Original Article

# Correlates of Cigarette Smoking Among Adolescents in India

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## Abstract

**Background:** The use of cigarettes/tobacco among adolescents is quite high in India. Worldwide, nearly, all (88%) initiation of smoking occurs before the age of 18 years. Smoking caused about 1 million deaths or 10% of all deaths in India, with about 70% of these deaths occurring at the ages of 30–69 years. **Aims and Objectives:** Different correlates of cigarette smoking among adolescents were investigated, which may help to improve public health interventions in India. **Materials and Methods:** Global Youth Tobacco Survey data collected in India during 2009 were taken. Bivariate analysis, logistic regression, receiver operating characteristic, and nomogram were used to examine association between exposure and outcome variables. Cigarette smoking within the past 30 days preceding the survey was the outcome variable while independent variables were age, education, gender, parental smoking, people smoking at home/smoking in the presence of adolescents, felt boys/girls who smoke have more friends, accepting cigarette offered by one of the best friends, perception of attractiveness of boys/girls who smoke, perception smoking makes one loss or gain weight, and perception cigarettes smoking harmful. **Results:** 11768 adolescents participated, of which 9951 (48% males and 52% female) responded on cigarette smoking. Current cigarette smoking was associated with female gender (odds ratio [OR]: 0.68; 95% confidence interval [CI]: 0.52–0.90), parental smoking (OR: 1.00; 95% CI: 0.62–1.60), smoking cigarette at home (OR: 3.66; 95% CI: 2.64–5.09), and smoking cigarette in presence of adolescent (OR: 4.14; 95% CI: 2.92–5.87). Observed associations between the outcome and exposure variables reported in this study should be considered in the design of public health interventions. **Conclusion:** To eliminate smoking habits, efforts should also be made in the exploration of new ideas and their implementation by the public health experts in collaboration with international agencies, various nongovernmental organizations, and academic and research institutions. Let's plan for active action to make smoke-free environment based on evidence.

**Keywords:** Adolescent, Global Youth Tobacco Survey, logistic regression, school-going, smoking

## Introduction

Globally, smoking-related diseases kill an estimated four million people every year. This number is predicted to rise to a staggering 10 million a year over the next two decades.[1] Around 80% of the world's 1.1 billion smokers live in low-and middle-income countries.[2] Cigarette smoking among adolescents is the biggest public health concern of the present era. Smoking is contributing in a major way to India's increasing burden of noncommunicable diseases such as asthma, chronic cough, some cancers, and cardiovascular diseases. In India, one in ten adolescents aged between 13 and 15 years has ever smoked cigarettes.[3-5] If the current trends continue, it will account for 13% of all deaths in India by 2020.[6]

The association between cigarette smoking and sociodemographic factors has been reported in various studies in respect of adults as well as adolescents both.[7-10] Limited published research articles are available on Global Youth Tobacco Survey (GYTS) data, which measure different correlates of current cigarette smoking among school-going adolescents at national level. Siziya *et al*. in their study reported that, overall, 3.3% of all respondents were current cigarette smokers. Boys were more likely to be smokers than girls. Adolescents who received pocket money, who had parents who smoked, who said that boys or girls who smoke have more friends, who said that there is no difference in weight, whether one smokes or not, and those who said that smokers gain weight, who said that boys who smoke or chew tobacco

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are less attractive, who had most or all of their closest friends who smoked were more likely to smoke.

Siziya *et al*. reported association between current cigarette smoking among school-going adolescents in Punjab, India, using data of GYTS 2003; and factors, namely, parental smoking habits, fat boys/girls who smoke have more friends, accepting a cigarette offered by one of the best friends smoking, perception of attractiveness of boys/girls who smoke and perception smoking makes one loss or gain weight. An association of some other factors, namely, age, education, people smoking at home, people smoking in the presence of adolescents, perception cigarettes smoking harmful was not investigated. Furthermore, they studied only in Punjab state.

The aim of this study was to use the most recently available data representative at the national. All the aforesaid factors investigated together gender-wise. We also validated the model used to see the association through receiver operating characteristic (ROC). Pictorial and graphical depictions of all the related variables in the model are presented by a nomogram. Knowledge about all correlates is important to understand smoking behavior, which may help to improve public health policy as well as interventions.

