Original Research Article

A Latent Class Analysis of the Youths' Attitudes towards Smoking

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ABSTRACT

Today, about twenty percent of young teens who are at the age between 13 and 15 smokes worldwide and about 730 thousands youths begin smoking every day before the age of 20. Therefore, it is necessary to reduce the number of youths who start smoking before this age to reduce the total number of smokers. In the literature, researchers have examined the youths smoking habits in their studies, but the correlation between "how do youths obtain/buy their cigarettes?" and "youths' attitudes towards smoking" have never been taken into consideration by the researchers. The main purpose of this study is to analyze this correlation and to identify the youths' buying habits of their cigarettes. In order to achieve this aim, the data of National Youth Tobacco Survey conducted in 2012 were used. Five different buying habits of cigarette (latent classes) were identified, which were named as "Only bought myself", "Someone else buys for me", "Bought them for a person", "Use someone to buy cigarette" and "Reaching cigarette other ways". Also, smoking attitudes of these groups were investigated. According to the results, youths who are curious about smoking use someone to buy cigarette and they will probably smoke a cigarette anytime during next year. 17% of youths may smoke if one of friends offers a cigarette. In conclusion, specific action plans may be created for youths who behave differently in terms of buying cigarettes to reduce the total number of young smokers.

Keywords: Latent class analysis, Clustering, Youth tobacco usage, Mixture models.

INTRODUCTION

The use of tobacco products is a fairly common habit all over the world. Today, it is estimated that 1.5 billion people smoke cigarette, worldwide. Although one of the major evitable causes of death in the world is use of tobacco, the World Health Organization (WHO) identifies over four million deaths a year with tobacco. [1] This figure is anticipated to reach to 10 million deaths a year by 2030. [2] In today's world, cigarette smoking is common among youths too. Most regular smokers initiate using tobacco products well before the age of 20 years. [3] Although, youth may have several arguments for initiating tobacco use, including looking 'cool' or 'sociable', it is necessary to increase awareness about harms of tobacco products to reduce the total number of young smokers.

In the literature, there are several studies about examining youth's smoking habits, [4-6] gender differences in terms of smoking, [7] tobacco control programs, [8, 9] understanding the reasons of initiating smoking or attitude towards smoking in order to understand which factors have an important effect on smoking. [10] However, the relationship between "youths' curiosity/attitudes towards smoking" and "how do youths obtain/buy their

cigarettes?" have never been modeled by the researchers. We assume that there is a strict connection between the way of obtaining cigarettes and youths' attitudes towards smoking. To confirm this assumption, we explored the relationship between these behaviors using Latent Class Classification approach with the data obtained from National Youth Tobacco Survey (NYTS), which was conducted in 2012. This paper presents a classification of youth in terms of the way of obtaining cigarettes and an investigation about youth's attitudes towards smoking of these classes.

The outline of this paper organized as follows. Latent Class Analysis (LCA) and the data were introduced in Section 2. In Section 3, empirical results were explained. Section 4 is a brief discussion section of the study.

MATERIALS AND METHODS

The data from the NYTS, which was conducted in 2012 at the United States of America (USA), were used in the study. The data are composed of 24.658 students (age greater than 9) within 228 schools in the USA. The survey was designed by stratified sampling method.

The Variables

In NYTS data, five questions are related to buying habits of cigarette and 12 questions are related to the attitudes towards smoking. With this study, five questions were used for classification method and other 12 questions were used to understand whether students' attitudes towards smoking become different.

In the data, youths' buying habits of their cigarettes are represented with the following five variables, which are used to classify how youths' buy their cigarettes.

How do you get cigarettes? (Multiple choice)

- Bought myself (Possible results: Yes, No)
- Someone else buy for me (Possible results: Yes, No)

- Ask someone to give me a one (Possible results: Yes, No)
- Someone offered to me (Possible results: Yes, No)
- Bought them for a person (Possible results: Yes, No)

In NYTS research, youths' attitudes towards smoking are represented with the following 12 variables.

