Prevalence of smoking habits and its determinants among adult males in Anuradhapura district

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Abstract

This study investigates the determinants of smoking prevalence and examines the impact of socio-economic status and smoking related factors on smoking behavior among male adolescents in Anuradhapura district of Sri Lanka. This study was conducted from January 2020 to July 2020 with 100 adult males obtained through random sampling technique and the respondents who aged above 21years were taken as the sample. The collected data were analyzed using frequency, chi-square test, ordered probit model, and marginal effects. Frequency analysis reveals that 15% of the adult males had never smoked, 27% of them had occasionally smoked, and the majority (58%) of them were daily smoke. Ordered probit regression model was used to examine the determinants of smoking behavior and its results indicated that among socio- economic factors, education level, status of employment, place of residence were positively while age, civil status, income and family size were negatively impact on the smoking habits. Among influence of other factors, expenditure on smoking, age starts to smoke and influence of friends were positively impact on smoking habits except smoking status of family members. Further, determinants of smoking prevalence was examined when the number of cigarettes taken as dependent variable in the poisson model and zero – inflated poisson models. Vuong test is done to compare the two models and obtain the result proved that the Zero-inflated Poisson regression is more suitable for modeling the frequency of smoking habits than poisson model. This study suggests the need for essential strategies and public policies which promote higher educational attainment and motivate the smokers to reduce and cessation the smoking habits in future.

Keywords: Demographic and socio-economic characteristics, expenditure on smoking, smoking prevalence, ordered probit model, zero – inflated poisson model.

Introduction

Tobacco use is among the greatest public health problems worldwide, and cigarettes are the only legal consumer product in the world that causes 50 percent of its long-term users to die prematurely (Doll et al., 2004; Fagerström, 2002). The numbers are increasing in low- and middle-income countries that are relatively unable to afford the resulting health and economic consequences (Peto & Lopez, 2004; Reddy et al., 2006). Smoking is also a significant health hazard, a highly preventable cause of morbidity and mortality (Duko et al., 2019). Despite the adverse health and financial implications of smoking, it remains one of the leading causes of preventable diseases and deaths globally. Smoking of tobacco products occurs occasionally or habitually as a consequence of a physical addiction to some chemicals, primarily the highly addictive psychoactive ingredients, such as, nicotine. Over 1 billion people smoke globally and 80 percent of them live in low- and middle-income countries and in case of Sri Lanka, it records indicate that 29 % the of individuals currently smoke (Fernando et al., 2019). However, the country's government has introduced many programs against to reduce the consumption of tobacco products, especially cigarettes and beedi, among Sri Lankans. Prohibition of sales and promotion of these products below 21 years, prohibition of advertising, elevation and sponsorship, compulsory health warnings on cigarette packets, at theatres and on the television programs., as well as the prevention of smoking in public places are some of the important provisions made to reduce the usage of tobacco products in Sri Lanka. Moreover, a policy relating to an increase of pricing was introduced in 2010 and it aimed to discourage the consumption of cigarettes in the country.

Extant literature highlights a plethora of studies conducted on determinants of cigarette smoking in both developed and developing countries; however, the prevalence of smoking habits and its determinants among adult males is an area understudied within the Sri Lankan context. Considering how the reduction of tobacco usage has been one of the main government policies in Sri Lanka, and the price of cigarettes has been raised several times in the last few years in order to demotivate smoking (Fernando et al., 2019), understanding the factors influencing the smoking status of adult men is essential to policymakers to reduce the health burden and associated cost of smoking that extends beyond the smoker himself. As such, the current study intends to understand the prevalence of smoking habits and its determinants in Sri Lanka to assist in executing the relevant policies consistently and aggressively – as that is the most straightforward and effective method in making future generations tobacco-free.

Objectives of the study

This study has the following objectives.

1. To identify the association between socio - economic and smoking related factors with prevalence of smoking habits among agult males in Anuradhapura district.
2. To examine the impact of the socio-economic and smoking-related factors on the prevalence of smoking behavior among adult males using ordered probit model in the study area.
3. To evaluate the impact of socio-economic and smoking-related factors on the number of cigarettes smoking using poisson and zero – inflated poisson model.

To attain the second objective, the prevalence of smoking behavior which is the dependent variable, categorized as 1 for never smoke, 2 for occasionally smoke and 3 for daily smoke in the ordered probit model. For third objective, the number of cigarettes smoking per week taken as dependent variable in both poisson and zero – inflated poisson models.

Review of literature

Before reviewing the previous literature, theoretical background of the smoking habits need to addressed. There are some theories of smoking have been developed about the conditions and causes of smoking as well as for explaining its maintenance.

Moreover, factors of smoking motivation have been identified, which describe incentives to smoke and types of smoking behavior. The most frequently reported motives are psychosocial smoking, sensorimotor smoking, indulgent smoking, stimulation smoking, sedation smoking, dependent smoking, and automatic smoking. (Claudia Lujic, Martin Reuter and Petra Netter, 2006)

A number of factors have been revealed in the empirical literature elsewhere to influence a person's decision to smoke. Previous national and international studies have analyzed the factors influencing the prevalence and smoking habits among university students and adult males. Most of the scholars found that socio-economic status, family or friends' smoking behavior, alcohol use, sex, education level, place of residence, whether rural or urban, and residing with friends were the major factors that determine the smoking habits. However, geographical regions, different risk factors, and cultural and sociological differences also identified as other factors which affect smoking habits. Also, most of the studies applied descriptive analysis, chi-square test, and probit or logit model. But, as the smoking habits are categorized into various frequencies or it may measure by the number of cigarettes smoking by the respondents. In such a situation, ordered probit model and poisson regression model are more applicable that other models. However, where the dependent variable is a count data with excess zeros, zero – inflated poisson model is more relevant than standard poisson model. Therefore, by applying different suitable models to examine the factors that determine the prevalence of smoking habits in Anuradhapura district of Sri Lanka, these research gaps can be full fill.

