

Smoking Patterns Among Third Level Students: A latent class analysis

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Abstract

Introduction: The psychosocial framework of adolescent transformation period is characterised by risk-taking behaviours such as the use of psychoactive substances like tobacco. Smoking initiated at this stage may lead to a lifetime nicotine-addiction. This study aims to identify and describe a typology of smoking among third level student smokers according to their pattern of smoking and to inform the designing of effective interventions in tobacco use among students

Methods: Latent class analysis was used to characterise different smoking pattern among 361 third level students in an Irish university. The participants were enrolled in this cross-sectional study by inviting them to complete an online survey.

Results: Three groups were identified: (1) **Late-onset, Social smokers** (n=88, 41.3%). (2) **late-onset, light smokers** (n = 74, 34.4%). (3) **Early-onset, Nicotine addicts** (n = 52, 24.3%). The predominantly female **Late-onset, Social smokers** has a low probability of regular use of tobacco, a low number of lifetime cigarettes smoked and a high probability (83.0%) of initiating smoking in their adulthood. Nearly 100% of them had neither of the parents as smokers. The predominantly male **late-onset, light smokers** exhibits similar characteristics with the female-dominated class 1 but has consumed more of cigarettes in the lifetime relative to class 1. 33.8% of class 2 smokers had both parents as smokers; 42.0% had mothers and 33.8% reported their father was a smoker. 64.6% of this class reported their parents to smoke in the home and 54.3% initiated smoking in adulthood. Class 3 (**Early-onset, Nicotine addicts**) dominated by males has a higher probability of regular tobacco use and has smoked the largest number of cigarette in their lifetime compared to classes 1 and 2. The majority (60.0%) of those in this group had initiated smoking as a teenager. 14.9% had both parents as smokers; 10.6% had mothers who smoke and 20.6% reported their father was a smoker. 23.7% of this class reported their parents to smoke in the home.

Conclusion: This study reveals the cigarette smoking behaviours among students and can further inform interventions and strategies to achieving a tobacco-free Ireland.

Background

The period of adolescence is the time when most young adults try to explore the many possibilities in their environment. It is the period they try to prove they have reached the age of independence and autonomy by indulging in many risky behaviours [1], which is recognised as a psychosocial framework of adolescent transformation [2], [3]. Among these risk-taking behaviours include the use of substances like tobacco [2], [4]. The adolescent stage is a critical formation stage. Smoking commenced at this period may develop into a lifetime smoking habit due to nicotine additive effect [5], [6]. Early initiation of cigarette use increases the duration of lifetime exposure to tobacco and its associated adverse health effects [7], [8].

Parental smoking has more impact on a child's cognitive vulnerability to smoking compared to peer influence [9]–[11]. The observation of parental smoking habits may greatly influence early smoking

uptake in adolescents [12]. Various studies [13]–[16] have reported gender differences in the influence of parental smoking habits on adolescents' smoking uptake. Maternal smoking status is more likely to influence smoking uptake in females [13], [16], whereas paternal smoking has a stronger influence on males [15].

A decline in the trend of smoking among young adults in Ireland was reported [17] with the series of Public Health (Tobacco) policies such as age limit law under the Tobacco Act 2020. This act criminalised sales of tobacco products to a person below 18 years [18]. However, this is only a change in the mechanism of tobacco use – from conventional cigarette use to e-smoking [19]. E-smoking has been reported to have a similar level of toxicity as the conventional cigarette [20], [21]. A survey of young people across the 27 European Union countries reported that e-smoking is on the increase [22]. Current use of cigarette is a major predictor of e-cigarette use among young adults [23], [24]. Majority of tobacco users believed e-smoking to be safer than conventional cigarette smoking and has the potential to aid smoking cessation [25]–[27]. The safety and the probability of e-cigarette to aiding smoking cessation are inconsistent [28]–[32]. Findings from various studies [33]–[35] reported the possibility of transition of e-cigarette users to conventional cigarette smokers. In a French study [1], lower cost of e-cigarette and permissibility of its use in places where conventional cigarettes are not allowed were among the reasons given by participants for e-cigarette use. Thus, an e-cigarette may undermine the aim of Public Health (Tobacco) policies by renormalizing smoking in public places and its lower cost compared to the conventional cigarette [1], [23].

Recently, audience segmentation strategies have successfully been utilized in public health to identify various health-risk behaviours and lifestyles such as psychoactive substance-related uses and behaviours [36], [37]. This study aims to identify and describe a typology of smoking among third level student smokers according to their pattern of smoking and to inform the designing of effective interventions in tobacco use among students.