- SIM: Curious about smoking cigarette (Possible results: Yes, No)
- SID: Tried cigarette smoking, even 1 or 2 puff (Possible results: Yes, No)
- ISID: Think will smoke a cigarette anytime during next year (Possible results: Yes, No)
- YSDD: Think will try a cigarette soon (Possible results: Yes, No)
- EABT: May smoke if one of friends offered a cigarette (Possible results: Yes, No)
- SDY: The age that you first tried smoking cigarette (Possible results: I have never smoked cigarettes not even one or two puffs, 8 years old or younger, 9 years old, … , 19 years old or older)
- GIS: Past 30 days, cigarettes smoke per day (Possible results: I did not smoke cigarettes during the past 30 days, 1 or less cigarettes per day, 2 to 10 cigarettes per day, more than 10 cigarettes per day)
- MS: Past 30 days, cigarettes smoked were menthol (Possible results: I did not smoke cigarettes during the past 30 days, Yes, No, I am not sure)
- SBD: Seriously thinking about quitting cigarettes (Possible results: I do not smoke cigarettes, Yes, No)
- SHD: Think smoking cigarettes make young people look cool (Possible results: Yes, No)
- SA: Think young people who smoke cigarettes have more friends (Possible results: Yes, No)
- TUHT: Agreement with "All tobacco products are dangerous (Possible results: Agree, Disagree).

In order for the convenience and the determination of latent classes, the variables with high number of categories were recoded and the number of categories was reduced. For example; the category of GIS (number of cigarette smoked in last 30 days) variable was reduced from 7 to 4.

The Method: Latent Class Analysis

In order to determine unobserved diversity of population and to reveal presence or absence of behavioral differences in buying cigarettes, LCA was used in this study. LCA classifies people with similar answer set, which can be used to determine the pattern of related cases. [11] Analyses were computed by R software.

Suppose that categorical variables A, B and C consist of i, j, k classes, respectively. According to categories of variable C, situation of A and B variables to be independent each other shown as follow: [12]

$$\hat{P}_{ijk} = \hat{P}_{ik}^{\bar{A}C} \ x \ \hat{P}_{jk}^{\bar{B}C} \ x \ \hat{P}_k^C \ (1)$$

$\hat{P}_{ik}^{\bar{A}C}$ is conditional probability of variable A, $\hat{P}_{jk}^{\bar{B}C}$ similar conditional probability and $\hat{P}_k^C$ is probability of anyone observation will be at a specific category of variable C. Explanatory variable C when unobserved, so variable C when latent, probabilities are symbolized as π and latent classes are designed as latent variable X with T class (t = 1, … , T)

$$\pi_{ijt}^{ABX} = \pi_{it}^{\bar{A}X} \ x \ \pi_{jt}^{\bar{B}X} \ x \ \pi_t^X \qquad (2)$$

π_{ijt}^{ABX} denotes the probability that an observation will be at category (i, j, t) of joint variable (A, B, X), π_t^X denotes the probability that an observation will be at category t of variable X, $\pi_{it}^{\bar{A}X}$ denotes the conditional probability that an observation will be at category i of variable A and $\pi_{jt}^{\bar{B}X}$ denotes similar conditional probability. [13] If we widen equality (2), we showed as follow; [14]

$$\pi_{ij\ldots mt}^{AB\ldots EX} = \pi_{it}^{\bar{A}X} \ x \ \pi_{jt}^{\bar{B}X} \ x \ldots x \ \pi_{mt}^{\bar{E}X} \ x \ \pi_t^X \ (3)$$

Total of latent class probabilities (π_t^X) of all latent classes (T) of latent variable (X) must 1.00 and there are T-1 estimated latent class probabilities. [15]

$$\sum_t \pi_t^X = 1.00 \qquad (4)$$

There are I+J conditional probabilities for T latent classes of latent variable (X) with two observed variables. Total of conditional probabilities for each of the observed variables are 1 in each of the T latent classes.

$$\sum_i \pi_{it}^{\bar{A}X} = \sum_j \pi_{jt}^{\bar{B}X} = 1.00 \qquad (5)$$

The number of estimated parameters are (T-1) + T(I - 1) + T(J - 1) = T(I+J-1) − 1. That is, we should estimating (T-1) latent class probabilities and (I − 1) + (J − 1) conditional probabilities for each of the T latent classes. [14] In this case, degree of freedom (df) for two categorical variables as follow:

DF = (IJ − 1) − [T (I + J -1) − 1]   (6)

Model rewritten as follow for shown that a model estimated from sample: [16]

$$\hat{\pi}_{ijt}^{ABX} = \hat{\pi}_{it}^{\bar{A}X} \ x \ \hat{\pi}_{jt}^{\bar{B}X} \ x \ \hat{\pi}_t^X \qquad (7)$$

Model's goodness of fit can be measured with chi-squared goodness-of-fit test (χ^2), likelihood ratio (G^2) tests and standardized residuals (χ^2) and (G^2) tests are used to test '(H_0): The model fits the data' hypothesis. If the H_0 hypothesis is not rejected, model is accepted as 'fit' and standardized residuals are examined to see if their absolute values rise above 2. [15] χ^2 and G^2 are calculated as follows:

$$e_{ij} = \frac{F_{ij} - \hat{F}_{ij}}{\sqrt{\hat{F}_{ij}}} \qquad (8)$$

$$\chi^2 = \sum_{ij} \frac{(F_{ij} - \hat{F}_{ij})^2}{\hat{F}_{ij}} \qquad (9)$$

$$G^2 = 2 \sum_{ij} F_{ij} \ x \ \ln \frac{F_{ij}}{\hat{F}_{ij}} \qquad (10)$$

$$\hat{F}_{ij} = N * \pi_{ij}^{AB} \qquad (11)$$

Akaike (AIC) and Bayesian (BIC) Information Criteria were used to deciding which model is better fit. Thus, the number of the latent class was determined in terms of the smallest AIC and BIC statistics.

AIC=G^2 − 2df   (12)
BIC=G^2 − df * (lnN)   (13)

According to the AIC and BIC statistics, five-latent class model was the most appropriate model for this dataset.

RESULTS

Background Data

In the study, 42.7% of the respondents are female and 57.3% are male. Also, 28.5% are aged (9 - 14) and 71.5 are aged (15 - 19+). In total, in terms of ethnicity, 57% are withes, 21% are Hispanic and 14% are Blacks. Although 62% of the respondents are curious about smoking cigarettes, 65% of all respondents are thinking seriously about quitting cigarettes.

Model Selection and Results of the Appropriate Model

The dataset was analyzed with Latent Class Classification Approach and consisted of one latent variable. In order to decide on the number of classes, Models in which the latent variable had one, two, three, four and five classes were tested. The model results are given in Table 1.

According to the AIC, BIC, χ^2 and G^2 statistics, the number of latent classes that fitted the best for our dataset was determined. As a result, the smallest values of AIC and BIC were founded in the model with five latent variables.

Table 1. AIC, BIC, χ2, G² statistics

Model	AIC	BIC	χ2	G²
1-Class	14.605,07	14.635,08	2.275,3	1.493,01
2-Class	14.132,43	14.198,47	2.137,69	1.008,46
3-Class	13.727,18	13.829,24	527,77	591,21
4-Class	13.376,69	13.514,77	206,11	228,72
5-Class	13.238,84	13.412,94	55,797	78,87

The latent class probabilities derived from five-class model are given in Table 2.

Consequently, the probability of individuals is 0.168, 0.147, 0.03, 0.085 and 0.570 to be in Class 1, Class 2, Class 3, Class 4 and Class 5, respectively.

The conditional probabilities in Class 1 indicate that only one variable appears to have a very high possibility for the way of buying cigarettes, which is "Only bought myself". Therefore, Class 1 can be named as "Only bought myself". According to the distribution of conditional probabilities in Class 2, Class 3, Class 4 and Class 5, these classes can be named as "Someone else buy for me", "Bought them for a person", "Use someone to buy cigarette" and "Reaching cigarette other ways", respectively.