Karadoğan et al., (2018) examined the prevalence and determinants of smoking status among university students. Results showed that regarding familial smoking behavior, 36.1 percent had a father who smoked, 10.3 percent had a mother who smoked, and 15.0% had siblings who smoked. Among participants, 27.9 percent were current smokers: 46 percent of the men and 15.3percent of the women in the study. In a study conducted by Alkhalaf et al., (2021) in Saudi Arabia, the prevalence of smoking among medical students was 12.4 percent, while passive smoking prevalence was

39.9 percent of all medical students. The research shows that 18.6 percent of male and 5.9 percent of female medical students were active smokers and regarding the type of tobacco, they found that 47 percent of male smokers used waterpipe, while the percentage among female smokers using waterpipe reached 77.8 percent in the study area. In 2004, factors related to smoking habits among secondary school boys were identified by Naing et al., (2004) in Malaysia. Scholars found that, the highest prevalence of smoking among schoolboys from the vocational school and mean duration of smoking reported as 2.5 years. Further, results revealed that significant association between smoking status and parents' smoking history, academic performance, perception of the health hazards of smoking, and type of school attended in the study.

De Silva et al., (2009) examined the alcohol and tobacco use among males in Colombo and Polonnaruwa districts in Sri Lanka. Results shows that abstinence was significantly higher in the rural areas compared to urban areas and the prevalence of current drinking in the urban areas was significantly higher than in rural areas. Chulasiri et al., (2017) analyzed the factors associated with smoking among adult males in Sri Lanka studied and results revealed that age above 40 years, a low educational level, being married, unemployed and unfavorable attitudes that promote smoking were found to be significant predisposing factors associated with smoking habits in the study. A study conducted by Fernando et al., (2019) on socio-economic factors associated with tobacco smoking among adult males in Sri Lanka identified that frequency of tobacco smoking was negatively associated with the improvement of educational levels and employment, monthly income, influence of friends, smoking frequency before price increment, weekly expenditure for smoking, low educational level and the age of first smoking exposure was significantly associated with tobacco smoking among smokers. Another study conducted by Katulanda et al., (2011) aimed to determine the prevalence and underlying socio - demographic correlates of smoking among Sri Lankans and findings revealed that, overall, urban and rural prevalence of current smoking as 18.3 percent, 17.2 percent, and 18.5 percent respectively and smoking was much higher in males than in females. In another study in 2016 conducted in Colombo District, Sri Lanka using community based cross-sectional study which drawn from a representative sample of 1200 males who aged 20-59 years. According to their study, prevalence of ever smoking, current smokers and former smokers were 54.1%, 36.5% and 17.6% respectively.

Method of data collection

This study was conducted in Anuradhapura district from January 2020 to July 2020 which spreads an area of 7179 km^2 and is located in the North-central province of Sri Lanka. The district has 22 DS divisions and out of them, only the Thambuttegama division was selected as the study area. Data regarding smoking were obtained using an interviewer administrated questionnaire and the sample of 100 adult males who are aged above 21years were selected randomly. Thus, this study excluded the males below the age of 21 and since the female prevalence of smoking is very low, they also not counted in the sample. The questionnaire consisted of three sections regarding socio-demographic characteristics, influence and habits of friends' and family members on smoking and finally attitudes of smokers towards cigarette.

Methods of data analysis

To investigate the factors that determine the prevalence of smoking habits and its frequency among adult males in the study, different statistical techniques such as frequency analysis, descriptive statistics, chi-square test, ordered probit model and marginal effects. In addition to that, the number cigarettes taken as dependent variable and thus, poisson regression and zero inflated poisson regression models also applied in the study.

Frequency analysis

Frequency analysis shows the basic information in terms of percentage as well as graphical method. Frequency of smoking habits and the selected socio-economic and influence of other factors were analyzed using frequency in the study.

Descriptive statistics

Descriptive statistics such as mean, minimum, maximum and standard deviation for the scale variables related to the socio-economic characteristics and smoking habits were analyzed in the study.

Chi-squared test

The chi-squared test is used to determine whether there is a significant association between any two categorical variables. In order to find out the association between smoking habits and the selected categorical variables such as educational level, status of employment, civil status, place of residence, influence of family member and influence of friends, chi – square test was employed in the study.

Ordered probit model and marginal effects

Ordered probit model is widely used the case where the dependent variable is more than two outcomes in an ordinal data. The dependent variable is smoking prevalence was measured in terms of frequency with an order using three categories and they are coded as.

1 for never smoke

2 for occasionally smoke

3 for daily smoke

The dependent variable is the smoking prevalence among the adult males measured by three different frequencies such as 1 for never smoke, 2 for occasionally smoke and 3 for daily smoke whereas socio-economic characteristics and influence of other factors including influences of parents and friends on smoking considered as explanatory variables the model. The general form of the models for the two sets of explanatory variables is given below.