## Materials and Methods

It is a cross-sectional study on the secondary data of the GYTS conducted in India during 2009. It includes data on the prevalence of cigarette and other tobacco use, perceptions and attitudes about tobacco, access and availability of tobacco products, exposure to second-hand smoke, school curricula, media and advertising, and smoking cessation. Cigarette smoking within the past 30 days preceding the survey is the outcome variables while independent variables are age, education, gender, parental smoking habits, people smoking at home, people smoking in the presence of adolescents, boys and girls felt adolescents who smoke have more friends, accepting a cigarette offered by one of the best friends, perception about harmful, attractiveness, and gain/loss weight. The association between the exposure variables and the outcome variable was explored using bivariate statistics, univariate, and multivariable logistic regression analysis. ROC and nomogram were used to examine associations between exposure and outcome variables.

## Results

Table 1 represents the gender-wise descriptive characteristics of school children (population) considered under this study. A total of 11,768 adolescents aged between 11 and 17 years participated, of which 9951 students (approximately 48% boys and 52% girls) responded on cigarette smoking (response rate was 84.6%). Among all the respondents, 3.8% (approximately 5% boys and 2.6% girls) were current cigarette smokers. Regarding parental smoking habits, 4.8% of adolescents reported, mother and father both were smokers, while father only 18.7% and mother only 1.8% were smokers. 20.6% reported that the people were smoking cigarettes in their homes. More than 35% of adolescents also reported that people were smoking cigarettes in their presence. One-fourth adolescents (boys and girls both) felt that boys/girls who smoke cigarettes have more friends. Adolescents were asked if your one of the best friends will offer a cigarette to smoke, whether you will accept this or not. Approximately 7.4% of boys and 4.2% of girls reported definitely/probably yes. More than 84% of adolescents have the perception that cigarette smoking is harmful.

Bivariate analysis of adolescents who are current cigarette smokers as compared to age 11–12 years, adolescents ages 13 years (odds ratio [OR] = 1.38, 95% confidence interval [CI]: 0.83–2.29, $P = 0.22$), 14 years (OR = 1.26, 95% CI: 0.76–2.09, $P = 0.37$), 15 years (OR = 1.76, 95% CI: 1.07–2.90, $P = 0.03$), and 16–17 years (OR = 1.06, 95% CI: 0.51–2.19, $P = 0.87$) was more likely to smoke cigarettes. Male adolescents were 49% more likely to smoke cigarettes as compared to female adolescents. As compared to those adolescents whose parents were none smoking, adolescents with both parents smoking (OR = 3.44, 95% CI: 2.39–4.94, $P < 0.001$), with only father smoking (OR = 2.97, 95% CI: 2.36–3.75, $P < 0.001$), and with only mother smoking (OR = 7.65, 95% CI: 4.97–11.76, $P < 0.001$) were more likely to smoke cigarettes. Male adolescents with only mother smoking were 5.8 times more likely to smoke as compared to those who had no smoking mother, but in female adolescents with only mother smoking was 10.49 times more likely to smoke as compared to those who had no smoking mother. For both male and female adolescent respondents, having smoked in the home and in the presence of adolescents was associated with a >10 times the odds of smoking (OR = 12.20; 95% CI: 9.65–15.43; $P < 0.001$) for home and (OR = 10.50; 95% CI: 7.95–13.89; $P < 0.001$) for the presence of adolescents. Respondents (boys/girls) who smoke said that they definitely/probably accept cigarette offered by one of the best friends smoking. These respondents were >50 times more likely to smoke as compared to the adolescents who had nonsmoking closest friends.

In Table 2, gender, parental smoking habits, felt girls who smoke had fewer friends, perception about harmful of smoking and perception on the attractiveness of boys/girls who less smoke was negatively associated with current cigarette smoking. Girls were 32% (OR = 0.68, 95% CI: 0.52–0.90, $P = 0.01$) less likely to be smoke cigarette than boys. As compared to those adolescents whose parents were none smoking, adolescents with only father smoking were statistically significant and less likely to smoke cigarettes whereas only mother smoking and both parents smoking were not statistically significant. Smoking in the home or in the presence of the adolescent was found to be positively associated with current cigarette smoking. Adolescents having 3.66 times more odds of smoking (OR = 3.66; 95% CI: 2.64–5.09; $P < 0.001$) where people smoke in their home, whereas smoking in the presence of adolescents was 4.14 times more (OR = 4.14; 95% CI: 2.92–5.87; $P < 0.001$). Regarding accepting cigarettes to smoke, respondents (boys/girls) reported that they

