



Behavioral problems and the occurrence of tobacco, cannabis, and coca paste smoking in Chile: Evidence based on multivariate response models for school survey data

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ABSTRACT

Background: In this study we estimate suspected links between youthful behavioral problems and smoking of tobacco, cannabis, and coca paste.

Methods: In the Republic of Chile, school-attending youths were sampled from all 13 regions of the country, with sample size of 46,907 youths from 8th to 12th grades. A Generalized Estimating Equations (GEE) approach to multiple logistic regression was used to address three interdependent response variables, tobacco smoking, cannabis smoking, and coca paste smoking, and to estimate associations.

Results: Drug-specific adjusted slope estimates indicate that youths at the highest levels of behavioral problems are an estimated 1.1 times more likely to have started smoking tobacco, an estimated 1.6 times more likely to have started cannabis smoking, and an estimated 2.0 times more likely to have started coca paste smoking, as compared to youths at the lowest level of behavioral problems ($p < 0.001$).

Conclusion: In Chile, there is an association linking behavioral problems with onsets of smoking tobacco and cannabis, as well as coca paste; strength of association is modestly greater for coca paste smoking.

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1. Introduction

The primary goal of this study is to investigate possible causal links between behavioral problems and onsets of drug-smoking behavior among school-age youths in Chile, a South American democracy with land mass of slightly more than 750,000 km², stretching southward from roughly 18° latitude (South of the equator) to roughly 55°, and with a population of 16–17 million by recent census. Smoking of tobacco and cannabis are covered in this report, but a special focus is inhalation of the fumes from coca paste (hereinafter termed ‘coca paste smoking’). Coca paste smoking is noteworthy, in part due to associated toxicity, but also because there is little coca leaf cultivation or production of coca paste or cocaine in Chile. The nearby sources of coca leaf products primarily are plantations in Bolivia and Peru.

Just three or four decades ago, the illegal market for cocaine in Chile was quite small, even during peak years of the North Amer-

ican cocaine epidemic, 1976–1986, as gauged by estimated annual incidence of new cocaine users. Nonetheless, by the closing years of the last century, Chile had experienced increased numbers of coca paste smokers and cocaine hydrochloride powder users (hereinafter, ‘cocaine’), as reported by Fuentealba and colleagues (2000), whose prevalence estimates provide context for the present study. In specific, the Fuentealba research team drew and assessed community samples in Chile during 1998. Among Chilean community residents aged 12 years and older, they found that an estimated 71–72% had smoked tobacco, 17–18% had smoked cannabis, 4% had taken cocaine, and 2–3% had smoked coca paste, with a general male excess in drug experience as well as age-of-onset distributions consistent with earlier onsets of tobacco and cannabis smoking, and with later onsets of coca paste and cocaine (Fuentealba et al., 2000).

Whereas the Fuentealba survey was focused upon descriptive estimation of prevalence for all ages past the childhood years, and upon basic comparisons of prevalence in population subgroups (e.g., male–female, socioeconomic status), this study’s data are from epidemiological surveys based upon nationally representative samples of school-attending youths in Chile. Here, the starting point is a specific hypothesis about early behavioral or conduct

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problems that elsewhere have been observed to be sturdy predictors of later drug involvement (e.g., Robins, 1978). The underlying conceptual model is one in which inhalation of a drug product after combustion–oxidation (i.e., ‘smoking’) is a learned behavior that can be distinguished from other forms of drug self-administration (e.g., oral, injecting, inhalation of volatile solvents without combustion). This conceptual model is required in the cross-national and cross-cultural research context, due to observed ethnic variations in preference for administration routes (e.g., see Reeler, 2000; Marshall et al., 2001).

Here, our research group seeks to understand suspected causal determinants of starting to smoke three drugs: tobacco, cannabis, and coca paste, with particular focus on the latter, about which there is very little published epidemiological evidence. Health risks associated with coca paste smoking are compounded by contaminants such as kerosene and solvents used to extract cocaine from its original plant matrix (e.g., see Montoya and Chilcoat, 1996).

Robins (1978), among others, placed emphasis upon early-onset deviant conduct or behavior problems in predictive models for illegal drug involvement. Kellam et al. (1980) theorized and presented longitudinal evidence that early onsets of tobacco and alcohol consumption might be influenced by early behavior problems as well, especially among males. In multivariate research, a problem behavior syndrome often has been specified as a key explanatory variable in observed co-variation of drug taking with other problem behaviors (e.g., see Jessor et al., 1998). Nonetheless, evidence on this topic largely is from United States (US); evidence from less-established market economies is quite limited, even with respect to the most basic descriptive statistics on illegal drug use in the community (e.g., see Degenhardt et al., 2008).