Model 1: Ordered probit regression for socio-economic status of the adult males.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon$$

Where;

Y= Prevalence of smoking habits was categorized as, 1 for never smoke, 2 for occasionally and 3 for daily

X_1 = Age of the adult males

X_2 = $(Age)^2$ of the adult males

X_3 = Education of the adult males coded as 1 for primary and 0 for secondary

X_4 = Civil status coded as 1 for married and 0 for single

X_5 = Employment coded as 1 employed and 0 for not

X_6 = Family size

X_7 = Residential place categorized as 1 for urban and 0 for rural

X_8 = Monthly income coded as 1 for less than Rs. 20000/= and 0 for higher than Rs.20000/=

β_0 = Constant

$\beta_1, \beta_2 \dots \dots \beta_8$ represents the coefficients of each independent variable respectively.

ε = Error term which are normally distributed with a mean of zero and standard deviation of one.

Among the above explanatory variables, the respondents have the maximum educational qualification up to secondary and no one has higher education. Thus, the variable for education taking as a dummy variable for primary and secondary levels. Similarly, monthly income of the respondents lies the range between Rs 20000/= to Rs 25000/- it is better to have only two categories as below Rs 20000/- and above Rs 20000/- rather than taking more than two categories.

Model 2: Ordered probit regression for influence of smoking related factors on smoking habits.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 \; X_4 + \varepsilon$$

Where;

Y= Prevalence of smoking habits is categorized as, 1 for never smoke, 2 for occasionally and 3 for daily

X_1 = Expenditure on smoking

X_2 = Age start to smoke

X_3 = Influence of family coded as 1 for yes and 0 for no

X_4 = Influence of friends coded as 1 for yes and 0 for no

β_0 = Constant

$\beta_1, \beta_2 \dots\dots \beta_4$ represents the coefficients of each independent variable respectively

ε = Error term which are normally distributed with a mean of zero and standard deviation of one.

In both models, dependent variable is the prevalence of smoking habits which is similar, but the explanatory variables were categorized into two different characteristics such as, socio - economic status of the adult males and smoking related factors and thus the two models were analyzed separately. Since the above model consists of two different characteristics with twelve independent variables including scale, binary may pull down the performance level of the model and there is a possibility for a minimal chance of making a real impact on model fit. Because of this, on theoretical basis for having two models is better than having one model which included all the explanatory variables in the same model.

Zero Inflated Poisson regression

The distribution of zero inflated poisson regression model is a modification of poisson distribution and logit or probit distribution. With the possible value of Y being a non-negative integer: 0,1,2,3, etc. In zero-inflated poisson regression, the dependent variable is mutually independent. According to Lambert (1992), the zero inflated poisson model assumes a population or observation of two latent groups (unobserved). The whole model is a mixture of the probabilities of both groups that allow for overdispersion and zero excess that cannot be predicted by the standard Poisson model. An individual (observation unit) will enter in group A whose value is always zero (zero state) with probability p or will enter the group (non-zero state), where the value of zero and positive value is generated by a poisson distribution function, with chances 1-p. So the probability functions for the zero and positive values that can be written in the equation is as follows:

$\Pr(Y = y_i) = \Theta_i(z_i) + (1 - \Theta_i(z_i))Pois(\lambda_i;0\backslash x_i)$,

Where $y_i = 0$

$(1 - \Theta_i(z_i))Pois(\lambda_i;0/x_i)$

Where $y_i > 0$

With

- z_i is a covariate vector that defines the probability of Θ_i
- $Pois(\lambda_i;0\backslash x_i)$= exp $(-\lambda_i)$
- $Pois(\lambda_i; y_i\backslash x_i = \frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i}$, where λ is the mean and variance of the distribution.

Based on Lambert (1992), Θ_i can be modeled with Logit model (with γ is a vector of parameters):

$$\Theta_i(z_i) = \frac{\exp(z_i'\gamma)}{[1 + \exp(z_i'\gamma)]}$$

so the relationship model for λ and Θ in the Zero Inflated Poisson regression model are:

$\ln(\lambda)$ =X β

$$Logit(\Theta) = log\frac{\Theta}{1 - \Theta} = X\gamma$$

It is assumed that $y_{1,}y_{2,}\cdot\cdot\cdot, y_n$ independent and Θ_i is not related to λi . Then the likelihood function can be defined by:

$$\prod_{y_i=0}[\,\Theta_i(z_i) + (1 - \Theta_i(z_i))\exp(-\lambda_i)\,]$$

$$\prod_{y_i\neq 0}\left[(1 - \Theta_i(z_i))\frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!}\right]$$

Results and Discussion

The results obtained from frequency analysis, descriptive statistics, chi-square test, ordered probit model and its marginal effects in terms of probabilities were described in this section as below. Further, results of Poisson regression and Zero Inflated Poisson regression also discussed.

Results of frequency for smoking habits

Results of frequency on smoking habits among adult males in Anuradhapura district described in Figure 1 and according to that among 100 respondents, 15 percent of them are never smoke, 27 percent of them are occasionally smoke and 58 percent of them are daily smoke. This reveals that most adult males have smoking habits daily, which may happen due to many reasons. Nowadays, even though they don't have enough income, adult males like to smoke as a style in their lives.

