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(Article begins on next page)

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Short-Term Mediating Factors of a School-Based Intervention to Prevent Youth Substance Use in Europe

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ABSTRACT

Purpose: To investigate factors mediating the effects of a European school-based intervention (Unplugged) based on a social influence approach to youths' substance use.

Methods: Schools in seven European countries (n = 143, including 7,079 pupils) were randomly assigned to an experimental condition (Unplugged curriculum) or a control condition (usual health education). Data were collected before (pre-test) and 3 months after the end of the program (post-test). Multilevel multiple mediation models were applied to the study of effect mediation separately for tobacco, alcohol, and cannabis use. Analyses were conducted on the whole sample, and separately on baseline users and nonusers of each substance.

Results: Compared with the control group, participants in the program endorsed less positive attitudes toward drugs; positive beliefs about cigarettes, alcohol, and cannabis; and the normative perception of peers using tobacco and cannabis. They also increased in knowledge about all substances and refusal skills toward tobacco. Decreased positive attitudes toward drugs, increase in refusal skills, and reappraisal of norms about peer using tobacco and cannabis appeared to mediate the effects of the program on the use of substances. However, mediating effects were generally weak and some of them were only marginally significant.

Conclusions: This study lends some support to the notion that school-based programs based on a social influence model may prevent juvenile substance use through the modification of attitudes, refusal skills, and normative perceptions.

School-based interventions are considered effective in the prevention of substance use in adolescence. Recent reviews suggest that even long-term prevention of alcohol, cigarettes, and marijuana use among youths is possible (e.g., [1e3]). In particular, interventions based on a social influence approach, which aims to reinforce personal and interpersonal skills using interactive techniques, and including a normative education component, are more likely to be effective than others [1,2,4].

Whereas evidence of effectiveness of social influence interventions is well established [2], evidence about potential mediating mechanisms is still lacking. Identification of mediators of the intervention's effects, if any, is important to support the theoretical model behind the program [5]. This, in turn, allows the individuation of effective components and guides the efforts of development of new interventions [6].

Components of theories on adolescents' behaviors have been tested through mediation analyses in randomized trials. Specifically, school-based interventions have been shown to modify youths' substance use mainly by changing normative expectations or perceived norms about the use [7e14], intentions [8,15], refusal and resistance skills [12,16,17], risk-related attitudes and behaviors [12,14,16,18], positive and negative beliefs about consequences [15], reasons to use [13,18], and perceived peers' influence and friends' use [14,15,18].

However, only few studies in the past adopted up-to-date methods to investigate mediation: namely, a multiple mediation approach [19] and calculation of the statistical significance of mediating effects [6]. Moreover, all these studies were conducted in the United States. To understand whether the identified mediating mechanisms can be generalized to other populations, replication of similar approaches is required.

This study aimed to analyze short-term mediating factors of a school-based curriculum (Unplugged) for the prevention of tobacco, alcohol, and drugs use evaluated in seven European countries. Unplugged is a social influence curriculum consisting of 12 1-hour sessions delivered weekly by class teachers (for more details, see [20]). It has been shown to reduce the use of tobacco, alcohol, and cannabis in the short term [21]. According to the leading theories of the social influence approach (social learning and social norms), drug use initiation is the result of social influence, from which adolescents can derive erroneous perceptions of frequency and acceptability of use. Normative education and resistance skills training included in prevention curricula are thought to reduce the effect of social influence by modifying attitudes, beliefs, and normative perceptions, finally supporting the development of general social skills and skills to resist social pressures. Accordingly, we hypothesized that beliefs about consequences of substance use; attitudes toward drug use; ability to resist an offer of alcohol, cigarettes, or cannabis (refusal skills); and perception of prevalence of use among peers would mediate the effects of the program on behavioral outcomes (Figure 1). Because previous studies have shown that school climate and school bonding were positively affected by school-based interventions [22e24] and could act as protective factors for substance use [23e26], we also included perceived social climate in the class, to investigate whether it mediates interventions' effects . Finally, we were interested in examining whether the Unplugged curriculum works differently for students who were users versus those who were not, as suggested in a previous study [18].

