



Quantification of the influence of friends and antisocial behaviour in adolescent consumption of cannabis using the ZINB model and data mining

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ABSTRACT

Cannabis is the most consumed illegal drug in Europe and its repercussions are more important when taken up at an early age. The aim of this study is to analyse and quantify the predictive value of different personal, family and environmental variables on the consumption of cannabis in adolescence. The sample is made up of 9284 adolescents (47.1% boys and 52.9% girls) with an average age of 15.59 years ($SE = 1.17$). The ZINB model highlights, as factors that increase the number of joints consumed per week, consumption by the peer group, nights out during the week, gender, the production of forbidden behaviour and the use of other substances, whereas the risk factors for the consumption of cannabis are consumption by friends, ease of access, production of forbidden behaviour and the use of other substances. Association rules highlight the relationship between cannabis consumption, ease of access, production of forbidden behaviour and tobacco consumption. Finally, decision trees enable us to predict cannabis consumption as well as the number of joints an adolescent will consume per week based on the production of forbidden behaviour, consumption of other substances and number of friends who consume cannabis. The results of this work have practical implications concerning the prevention of cannabis consumption in an adolescent population.

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1. Introduction

Cannabis is the most consumed illegal drug in Europe and is the one that people begin to consume at the earliest age (European Monitoring Centre for Drugs and Drug Addition, 2008). The repercussions of the use of this substance have been well described and its effects are even more important when consumption is initiated in adolescence, involving deteriorated academic performance, consequences in long term social adaptation and greater odds of using other illegal drugs (Broman, 2009; Brook, Stimmel, Zhang, & Brook, 2008; Fergusson & Boden, 2008a,b; Georgiades & Boyle, 2007; Hall, 2009; Jeynes, 2002; Lessem et al., 2006; Zimmerman et al., 2005).

The main aims of prevention are not only to decrease the prevalence of consumption, but also to reduce the quantity of consumption among consumers and, in order to achieve this, it is necessary to identify the risk factors that lead to greater consumption among adolescents who have already taken up consumption. In this sense, many studies have insisted on the existence of different variables related with the family environment as risk and protection factors involved in drug consumption by adolescents (Fernández, Secades, Vallejo, & Errasti, 2003; Olsson et al., 2003). Thus, how fathers/mothers bring up their children, together

with the type and degree of monitoring exercised by parents, directly influence vulnerability to consumption, in the sense that adolescents who perceive less parental monitoring will have greater odds of consuming addictive substances (Adalbjarnardottir & Hafsteinsson, 2001; Barrett & Turner, 2006; DiClemente et al., 2001). Nevertheless, the relationship between parental practices and the use of substances seems to be mediated by the number of friends who are consumers (Simons-Morton, 2007). Indeed, one of the explanatory variables that stands out due to its influence on drug consumption in adolescence is the use of these same drugs by the peer group (Ciairano, Bosma, Miceli, & Settani, 2008; Dick et al., 2007; Kokkevi, Richardson, Florescu, Kuzman, & Stergar, 2007; Kuntsche & Delgrande, 2006). Furthermore, certain personality factors, such as antisocial behaviour, thrill seeking or impulsivity have been related to the use of addictive substances at this age of development (Fergusson, Horwood, & Ridder, 2007; Fothergill, Ensminger, Green, Robertson, & Juon, 2009; Franken, Muris, & Georgieva, 2006; Grant et al., 2010; Hayatbakhsh et al., 2008; Wong et al., 2006). On the other hand, since Kandel posed the gateway theory (Kandel, 1975), that is, that the use of certain addictive substances like alcohol or tobacco exerts a causal influence on the use of other drugs like cannabis (Kandel, 2003), several studies have found a relationship between the use of cannabis and the consumption of other substances such as tobacco or alcohol (Agrawal, Silberg, Lynskey, Maes, & Eaves, 2010; Korhonen et al., 2010; Pérez, Ariza, Sánchez-Martínez, & Nebot, 2010).

The relationship between the aforementioned risk factors and the consumption of substances such as cannabis has been analysed in

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several works in terms of a statistically significant relationship, odds of consumption or explained variability, but few studies have measured the power of these variables to increase or decrease, in quantitative terms, the number of joints consumed a week. In this sense, the appropriate model for analysing count data is the Poisson regression model (Long, 1997). Besides, there are even fewer studies which try to explain these relationships using tools that can provide new perspectives which go beyond traditional data analysis techniques. In this context, *Data Mining* technology, defined as the extraction of useful information from large databases, contains relatively little used tools to date which can be used to exploit information concerning substance consumption. Two popular examples of some descriptive and predictive tools included in this methodology are, respectively, association rules and decision trees (see Han & Kamber, 2006; Kantardzic, 2003; Larose, 2005, 2006; Witten & Frank, 2005; Ye, 2003).