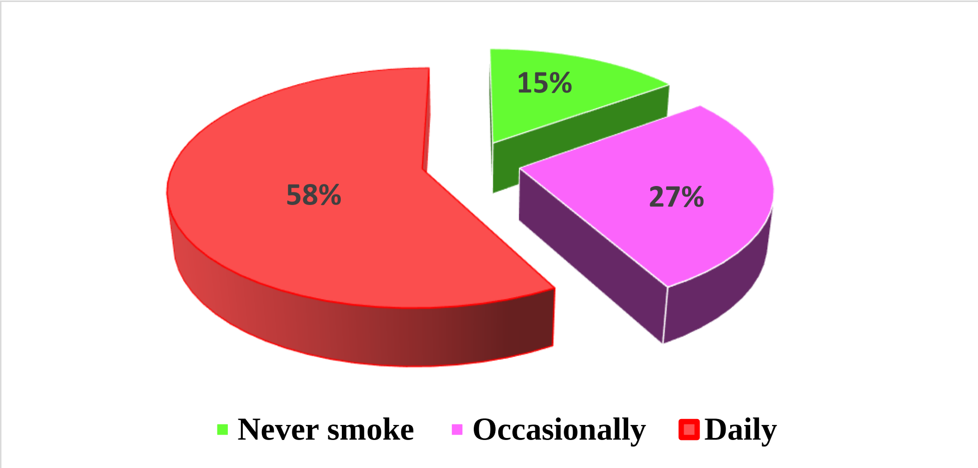

Figure 1: Frequency of smoking habits

Source: Author's calculation, 2020

Box – plot graph for smoking habits

Box plots are used to show the median age of adult males across their employment whether they work or not based on their smoking habits. Figure 2 shows that, median ages of male employed and unemployed respondents differ on their prevalence of smoking habits and its frequency in the study.

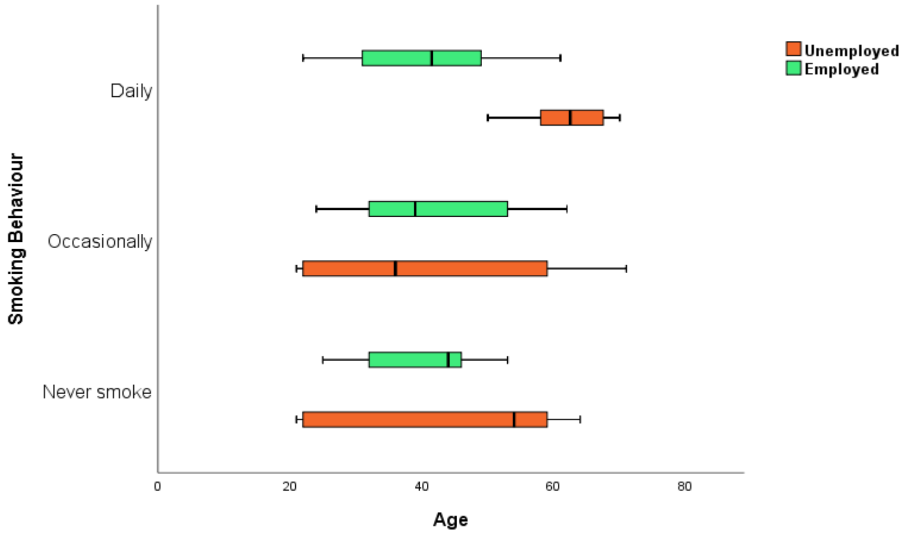

Figure 2: Median age of the smokers across their employment status

Source: Author's calculation, 2020

In addition to the above results, frequency analysis for selected variables also measured and its results were illustrated in Table 1. The results show that, out of 100 male respondents, 43 percent have primary educational level and rest of the 57percent of them are educated up to secondary level. Similarly, majority of the males were employed (63 percent) while the rest of 37 percent of them were unemployed. About one-third of males were single (73 percent), and the other 27percent were married. Around 82 percent of respondents live in urban areas, while only 18 percent live in rural areas in the district. About 56 percent of the adult males stated that their family member's smoking habits influenced their smoking habits, and 44 percent did not agree. On the other hand, 91 percent of them said that their smoking habits were influenced by their friends smoking behavior in the study.

Table 1: Frequency analysis for selected variables

Variable	Frequency	Percentage
Education level		
Primary	43	43
Secondary	57	57

Employment		
Employed	63	63
Unemployed	37	37
Civil status		
Single	73	73
Married	27	27
Place of residence		
Urban	82	82
Rural	18	18
Influence of Family		
Yes	56	56
No	44	44
Influence of friends		
Yes	91	91
No	9	9

Source: Author's calculation, 2020

Results of descriptive statistics

Descriptive statistics is applied to describe the basic features of the data in terms of minimum, maximum, mean and standard deviation.

Table 2: Summary of descriptive statistics

Variables	Minimum	Maximum	Mean	Standard deviation
Age	21	71	44.41	14.91
Family size	3	10	4.79	1.39
Number of cigarettes	0	42	14.10	10.58
Expenditure for cigarette	0	2275	820.10	599.58

Source: Author's calculation, 2020

As tabulated in the Table 2, mean age of respondent is 44.41 with the standard deviation of 14.919 and the minimum and maximum ages of 21 and 71years respectively. The sample has minimum and maximum family size of 3 and 10 respectively, whereas the adult males who never smoked, their minimum cigarette consumption and its expenditure were 0 respectively.

Results of chi-square test

The chi-square test explains the association between the smoking habits with selected socio-economic and smoking-related factors of adult males. The results are shown in the Table 3.

