, household assets, place of residence among others as major determinants (Schaap & Kunst, 2009). Most studies conclude that the smoking prevalence rate is higher among individuals with lower socio-economic status. Poor and marginalized are 2.5 times more likely to smoke (Hosseinpoor et al., 2012). And their smoking-related health expenses are three times higher as compared to the non-poor group (Hiscock et al., 2012). These evidences suggest that a deeper understanding of the socio-economic determinants and inequality in smoking is imperative for better targeting of the public sector interventions especially in low-income countries where there exists sheer disparity in socio-economic indicators.

Nepal, a developing economy in South Asia, is not an exception where smoking alone accounts for second largest cause of deaths and disease burden (Ritchie and Roser, 2017). Nearly 25.7% of the total population are smokers; of these 44.4% are male and 11.1% are female, indicating significant gendered variation in smoking prevalence (WHO, 2021). There also exists significant differences in smoking rate across other socio-economic determinants. For instance, Sreeramareddy & Harper (2019) illustrates significant gender, wealth, and education based differences in smoking; this is despite

the general decline in use of tobacco prevalence for both men and women. It is therefore important to take into account these differences in characteristics while formulating policies and regulations aimed at reducing smoking prevalence.

The government of Nepal has taken several initiatives to minimize the smoking prevalence in Nepal. The "Tobacco Product (Control and Regulatory) Act" was put into effect by the government in 2011 to control the manufacture, sale, and consumption of tobacco products. The legislation forbids the selling of tobacco goods to minors, smoking in public areas, and tobacco product advertising. Government-led awareness initiatives have been launched to inform the public of the negative effects of smoking. The campaigns focus on the negative effects of smoking on health and were directed at both adults and children. The act also marked smoke-free zones in places like hospitals, schools, and office buildings. While blanket interventions may curb the use of smoking to some extent, it may not be as effective and welfare maximizing unless they can also consider specific demographic and socio-economics characteristics of the smokers. In addition, it is also important to understand what characteristics distinguish smokers from non-smokers to adequately strategize the policies, programmes and interventions targeted to reduce smoking prevalence. This study is therefore an attempt to unveil what sort of demographic and socio-economic attributes explain smoking behavior in low-income countries like Nepal.

This study contributes to the existing shred of literature by examining two specific objectives. First, we examine the socio-economic predictors of smoking by an individual. This study identifies such predictors for men and women separately, as well as for the overall sample. This disaggregation will help explain the differences in smoking behavior between men and women when linked with their socioeconomic well-being. Second, we explore the smoking intensity of an individual, measured by number of cigarettes consumed in a day. With these objectives to explore, this paper, therefore, analyses the demand side determinants of the likelihood of smoking by an individual; and smoking quantities. As argued earlier, knowing demand side factors influencing the smoking behavior is important as it helps to gauge the welfare implications of smoking in terms of pre-mature death, health expenditure and productivity losses. Further, it also helps designing a targeted intervention focusing on the age groups, gender or geographic location.

To our knowledge, only limited studies explore the socio-economic correlates of tobacco use and its trends in Nepal (Hashibe et al. 2010; Hosseinpoor et al. 2011; Sreeramareddy et al. 2011; and Sreeramareddy & Harper 2019). As already argued, understanding such socio-economic determinants of smoking is important for designing a targeted intervention.

The remaining sections of this article are organized as follows. Section 2 provides a survey of previous literature. Section 3 discusses the data source, relevant sample, and description of the variables. Section 4 presents the summary statistics of the key variables along with the main empirical results contextualizing the results concerning existing hypothesis and previous findings. Finally, section 5 provides a brief conclusion of the study and possible policy implications.

2. REVIEW OF LITERATURE

While the literature from public health and epidemiology is rich in documenting the ill effects of smoking, literature examining the socio-economic correlates of smoking is limited (Bauer et al., 2007; Islam & Johnson, 2003; Nketiah-Amponsah et al., 2018; Zajacova et al., 2020). This section briefly presents a review of the national and international literature that examines the socio-economic determinants of smoking. This section concludes with a research gap.

Number of literatures examine association of smoking prevalence and socio-economic characteristics. Most studies find smoking is highly prevalent among individuals with poor socio-economic, behavioral and location-specific characteristics (Cavelaars, 2000; Martin & Wardle, 1999), such as those with low income, low level of education and awareness about the harms of smoking, limited access to financial resources, and psychological stress due to unfavorable social status and poor living conditions (Martin & Wardle, 1999; Stronks et al., 1997).

In some cases, the relationship between the economic status and smoking in not straight forward. While lack of adequate material resources, that indirectly measures well-being, may limit opportunities for engaging in certain healthy behaviors, this does not stop people from smoking since choosing not to smoke is always the most economical option (Pampel, 2002; Stronks et al., 1997). In addition, if smoking was solely determined by financial capacity, individuals with fewer material resources would smoke less frequently than those with greater resources. However, direct measures of well-being such as income and others may be inversely correlated with the smoking (Martin & Wardle, 1999). For example, literature shows education as another important predictor of smoking behavior vis-à-vis other measures of well-being since it reflects knowledge and skills that are relevant to making informed choices about health behaviors, including smoking (Backlund et al., 1999; Mirowsky & Ross, 1998). Hence, understanding of these differences in correlation between direct and indirect measures of well-being with smoking behavior may need further investigation into the psychological well-being of individual. For example, individuals with poor socio-economic status may resort to smoking to cope with stressful situations while those with better material resources may have more accessible options for dealing

with adversity and stress, rather than resorting to smoking. Hence, understanding their economic circumstances may reveal additional insights into the socioeconomic disparities associated with smoking (Pampel, 2002; Stronks et al., 1997).