**Table 1: Gender-wise association of predictor variables with current cigarette smoking**

| Description of categories and its subcategories of adolescents | Male/female/ both | Status of current smoking among adolescents | | | | | |
|---|---|---|---|---|---|---|---|
| | | Male | | Female | | Both | |
| | | OR 95% CI (LL-UL) | Significant | OR 95% CI (LL-UL) | Significant | OR 95% CI (LL-UL) | Significant |
| Age (Reference: 11-12 years) | | | | | | | |
| 11-12 | 350/309/659 | 1.00 | 0.03 | 1.00 | 0.59 | 1.00 | 0.03 |
| 13 | 1251/1545/2796 | 1.47 (0.78-2.76) | 0.23 | 1.41 (0.59-3.35) | 0.43 | 1.38 (0.83-2.29) | 0.22 |
| 14 | 1495/1812/3307 | 1.24 (0.66-2.32) | 0.50 | 1.43 (0.61-3.37) | 0.41 | 1.26 (0.76-2.09) | 0.37 |
| 15 | 1423/1317/2740 | 1.97 (1.07-3.64) | 0.03 | 1.42 (0.59-3.40) | 0.43 | 1.76 (1.07-2.90) | 0.03 |
| 16-17 | 291/158/449 | 1.21 (0.54-2.74) | 0.64 | 0.32 (0.04-2.70) | 0.30 | 1.06 (0.51-2.19) | 0.87 |
| Education (Reference: Eighth) | | | | | | | |
| Eighth | 1582/1659/3241 | 1.00 | 0.01 | 1.00 | 0.78 | 1.00 | 0.05 |
| Ninth | 1456/1885/3341 | 1.28 (0.90-1.81) | 0.17 | 0.92 (0.61-1.37) | 0.67 | 1.08 (0.83-1.41) | 0.57 |
| Tenth | 1772/1597/3369 | 1.65 (1.20-2.27) | 0.00 | 0.86 (0.56-1.32) | 0.49 | 1.34 (1.04-1.73) | 0.02 |
| Gender (Reference: Male) | | | | | | | |
| Male | 4810 | | | | | 1.00 | |
| Female | 5141 | | | | | 0.51 (0.41-0.63) | 0.00 |
| Parental smoking (Reference: None) | | | | | | | |
| None | 3408/4031/7439 | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 |
| Both | 245/234/479 | 2.70 (1.68-4.34) | 0.00 | 4.70 (2.67-8.28) | 0.00 | 3.44 (2.39-4.94) | 0.00 |
| Father only | 1054/805/1859 | 2.31 (1.73-3.09) | 0.00 | 3.97 (2.70-5.84) | 0.00 | 2.97 (2.36-3.75) | 0.00 |
| Mother only | 103/71/174 | 5.80 (3.38-9.96) | 0.00 | 10.49 (5.14-21.43) | 0.00 | 7.65 (4.97-11.76) | 0.00 |
| People smoke a cigarette in home (Reference: No) | | | | | | | |
| No | 3706/4197/7903 | | | | | | |
| Yes | 1104/944/2048 | 11.19 (8.32-15.05) | 0.00 | 13.02 (8.86-19.15) | 0.00 | 12.20 (9.65-15.43) | 0.00 |
| People smoke cigarette in your presence (Reference: No) | | | | | | | |
| No | 2974/3456/6430 | | | | | | |
| Yes | 1836/1685/3521 | 11.87 (8.15-17.31) | 0.00 | 8.30 (5.45-12.64) | 0.00 | 10.50 (7.95-13.89) | 0.00 |
| Felt boys who smoke had more friends (Reference: More friends) | | | | | | | |
| More friends | 1237/1237/2474 | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 |
| Less friends | 2584/2717/5301 | 0.47 (0.34-0.63) | 0.00 | 0.51 (0.35-0.76) | 0.00 | 0.48 (0.38-0.61) | 0.00 |
| No difference from nonsmoker | 989/1187/2176 | 0.92 (0.66-1.28) | 0.62 | 0.75 (0.48-1.17) | 0.20 | 0.83 (0.63-1.08) | 0.16 |
| Felt girls who smoke had more friends (Reference: More friends) | | | | | | | |
| More friends | 708/613/1321 | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 |
| Less friends | 2970/3387/6357 | 0.52 (0.35-0.76) | 0.00 | 0.25 (0.16-0.39) | 0.00 | 0.37 (0.28-0.50) | 0.00 |
| No difference from nonsmoker | 1132/1141/2273 | 1.85 (1.27-2.69) | 0.00 | 0.89 (0.57-1.39) | 0.61 | 1.36 (1.03-1.81) | 0.03 |
| Accepting cigarette offered by one of the best friends smoking (Reference: definitely/probably not) | | | | | | | |
| Definitely/probably not | 4456/4927/9383 | 1.00 | | 1.00 | | 1.00 | |
| Definitely/probably yes | 354/214/568 | 53.49 (39.22-72.95) | 0.00 | 78.74 (52.79-117.44) | 0.00 | 64.79 (50.72-82.77) | 0.00 |