Table 3: Association between the variables

Variables		**Never**	**Occasionally**	**Daily**	**χ^2 value**
Educational level					7.202**
	Primary	4.7%	34.9%	60.5%	
	Secondary	22.8%	21.1%	56.1%	
Employment					5.361*
	Employed	12.7%	20.6%	66.7%	
	Unemployed	18.9%	37.8%	43.2%	
Civil status					9.335**
	Single	12.3%	20.5%	67.1%	
	married	22.2%	44.4%	33.3%	
Place of residence					3.280*
	Rural	27.8%	16.7%	55.6%	
	Urban	12.2%	29.3%	58.5%	
Influence of family					7.445**
	Yes	12.5%	17.9%	69.6%	
	No	18.2%	38.6%	43.2%	
Influence of friends					31.805***
	Yes	8.8%	27.5%	63.3%	
	No	77.8%	22.2%	0.0%	

Note: ***, ** and * indicates the levels of significant at 1%, 5% and 10% respectively.

Source: Computed by author from survey data, 2020.

The estimated results of chi-square test show that all the above variables taken in the study have significantly associated with the frequency of smoking habits among the adult males in the sample. Education level significantly associated with the smoking habits at 5 percent level reveals that 60.5 percent of the primary educated males have smoking habits on daily while 4.7 percent of them are never smoke. Among the respondents who studied up to the secondary level, 22.8 percent of them never smoke whereas 56.1 percent are daily smokers. Employment and smoking habits have a significant association at 10 percent level suggests that 66.1 percent males who are employed are more likely to daily smoke while 12.7 percent never smoke. Nevertheless, 43.2 percent of the unemployed males smoke daily, while 18.9 percent of them never smoke. Civil status has been significantly associated with frequency of smoking, indicating that 67.1 percent of the single males and 33.3 percent married males smoke cigarettes daily. Similarly, 12.3 percent of single males and 22.2 percent of married males never smoke, whereas 44.4 percent of the married males smoke occasionally. Residential place of the respondent also significantly associated with the prevalence of smoking habits suggest that even the adult males live in rural or urban, majority of them are smokes daily and 27.8 percent and 12.2 percent of the rural and urban males never be smoke respectively. In addition to the adult males' socio- demographic status, the influence of family members and friends is also significantly associated with the prevalence of smoking habits in the study.

Results of ordered probit model: Socio-economic characteristics

The impact of socio-economic characteristics of adult males on their prevalence of smoking habits in terms of frequency was estimated using ordered probit model. The estimates were depicted in Table 4.

Table 4: Results of ordered probit model for socio – economic characteristics

Variables	Coefficients	Marginal effects for		
		Never smoke	Occasionally	Daily
Age	-0.159* (0.0913)	0.027	0.033	-0.061
$(Age)^2$	0.0018* (0.0010)	-0.0003	-0.0003	0.0007

Education	0.678** (0.315)	-0.1125	-0.1418	0.254
Employment	0.767** (0.372)	-0.152	-0.1429	0.295
Civil status	-1.019** (0.503)	0.2343	0.1553	-0.389
Family size	-0.307** (0.097)	0.0535	0.0653	-0.118
Residential place	0.703** (0.339)	-0.1600	-0.1149	0.275
Monthly income	-0.485* (0.317)	0.0951	0.0942	-0.189
Log likelihood	-80.73			
LR chi^2 (8)	29.33			
Probability > chi^2	0.0003			
Pseudo R^2	0.1537			

Note: ** and * indicates the levels of significant at 5% and 10% respectively.

: Standard errors are in the parentheses.

Source: Computed by author from survey data, 2020.

The model estimation results suggest that education level, employment whether the adult males are employed or not, civil status, family size, and the residential place whether they live in rural or urban areas appear to be the major contributors to the frequency of smoking habits than other factors variables. Based on the probability statistics of Pseudo R^2 which is statistically significant at 1percent level shows the goodness of fit measures where the above socio-economic status of the respondents was more appropriate to examine their impact on smoking habits in the study. Among the above variables, age, civil status, family size, and monthly income negatively impact smoking habits while (age)2, education, employment, and residential place positively impact on smoking habits.

The coefficient of age has negative sign indicates that, as age increases the probability of smoking frequency falls from never to daily. In other words, as the respondent becomes older, he will mature and thus intend to smoke less and less. The marginal effects of age reveal that respondents who become elder will reduce the probability of smoking daily by 6.1 percent. Similarly, the marginal effect for $(age)^2$ shows that the probability of daily smoking for elders is nearly zero. Education level has positive and significant at 5percent level reveals that, the respondents who have primary education the probability of smoking frequency for never will reduce by 11.25 percent while they have 25.4 percent of more probability to smoke daily compared to the respondents who have secondary educated in the study. Secondary educated respondents more concern on health issues resulting from smoking and thus they try to avoid those issues by smoking than primary educated respondents.