There are few studies that examine the demographic and socio-economic determinants of smoking behavior in Nepal. Studies show that use of tobacco, either chewing or smoking, is significantly high among male than female (Sreeramareddy et al., 2011). In addition, Khanal et al (2013) and Shrestha et al. (2019) show that individuals with low levels of education, lower socioeconomic status, those residing in the Terai region, and of higher age are more likely to use tobacco. Comparison of determinants show that, in general, the use of tobacco decrease with level of education and wealth status and that education is more influential than wealth in determining the use of tobacco (Sreeramareddy & Harper, 2019). Their literature also assesses disparities in the use of tobacco between men and women and shows that the inequality has reduced over time in Nepal. A study by Binu et al. (2010) shows that people resort to smoking for reasons such as enjoyment, relaxation, boredom, and appearing mature.

This research adds to the existing literature in multiple ways. First, since previous studies focuses on one or few aspects of socio-economics statuses, either direct or indirect measure of well-being; this study will set a departure by simultaneously considering them into the study. For example, we include level of education, occupational status, house structure, and household income in a single equation framework of smoking behavior. By doing so, we are able to make a comparative assessment of the importance of both direct and indirect measures of well-being. The findings from this study, as such, is important for devising targeted interventions towards reducing smoking prevalence. Second, unlike previous studies that use Nepal Demographic Health Surveys (NDHS), this study uses the most recent Nepal Multiple Indicator Survey 2019 (NMICS 2019) that provides the fresh quantitative assessment of the demographic and socio-economic determinants of smoking behavior in Nepal. Third, the study, in addition to using extensive measure of smoking behavior, also looks into intensive measure by analyzing the determinants of number of cigarettes smoked per day. Extensive measure is useful, as already mentioned, to examine the set of characteristics that distinguish smokers from non-smokers while intensive measure is useful to understand the importance of the smoker's characteristics in determining the intensity of smoking. Last, as already mentioned in the previous section, this adds to the existing body of literature assessing the socio-economic determinants of smoking behavior in the region and in Nepal.

3. DATA AND METHODOLOGY

3.1 Data Source

The study uses data from the latest wave of nationally representative Nepal Multiple Indicator Cluster Survey (NMICS) 2019 collected by the Central Bureau of Statistics, Government of Nepal. The survey asks household specific questions to 14805 households and administer health specific and smoking-related questions separately to 14805 women and 5501 men in those households, both aged 15-49. As such, the data used in this study relies on a total of 3284 individuals, both men and women.

3.2 Estimation Strategy

The estimation strategy evaluates two equations: first, a logit model is used where dependent variable is a binary indicating whether an individual smokes cigarettes (extensive measure); and second, Poisson regression method is used where dependent variable is number of cigarettes smoked in the last 24 hours (intensive measure). Both equations uses same set of socio-economic variable on the right hand side. As such, the binary indicator for smoker is 1 while it is 0 for non-smokers. A simple exposition of the logit model is shown below:

$$Y_i = \begin{cases} 1, & if\ an\ \text{ith individual is observed to smoke} \\ 0 & otherwise \end{cases}$$

The probability that an individual is observed to smoke is given by the logistic function:

$$\Pr(Y_i = 1) = \frac{1}{1+e_i^{-X_i\beta}} \qquad (1)$$

Where Xi represents a vector of the socio-economic determinants for ith individual, β is the vector of coefficients to be estimated. Equation (1) can be estimated with the following relationship

$$ln\left[\frac{P_r(Y_i)}{1-P_r(Y_i)}\right] = \alpha + \sum_k \beta_k x_{ki} + \epsilon_i \qquad (2)$$

Where the variables have the usual interpretation as above, and ϵ_i represents the random error term that is assumed to be independently and identically distributed. The socio-economic covariates (Xi) mainly include individual specific characteristics, household specific characteristics, geography related indicators, and other variables that are likely to influence individual's decision to smoke. The equation of primary interest of estimation, therefore, is given by

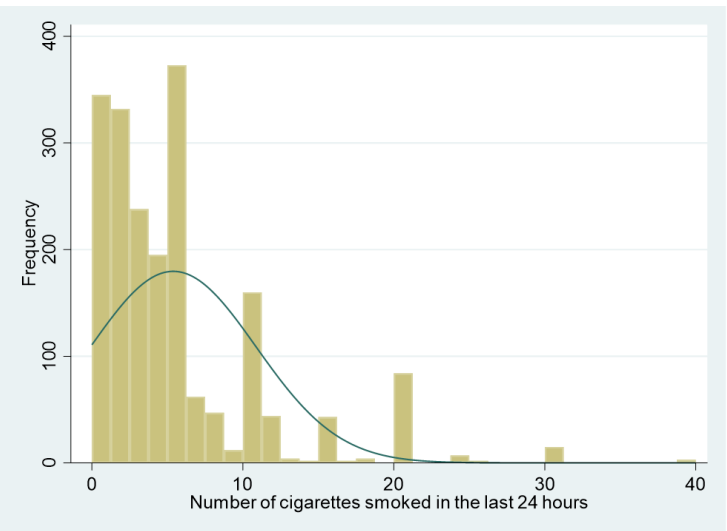
$$\begin{aligned} ln\left[\frac{P_r(Y_i)}{1-P_r(Y_i)}\right] &= \alpha + \beta_1 age + \beta_2 age^2 + \beta_3 edu + \beta_4 married + \beta_5\ child + \beta_6\ slt \\ &+ \beta_7 alcohol + \beta_8 insurance + \beta_9\, tv_{radio} + \beta_{10}\ hhsize + \beta_{11}\ cement \\ &+ \beta_{12}\ room + \beta_{13} dwell + \beta_{14} urban \\ &+ \sum \beta_{15} caste + \sum \beta_{16} wealth\_quintile + \sum \beta_{17} provice + \epsilon_i \end{aligned} \qquad (3)$$

Table 1 provides the description of the control variables included in equation (3), and subsequent write up below discusses on the relationship between socio-economic covariates and smoking along with expected sign. The equation (3) is estimated for overall sample and for men and women separately to see if some of the variables are the more important in explaining the smoking status of men as compared to women.

