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Multiple substance use patterns in adolescents—A multilevel latent class analysis



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ABSTRACT

Background: Multiple substance use among adolescents is associated with a number of negative consequences. Therefore, we aim to investigate multiple substance use patterns among young adolescents and identify possible multilevel predictors.

Methods: We analyzed a longitudinal sample of 2490 German students (51% male; $M_{age} = 13.32$, $SD = 0.57$) at 45 schools in four German states (Bremen, Hesse, North Rhine–Westphalia, Schleswig–Holstein), who completed two assessments in fall, 2010 and fall, 2013. We conducted multilevel latent class analysis for follow-up data on a variety of outcomes, and tested our final 3-class-model for possible baseline predictors. Follow-up substance use measures included lifetime use, current use, and amount of substance for cigarettes and alcohol. Baseline covariates comprised age, gender, socio-economic status, bullying, victimization, peer and parental use, type of school, and health certification of school.

Results: We identified three latent classes: non-users ($n = 1541$; 61.9%), experimenters ($n = 722$; 29.0%), and multiusers ($n = 227$; 9.1%). Experimental consumption was predicted by higher baseline age ($OR = 1.71$; 1.31–2.24), paternal drinking ($OR = 2.89$; 1.23–6.79), and school type ($OR = 2.57$; 1.83–3.61), while multiuse was predicted by peer smoking ($OR = 2.94$; 1.80–4.80) and drinking ($OR = 2.13$; 1.32–3.44), maternal drinking ($OR = 6.26$; 2.02–19.43), bullying ($OR = 1.69$; 1.15–2.48), higher age ($OR = 1.92$; 1.40–2.62), and school type ($OR = 4.76$; 2.75–8.24) compared to the non-users class.

Conclusions: Prevention and further research on multiple substance use need to concentrate on social influence models and behavior-related interventions, especially at schools without a college-preparatory track.

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1. Introduction

Substance use among adolescents is a serious issue, as it is often connected to social, financial, and health problems (World Health Organisation, 2014). Research shows that use of multiple substances is associated with even higher risks and worse consequences than single substance use (Kelly et al., 2015; Kokkevi et al., 2014), e.g., multiusers are more likely to fail at school (Kelly et al., 2015) than non-users or single substance users. In addition, according to the gateway hypothesis, excessive alcohol or tobacco use fulfills a gateway function for illicit drug use (Kandel et al., 1992), more recent studies prove an increased chance for such a pathway, if multiple substances are used (Maldonado-Molina and Lanza, 2010). However, most studies on adolescent substance use focus on one-dimensional outcomes, e.g., smoker versus non-smoker, or

frequent versus infrequent use, and thus neglect more complex use patterns. Even when multiple substances are accounted for, indicators for each substance are seldom combined in a methodologically sophisticated way, but rather analyzed via simple contingency tables, which makes consecutive testing very difficult due to low cell frequencies (Choquet et al., 2004). In recent years, latent class analysis (LCA) has emerged as a more popular way of empirically identifying ecologically valid substance use patterns among adolescents, and additionally allowing for predictors of class membership (Lanza and Rhoades, 2013).

Latent classes refer to homogenous subgroups among participants with similar response patterns. LCA is usually used iteratively, until the best empirical solution, i.e. number of classes is determined (Nylund et al., 2007). So far, LCA has been used to identify a variety of behavioral patterns in adolescent smoking (Guo et al., 2009), alcohol use (Connell et al., 2009; McBride et al., 2014), drug use (James et al., 2013), and risk behavior (Cook et al., 2015; Laska et al., 2009), all of which offer useful risk profiles for future prevention practice and research. Nevertheless, LCA studies on multiple substance use are scarce, and mostly limited to certain groups, e.g.,

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adolescents in treatment (Ramo et al., 2012), female adolescents only (Chung et al., 2005) or children in foster care (Shin et al., 2010). In addition, most studies on adolescent substance use include substance-related problems like sexual risk behavior or delinquent behavior into the LCA (Jackson et al., 2014; Laska et al., 2009), which is problematic, as consumption patterns and problems can no longer be clearly discerned, thus, it is difficult to interpret longitudinal associations between them. To our knowledge, there are only three longitudinal LCA studies with a general sample that analyze poly substance use behaviors exclusively (Kelly et al., 2015; Lamont et al., 2013; Lanza et al., 2010). They identify three to six latent classes, from no/minimal use, single substance use, to multiuse further differing with regards to substance (cigarette, alcohol, marijuana) and severity of use (light, moderate, heavy). Predictors for multiple substance and polydrug use vary between studies, but all of them include gender (males are more likely to be multiusers), low socio-economic status, age, victimization, and high parental and peer use (Kelly et al., 2015; Lamont et al., 2013; Lanza et al., 2010), hence these predictors will be included in our analyses.

Interestingly, none of these studies controlled for contextual effects like school or communal effects on class membership. Students of schools with poor health policy, for instance, express higher antisocial behavior (Patrick and Schulenberg, 2013; Perra et al., 2012), thus, a higher proportion of multiusers can be anticipated. In a multilevel LCA (MLCA) for adolescent smoking (Henry and Muthén, 2010), poor and tobacco cultivating communities predicted higher rates of heavy smokers, illustrating an important community level risk factor.