The employment status also significant in the model suggests that the working respondents have 15.2 percent less probability to never smoke, 14.29 percent less probability to smoke occasionally, and 29.5 percent more likely to smoke daily. This means that, as the respondents earn income by working, they can buy cigarettes and smoke daily than unemployed persons. In case of civil status, the person who is married smoking frequency will be less due to their family responsibilities compared to unmarried persons. The marginal effects of civil status for never smokers and occasionally smokers are 0.2343 and 0.1553 implies that married persons have 23.43 percent and 15.53 percent of more likely to become as never and occasionally smokers respectively. The respondents who have more members in the family, less likely to smoke than the respondents who have less members. Because, as the family members increase, the person will have more financial responsibilities and thus unable to smoke like others. The marginal effects for family size show that the respondents who have more members in the family, the probability of never smoke also increase by 5.35 percent whereas the probability of daily smoke will reduce by 11.8 percent, but their probability of occasionally will increase by 6.53percent indicates that, even their family size is larger, in some certain occasions they prefer to smoke. The coefficient of residential place has positive sign and its marginal effects for never smoke and occasionally have negative sign while probability of daily smokers is positive. This represents that, the respondents who lives in urban areas their probability of never smoke will be lower by 16 percent and the probability of daily smoke will increase by 27.5 percent than the respondents who lives in rural areas in the district. The above results suggest that, rural respondents don't have much smoking habits than urban adult males. Due to the urbanization and their different lifestyles make the urban respondents to addict easily to smoke while rural areas are mostly traditionalized and may restrict them to addict smoking habits.

The above results further indicate that, as their monthly income is less than LKR 20,000, the probabilities of never smoke and occasionally will be higher by 9.51 percent and 9.42 percent respectively, but the probability of daily smoking habits will be lower by 18.9 percent than the respondents who earns the income more than LKR 20,000 per month. Since the respondents who have more earning capacity, they were able to spend more money on cigarette consumption than less income earners. However, cigarette consumption is not like as other normal goods and even the income increases, due to the health issues they do not much increase its consumption.

Results of ordered probit model and marginal effects for smoking related factors

In addition to the socio-economic characteristics of the adult males, prevalence of smoking habits and frequency is determined by other factors such as, expenditures on cigarette per week, age start to smoke, influence of family members whether any of them has smoking habits or not and influence of friends whether any of their friends have smoking habits or not. Using these variables, ordered probit model was estimated and results were given below.

Table 5: Results of ordered probit model: Smoking related factors

Variables	Coefficients	Marginal effects for		
		Never smoke	Occasionally	Daily
Expenses on smoking	0.0146** (0.006)	0.000	-0.001	0.001

Age starts to smoke	0.0708* (0.097)	0.000	-0.008	0.008
Influence of family	-0.863* (0.919)	2.47e -32	0.111	-0.111
Influence of friends	3.087* (6.102)	-1.64e-21	-.0859	0.859
Log likelihood	-7.32			
LR chi^2 (8)	176.17			
Probability > chi^2	0.0000			
Pseudo R^2	0.9233			

Note: ** and * indicates the levels of significant at 5% and 10% respectively.

: Standard errors are in the parentheses.

Source: Computed by author from survey data, 2020.

In the above Table 5, probability statistics of Pseudo R^2 is statistically significant at 1 percent level shows that the estimated model is fitted one. Also, all the above variables were statistically significant at 5 percent and 10 percent levels and out of them, expenditures on cigarettes is the most influencing factor to determine the smoking habits than other two factors. The coefficient of smoking expenditure per week has a positive sign that implies that the respondents who spent more money on cigarettes have 0.1 percent more probability of smoking daily whereas 0.1percent of less probability to smoke occasionally than the respondents who spent less money. For respondents who start to smoke at an early age, their probability of daily smoke will be higher by 0.8 percent and the probability of never smoke is zero. For the respondents who said the smoking habits influence by their family members, the probability of daily smoke will be lower by 11.1percent whereas, the respondents who said the smoking habits influence by their friends, the probability of daily smoking will increase by 85.9 percent. However, the probability of occasionally smoke will reduce by 8.59 percent in the study.

Results of Poisson regression and its marginal effects

The ordered probit model is applied to describe the frequency of smoking among the respondents where the frequency of smoking is taken as a dependent variable with an ordinal variable. Apart from that, the respondents were asked how many cigarettes they smoke per week which was taken as counting variable and thus it was considered as dependent variable in the Poisson regression model. The estimated results of Poisson regression model and its marginal effects illustrated in the following table.

Table 6: Results of Poisson regression and its marginal effects

Variables	Coefficients	Standard error	Z- value	Marginal effects
Age	0.0052*	0.003	1.68	0.074*
Level of education	0.059	0.066	0.90	0.837
Employment	0.289***	0.081	3.54	4.08***
Monthly income	-0.273***	0.072	-3.79	-3.85***
Civil status	-0.046	0.090	-0.51	-0.652
Place of residence	0.184**	0.076	2.42	2.60**
Family size	-0.013	0.023	-0.59	-0.191
Smoking habits of family members	-0.333***	0.075	-4.40	-4.69***
Smoking habits of friends	2.560***	0.307	8.34	36.10***
Constant	-0.1513	0.364	-0.42	…….

Number of observations	100
LR Chi – square (9)	298.90
Probability > chi - square	0.0000
Pseudo R- squared	0.2273
Log likelihood	-508.108

Note: ***, ** and * represents the significant levels at 1%, 5% and 10% respectively.
Source: Estimated by authors using Stata 17.