Since the study further aims to examine the determinants of smoking quantity, and given the count nature of the dependent variable, a Poisson function remained a preferred estimation technique. The Poisson function is relevant because of two main reasons. First, smoking quantity is a count variable with a significant number of 'zero' in the observation (see figure 1). And, second, the mean and average of the dependent variable are similar.

Figure 1 shows the distribution of the smoking quantity. The distribution reveals that about one tenth of the individuals did not smoke during last 24 hours despite that they categorized themselves as a current smoker. That means, the presence of '0' in our data is quite significant. Nearly next 80 % of the individuals reported smoking between 1-10 cigarettes during a day (24 hours) while proportion consuming in more than 10 cigarettes is nearly 10 %. The average quantity of the cigarettes consumed during a typical day is 5.38 with a standard deviation of 5.47. The number of cigarettes consumed in a day ranges from zero to as high as 40 cigarettes.

Figure 1: Distribution of the Smoking Quantities



Source: Author's illustration based on NMICS (2019)

Therefore, we exploit a Poisson estimation technique to identify the factors determining the smoking quantity by an individual. A Poisson specification considering the number of cigarettes smoked in last 24 hours as a dependent variable (say y) can be specified as below.

Let $\lambda = E(Y|X) = e^{\beta X}$ is the mean number of smoking by an individual. The Poisson distribution mass function is given by:

$$P(y|x;\beta) = \frac{\lambda^{y} e^{-\lambda}}{y!} = \frac{e^{y\,\beta x}\, e^{-e^{\beta x}}}{y!} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

The corresponding likelihood function of (4) is given by assuming that there are n individuals,

$P(y_1, y_2, y_3 \ldots\ldots y_n \,|x;\, \beta) = \prod_{i=1}^{n} \frac{e^{y\,\beta x}\, e^{-e^{\beta x}}}{y!}$, and corresponding log of likelihood function is

$$L(\beta; x, y) = \sum_{i=1}^{n} (y_i \beta x_i - e^{\beta x_i} - \ln(y_i!)) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

Here, Y is the number of cigarettes smoked by an individual during last 24 hours, Pr(Y=y) is the probability that an individual is observed to consume exactly 'y' cigarettes in a typical day, X are the set of covariates as specified in the equation (3) and β are the parameters of interest to be estimated. Since equation (5) remains a non-linear model, a maximum likelihood estimation strategy, has been followed.

Here, it is worthwhile to consider the number of cigarettes smoked as observed for those who were found to currently smoke in the data. However, this may induce sample selection biases resulting into an inconsistent estimate of the parameters. To address this concern, a Heckman two-stage model is also estimated to confirm whether sample selection remains a valid concern in this data set. Therefore, detailed discussions and derivations of these models are skipped here. Since equation (5) is estimated for those currently smoking, we attempt to estimate separate equations for men and women.

In specifications (3) and (5), individual specific information included are age, age squared, education, marital status, whether individual uses other smokeless tobacco (SLT) and whether they have ever used alcohol. Among these variables, age is expected to be positively related with smoking meaning that chances of smoking increase with increase in age. Age squared captures the non-linear relationship between age and the probability of smoking. In other words, smoking probability may be positively correlated with age until certain maximum age is reached; thereafter, smoking probability may decline with age. This later phenomenon is established when sign of the coefficient on age square is negative. Likewise, it is hypothesized that education is negatively associated with the smoking since educated person may be able to

comprehend the economic burden associated with smoking. Here, years of formal schooling is used as level of education. The marital status can also be an important determinant of smoking; peer influence is expected if spouse is a smoker. Likewise, the model also includes a variable that capture whether an individual is currently living with a children below 15 years. It is expected that an individual currently living with a child would have a less probability of smoking. The inclusion of the children and marital status in the estimation equation follows the theoretical foundation of the 'peer effects' in smoking (Krauth, 2005).

The equations (3) & (4) also includes whether an individual ever tried alcohol or is currently using the SLT products. Relationship of these variables with smoking may depend on whether an individual considers these products to be complement or substitute to smoking (Zimmerman et al., 1990). In line with the alcohol myopia theory, excessive alcohol consumption diminishes an individual's ability to focus their attention, causing them to prioritize only the most noticeable elements of their surroundings when they are intoxicated (Steele & Josephs, 1990). Likewise, within the framework of classical conditioning, it is also suggested that the ongoing association between alcohol consumption and smoking leads to the development of a situation where alcohol itself becomes a stimulus, triggering the conditioned response of craving for cigarettes (Tiffany, 1995).

Among the household-specific characteristics, the equations also include the caste/ethnic group of the household, wealth status measured by the wealth quintile, household size and construction materials of the house, and dwelling status. The earlier literature suggests that wealth remains an important predictor of smoking with high prevalence of the smoking among the less wealthy households (Hosseinpoor et al., 2011). On a similar note, an individual with better construction materials (e.g., cement-bonded walls) might have lower chances of smoking. Similar association can be expected for the dwelling status i.e., whether an individual currently resides on his/her own home or on rented one. The family size may have either of relationship depending on how far a 'peer effect' matters for an individual (Emory et al., 2010).. Since relatively poorer individuals might have limited access to information and health related infrastructure coupled with limited educational level, the chances of smoking remain high among these groups.

Following the same explanations, the caste/ethnic group that have lower economic status may have higher chances of the smoking. In our case, Dalits and Janajatis may have higher smoking probability compared to other caste/ethnic groups due to the 'wealth effect' as explained earlier. At the same time, the smoking behavior of the various caste/ethnic groups may vary due to the differences in socio-cultural attributes they possess (Bobo & Husten, 2000). In particular, some of the caste/ethnic groups may have the social norms for the acceptance of smoking or may be part of their culture and beliefs, thereby increasing the likelihood of the smoking (Reeder, 1977)

The equation (3) includes the place of residence (urban vs. rural) and provinces as the geography related indicators. In general, urban centers are assumed to have the better education system and better health facilities along with better enforcement of smoking ban related laws. Accordingly, an individual residing in the urban center is expected to have lower chances of smoking compared to the rural counterpart.