Methods

Study design

The present study was based on a four-arm, cluster randomized, controlled trial (the EUropean Drug Addiction Prevention [EU-DAP] trial), in which schools were randomly assigned either to one of three experimental arms (Unplugged curriculum alone, or Unplugged complemented by parents' seminars or peer sessions) or to a control group receiving the usual health education curriculum. Of 323 eligible schools, 33 were excluded because they did not meet the inclusion criteria, which were

following the national educational curricula, encompassing at least two classes in the target grade, and not concurrently conducting other comprehensive interventions against substance use. An additional 120 schools declined participation, mainly because they were unable to schedule the intervention during the 2004e2005 school year (74%). Thus, 170 schools were randomized, after stratification into three levels of neighborhood average socioeconomic status.

Computer-generated blocks of four digits were used to allocate schools within centers. Every five schools, two were assigned to the control group, and the remaining three were assigned to one of the intervention arms. Sixteen percent of schools (n = 27) withdrew from the study before the baseline survey (23.5% in the intervention arms and 4.4% in the control arm). This withdrawal occurred mainly during or just before the training of teachers, was comparable in all centers, and was similar across the three levels of area social stratification. Details on the study design and participation rates have been published elsewhere [27]. The program was conducted in 78 schools, whereas 65 acted as controls.

Because the added component of parents' education and the peer sessions was not implemented in practice [20], analyses were conducted pooling together the three intervention arms, in line with previous reports from this trial [21].

Participants

Pre-test data were collected from 7,079 students in seven different countries (Austria, Belgium, Germany, Greece, Italy, Spain, and Sweden). For 6,370 of them (48% females; mean age, 13.25 years; standard deviation [SD], .99 years), valid post-test information was obtained 3 months after the end of the program.

Students with both assessments did not differ significantly from those who dropped out, with respect to socio-demographic variables and substance use at baseline.

A general policy of informed consent was not adopted in the trial. Each participating center followed the practice of ethical clearance required locally.

Fidelity

The curriculum consisted of 12 1-hour units taught by class teachers who had previously attended a 2.5-day training course. Fidelity of the program's implementation was assessed across the different centers (for details on the procedure, see [20]). A total of 56% of the enrolled classes implemented all the units in the curriculum, 66% at least 10, and 77% at least six.

Fewer than 5% of classes failed to implement any part of the curriculum. On average, each unit was taught to 78% of the target population. This level of program implementation is comparable to that of other curricula administered in a European setting [28].

Measures

The questionnaire items were drawn primarily from existing international surveys included in the European Monitoring Centre for Drugs and Drug Addiction Evaluation Instrument Bank database (http://eib.emcdda.europa.eu/index.cfm?nNodeID=3267). Table 1 presents the measures adopted in this analysis, along with their psychometric properties. For all constructs (except knowledge), higher scores indicate a higher level of risk (see score points), so that negative values of Path a in Tables 2e4 indicate a reduction of the risk level.

Because of the statistical models adopted for the analysis in this study (i.e., linear regression models), the measures were used as continuous, whereas in the previous papers they were dichotomized [21]. In this analysis, we did not employ the frequency of drunkenness and cannabis use in the past 30 days because of the low variance of these variables at baseline. Statistical analyses We fitted multilevel multiple mediation models in Mplus 6 (Muthén & Muthén, Los