Methods

This is a cross-sectional online study of undergraduate students at the University College Cork. This study focused on the pattern of cigarette smoking among college students and how parental smoking habit and access to cigarette influenced this pattern.

Participants

Undergraduate students attending the University College Cork in the 2018/2019 academic year were included in the study. The student population in 2018 was 15,454 [38]

Data collection

A validated and self-assessment questionnaire on parental and adolescent smoking adapted from a similar study that surveyed students in New Zealand [16] was distributed to students via e-mail in June

2019. Lime Survey was used to facilitate data collection. The central information technology department aided in the distribution of the survey to all undergraduate students. The e-mail briefed students on the aims and objectives of the study and included a link to the survey. The survey opened to an information sheet detailing the confidentiality, anonymous and voluntary nature of the study. To enhance the response rate, a reminder was sent to students one week after the initial survey distribution. The link to the survey was deactivated after 14 days. Listwise technique of handling missing data [39] was employed.

Data Analysis

Data were downloaded to Excel and exported to SPSS, cleaned and coded. Latent class models were conducted to identify patterns of cigarette smoking use using R software. Multinomial logistic regressions (with gender as a covariate) of the latent classes were performed using poLCA package in R to determine class membership.

The Bayesian Information Criterion (BIC), the Akaike Information Criterion (AIC) and the maximum log-likelihood value were used to assess the model fit. The model-class with the best class homogeneity and latent class separation [40] based on their posterior probability of class membership was then selected. Three variables: 1) smoking frequency; 2) life-time number of cigarettes smoked; 3) age initiated smoking were used during latent class analysis (LCA) modelling.

Ethical Considerations

There were no anticipated ethical issues. Students were requested to indicate that they were over 18 years of age. Participants consented to participate by electronically completing the consent form before commencing the survey. No personal identifiers were collected therefore there were no confidentiality issues. Ethical approval was obtained from the Social Research Ethics Committee, School of Public Health, University College Cork.

Participants were informed that participation was voluntary, and they could withdraw at any time with no consequences.

Results

A total of 361 students responded, giving a response rate of 2.3%. Of these respondents, 256 were females and 105 were males. Majority of the participants (60.4%, $n = 218$) aged 22 years and above. 36.6% ($n = 132$) were aged 20–21 years and 3.0% ($n = 11$) aged 18–19 years. 215 students (Females, 144; males, 71) identified as smokers. Female students (43.9%, $n = 112$) were significantly ($p = 0.04$) more likely to report a negative smoking status compared to male students (32.4%, $n = 34$). Table 1 shows the range of variable responses students who reported positive smoking status by gender.

Table 1
Student (smokers) responses by gender

Variables Responses	Total (smokers) N = 215 No. (%)	Females N = 144 No. (%)	Males N = 71 No. (%)	P-values
*Smoking frequency				0.05
■ At least, once a day	41 (18.1)	22 (14.4)	19 (25.7)	
■ At least, once a week	16 (7.0)	8 (5.2)	8 (10.8)	
■ At least, once a month	23 (10.1)	17 (11.1)	6 (8.1)	
■ Less often than once a month	147 (64.8)	106 (69.3)	41 (55.4)	
**Age Initiated smoking				0.673
■ Below 18 years	73 (38.6)	50 (39.7)	23 (36.5)	
■ Above 18 years	116 (61.4)	76 (60.3)	40 (63.5)	
**Cigarette source	77 (37.6)	47 (34.3)	30 (44.1)	0.268
■ Self	4 (2.0)	2 (1.5)	2 (2.9)	
■ Parents/Siblings	124 (60.5)	88 (64.2)	36 (52.9)	
■ Friends/some else				
**Lifetime number of Cigarette smoked				0.012
■ 1–2 puffs	29 (13.2)	20 (13.5)	9 (12.5)	
■ 2–10 puffs	36 (16.4)	30 (20.3)	6 (8.3)	
■ 10–50 puffs	41 (18.6)	32 (21.6)	9 (12.5)	
■ More than 50 puffs	114 (51.8)	66 (44.6)	40 (66.7)	

* Variables added up above the total N because smoking experimenters may have regarded themselves as non-smokers

**Variables did not add up to the total N because of missing values

A three-class model was considered the best fit based on the model fit indices (AIC and BIC) and application of the principle of latent class separation and homogeneity. Table 2 shows the details of the model fit indices of the classes