In addition to the usual socio-economic covariates, we include three specific variables that are likely to affect the smoking status of the smoking in equation (3) viz., ownership of television and radio, whether an individual is currently covered by an insurance and is currently living with a child below 15 years. Television or radio may be source of information to an individual to learn about the negative effects of smoking and this may reduce the probability of smoking (Wakefield et al., 2003). Insurance coverage, on the other hand, may increase the smoking probability since those covered may not take adequate precautions to remain healthy because of the moral hazard problem. The implication may be otherwise if the insured are also aware of the health costs associated with morbidity.

Table 1: Description of the Variables Included in Model Specifications

Variable name	**Description**
Dependent variables	
Smoke (Y)	Binary: 1 if respondent reported currently smoking, 0 otherwise
Count of Smoke (Z)	Number of cigarettes smoke during last 24 hours by respondent, among those who currently smokes.
Independent variables	
Age	Age in completed years of respondent
Age^2	Square of the Age of a respondent
Education	Years of formal education of respondent. It assumes zero if individual is illiterate or has information education such as 'elderly education.
Married	Binary: 1 if respondent is currently married when asked marital status
Child15	Binary:1 if respondent has a child below 15 years in the house
SLT	Binary: it takes 1 if respondent is currently using smokeless tobacco
Alcohol	Binary variable: 1 if respondent has ever consumed alcohol
Insurance	Binary: 1 if respondent is covered by health or other types of social security insurance
Tv_Radio	Binary: 1 if respondent owns Television or Radio or both
Hhsize	Number of Family Members currently residing in the home
Cement	Binary: 1 if the construction material of the exterior wall is cemented
Room	Binary: 1 if has more than one room
Dwell	Binary measuring the dwelling ownership status of the respondent. 1 if it is owned by respondent or his/her family members.

Caste	Categorical variable classified as Brahmin/*Chhetri*/ Brahmin/*Chhetri*/*Thakuri*/ *Sanyashi* including both Hill and *Madhesh*, *Janajatis* from Mountain/Hill, Dalits from Mountain/Hill, *Madhesi* others that include *Tharu* and other scheduled *madhesi* caste, Muslims, and other not included above. Brahmin/ *Chhetri*/*Thakuri*/*Sanyashi* is taken as reference category.
Wealth	Wealth quintiles based on the wealth index as reported in NMICS dataset (reference category: poorest)
Urban	Binary: 1 if one belongs to urban area
Province	Categorical classified as *Koshi*, *Madhesh*, *Bagmati*, *Gandaki*, *Lumbini*, *Karnali* and *Sudur Paschim* (*Bagmati* is taken as reference category)

Source: Author's illustration based on NMICS

4. RESULTS AND DISCUSSION

Table 2 presents the summary statistics of the variables used in the regression analysis. The total eligible sample size is 3284 individuals including both men and women. Of these, nearly 60% of the individual aged 15-49 years are the smokers. A typical smoker smokes 5 times in a day. Proportion of men is higher than men. Most of the samples are indigenous ethnic (*Janajatis*) groups followed by Brahmin/*Chhetri*, Dalits, *Madhesis* and Muslims. Average age is 34 years and average years of schooling is 5.71. As expected, most individuals are married since the sample does not include those below 15 years of age. While 72 % of individuals have tried alcohol, 38% have used smokeless tobacco products. Only 6% have an insurance. More than two-third have children below 15 years.

Table 2: Summary Statistics of the Variables Used in the Study

Variables	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Smoking status (1 if smoke)	3284	.601	.49	0	1
Number of cigarettes consumed in a day	1974	5.389	5.48	0	40
Gender of the Respondent (1 if male)	3284	.68	.467	0	1
Age in Years	3284	34.567	9.025	15	49
Square of Age	3284	1276.306	612.916	225	2401
Years of Formal Schooling	3284	5.716	4.657	0	14
Marital Status (1 if married)	3284	.86	.347	0	1
Has a child (1 if has children aged below 15 years)	3284	.693	.461	0	1
Ever consume alcohol (1 if yes)	3284	.728	.445	0	1
Uses smokeless tobacco (1 if yes)	3284	.385	.487	0	1
Has insurance (1 if yes)	3284	.062	.242	0	1
Has TV/Radio (1 if yes)	3284	.604	.489	0	1
Number of HH members	3284	5.364	2.662	1	28
Has more than one room (1 if yes)	3284	.771	.42	0	1

Materials of Roof (1 if Galvanized sheet)	3284	.451	.498	0	1
Materials used in exterior wall (1 if cemented wall)	3284	.285	.451	0	1
Ownership of Dwelling (1 if owns a house	3284	.887	.316	0	1
Wealth quintile (1 if from poorest)	3284	.304	.46	0	1
Wealth quintile (1 if from Second)	3284	.2	.4	0	1
Wealth Quintile (1 if from Third)	3284	.184	.387	0	1
Wealth Quintile (1 if from Fourth)	3284	.178	.382	0	1
Wealth Quintile (1 if from Richest)	3284	.135	.342	0	1
Caste/ethnicity (1 if from Brahmin/*Chhetri/ Thakuri/Jogi/Sanyashi*)	3284	.278	.448	0	1
Caste/ethnicity (1 if from *Janajatis*)	3284	.463	.499	0	1
Caste/ethnicity (1 if from Dalits)	3284	.163	.369	0	1
Caste/ethnicity (1 if from *Madhesi* others)	3284	.066	.248	0	1
Caste/ethnicity (1 if from Muslims)	3284	.018	.134	0	1
Caste/ethnicity (1 if form others not included elsewhere)	3284	.012	.111	0	1
Place of Residence (1 if from Urban)	3284	.556	.497	0	1
1 if from Province 1	3284	.147	.355	0	1
Province (1 if from *Province 2*)	3284	.087	.282	0	1
Province (1 if from *Bagmati*)	3284	.253	.435	0	1
Province (1 if from *Gandaki*)	3284	.104	.305	0	1
Province (1 if from *Lumbini*)	3284	.135	.341	0	1
Province (1 if from *Karnali*)	3284	.12	.325	0	1
Province (1 if from *Sudur Paschim*)	3284	.154	.361	0	1