Angeles, CA), entering all hypothesized mediators simultaneously [19]. The conceptual model of mediation is depicted in Figure 1. We calculated the intervention effect for each mediator (Path a in Figure 1), the effect of each mediator on the outcome (Path b), and the intervention effect that was mediated by each mediator (Path a*b in the tables or "indirect effect" in the text). For each model, we computed the total indirect effects of the intervention (i.e., the total effect of intervention mediated by the sum of the mediating factors) and also the single indirect effect for each mediator, as suggested by Preacher and Hayes [19]. Moreover, we calculated the program's direct effect (i.e., the effect that was not explained by the hypothesized mediators). Because the randomization occurred at the school level, we entered school as the second level, and individuals as the first level. To control for variability across centers, we used the stratification option in Mplus. We fitted separate models for tobacco, alcohol, and cannabis. We performed separate analyses among students who were nonusers (had not smoked in the past 30 days, never got drunk, never used cannabis) and among users at baseline. In all models, we controlled for gender, age, and the initial levels of the variables at baseline. We allowed covariations among all variables within time. Concerning model fit, we examined the chi-square, comparative fit index (recommended values > .94), root mean square error of approximation (recommended values <.08) and standardized root-mean-square residual (recommended values <.08 [29,30]). All tests were two-tailed. Given the reduction of statistical power as a result of mediation analyses [19], we also presented effects with .05 < p < .10 as marginally significant.

Results

Whole sample

All models showed a good fit to the data (Tables 2e4). Participants in the intervention significantly reduced their positive attitudes toward drugs; positive beliefs about consequences of tobacco, alcohol, and cannabis use; and the perception of having many friends who smoke cigarettes and cannabis compared with the control group (Path a of Tables 2e4). They also increased their ability to refuse peers' invitations to smoke cigarettes and their knowledge about tobacco, cannabis, and alcohol, and reported an improvement in class climate. Although only marginally significant (p< .10), Unplugged also increased refusal skills for alcohol and cannabis, and negative beliefs about the consequences of tobacco use.

Concerning tobacco use, the total indirect effect of intervention (β = -.016; p = .013) was significant, whereas the direct effect (β = -.014; p = .092) was only marginally significant (Table 2).

Ability to refuse peers' invitation to smoke (β =-.008; p=.040) and perception of the number of smoking friends (β =-.004; p = .016) were significant mediators of intervention effects on cigarettes use (Path a*b), whereas the mediating effect of positive attitudes toward drugs was only marginally significant (β =-.003; p = .070).

For alcohol-related behavior, the total indirect effect of intervention (β = -.013; p = .050) was significant, whereas the direct effect was not (Table 3). Positive attitudes toward drug were mediators of the intervention effects on alcohol (β =-.005; p = .046) (Path a*b). The mediating effect of positive beliefs about consequences of alcohol use (β = -.001; p = .096) and of the ability to refuse peers' invitation to drink was instead only marginally significant (β = -.005; p = .078).

Both total indirect effects (β = -.013; p = .066) and direct effects (β =-.018; p = .090) of the intervention toward cannabis use were only marginally significant (Table 4). The decrease in perception of having many smoking friends (β =-.002; p = .048) (Path a*b) was a significant mediator of the intervention effects on cannabis use, whereas the mediating effects of the decrease in positive attitudes toward drugs (β = -.005; p = .060) and the increase in the ability to refuse peers' invitation to smoke (β = -.006; p = .078) were only marginally significant.