Variables Responses	Total (smokers) N = 215 No. (%)	Females N = 144 No. (%)	Males N = 71 No. (%)	P-values
**Parental smoking status				0.775
■ Both	32 (15.2)	21 (14.8)	16 (16.2)	
■ Father	29 (13.8)	21 (14.8)	8 (11.8)	
■ Mother	27 (12.9)	20 (14.7)	7 (10.3)	
■ None	122 (58.1)	80 (56.3)	42 (61.8)	
** Parents smoke at home				0.058
■ No	143 (68.4)	91 (64.1)	52 (77.6)	
■ Sometimes	13 (6.2)	8 (5.6)	5 (7.5)	
■ Yes	53 (25.4)	43 (30.3)	10 (14.9)	
* Variables added up above the total N because smoking experimenters may have regarded themselves as non-smokers				
**Variables did not add up to the total N because of missing values				
A three-class model was considered the best fit based on the model fit indices (AIC and BIC) and application of the principle of latent class separation and homogeneity. Table 2 shows the details of the model fit indices of the classes				

Table 2
Latent class analysis of the smoking typology of students

Model Class	AIC*	BIC**	(X ²) Chi-square goodness of fit	Maximum log-likelihood
2 classes	1903.643	1849.114	1280.424	-909.8217
3 classes	1849.114	2054.463	584.7915	-860.5568
4 classes	1969.812	2244.406	614.2618	-898.9059
5 classes	2182.732	2527.572	1829.542	-983.3661
*AIC, Akaike Information Criterion;				
**BIC, Bayesian Information Criterion. The best-fit model is indicated in bold.				

The 2-class model has the lowest BIC model fit index while the 3-class model has the lowest AIC model fit index. Both the 2-class model and 3-class model has similar latent class homogeneity. Though the 2-class model has a higher latent class separation than the 3-class, the parsimonious 3-class model was selected over the 2-class model due to a lower AIC and better maximum log-likelihood. Using item-response probabilities, we interpreted the 3 classes distinct (Table 3) as 'late-onset, social smokers' (class

1), 'late-onset, light smokers' (class 2) and early-onset, nicotine addicts (class 3). Table 4 represents the table of prediction of latent class membership with gender as covariates.

Table 3
Item response probabilities for a 3-class model of students' smoking typology

Variables	<i>Late-onset, Social smokers</i>	<i>Late-onset, light smokers</i>	<i>Early-onset, nicotine addicts</i>
Smoking Frequency			
• Less often than once a month	0.80	0.81	0.15
• At least, once a month	0.17	0.13	0.05
• At least, once a week	0.03	0.06	0.17
• Daily	0.00	0.00	0.63
Life-time Number of Cigarettes Smoked			
• 1–2 puffs	0.20	0.05	0.00
• 2–10 puffs	0.22	0.18	0.00
• 10–50 puffs	0.28	0.34	0.00
• more than 50 puffs	0.31	0.42	1.00
Age Initiated Smoking			
• Before 18 years	0.16	0.43	0.60
• After 18 years	0.84	0.57	0.40
n (% of samples)	88 (41.3)	52 (24.3)	74 (34.4)

Table 4
Latent class membership prediction with gender as covariates

2/1	Coefficient	Standard error	t-value	Pr(> t)
Intercept	0.2357	0.71401	0.330	0.742
Gender (female)	-0.61815	0.56636	-1.091	0.277
3/1	Coefficient	Standard error	t-value	Pr(> t)
Intercept	-0.5542	1.3003	-0.426	0.084
Gender (female)	-0.0337	0.9612	-0.035	0.116

Overall, females are more likely to be 'late-onset, social smokers' (class 1) while the males are more likely to be 'late-onset, light smokers' (class 2) and 'early-onset, addicted smokers' (class 3). Females have

46.0% lesser odds of being in class 2 and 3.4% lesser odds of being in class 3 compared to the males.

Class 1: Late-onset, Social smokers

This class (n = 88, 41.3%) was considered social smokers because of the low probability of regular use of tobacco and a low number of lifetime cigarettes smoked. More than 83% of students that belong to this class had initiated smoking in their adulthood. Nearly 100% of them had neither of the parents as smokers. Regarding the source of cigarettes, 90% get from friends and peers and 10% purchase the cigarettes themselves.

Class 2: late-onset, light smokers

This class (n = 74, 34.4%) was considered moderate smokers because of the low probability of regular tobacco use and a higher probability of smoking more cigarettes in their lifetime compared to class 1. A majority (54.3%) of those in this group had initiated smoking in their adulthood. 33.8% had both parents as smokers; 42.0% had mothers who smoke and 33.8% reported their father was a smoker. 64.6% of this class reported their parents to smoke in the home. Regarding the source of cigarettes, 73.8% get from friends and peers; 24.0% buy themselves and 2% from parents/elder siblings.