Source: Author's computation based on NMICS-2019

So far as economic well-being is concerned, most of the samples are in the poorest wealth quintile (30%), and the least belong to the richest quintile (13%). In terms of ownership of assets, more than 60% have TV or radio in their homes. While substantial population owns their own house, only 28% live in houses with cement bonded exterior wall and 45 % have the roof made from galvanized metal sheet. Further, three-fourths of the respondents reported that they have more than 1 room in the house. In terms of place of residence, 55% reside in urban area. Further, nearly one-fourth are from *Bagmati* province followed by *Koshi*, *Sudur Paschim*, *Karnali*, *Lumbini*, *Gandaki* and *Province 2*.

We now present and discuss main results in Table 3. Overall sample results are shown in column (1) while results from male and female are shown separately in columns (2) and (3) respectively. The first three columns present the result in log-odds ratio while the next three columns present the marginal effects of logit estimates. The results show that age and education have important effects on smoking probability. One additional

years of schooling decreases the probability of smoking by 2 percentage points; the smoking probability in case of female (3%) is higher than male (2%). It may be the case that higher education leads to better awareness and understanding of health risks and the ability to observe the ill effects of smoking over the long run, thereby resulting in lower smoking prevalence. Likewise, smoking probability increases with age; getting one year older increases the probability of smoking by 2 percentage points. Surprisingly, the uptake probability with age is two-times higher among female than male. The negative sign in case of age squared indicates that the smoking probability decreases after certain years of age. This means that there is an inverted U-shaped relationship between age and smoking probability. These results are consistent with the several previous studies in Nepal and elsewhere such as by Hosseinpoor et al., (2011) and Khanal et al. (2013) that also show that the level of education is negatively associated with smoking probability while age is positively associated. Research conducted in low-income countries also underscores the significance of factors such as low socioeconomic status and limited education in shaping smoking behavior (Osler et al., 1999). Our results further show that marital status, having a children below 15 years of age, and having an insurance does not affect smoking probability. This means these factors are not important when making smoking decisions.

The probability of smoking increases among individuals who also consume alcohol indicating that they are complements to each other. However, this is true for male only. The results show that smoking and the use of SLT are negatively associated. This means that they are substitutes and this is true for both men and women. Although SLT itself poses health risks, this correlation suggests that exploring less harmful alternatives could potentially help reduce smoking prevalence in Nepal.

We now explore the wealth effect. The wealth quintile is negative and significant only for the richest quintile. We do not find statistical significance in the case of other quintiles. This result is not very much consistent with our priori expectation that the probability of smoking is lower among relatively wealthier population (see, for example, Cavelaars, 2000; Martin & Wardle, 1999); our coefficients are not significant for quintiles lower than the richest ones. In case of other well-being indicators such as the use construction materials and ownership of dwelling, the results are similar. In other words, they hold a negative association with the probability of smoking. Notably, inclusion of multiple well-being related indicators in the same equation may induce the problem of multicollinearity. We find that there is no such issue.

In terms of caste and ethnic groups, the results show that the probability of smoking is higher among *Janajatis*, *dalits*, *madhesi*, *muslim* and other castes as compared to Brahmin and *Chettri*. The study by Hashibe et al (2010) also shows that *janajatis* and other castes

in Nepal have higher smoking probability and risk of lung cancer as compared to Brahmin. Although, no such clear association emerges when examined for males and females separately in this study, the statistical significance of the estimated coefficients suggests that caste/ethnic group may be a strong predictor for females than males.

Location is also a strong predictor of smoking probability. Both place of residence and provinces are important. The results show that urban residents have 10 percent higher probability to smoke vis-à-vis rural residents. But such an association is significant for men only. This result is also not as expected since it was expected that rural residents have higher smoking probability since they have limited access to information due to poor health and education infrastructure. Our results also suggest a strong association between the prevalence of smoking and provinces. Other than *Gandaki*, residents in all other provinces had a higher likelihood of smoking as compared to the residents in *Koshi* provinces.

Table 3: Logistic Regression Results on the Socioeconomic Predictors of Smoking

Variables	Log of Odds			Marginal Effects		
	Overall	Male	Female	Overall	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)
Age in Years	0.10***	0.11***	0.15*	0.02***	0.03***	0.04*
	(0.04)	(0.04)	(0.09)	(0.01)	(0.01)	(0.02)
Square of Age	-0.00***	-0.00***	-0.00	-0.00***	-0.00***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Years of Formal Schooling	-0.07***	-0.09***	-0.13***	-0.02***	-0.02***	-0.03***
	(0.01)	(0.01)	(0.03)	(0.00)	(0.00)	(0.01)
Marital Status (1 if married)	-0.12	0.14	-0.39	-0.03	0.03	-0.09
	(0.13)	(0.16)	(0.28)	(0.03)	(0.04)	(0.06)
Has a child (1 if has children aged below 15 years)	-0.04	-0.05	0.16	-0.01	-0.01	0.04
	(0.09)	(0.11)	(0.18)	(0.02)	(0.02)	(0.04)
Ever consume alcohol (1 if yes)	0.44***	0.31**	0.26	0.11***	0.07**	0.06
	(0.10)	(0.14)	(0.19)	(0.02)	(0.03)	(0.05)
Uses smokeless tobacco (1 if yes)	-0.22***	-0.35***	-0.73***	-0.05***	-0.08***	-0.18***
	(0.08)	(0.10)	(0.23)	(0.02)	(0.02)	(0.05)
Has insurance (1 if yes)	0.02	-0.10	0.44	0.00	-0.02	0.10
	(0.15)	(0.18)	(0.35)	(0.04)	(0.04)	(0.08)
Has TV/Radio (1 if yes)	-0.23**	-0.27**	-0.16	-0.05**	-0.06**	-0.04
	(0.09)	(0.11)	(0.17)	(0.02)	(0.03)	(0.04)
Number of HH members	0.01	-0.01	0.04	0.00	-0.00	0.01
	(0.02)	(0.02)	(0.04)	(0.00)	(0.00)	(0.01)