According to the above results, the probability value of chi-square is statistically significant, indicating the estimated model is fitted and it concludes that at least one of the regression coefficients in the model is not equal to zero. Among the explanatory variables, age has significant at 10% level, marginally suggest that as age increases logs of expected number of cigarettes to smoke would be expected to increase by 0.052 units while holding the other variables in the model constant. The coefficient of employment has positive and significant at 1 percent level implies that the log of expected number of cigarettes of the smoker who has work would be higher by 0.289 unit than an unemployed smoker. Negative sign of monthly income shows that, the respondents who have less than LKR 20,000 income, their log expected counts of cigarette smoking would be less than by 0.273 unit compared to the respondents who have more than LKR 20,000 assuming other variables constant in the model. The estimated Poisson regression coefficient comparing the respondents who live in urban and rural areas reveals that logs of expected cigarette counts are expected to be 0.184 units higher for urban than rural respondents in the study. Similarly, the respondents who have any members in the family addict to smoke, expected to have 0.333 unit less log of expected number of cigarettes than others. However, influencing friends' smoking habits significantly increases the logs of expected counts by 2.56 units compared to the respondents who don't have smoking friends. The marginal effects of the Poisson model reveal that, older respondents have 0.07 percent of more likely to smoke more cigarettes than elders whereas the person who have work the probability of smoking more cigarettes will be higher by 4.08 percent than unemployed smoker. The person who earns income less than LKR 20,000 per month their probability to smoke more cigarettes would be less by 3.85 percent than the person who earns income more than LKR 20,000. The respondents who have any members smokes in the family, the probability to smoke more cigarettes would be less by 4.6 percent than their counterpart. Marginal effect for friends' smoking behavior is 36.1 implies that, the respondents who have smoking friends, their probability of smoking more cigarettes would be higher by 36 percent than other respondents in the study.

In addition to the Poisson regression model, zero-inflated Poisson model is also used to model count data with an excess of zero counts. Further, theory suggests that the excess zeros are generated by a separate process from the count values and that the excess zeros can be modeled independently. Thus, the zero-inflated Poisson model has two parts, a Poisson count model and the logit or probit model for predicting excess zeros.

Table 7: Frequency of cigarettes in smoking per week

Number of cigarettes	Frequency
0	16
4	2
5	12
6	2
7	4
8	3
10	4
14	12
15	7
16	1
18	1
20	8
21	8
25	3
26	1
28	5
30	6
35	4
41	1

Source: Estimated by authors using Stata 17.

The table indicates that there are 16 zeros who do not smoke and thus in case of excess zeros, zero inflated Poisson model is more applicable than normal Poisson model.

Table 8: Results of Zero Inflated Poisson regression

Variables	Coefficients	Standard error	Z - value	Significant value
Number of cigarettes smoking				
Age	0.011	0.003	3.44	0.001
Civil status	-0.024	0.088	-0.28	0.780
Level of education	-0.115	0.067	-1.71	0.088
Employment	0.230	0.080	2.87	0.004

Place of residence	0.094	0.077	1.23	0.220
Smoking habits of friends	0.985	0.319	3.08	0.002
Smoking habits of family members	-0.076	0.080	-0.94	0.345
Family size	-0.044	0.023	-1.93	0.053
Monthly income	-0.234	0.071	-3.26	0.001
Constant	1.458	0.400	3.64	0.000
Inflate				
Age	0.047	0.027	1.78	0.076
Civil status	0.781	0.925	0.84	0.399
Level of education	-2.505	1.133	-2.21	0.027
Employment	-0.485	0.655	-0.74	0.458
Place of residence	-0.834	0.679	-1.23	0.219
Smoking habits of friends	-3.809	1.157	-3.29	0.001
Smoking habits of family	1.890	0.730	2.59	0.010
members	-0.119	0.217	-0.55	0.582
Family size	0.370	0.613	0.60	0.546
Monthly income				
Constant	1.08	1.605	0.67	0.501

Note: Vuong test of zero inflated Poisson Vs standard Poisson: z = 3.43 Probability > z = 0.0003

Number of observations	100
Non - zero observations	84
Zero observations	16
LR chi – square (9)	91.66
Probability > chi - square	0.0000
Log likelihood	-388.436
Inflation model	Probit

Source: Estimated by authors using Stata 17.

According to the table, it suggests that the number of observations used in the study is 100 and out of them, the numbers of non-zero observations and zero observations are 84 and 16 respectively. Further, loglikelihood ratio chi-square compares the full model to a model without count predictors and the probability value is significant indicating that the model as a whole is statistically significant.

A standard Poisson model would not distinguish between the two processes causing an excessive number of zeroes, but a zero-inflated model allows for and accommodates this complication. Thus, Vuong test used to compare the zero inflated model with ordinary Poisson regression to decide which model is the best fitted one where the dependent variable takes a count data. In the above table, test statistic of Vuong test is significant at 1 percent level indicating that the zero inflated Poisson model is superior to the standard Poisson model. Thus, a zero-inflated model should be considered when analyzing a dataset with an excessive number of outcome zeros and two possible processes that arrive at a zero outcome.

The zero-inflated Poisson regression generates two separate models and then combines them.

First, a probit model is generated for the "certain zero" cases, predicting whether or not a respondent would be in this group and then, a Poisson model is generated to predict the counts for those respondents who are not certain zeros. Finally, the two models are combined and when running a zero-inflated Poisson model in Stata, must specify both models. First part represents the count model coefficients in the Poisson regression whereas the second part represents the zero inflation coefficients predicting the certain zeros used in the probit model.
The Zero-inflated Poisson regression model shows that the dependent variable Y, the number of cigarettes smoked is influenced by six explanatory variables, age, education level, employment, smoking habits of friends, family size and monthly income with significance levels at 1 percent and 10 percent whereas there are 4 variables such as age, education, smoking habits of friends and smoking habits of family members and those have significant influence at 1percent level in the probit model.