For these reasons, not only do we aim to corroborate previous LCA results in a sample of German students, but we also include school-level variables to predict individual class membership. Previous research revealed type of school, and school health policy as significant predictors for substance use levels via mixed-effects multilevel regression models. Students without college-preparatory education vis-à-vis students on a college-preparatory high school track, and students at schools with poor health policy (Bisset et al., 2007; Fletcher et al., 2008) were more likely to use multiple substances. Moreover, we examine a longitudinal sample of young adolescents with baseline values (5th grade) as predictors for substance use patterns at follow-up (8th grade) for two reasons: firstly, we obtain chronological rather than cross-sectional associations, which strengthen the postulated causal interpretation, secondly, students in mid-adolescence are more likely to vary in substance use patterns than younger adolescents (Donovan and Molina, 2013; Percy and Iwaniec, 2007), providing a broader spectrum of data for MLCA.

2. Material and methods

The baseline sample ($N=3444$; 52% male) with a mean age of 10.37 ($SD=0.59$) was recruited from 45 schools in four German states (Bremen, Hesse, North Rhine–Westphalia, and Schleswig–Holstein) at baseline assessment of the “Eigenständig werden” (“Becoming Independent”) prevention trial. This was a cluster-randomized controlled trial to assess effectiveness of a school-based program for grades 5 and 6, designed to delay onset of substance use and to foster development of personality among schoolchildren (Hansen et al., 2011).

In Germany, after finishing elementary school (grades 1–4), there are several different types of secondary schools to be attended that differ between federal states. In general, there are schools with a college-preparatory track, e.g., ‘Gymnasium’ and other schools or educational tracks. A ‘Gymnasium’ diploma is mandatory for further academic education, thus education is more academic-oriented and more demanding than other forms of schools/education.

36-month follow-up data of the remaining participants of both groups (intervention and control group) of the “Eigenständig werden” trial ($N=2490$; $M_{age}=13.32$ [$SD=0.57$]; 51% male) was used to determine latent classes, while baseline values were used to identify significant predictors for latent class membership. Sampling process and sample characteristics are described in detail elsewhere (Hansen et al., 2011). Informed consent was obtained from all individual participants’ parents. The trial was approved and registered by the ethics committee of the Medical Faculty of the University of Kiel (AZ D 419/10) and approved by the Ministries of Education of the participating states.

2.1. Measures

All measures were assessed by self-report questionnaires.

2.1.1. Substance use measures (follow-up). Lifetime alcohol use was assessed via a single item (“Have you ever drunk alcohol, even a small sip?”) with answer categories 0 = no and 1 = yes.

Lifetime binge drinking was assessed by asking “How many times have you consumed five or more drinks on a single occasion in your life?” (never, 1, 2, 3–5, >6 times), answers were dichotomized into 0 = never, 1 = once or more.

Lifetime drunkenness was measured by asking how many times the respondent has been drunk (never, 1, 2, 3–5, >6 times), answers were dichotomized into 0 = never, 1 = once or more.

Current alcohol use was measured by asking on how many days the respondent consumed alcohol during the last month (none, 1–2, 3–5, 6–9, 10–19, 20–29, >29). Answers were dichotomized into 0 = 0–5 days, and 1 = more than five days.

Amount of alcohol consumed was measured by the number of alcoholic beverages on a typical, single occasion (0, <1, 1–2, 3–4, 5–6, >6), dichotomized into 0 = less than one (“no/light”), 1 = one or more (“heavy”).

Lifetime smoking was assessed by asking how many cigarettes have ever been smoked in life. Nine answering categories (“none” to “>100 cigarettes”) were dichotomized into 0 = none, and 1 = a few puffs or more.

Current smoking was measured by asking how frequently participants currently smoked (1 = I don’t smoke, 2 = less than once a month, 3 = at least once a month, but not weekly, 4 = at least once a week, but not daily, 5 = daily). Answers were dichotomized into 0 = 1–2 (“no/light”), and 1 = 3–5 (“heavy”).

2.1.2. Predictors (baseline). Peer substance use was assessed via a single item for smoking and drinking (“How many of your friends do smoke/drink alcohol?”). Answer categories for both comprise 0 = none, 1 = few, 2 = some, 3 = most, 4 = all of them. Answers were dichotomized into 0 = 0–1, and 1 = 2–4.

Parental substance use was separately assessed for smoking and drinking. Parental smoking was assessed via yes-no-questions (“Does your father smoke?”, “Does your mother smoke?”), with a single indicator for each (0 = no, 1 = yes). Based on these answers, we constructed an additional dichotomous indicator (0 = “not smoking”, 1 = “smoking” parents), parental alcohol use was assessed likewise.

Bullying was separately assessed for bullying ($\alpha=0.71$) and victimization ($\alpha=0.78$) since the summer holidays with three items, respectively on a five-point scale (0 = never, 1 = in total one or two times, 2 = two or three times a month, 3 = once a week, 4 = more than once a week). Answers for both bullying (“How often did you participate in laughing at other students?”, “How often did you participate in beating up other students?”, “How often did you participate in isolating other students?”) and victimization (“How often have you been laughed at by other students?”, “How often have you been beaten up by other students?”, “How often have you

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