Never-users at baseline

All models fit the data well (Tables 2e4). Students who did not smoke in the past 30 days at baseline and took part in the intervention significantly increased in knowledge about tobacco (β= .056; p = .010) and decreased in the perception of having many friends who smoked (β= -.047; p= .032) and in marginally positive beliefs about the consequences of tobacco smoking (β= -.039; p= .064), compared with controls (Path a, Table 2). Students in this group also reported an increase in positive class climate (β = -.062; p = .006). The total indirect effect of the intervention was significant (β = -.017; p = .033), whereas the direct effect was not significant (Table 2). Increased knowledge about tobacco (β = -.002; p = .070) and the reduction in the perception of having friends who smoke (β = -.003; p = .058) were marginally significant mediators of the intervention effects on smoking frequency among non smokers at baseline (Path a*b, Table 2).
Among students who never had never been drunk, taking part in the program strongly increased knowledge about alcohol (β = .164; p = .000) and the perception of a positive class climate (β = -.045; p = .034), compared with the control group (Path a, Table 3). However, mediation analyses showed that neither total indirect effects nor direct effect of the intervention were significant (Table 3). None of the factors examined were revealed to be a mediator of the intervention's effects (Path a*b, Table 3).
Finally, among those who had never tried cannabis, participants in the intervention decreased their positive beliefs about the consequences of cannabis use (β =-.045; p = .014) and increased in knowledge about cannabis (β = .141; p = .000) and the perception of a positive class climate (β = -.053; p = .012) compared with controls (Path a, Table 4). The program also marginally reduced the perception of having friends who smoked cannabis (β = -.035; p = .066). Total indirect effects of the intervention were not significant. Only the perception of having friends who smoked cannabis was found to be a marginally significant mediator of the intervention's effects (β = -.025; p = .090) (Path a*b, Table 4).

Users at baseline

All models fit the data well (Tables 2e4). Participants in the intervention who at baseline reported cigarette smoking in the past 30 days decreased their positive attitudes toward drugs (β =-.075; p= .006) and the perception of having many friends who smoked cigarettes (β = -.055; p = .038), relative to the control group (Path a, Table 2). Moreover, they increased in negative beliefs about the consequences of smoking cigarettes (β = -.040; p = .084) and their ability to say no to peers' invitation to smoke cigarettes (β = -.041; p = .066), although these two effects were only marginally significant. Notwithstanding, there was a significant total indirect effect of the intervention (β=-.027; p = .013) and a marginally significant direct effect (β =-.027; p = .062) (Table 2). The decrease in positive attitudes toward drugs (β = -.006; p = .044) and in the perception of having many friends who smoked (β = -.007; p = .044) mediated the intervention's effects on frequency of tobacco use among smokers at baseline (Path a*b, Table 2). The increase in the ability to resist peer pressure to smoke mediated the intervention effects on tobacco use (β = -.013; p = .066), but it attained only marginal significance.
Intervention students who reported an experience of drunkenness at baseline decreased positive attitudes toward drugs (β = -.091; p = .002), positive beliefs about alcohol drinking(β = -.084; p= .004), as well as the perception of having many friends who got drunk (β = -.59; p = .044), compared with controls (Path a, Table 3). They also increased in negative attitudes toward drugs (β= -.069; p = .020), knowledge about alcohol (β =-.128; p = .000), and marginally, the ability to say no to peer pressure to drink (β = -.055; p = .068), compared with controls. Mediation analyses revealed a significant total indirect effect of the intervention (β = -.035; p = .006), whereas the direct effect was no longer significant (Table 3). The decrease in positive attitudes toward drugs (β=-.015; p = .008) and in positive beliefs about the consequences of alcohol use (β = -.006;

p= .038) mediated the intervention's effect on the frequency of drunkenness among baseline drinkers, whereas the decreased perception of having many friends who got drunk (β = -.005; p= .076) and the increased ability to refuse a peer's invitation to drink (β = -.007; p = .094) were marginally significant mediators (Path a*b, Table 3).

Students who had already tried cannabis at baseline and who took part in the intervention decreased their positive attitudes toward drugs (β =-.137; p = .004), and they marginally decreased their positive beliefs about the consequences of cannabis use (β = -.085; p = .076) and the perception of having many friends who smoked (β =-.081; p = .094), compared with controls (Path a, Table 4). They also increased their negative attitudes toward drugs (β = -.111; p = .030) and their knowledge about cannabis (β = -.130; p = .010). Overall, the total indirect effects were significant and in the anticipated direction (β = -.048; p = .072), whereas the direct effect was no longer significant (Table 3). Single mediation analyses did not identify significant mediation effects of any of the proposed mediators. However, the increased negative attitudes toward drugs (β = -.010; p = .096) were marginally significant mediators of the intervention effects (Path a*b, Table 4).