As the age increases, they are more likely to become as a smoker and more likely to smoke more cigarettes. In other words, elder respondents have more probability to smoke and thus they will smoke more cigarettes than youngest.

The primary educated respondents less likely to smoke and the expected number of cigarettes to smoke also lower by 0.115 compared to the secondary educators. Compared to the unemployed respondents, the expected number cigarettes smoked by working respondents would be higher by 0.230 and it is significant at 1 percent level.

Smoking habits of friends was another significant factor associated with both models and it suggests that the respondents whose friends have smoking habits, less likely to become as a smoker even though, expected number cigarettes smoked by the respondents who have smoking friends would be higher by 0.985 holding other factors held constant. The respondents who have family members with smoking habits, their probability of becoming a smoker would also be higher, even though their expected number of cigarettes to smoke is lower by 0.076. But it is not significant in the count portion of the Poisson model.

As the number family size increases, the expected number of cigarettes smoked by the respondents would be lower by 0.044 and among the respondents who are smokers with less than LKR 20,000 the expected number of cigarettes would by less by 0.370 in the study.

The expected count for the number of cigarettes smoked by the respondents can be measured at mean across selected categorical variables related to demographic and socio–economic characteristics as follows.

Table 9: Results of the expected number of cigarettes in smoking

Variables	dy/dx	Standard error	Z - value	Significant value
Level of education	3.236	2.360	1.370	0.170
Employment	4.179	1.683	2.480	0.013
Smoking habits of family members	-4.731	1.727	-2.740	0.006
Smoking habits of friends	21.201	4.786	4.430	0.000

Monthly income	-4.00	1.550	-2.580	0.010
Place of residence	2.945	1.693	1.740	0.082

Note: dy/dx for factor levels is the discrete change from the basic level.

Source: Estimated by authors using Stata 17.

The above results imply the difference in expected counts of the number of cigarettes smoked by the respondents between the selected variables in the study. The difference in the number of cigarettes smoked by primary and secondary educated respondents is 3.236 which shows that primary educators' expected number of cigarettes smoked is higher by 3.236 than secondary educators. But it is statistically insignificant in the study. The respondents who have work, their number of cigarettes in smoking is higher by 4.179 than non – workers.

The respondents who have the smokers in their family will have a smaller number of cigarettes by 4.731than who have the smoking member in their family and it is significant at 1 percent level. A respondent who has a smoking friend, his number of cigarettes to smoke is higher by 21.20 than other respondents who don't have smoking friend. The difference in the number of cigarettes smoked by the persons who have monthly income of less than LKR 20,000 and more than LKR 20,000 is 4.00 which shows that the person who earn less than LKR 20,000 smoke less cigarettes by 4.00 than other income earners. The respondents who live in urban areas would be smoke more cigarettes by 2.945 than the respondents who live in rural areas and it is statistically significant at 10 percent level.

Conclusion

This study was found out the determinants of smoking habits among adult males in Tambuttegama division in Anuradhapura district. Among 100 adult males, 58 percent were daily smokers while 27 percent males were occasionally smoke, and 15 percent were never smoke. The results derived from the chi-square test conclude that education level, status of employment, civil status, influence of family and friends were significantly associated with smoking prevalence. Results of ordered probit model revealed that, education level, employment, civil status, family size and the residential place were the principal modifiable predisposing factors which determine the prevalence of smoking habits in the study. In addition to the above socio-economic characters, smoking related factors including influence of family members and friends, also affect smoking prevalence. Among these variables, expenses on *cigarette* consumption is the main factor to determine the frequency of smoking behavior in the study. The overall findings of the study summarized that among the socio-economic characters, education level, employment whether the adult males are employed or not, civil status, family size and the residential place whether they live in rural or urban areas appear to be the major contributors for the frequency of smoking habits than other variables. Among the smoking related factors, expenditures on cigarette consumption are the main factor to determine the smoking habits in the study. The results of the zero inflated poisson regression model show that as people get older, they consume more *cigarettes*, while as their family size grows, they consume fewer *cigarettes*. Further, employed respondents were more likely to be a smoker with consuming more *cigarettes* When considering the level of education, primary educated respondents were less likely to be a smoker compared to secondary educated respondents. Friends' smoking habits reduce the likelihood of becoming a smoker, but they increase the expected number of *cigarettes* consumed. In contrast, smoking habits of family members tend to increase the probability to be a smoker with less number of *cigarettes* consumption. The respondents who earn less than LKR 20,000 tend to consume less number of cigarettes compared to other income earners. Most of adult male smokers in this study smoke the *cigarettes* on daily basis which reveals their addiction to cigarettes and whether the adult males are employed or not and expenditures on cigarette consumption also affecting their smoking prevalence and the number of smoking *cigarettes.* The study recommends that a comprehensive mindfulness programs on smoking in community level should be commenced targeting all strata of the population and making them aware about the harmful effects and disease conditions of cigarette use. Anti-smoking campaigns must also be initiated in a broad manner, specially targeting the smoking population as well as their family and friends. In addition to these, media campaigns for anti-smoking are also very effective to achieve the reduction in the prevalence of smoking behavior among adult males in Tambuttegama division in Anuradhapura district.

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