Class 3: Early-onset, Nicotine addicts

This class (n = 52, 24.3%) were considered addicted smokers because of a higher probability of regular tobacco use and has smoked the largest number of cigarette in their lifetime (100% of them) compared to classes 1 and 2. The majority (60.0%) of those in this group had initiated smoking as a teenager. 14.9% had both parents as smokers; 10.6% had mothers who smoke and 20.6% reported their father was a smoker. 23.7% of this class reported their parents to smoke in the home. Regarding the source of cigarettes, 10.9% get from friends and peers; 87.5% buy themselves and 2% from parents/elder siblings.

Discussion

The psychosocial framework of adolescent transformation period is characterised by risk-taking behaviours such as the use of psychoactive substances like tobacco [1]–[4]. Smoking initiated at this stage may lead to a lifetime nicotine-addiction [5], [6]. Latent class analysis (LCA) identifies and segments a population into distinct groups based on similar behavioural profiles and responses by allowing multiple-dependent variables to be investigated together [41], [42].

This study identified a typology of cigarette smoking among male and female students. Female students have a higher odd of belonging to late-onset, social smokers (class 1) while male students have a higher odd of belonging to late-onset, light smokers (class 2) and early-onset, nicotine addict class (class 3). This study is in tandem with previous studies [43], [44] which reported a segment of female smokers who are late-onset and non-addicted smokers, have a college education and smoked for socialization. Contrary to our finding that majority of social smokers (88.9%) get their cigarette from friends and peers, Rose et al. [44] reported that such females had fewer friends who smoked cigarettes. A very recent study

[45] carried out among university students in Turkey reported that most female and male students have a very low level of addiction. Our study identified a male-dominated late-onset, light smoker class (class 2) which exhibited similar characteristics with the female-dominated class 1 but has consumed more of cigarettes in the lifetime relative to class 1. Peer influence, curiosity and stress adaptation were among the reasons for smoking initiation among these groups of smokers [45], [46].

Nicotine-addiction is not yet the primary motive of the female-dominated class 1 and the male-dominated class 1 which consisted of 41.3% and 34.4% of the smokers in the study population. Smokers in this group have a high potential of quitting smoking with appropriate intervention uniquely tailored to these groups [43], [44] like interventions focused on common stressors encountered by third-level students. Majority of those in these groups who continued to smoke metamorphoses into heavy smokers [44]. In line with a study [45] that reported that the males generally display a higher level of cigarette-addiction compared to the females, the early-onset, nicotine-addicted class 3 was male-dominated. The fact that this class 3 consisted of a fewer number of the study population ($n = 52$, 24.3%) further corresponds with the findings of the previous study [45] which revealed that the segment of student smokers who are nicotine-addicts are smaller compared to non-addicted smokers.

Strength And Weakness

The use of an electronic survey in data collection in this study is preferred to other methods of data collection in research because of its higher capability in assessing a greater number of audiences compared to the traditional paper-based survey [47]. Secondly, our study is a snapshot in time and not affected by sample attrition [48].

There are some limitations to this study. This data included students from a single Irish university and thus limits the extrapolation of the findings to students in other tertiary institutions and outside Ireland. Assessing students' smoking habits using self-reported data is prone to information bias. This ratio of female to male respondents in this study is two to five (females, 70.9%; males, 29.1%). An approximately equal gender distribution (females, 58%; males, 42%) was reported at UCC academic year 2015/2016 [49]. A study with a more representative of the students' demographic is needed. Furthermore, this study included gender as a covariate. Other sociodemographic factors may be important in determining class memberships of students. Finally, because data used in this study was not collected specifically for determining smoking typologies of students and no data collected on whether the respondents use E-cigarette or the conventional cigarette, future researches may benefit from including more variables that may influence students' smoking behaviours and lifestyle.

Conclusion

Majority of the smokers in the study population (75.7%) consist of the nicotine non-addicted classes 1 (41.3%) and 2 (34.4%). Public policies and intervention programs focused on preventing these groups of students from upgrading to heavy smoking will be a great feat to achieving a tobacco-free Ireland.

Availability of data and materials

The dataset analysed during the current study is available at <https://1drv.ms/x/s!AhmtKfmmamW2kHJkruq-sxch9ld?e=4iwmh9>

Abbreviations

AIC
Akaike Information Criterion
BIC
Bayesian Information Criterion
LCA
Latent Class Analysis
SPSS
Statistical Package for the Social Sciences

Declarations

Availability of data and materials

The dataset analysed during the current study is available at <https://1drv.ms/x/s!AhmtKfmmamW2kHJkruq-sxch9ld?e=4iwmh9>

Competing interest

The authors declare that they have no competing interests

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Author's contributions

AMR collected the data and edited the manuscript. TKI analysed and interpreted the participants' data and is the major contributor in writing the manuscript. All authors have read and approved the manuscript.

Consent for publication

Not applicable

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