In order to fill this gap in evidence, our research group previously has described modest but statistically robust associations that link higher levels of behavior problems (BP) with greater occurrence of tobacco smoking among youths in the Dominican Republic and six Central American countries (Vittetoe et al., 2002) and in Chile as well (Caris et al., 2003). For the current investigation, the approach is one that encompasses the previously observed association between behavior problems and tobacco smoking, along with suspected causal associations linking behavior problems with cannabis smoking and coca paste smoking. Moreover, the approach takes into account statistical interdependencies that must be confronted when these three smoking behaviors are studied all at once. Described succinctly, with three interdependent response variables, the approach requires a truly multivariate response model (i.e., multiple y -variables in the equations), and the interdependencies are addressed using the generalized estimating equations (hereinafter, ‘MRM/GEE’). When the goal is to derive population-averaged slope estimates for multiple binary response variables, the MRM/GEE approach is more appropriate than an alternative structural equations model (SEM) approach. For example, the MRM/GEE approach involves statistical assumptions that are not as constraining as the assumptions required for the SEM approach (e.g., see Diggle et al., 1994). Here, the MRM/GEE are used to express the cumulative occurrence of starting to use each of these drugs for the first time (against a background of no prior use) as a function of the level of behavioral problems (BP); two conceptual models are in mind. To begin, we posit a model with a single common slope that links BP level to onset of smoking these three drugs, and this parsimonious model asserts that starting to smoke each drug is an observable manifestation of a single drug-involvement construct. The second model is more complex, and treats starting to smoke each drug – tobacco, cannabis, and coca paste – as if each involves a separate but interlinked construct, such that the association between behavioral problems and coca paste smoking should be stronger than the association linking behavioral problems to onset of cannabis smoking, which in turn should

be stronger than the association linking behavioral problems to onset of tobacco smoking. While the common-slope model is a simpler explanation for the observed patterns, the more complex multiple-slope model actually might be the more plausible model, because it takes into account a hypothesized selection process wherein youths with greater levels of socially deviant behaviors (evaluated based on the severity and frequency of conduct norm violations) might progress to the more deviant forms of smoking (evaluated from the standpoint of rarity of the drug’s use and availability).

In order to retain clarity in our analysis, we have limited our focus to the use of three drugs, all plant-based and all used via inhalation of fumes after combustion–oxidation: coca paste, as well as cannabis/marijuana and tobacco. That is, we hold smoking as a constant. We do not incorporate evidence on other more or less prevalent forms of drug use, such as drinking of alcoholic beverages, glue-sniffing, ingestion of sedative or hypnotic drugs in pill or tablet form, or drug injection. We cannot claim that this research is the first study on illegal drug involvement in Chile, and there are prior studies that report estimates of prevalence of drug-taking among Chilean youths (e.g., see Valdivia et al., 2004), and in the more general community populations of Chile (e.g., see Fuentealba et al., 2000). Nonetheless, this research can be distinguished by its focus upon a specific hypothesis about behavioral problems that might influence the occurrence of drug involvement, as well as its truly multivariate approach to three interdependent response variables: tobacco smoking, cannabis smoking, and coca paste smoking.

2. Methods

The data under study were collected during epidemiological surveys conducted in Chile in 1999, for which the first author (Luis Caris) was principal investigator. Sample selection was via probability sampling at four levels: the type of school (e.g., public, semi-private, private), the individual school chosen, the grade level, and the students themselves within grade, school, and type. Each selection yielded up to 20 students from each school and grade level, with the number proportional to the school’s size. The sampling process was one in which more than 500 private, semi-private, and public schools were selected according a stratified design that sampled from among 7974 schools ($N=721,989$ students in grades 8–12) within the most populous areas of all 13 regions of Chile, in accord with the students’ proportional distributions by area and type of school. All but five sampled schools participated. After sampling of schools, grades, and classrooms, the total sample size was 46,907 school-attending youths aged 12–20 years old. Selected characteristics of the survey respondents are given in Table 1. Approximated by the standard approach of taking the product of school-level and respondent-level participation, the overall survey participation level was 97%.

Survey assessments were guided by a protocol for anonymous classroom survey questionnaires, with trained assessors in charge of the classroom session. Beforehand, parents received an informative letter and were allowed either to decline or to permit ‘tacit’ consent for participation of the child. This study was supported by the Ministry of Education, Ministry of Health, and was approved by the ethical committee of the University of Chile.

Assessment of drug involvement (DI) was nested within a more general survey of health, mental health, and behavior that included a standardized six-item assessment of behavioral problems described elsewhere (Caris et al., 2003). The behavioral problems (BP) assessment module included true/false questions focused on a recent interval prior to assessment as expressed in these items, each of which refers to the six months prior to the assessment: “Have you threatened to hurt people?”, “Have you ever teased or done harmful things to animals?”, “Do you swear or use dirty language a lot?”, “Do you tease others a lot?”, “Have you taken advantage of other people?”, and “Do you do risky or dangerous things a lot?”. These items are from a Spanish-language adaptation of the Drug Use Screening Inventory (DUSI) described by Tarter and Hegedus (1991), with the latent construct derived from MPlus latent trait models for dichotomous items (Muthén and Muthén, 2000) with acceptable psychometric properties (Cronbach’s $\alpha=0.6$), as described elsewhere (e.g., see Vittetoe et al., 2002; Caris et al., 2003).

Standardized items on age of first smoking each drug were administered later during the survey session, separated from the BP assessment module by roughly 8–10 min of items on other topics. Neither assessors nor youths were told that the BP-DI association was of interest. During the DUSI-based assessment of drug involvement, via standardized and pre-written questions on the self-report survey form, each youth was asked to write down the age at first use of each of the drug compounds under study (tobacco, cannabis, coca paste), as well as other drug compounds

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