Has more than one room (1 if yes)	0.12	0.16	0.06	0.03	0.04	0.01
	(0.10)	(0.13)	(0.18)	(0.02)	(0.03)	(0.04)
Materials of Roof (1 if Galvanized sheet)	-0.06	-0.06	-0.10	-0.01	-0.01	-0.02
	(0.09)	(0.11)	(0.17)	(0.02)	(0.03)	(0.04)
Materials used in exterior wall (1 if cemented wall)	-0.17	-0.13	-0.23	-0.04	-0.03	-0.06
	(0.11)	(0.13)	(0.23)	(0.03)	(0.03)	(0.06)
Ownership of Dwelling (1 if owns a house)	-0.06	-0.05	-0.36	-0.01	-0.01	-0.09
	(0.14)	(0.17)	(0.29)	(0.03)	(0.04)	(0.07)
Wealth quintiles (Base Category: Poorest)						
Wealth quintile (1 if from Second)	-0.01	0.21	-0.37	-0.00	0.05	-0.09
	(0.13)	(0.16)	(0.22)	(0.03)	(0.04)	(0.06)
Wealth Quintile (1 if from Third)	-0.07	0.09	-0.38	-0.02	0.02	-0.09
	(0.14)	(0.17)	(0.26)	(0.03)	(0.04)	(0.07)
Wealth Quintile (1 if from Fourth)	-0.14	0.08	-0.55*	-0.03	0.02	-0.14*
	(0.16)	(0.19)	(0.32)	(0.04)	(0.04)	(0.08)
Wealth Quintile (1 if from Richest)	-0.50**	-0.22	-1.50***	-0.12**	-0.05	-0.35***
	(0.20)	(0.24)	(0.46)	(0.05)	(0.06)	(0.09)
Caste Ethnicity (Base category: Brahmin/Chhetri/Thakuri/Jogi/Sanyashi)						
Caste/ethnicity (1 if from *Janajatis*)	0.21**	0.17	0.47**	0.05**	0.04	0.11**
	(0.10)	(0.12)	(0.21)	(0.02)	(0.03)	(0.05)
Caste/ethnicity (1 if from Dalits)	0.36***	0.31*	0.53**	0.08***	0.07**	0.13***
	(0.12)	(0.16)	(0.21)	(0.03)	(0.04)	(0.05)
Caste/ethnicity (1 if from *Madhesi* others)	0.33*	-0.03	1.00**	0.07*	-0.01	0.22**
	(0.19)	(0.22)	(0.50)	(0.04)	(0.05)	(0.09)
Caste/ethnicity (1 if from Muslims)	0.94***	0.45		0.19***	0.10	-0.36*
	(0.33)	(0.35)		(0.05)	(0.07)	(0.19)
Caste/ethnicity (1 if form others not included elsewhere)	0.25	0.35	-1.63	0.06	0.08	0.02
	(0.34)	(0.39)	(1.16)	(0.07)	(0.08)	(0.04)
Place of Residence (1 if from Urban)	0.32***	0.43***	0.06	0.08***	0.10***	0.01
	(0.08)	(0.10)	(0.17)	(0.02)	(0.02)	(0.10)
Provinces (Base Category: Province 1)						
Province (1 if from *Province 2*)	0.44**	0.52**	0.05	0.10**	0.11**	0.13**
	(0.19)	(0.22)	(0.43)	(0.04)	(0.04)	(0.06)
Province (1 if from *Bagmati*)	0.55***	0.67***	0.53*	0.13***	0.15***	0.08
	(0.13)	(0.16)	(0.27)	(0.03)	(0.03)	(0.07)
Province (1 if from *Gandaki*)	0.13	-0.01	0.35	0.03	-0.00	0.20***
	(0.15)	(0.18)	(0.32)	(0.03)	(0.04)	(0.07)
Province (1 if from *Lumbini*)	0.44***	0.22	0.92***	0.10***	0.05	0.17**
	(0.14)	(0.16)	(0.34)	(0.03)	(0.04)	(0.07)
Province (1 if from *Karnali*)	0.48***	0.22	0.73**	0.11***	0.05	0.15**
	(0.17)	(0.21)	(0.33)	(0.04)	(0.05)	(0.07)

Province (1 if from *Sudur Paschim*)	0.30**	0.09	0.65**	0.07**	0.02	
	(0.15)	(0.18)	(0.32)	(0.03)	(0.04)	
Constant	-1.36**	-1.03	-3.11*			
	(0.58)	(0.69)	(1.61)			
LR Chi2	209.09 (0.00)	162.86 (0.00)	249.85 (0.00)			
AIC	4270.31	2873.93	1239.74			
BIC	4459.31	3050.98	1388.293			
Observations	3,284	2,233	1,045			

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Author's Computation based on NMICS (2019)

Table 4 shows the determinants of smoking quantity. We present the results from Poisson estimates as our main results on examining the determinants of the smoking quantity. Further, we also run a Heckman two-step model in order to gauge the sample selection issue. The results from the Heckman selection model confirm the absence of sample selection issue given by the insignificance of inverse mills ratio as shown in column 2 of Annex-1. To supplement the results reported in Table 4, we also report OLS estimates and results remains consistent across the model which are reported in Annex-1. We do not separately show the estimates from male and female sample but include gender as one of the explanatory variables in the models.