Table 2. Latent class probabilities

		Class 1	Class 2	Class 3	Class 4	Class 5
		(16.8%)	(14.7%)	(3.0%)	(8.5%)	(57.0%)
Bought myself	Yes	1.0000	0.0265	0.0000	0.3883	0.0115
	No	0.0000	0.9735	1.0000	0.6117	0.9885
Someone else buy for me	Yes	0.0000	1.0000	0.0000	0.7779	0.0176
	No	1.0000	0.0000	1.0000	0.2221	0.9824
Ask someone to give me a one	Yes	0.0125	0.0000	0.0000	0.9265	0.2656
	No	0.9875	1.0000	1.0000	0.0735	0.7344
Ask someone to give me a one	Yes	0.0000	0.0092	0.0139	0.7943	0.3993
	No	1.0000	0.9908	0.9861	0.2057	0.6007
Bought them for a person	Yes	0.0018	0.0033	1.0000	0.3622	0.0000
	No	0.9982	0.9967	0.0000	0.6378	1.0000

Table 3. Demographics characteristics of five latent classes.

	Class 1	Class 2	Class 3	Class 4	Class 5
	(16.8%)	(14.7%)	(3.0%)	(8.5%)	(57.0%)
Gender					
Girl	0,41	0,52	0,30	0,51	0,45
Boy	0,59	0,49	0,70	0,49	0,55
Age					
9	0,01	0,00	0,02	0,02	0,00
10	0,00	0,00	0,00	0,00	0,00
11	0,03	0,01	0,01	0,00	0,01
12	0,09	0,02	0,01	0,01	0,04
13	0,14	0,07	0,01	0,05	0,11
14	0,14	0,14	0,04	0,10	0,14
15	0,17	0,18	0,06	0,19	0,16
16	0,17	0,23	0,11	0,19	0,19
17	0,20	0,24	0,21	0,29	0,24
18	0,04	0,10	0,47	0,13	0,13
19+	0,01	0,02	0,05	0,02	0,02

As a result of Latent Class Classification Analysis, youths were classified according to their way of cigarette obtaining. Then, youths' attitudes towards smoking of the five different classes were examined in this study. Thus, it was revealed that youths' attitudes towards smoking differ in different latent classes which were determined by using Latent Class Classification.

Gender and age distribution of youths who belong to five latent classes are given in Table 3. Youths' attitudes

toward smoking of five latent classes are given in Table 4.

Table 4. Attitudes towards smoking by latent classes

	Class 1 (16.8%)	Class 2 (14.7%)	Class 3 (3.0%)	Class 4 (8.5%)	Class 5 (57.0%)
SIM					
Yes	0.57	0.61	0.76	**0.84**	0.51
No	0.43	0.39	0.24	0.16	**0.49**
SID					
Yes	0.84	0.97	0.99	0.99	**0.99**
No	**0.16**	0.03	0.01	0.01	0.01
ISID					
Yes	0.46	0.38	0.68	**0.78**	0.27
No	0.54	0.62	0.32	0.22	**0.73**
YSDD					
Yes	0.63	0.69	0.87	**0.94**	0.51
No	0.37	0.31	0.13	0.06	**0.49**
EABT					
Yes	0.66	0.75	0.89	**0.94**	0.62
No	0.34	0.25	0.11	0.06	**0.38**
SDY					
Never	**0.16**	0.01	0.01	0.01	0.01
< 8	0.14	0.06	0.12	**0.17**	0.05
9	0.04	**0.05**	0.04	0.03	0.02
10	0.07	0.06	0.04	**0.09**	0.05
11	**0.08**	0.06	0.08	0.08	0.06
12	**0.13**	0.12	0.11	0.10	**0.13**
13	0.12	0.15	0.11	**0.18**	0.14
14	0.11	**0.20**	0.13	0.13	0.15
15	0.09	0.13	0.14	0.14	**0.15**
16	0.06	0.11	0.14	0.05	**0.15**
17	0.02	0.06	0.07	0.02	**0.07**
18	0.00	0.01	**0.03**	0.00	0.02
19	0.00	0.00	0.00	**0.00**	0.00
GIS					
1 or less	0.34	**0.57**	0.19	0.20	**0.76**
2-10	**0.53**	0.40	0.65	0.67	0.22
10+	0.13	0.03	0.16	0.13	0.02
MS					
Yes	0.43	0.43	0.53	0.50	0.37
No	0.44	0.44	0.42	0.40	0.45
Not sure	0.14	0.12	0.05	0.09	0.19
SBD					
Yes	**0.61**	**0.71**	0.62	0.55	**0.76**
No	0.39	0.29	0.38	**0.45**	0.24
SHD					
Yes	0.29	0.28	0.26	**0.31**	0.25
No	0.71	0.72	0.74	0.69	**0.75**
SA					
Yes	0.32	0.31	0.27	**0.40**	0.32
No	0.68	0.69	**0.73**	0.60	0.68
TUHT					
Yes	0.73	**0.82**	0.75	0.75	**0.82**
No	0.27	0.18	**0.25**	**0.25**	0.18