The aim of this study is to analyse the predictive value of different personal, family and environmental variables on the consumption of cannabis in an adolescent population using appropriate modelling techniques and descriptive and predictive *Data Mining* tools capable of extracting interesting relationships from the data.

2. Material and method

2.1. Participants

Random sampling by conglomerates was conducted of schools in the island of Mallorca, and 47 schools out of a total of 122 were chosen. All of the selected subjects provided responses on the analysed variables. The total sample was made up of 9300 students aged between 14 and 18 years. After eliminating the unreliable answers of some adolescents, the useful sample was made up of 9284 adolescents (47.1% boys and 52.9% girls) with an average age of 15.59 years (SE = 1.17).

It is worth noting that the sample size represented 41.16% of the population size it was extracted from (N = 22,593).

2.2. Procedure

The adolescents anonymously answered a questionnaire which asked about the frequency of use of different addictive substances as well as a series of psychosocial variables.

In this work the data are analysed using statistical modelling of count data (Stata 10.0 program), association rules (R program, version 2.10.1) and decision trees (SPSS 15.0 program).

2.3. Variables

As well as gender and age, consumption by friends, ease of access to the substance, certain ways parents bring up their children, nights out during the week and at weekends, alcohol and tobacco consumption and some personality factors, were also taken into account.

Cannabis consumption by the peer group is a categorical variable, represented in the model by the variables codified as *friend1* ("all friends consume cannabis"), *friend2* ("most friends consume cannabis"), *friend3* ("half of the friends consume cannabis") and *friend4* ("few friends consume cannabis") with a reference category "no friends consume cannabis".

Regarding the way parents bring up children, 4 of the parents' behaviours are analysed, which the adolescents had to assess using the categories "always", "sometimes" and "never": parental monitoring, spending time with the adolescent, doing things together, and being at home. Thus, for instance, the father's monitoring is a categorical variable, represented in the model by the binary variables codified *ep1p1* (father always monitors) and *ep1p2* (father sometimes monitors)

with a reference category "father never monitors". The other family variables are analysed in the same way for the father and mother.

Information on personality is included in the model through 20 binary personality items that refer to self-esteem (i.e., "I am satisfied with myself"), impulsivity (i.e., "I usually rush"), thrill seeking (i.e., "I enjoy activities that involve risk") and antisocial behaviour (i.e., "I burn or damage other's people property"). Ease of access and gender are also binary variables (gender is codified as 0 = boy and 1 = girl).

The data concerning the number of nights an adolescent goes out (during the week and at weekends) is introduced through two quantitative variables. Alcohol and tobacco consumptions are analysed using two quantitative variables: number of Standard Drink Units (SDU) taken a week and number of cigarettes smoked per week. Students had to specify the number of cups of distilled and fermented alcohol consumed per week. Subsequently, these units were converted into SDU. The number of SDU consumed per week is one of the most used measurements to record alcohol consumption which counts the quantity of alcohol ingested by a person. In Spain, the standard value of SDU is 10 g of pure alcohol. Finally, age is introduced by a quantitative variable.

The dependent variable is the number of joints consumed a week.

With the aim of organizing the variables that predict cannabis consumption in adolescence, a decision tree is calculated, which, from the aforementioned variables, classifies the subject as a consumer or non consumer. Moreover, another tree to predict the number of joints consumed a week is also obtained.

In order to obtain the association rules, only the categorical variables are used.

3. Results

First of all, the prevalence of cannabis consumption in the sample is shown (Table 1).

Due to the low frequency of cannabis consumption in the sample, and with the aim of being able to predict both cannabis consumption and lack of consumption, a sample equalling cannabis consumption was constructed. In this way, all the adolescents who reported consuming cannabis were selected (n = 1638) and, from the remaining non consumers, a random sample of adolescents who did not consume cannabis was chosen (N = 1638).

As already mentioned, the Poisson regression model (PRM) is the appropriate model for analysing count data (Long, 1997) and was therefore used to measure the influence of the risk factors on the number of joints consumed a week. One of the basic assumptions of the PRM is that of equidispersion, which can be evaluated using the regression test proposed by Cameron and Trivedi (1990). After confirming the failure of this assumption, the models called *Negative Binomial Regression Model* (NBRM), *Zero Inflated Poisson* (ZIP) and *Zero Inflated Negative Binomial* (ZINB) were compared, and the ZINB model was observed to best fit the data (Greene, 1994; Lambert, 1992; Mullahy, 1986). The statistically significant variables are given in Table 2. The percentages that appear in this table provide information as

Table 1
Prevalence of adolescent consumers of cannabis in the sample (n = 9284).

Current consumption of cannabis	N	%
I have never consumed	5599	63.0
I have tried it a couple of times	1259	14.2
I used to, not any more	389	4.4
Occasionally	673	7.6
At weekends	404	4.5
During the week	215	2.4
Daily	346	3.9

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