Male smokes nearly 0.73 additional cigarettes than female. Similar to findings reported in Table 3, age also remains a significant determinant of the daily smoking intensity and the marginal effect shows that smoking count increases 0.17 units as one become a year older. The square of age has expected (negative) sing implying that smoking quantity increases with age but at the decreasing rate. Education is also an important predictor of smoking intensity. One additional year of schooling reduces the number of cigarettes smoked daily by 0.08. Marital status does not seem to have association with smoking quantity yet having a children aged below 15 years increases the smoking quantity by 0.23 units as compared to those who do have any children below 15 years. This remains counterintuitive to our original expectation. Consumption of alcohol has positive association but use of smokeless tobacco products are negatively associated with the smoking intensity. Unlike, Table 3, the insurance and having television at home remain as an important predictor of the smoking quantity; buying insurance or owning a television seems to decrease the smoking intensity.

Among the wealth quintiles, the coefficient is significant for all quintiles. For instance, the estimated marginal effects show that an individual from the richest and the

third wealth quintile consumes 1.20 fewer cigarettes as compared to the one from the poorest quintile. Interestingly, it is observed that the magnitude of the estimated coefficients keeps decreasing when moving to an upper wealth quintile, suggesting that smoking intensity decreases with an improvement in economic status. The construction materials such as type of exterior wall or roof do not seem to have effect on the smoking quantity. The findings from other indicators of well-being show mixed and counterintuitive results. For instance, an individual having more than one room is found to smoke 0.56 fewer cigarettes, contrary to the prior expectation that this coefficient would be positive. This is because having a few more rooms may provide smokers flexibility to engage in more smoking. The coefficient estimates of the construction material of the exterior wall and roof are insignificant.

The estimated coefficients for caste/ethnic groups are also insignificant expect for Dalits, indicating that the caste/ethnicity of an individual may not be strongly associated with the number of cigarettes consumed. The result, on the other hand, supports that place of residence (rural and urban) is important predictor. For provinces, residents in province 2 consume more cigarette followed by those in *Gandaki* and *Sudur paschim* province, all compared to residents in Province 1.

Table 4: Socio-economic Determinants of the Smoking Intensity/Quantity

Variables	**(1)**	**(2)**
	Poisson	**Marginal Effects**
Gender (1 if male)	0.15***	0.73***
	(0.03)	(0.15)
Age in Years	0.03***	0.17***
	(0.01)	(0.05)
Square of Age	-0.00*	-0.00*
	(0.00)	(0.00)
Years of Formal Schooling	-0.02***	-0.08***
	(0.00)	(0.02)
Marital Status (1 if married)	0.05	0.26
	(0.04)	(0.17)
Has a child (1 if has children aged below 15 years)	0.05*	0.23*
	(0.02)	(0.12)
Ever consume alcohol (1 if yes)	0.13***	0.62***
	(0.03)	(0.14)
Uses smokeless tobacco (1 if yes)	-0.15***	-0.76***
	(0.02)	(0.12)
Has insurance (1 if yes)	-0.15***	-0.73***
	(0.05)	(0.22)

Has TV/Radio (1 if yes)	-0.08***	-0.44***
	(0.02)	(0.12)
Number of HH members	0.01***	0.06***
	(0.00)	(0.02)
Has more than one room (1 if yes)	-0.11***	-0.57***
	(0.03)	(0.14)
Materials of Roof (1 if Galvanized sheet)	-0.03	-0.16
	(0.02)	(0.12)
Materials used in exterior wall (1 if cemented wall)	0.01	0.04
	(0.03)	(0.16)
Ownership of Dwelling (1 if owns a house)	0.19***	0.89***
	(0.04)	(0.17)
Wealth quintile (1 if from Second)	-0.07**	-0.37**
	(0.03)	(0.15)
Wealth Quintile (1 if from Third)	-0.13***	-0.63***
	(0.04)	(0.17)
Wealth Quintile (1 if from Fourth)	-0.13***	-0.63***
	(0.04)	(0.21)
Wealth Quintile (1 if from Richest)	-0.26***	-1.20***
	(0.06)	(0.24)
Caste/ethnicity (1 if from *Janajatis*)	0.00	0.01
	(0.03)	(0.14)
Caste/ethnicity (1 if from Dalits)	0.05*	0.28*
	(0.03)	(0.17)
Caste/ethnicity (1 if from *Madhesi* others)	-0.01	-0.07
	(0.05)	(0.26)
Caste/ethnicity (1 if from Muslims)	-0.05	-0.26
	(0.08)	(0.39)
Caste/ethnicity (1 if form others not included elsewhere)	-0.14	-0.67
	(0.11)	(0.50)
Place of Residence (1 if from Urban)	-0.06***	-0.33***
	(0.02)	(0.11)
Province (1 if from *Province 2*)	0.13**	0.70**
	(0.06)	(0.32)
Province (1 if from *Bagmati*)	0.63***	3.77***
	(0.04)	(0.28)
Province (1 if from *Gandaki*)	0.38***	2.31***
	(0.05)	(0.33)
Province (1 if from *Lumbini*)	0.16***	0.89***
	(0.05)	(0.26)
Province (1 if from *Karnali*)	0.14***	0.73***
	(0.05)	(0.28)

Province (1 if from *Sudur Paschim*)	0.40***	2.38***
	(0.05)	(0.31)
Constant	0.38**	
	(0.18)	
Observations	1,974	1974
R2	0.07	
LR Chi2	1121.29 (0.00)	
AIC	13967.09	
BIC	14145.9	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Author's Computation based on NMICS (2019)

In general, the results highlight the strong association between individual characteristics and smoking, and on the other hand, the household-specific covariates are weakly associated with smoking. Likewise, comparison of the results from direct and indirect measures of well-being suggests that direct measure such as wealth quintile is strong predictor of both smoking prevalence and smoking intensity as compared to indirect measures such as number of rooms, house structure and ownership etc.