*Contd...*

**Table 1: Contd...**

| Description of categories and its subcategories of adolescents | Male/female/ both | Status of current smoking among adolescents | | | | | |
|---|---|---|---|---|---|---|---|
| | | Male | | Female | | Both | |
| | | OR 95% CI (LL-UL) | Significant | OR 95% CI (LL-UL) | Significant | OR 95% CI (LL-UL) | Significant |
| Perception on attractiveness of boys who smoke (Reference: More attractive) | | | | | | | |
| More attractive | 1128/1118/2246 | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 |
| Less attractive | 2631/2711/5342 | 0.24 (0.17-0.33) | 0.00 | 0.18 (0.11-0.30) | 0.00 | 0.22 (0.16-0.29) | 0.00 |
| No difference from nonsmoker | 1051/1312/2363 | 0.97 (0.72-1.31) | 0.85 | 1.12 (0.76-1.64) | 0.56 | 0.99 (0.78-1.25) | 0.93 |
| Perception on attractiveness of girls who smoke (Reference: More attractive) | | | | | | | |
| More attractive | 905/720/1625 | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 |
| Less attractive | 2783/3027/5810 | 0.27 (0.20-0.36) | 0.00 | 0.19 (0.12-0.28) | 0.00 | 0.23 (0.18-0.29) | 0.00 |
| No difference from nonsmoker | 1122/1394/2516 | 0.57 (0.41-0.79) | 0.00 | 0.35 (0.23-0.54) | 0.00 | 0.45 (0.35-0.58) | 0.00 |
| Perception smoking makes one loss or gain weight (Reference: Gain weight) | | | | | | | |
| Gain weight | 416/354/770 | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 |
| Loss weight | 3451/3848/7299 | 2.12 (0.98-4.58) | 0.05 | 0.88 (0.40-1.93) | 0.75 | 1.43 (0.83-2.47) | 0.20 |
| No difference | 943/939/1882 | 8.03 (3.71-17.39) | 0.00 | 3.44 (1.56-7.60) | 0.00 | 5.54 (3.19-9.61) | 0.00 |
| Perception cigarettes smoking harmful (reference: Definitely/probably not) | | | | | | | |
| Definitely/probably not | 832/754/1586 | 1.00 | | 1.00 | | 1.00 | |
| Definitely/probably yes | 3978/4387/8365 | 0.97 (0.69-1.36) | 0.84 | 0.57 (0.38-0.85) | 0.01 | 0.77 (0.59-1.00) | 0.05 |

OR: Odds ratio, CI: Confidence interval, LL: Lower limit, UL: Upper limit

**Table 2: Association of predictor variables with current cigarette smoking pattern in multiple logistic regression analysis among adolescents**

| Description of categories and its subcategories of adolescents | Current cigarette smoking among adolescents | | | |
|---|---|---|---|---|
| | *B* | Exp(*B*) | 95% CI for Exp(*B*) | Significant |
| Gender | | | | |
| Female | −0.38 | 0.68 | 0.52-0.90 | 0.01 |
| Parental smoking | | | | |
| None/don't know | | | | 0.00 |
| Both | −0.01 | 1.00 | 0.62-1.60 | 0.98 |
| Father only | −0.72 | 0.49 | 0.33-0.71 | 0.00 |
| Mother only | −0.23 | 0.80 | 0.42-1.52 | 0.49 |
| People smoke in home | | | | |
| Yes | 1.30 | 3.66 | 2.64-5.09 | 0.00 |
| People smoke in presence | | | | |
| Yes | 1.42 | 4.14 | 2.92-5.87 | 0.00 |
| Felt girls who smoke had more friends | | | | |
| More friends | | | | 0.01 |
| Less friends | −0.50 | 0.61 | 0.41-0.90 | 0.01 |
| No difference | 0.01 | 1.01 | 0.66-1.55 | 0.96 |
| Accepting cigarette offered by one of the best friends | | | | |
| Definitely/probably yes | 3.56 | 35.02 | 25.27-48.53 | 0.00 |
| Perception about harmful of smoking | | | | |
| Definitely/probably yes | −0.99 | 0.37 | 0.26-0.54 | 0.00 |
| Perception on attractiveness of boys who smoke | | | | |
| More attractive | | | | 0.00 |
| Less attractive | −0.90 | 0.41 | 0.27-0.61 | 0.00 |
| No difference | 0.24 | 1.27 | 0.79-2.04 | 0.32 |
| Perception on attractiveness of girls who smoke | | | | |
| More attractive | | | | 0.00 |
| Less attractive | −1.24 | 0.29 | 0.20-0.43 | 0.00 |
| No difference | −1.80 | 0.17 | 0.10-0.27 | 0.00 |
| Perception smoking makes one loss or gain weight | | | | |
| Gain weight | | | | 0.00 |
| Lose weight | 1.04 | 2.82 | 1.42-5.57 | 0.00 |
| No difference | 1.32 | 3.73 | 1.81-7.66 | 0.00 |