According to conditional probabilities, female students were mostly in 2nd latent class with 52% and male students are mostly in 3rd latent class with 70%. Similar to the study of Richard et al., the number of cigarettes smoked by men is more than the number of cigarettes smoked by women. [17] While youths' curious about smoking in 4th latent class is

84%, youths who were not curious about smoking are in 5th latent class with 49%. Student thinking about to quit smoking (56%) and students smoking more than 10 cigarettes per day (15%) located in the same latent class (3rd latent class).

DISCUSSION

As a result of the analysis, youths who are in 1st (Only bought myself) and 5th classes (Reaching cigarette other ways) are less curious about smoking rather than others. Furthermore, youths in 2nd (Someone else buy for me) and 5th (Reaching cigarette other ways) classes smoke 1 or less cigarette a day. 40% of youths in 4th (Use someone to buy cigarette) class smoke cigarettes to become social. According to the study of Higgins and Conner, [10] friends, daily life problems, curiosity and socioeconomic position are the risk factors to initiate smoking. Also Engels et al. revealed the main effect for the growth of smoking among young people was supposed that friendship relationship. [18] In this study, the importance of youths' friends and relationship with their friends about smoking was emphasized.

1st class is named as "Only bought myself". In this class, students are curious about smoking cigarettes. Youths think to smoke cigarette anytime during next year and do not agree with all tobacco products are dangerous. Thus, these students could be called potential smokers because they do not know the damages of smoking cigarette. Furthermore, if one of their friends offers a cigarette to them, they probably smoke it because they think smoking cigarettes make young people look cool or fit and they think young people who smoke cigarette have more friends. [19] On the other hand, they are seriously thinking about quitting cigarettes. Hence, seminars about damages of smoking could be given at schools in order to inform these students about damages of smoking.

1st and 2nd classes have similar characteristics but youths in 2nd class generally have higher possibility of curious about smoking cigarette. They will probably try a cigarette soon and may smoke if one of friends offered a cigarette. [20] Thus, similar actions could be taken into consideration for these youths who belong to 1st and 2nd classes.

3rd class is named as "Bought them for a person". We can say female students more likely tend to smoke cigarette than male student in this class. Among surveyed youths, those high smokers with more than 10 cigarette (active smoker students) seriously thinking about quitting cigarettes, and disagree with idea of young people who smoke cigarette have more friends.

4th and 5th classes are named as "Use someone to buy cigarette" and "Reaching cigarette other ways", respectively. While first group tends to smoke, the second group equally tends not to smoke. While 4th latent class consists of mainly female at age from 15 to 17, 5th latent class consists of mainly 14-year-old male students.

CONCLUSIONS

Since youths' attitudes towards smoking differ from the way of obtaining cigarettes, different action plans should be taken into consideration in order to reduce the total number of smokers. Also, youths in all classes are seriously thinking about quitting cigarettes. Thus, youths' relationship with their friends could be monitored by parents or teachers for youths in 2nd, 3rd and 4th Class. Because the information about damages of smoking and socializing habits are the factors that affect students' smoking habits, some seminars should be hold especially for youths in 1st and 2nd classes (they do not agree that smoking are dangerous).

Examining the relationship between purchasing attitude of cigarettes and youths' curiosity about smoking cigarette was investigated using the data of NYTS. We believe that this study could be a reference study for further research.

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