5. CONCLUSION

The study examines the socio-economic predictors of smoking behavior and intensity using a nationally representative Nepal Multiple Cluster Indicator Survey (NMICS). Logistic regression function for smoking prevalence and an ordinary least square (OLS) technique for quantity of cigarettes consumption are used in the study. Our findings suggest that education and age stand out as strong predictors of smoking. Higher educational attainment is associated with lower smoking likelihood for both genders while increasing age raises the probability of smoking. Educational campaigns emphasizing the health risks of smoking and tailored interventions for different age groups could prove effective in reducing smoking rates. Media and communication channels also hold substantial promise as tools for tobacco control policies. Prolonged campaigns through these channels have the potential to effectively reduce smoking prevalence (McVey & Stapleton, 2000).

Smokeless tobacco (SLT) and smoking are found to be substitutes, suggesting anti-smoking initiatives may benefit from focusing on reducing SLT use as well. Conversely, alcohol consumption is linked to increased smoking, particularly among males, indicating the need for coordinated efforts to address dual consumption habits. Wealth-related indicators exhibit less robust relationships with smoking. Yet at the same time, the place of resident and provinces remain important predictors of smoking. Based on these findings, we conclude is that individual-specific characteristics remain more robust predictors of smoking and smoking quantity rather than household-specific characteristics. This means that the 'information and

awareness' channel seem to work in Nepal, while at the same time the 'wealth effect' and 'peer effect' are only weakly associated in determining smoking prevalence. These findings strongly suggest that public interventions should focus on raising awareness among young people about the harmful effects of smoking. Creating customized interventions for various age groups has the potential to reduce smoking prevalence.

In Nepal, the implementation of supply-side policies and the enforcement of tobacco regulations encounter significant obstacles. While the government has prohibited the sale of loose cigarettes and restricted tobacco sales to minors, the consistent enforcement of these measures remains a challenge. Similarly, despite bans on smoking in public places, adherence to these regulations varies. Enhancing the enforcement of the Tobacco Control Act of Nepal (2014) and implementing judicious taxation measures could foster a tangible reduction in tobacco use. Addressing the complex issue of smoking and tobacco use demands comprehensive interventions that consider determinants, raise awareness, and reinforce regulatory mechanisms. Effective strategies must encompass both supply-side policies and individual behavior change initiatives.

This study has some limitations. Due to the lack of data, the study could not examine the effects of variables such as health risks, social influence, and peer pressure on smoking behavior. Studies such as by De Vries (1986); Van Loon et al. (2005) and Mackay et al. (2003) have indicated that health risks associated with tobacco use remain a pressing concern. Evidence shows that social influence and peer pressure, especially among adolescents, play a pivotal role in the adoption of smoking habits.

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Annex-1: Results from OLS and Heckman Two Stage Regressions

Variables	**(1)**	**(2)**
	OLS	**Heckman Two stage**
Gender (1 if male)	0.77**	4.19
	(0.39)	(2.83)
Age in Years	0.11	0.50
	(0.12)	(0.38)
Square of Age	-0.00	-0.01
	(0.00)	(0.01)
Years of Formal Schooling	-0.08**	-0.45
	(0.04)	(0.31)
Marital Status (1 if married)	0.20	-0.17
	(0.40)	(0.79)
Has a child (1 if has children aged below 15 years)	0.24	0.09
	(0.29)	(0.52)
Ever consume alcohol (1 if yes)	0.71**	1.28*
	(0.34)	(0.76)
Uses smokeless tobacco (1 if yes)	-0.79***	-2.48*
	(0.28)	(1.45)
Has insurance (1 if yes)	-0.62	-0.53
	(0.53)	(0.93)
Has TV/Radio (1 if yes)	-0.46	-1.23
	(0.29)	(0.81)
Number of HH members	0.07	0.06
	(0.05)	(0.07)
Has more than one room (1 if yes)	-0.66**	-0.14
	(0.32)	(0.70)
Materials of Roof (1 if Galvanized sheet)	-0.11	-0.45
	(0.29)	(0.59)
Materials used in exterior wall (1 if cemented wall)	0.08	-0.50
	(0.37)	(0.80)
Ownership of Dwelling (1 if owns a house)	1.07**	0.76
	(0.46)	(0.85)

Wealth quintile (1 if from Second)	-0.51	-0.57
	(0.39)	(0.71)
Wealth Quintile (1 if from Third)	-0.79*	-1.15
	(0.43)	(0.83)
Wealth Quintile (1 if from Fourth)	-0.80	-1.42
	(0.52)	(1.06)
Wealth Quintile (1 if from Richest)	-1.51**	-3.49*
	(0.69)	(1.99)
Caste/ethnicity (1 if from *Janajatis*)	-0.01	0.91
	(0.33)	(0.94)
Caste/ethnicity (1 if from Dalits)	0.27	1.64
	(0.39)	(1.30)
Caste/ethnicity (1 if from *Madhesi* others)	-0.03	0.97
	(0.59)	(1.34)
Caste/ethnicity (1 if from Muslims)	-0.22	1.88
	(0.88)	(2.35)
Caste/ethnicity (1 if form others not included elsewhere)	-0.55	0.31
	(1.16)	(2.15)
Place of Residence (1 if from Urban)	-0.38	0.79
	(0.27)	(1.05)
Province (1 if from *Province 2*)	0.45	1.84
	(0.60)	(1.54)
Province (1 if from *Bagmati*)	3.18***	5.38***
	(0.44)	(1.92)
Province (1 if from *Gandaki*)	1.72***	2.26**
	(0.52)	(1.01)
Province (1 if from *Lumbini*)	0.60	2.22
	(0.48)	(1.54)
Province (1 if from *Karnali*)	0.28	1.94
	(0.55)	(1.65)
Province (1 if from *Sudur Paschim*)	1.84***	3.03**
	(0.51)	(1.30)
Constant	0.06	-14.54
	(1.98)	(12.15)
Observations	1,974	3,284
R2	0.10	-
LR Chi2		54.09 (0.006)
AIC	12170.26	
BIC	12349.07	
Inverse Mills (Lambda)	-	10.82 (8.86)