CI: Confidence interval

definitely/probably accept cigarettes offered by one of the best friends. These respondents were >35 times (OR = 35.02; 95% CI: 25.27–48.53; $P < 0.001$) more likely to smoke as compared to the adolescents who had none of their closest friends offer cigarettes to smoke. Perception of smoking leading to loss in weight was 2.82 times, whereas the perception of smoking makes no difference in gaining weight which was 3.73 times more likely than those having perceptions on smoking and gain in weight.

ROC was obtained between predicted probability (as test variable) and current cigarette smoking (as the study variable) expressing the relationship between the true positive rate (sensitivity) and the false-positive rate (1-specificity) for each of the total scores of predicted probabilities. This was Plotted [Figure 1] to test the diagnostic accuracy of predicted probabilities to diagnose current cigarette smoking habit. The result showed that the diagnostic accuracy of the predicted probability was 92.9% (area under the curve = 92.9, 95% CI: [91.3–94.5]). Of the various cut-off value, the predicted probability value 0.016 was identified as the most appropriate cut-off value as having balancing sensitivity and corresponding specificity (cut-off = 0.016, sensitivity = 89.1%, specificity = 80%).

Nomogram[11,12] incorporating each predictor of current cigarette smoking was constructed based on the model obtained though the logistic regression approach. The nomogram [Figure 2] is used by first locating an adolescent position on each predictor variable scale. Each scale position has corresponding predictive points (top axis). For example, parental smoking habits have four options (i.e. either no parent smoking or both are smoking, father only smoking, or mother only smoking). In this, if mother only smoking, it contributes approximately 20 points; this is determined by comparing the location of the four values on the "parental smoking habits" axis to the "points" scale above and drawing a vertical line between the two axes. The point values for all current cigarette smoking predictor variables of adolescents are determined in a similar manner and are summed to arrive at a total point

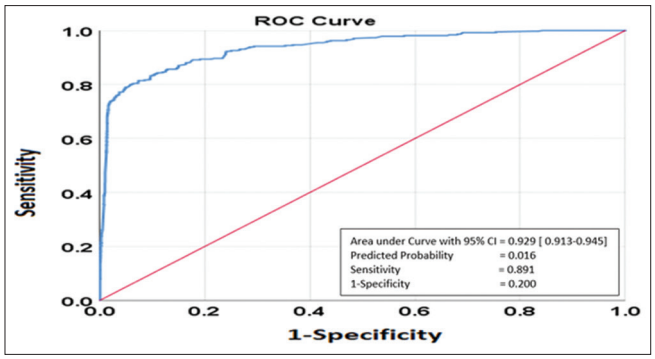


**Figure 1:** Receiver operating characteristic curve of the model for predicting current cigarette smokers

value. This value is plotted on the total points axis (third from the bottom). A vertical line drawn from the total points axis straight down to the predicted value (probability) axis, which will indicate the adolescent's probability of having current cigarette smoker.

## Discussion

This study explored the association between a selected list of variables and current cigarette smoking. Overall, approximately 3.8% of respondents (males and females) were current cigarette smokers. We observed that a higher percentage of current cigarette smoking was prevalent among male adolescents as compared to females. Similar findings were reported in some other studies.[1,13-15] This study suggests that the sociodemographic factors have an impact on current cigarette smoking, but this may be different from one setting to the other.

Current cigarette smoking was significantly associated with smoking at home or in the presence of adolescents. It significantly increases the likelihood of taking up smoking by adolescents. Similar results were reported in a study by Thakur *et al*.[4] Most of the things (both positive, negative, and unhealthy behavior) adolescents learn from their parents, neighbors, and their surrounding activity. Thus, smoking behavior at home or elsewhere in the presence of adolescents may influence them to adopt this habit.[16] Boys or girls who smoke have no difference between smokers and nonsmokers in terms of the number of friends; they have been less likely to smoke cigarettes. This observed association needs further study for more simplicity and clarity.

Adolescents were also asked to respond about their cigarette smoking, if cigarette offered by one of their closest friends. Responses were recorded in two groups: definitely/probably yes or definitely/probably no. This study found that those adolescents who had their closest friend's smokers were more likely to be smokers themselves. This finding was also reported in some other studies.[15,17-19] In general, it may be seen that adolescents/adults shared their habits with their best friends. Sometimes, they convince their best friend, forcibly to test or take a puff. Parental smoking, smoking at home, or smoking in their presence may also influence adolescents to start smoking.

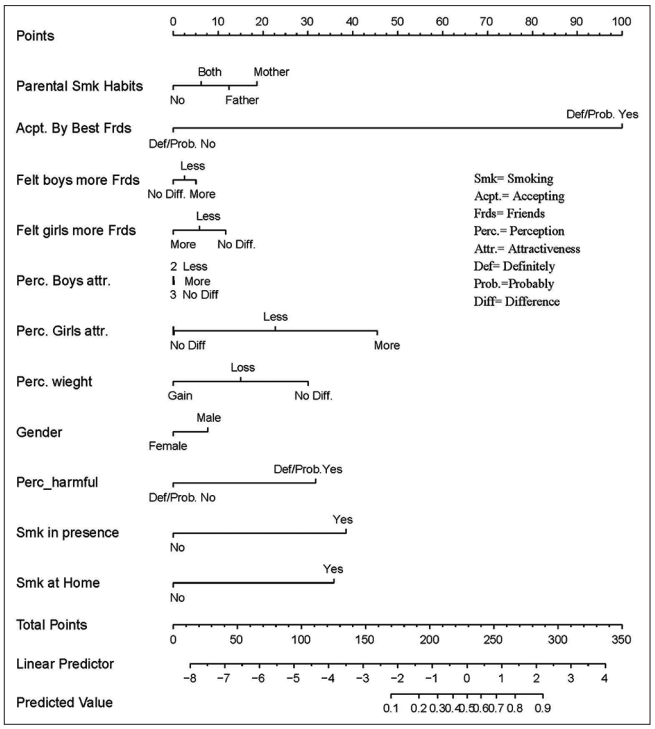


**Figure 2:** Nomogram of the model obtained from Table 2 through multiple logistic regression

These may be reasons to initiate smoking. However, we cannot conclude that this is the only reason to start smoking.

Perception on the attractiveness of boys and girls who smoke was also assessed in this study. Both gender adolescents who perceived that boys and girls who smoke are less attractive were less likely to be smokers compared to those who thought smoking makes an individual look more attractive. On the other hand, adolescent boys who perceived that boys who smoke are no different on attractiveness were more likely to be smokers compared to those who thought that smoking makes an individual look more attractive but adolescent girls seem to be less likely to be smokers. This result contradicts the study correlates of current cigarette smoking among school-going adolescents in Punjab, India, based on the results from the GYTS 2003.[15]

The hypothesis was that adolescents who thought that smoking would make one lose weight were more likely to be smokers as has been demonstrated in some western studies.[20-23] In this study, it was found that adolescents who believed that smoking makes one lose weight were more likely to be smokers. This finding support results reported in western countries where adolescent smokers generally believe smoking makes one lose weight but it also contradicts the results in the study correlates of current cigarette smoking among school-going adolescents in Punjab, India, based on results from the GYTS 2003.[15]

## Conclusion

Cigarette smoking among adolescents was found to be associated with various exposure variables reported in this

study. These factors/determinants should be considered in the design of public health interventions. To eliminate smoking habits, efforts should also be made in the exploration of new ideas and their implementation by the public health experts in collaboration with international agencies, various nongovernmental organizations, academic and research institutions. Let's plan for active action to make smoke-free environment based on evidence. The findings of this study may also be limited by not controlling unmeasured confounders and effect measure modifiers and hence cannot be generalized.

## Limitation of study

This study is based on GYTS 2009 data. No other relevant data are available in public domain at the time of study performed.


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Nil.


## Conflicts of interest

There are no conflicts of interest.

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