Finally, increased knowledge about cannabis owing to the intervention was marginally significant related to an increase in cannabis use (β = .007; p = .090).

Discussion

The aim of this study was to investigate the short-term mediating mechanisms of a European school program based on social influence (Unplugged) on youths' substance use. Overall, Unplugged reduced cigarette smoking, drunkenness episodes, and cannabis use through three common mediating factors: attitudes, refusal skills, and perception of prevalence of the behavior among peers. Although the associations between intervention and putative mediators were generally in the expected direction, and often so even at the conventional threshold for statistical significance, the mediating effects were in many cases only marginally significant, especially for nonusers at baseline. Among users, change in attitudes toward drugs and possibly the perception of the number of friends who used drugs mediated the intervention effects on cigarette smoking and alcohol misuse, as predicted by theories [31,32].

Overall, this study highlights similarities in the mediating mechanisms for tobacco, alcohol, and cannabis use. To our knowledge, this is an original finding in the context of experimental studies, in which substances are often combined together (e.g., [9,14]). Modification of positive attitudes toward drugs, of refusal skills, and of normative perceptions emerged as possible mediating factors of the effect of the program on all three classes of substances.

Our study leads to two main considerations of importance for future prevention. First, the intervention effects were not completely explained by the reinforcement of the skills targeted by the intervention. Second, in many cases, mediating effects were weak and only marginal, which suggests that Unplugged prevented substance use through alternative pathways. However, we cannot exclude other plausible explanations, such as inaccuracy of measurements, weak overall effects of the program, and strong interaction with contextual variables (e.g., at the center's level) that may have masked mediation effects, which emphasizes the need for careful planning of future evaluation studies that will enable the analysis of mediating mechanisms.

Almost all putative mediating factors included in this analysis affected outcomes in the predicted direction, they explained part of the program's effect among the whole study population, and they were significant among students with experience of substance use at the intervention's start, but not among nonusers. A possible explanation is that the program's educational activities, such as role-plays, were more relevant to students with this experience. Relevance, and consequent identification processes, may affect the motivation to learn and the acquisition of skills (see, for instance, [33]). However, because the effects of Unplugged on perceived peers' prevalence and resistance skills are found also among those who did not drink alcohol at baseline (Caria MP, Faggiano F, Bellocco R, et al. Effects of a school-based prevention program on European adolescents' intentions,

perceptions and expectations towards alcohol drinking. In preparation), we do not exclude the possibility that the program might work differently for pupils at different stages of alcohol use. The weak indication of an increased risk for cannabis use conveyed by an increase in knowledge about this substance might be due to chance. However, the role of knowledge enhancement in the prevention of illicit drug use is far from settled, because no study has shown that knowledge mediates intervention effects. Thus, the role of knowledge in prevention should be further explored.

Limitations

This study has several limitations that could explain part of the imprecision of results. Refusal skills and normative beliefs are complex constructs, and they were assessed with a single item. Another limitation is the small effect sizes of mediational effects, which suggests that other factors not captured by this evaluation are at work. In addition, the geographical diversity of the sample might have moderated the intervention effects, concurring in reducing their size.

A conceptual limit is related to the timing of assessments.

Despite the common praxis of interpreting a parallel change in the mediators and in the outcome as indicative of mediation effects, we acknowledge the inherent weakness of inferring causal relations with this approach [34], because the lack of lag time between the mediators change and the outcomes could make the direction of the effects uncertain. However, the experimental design and the explicit a priori hypothesis that manipulating individuals' attitudes, skills, and risk perceptions may subsequently affect behaviors make it more plausible that the observed cognitive and skills modifications led to modifications in drug use, rather than vice versa. The different rate of attrition in the experimental and control condition might have reduced the advantage of randomization. However, in a previous sensitivity analysis [21], we found no evidence that the attrition would explain the association between program and outcomes variables. For the results of mediation analyses to be biased, it would be necessary for attrition to be selectively associated with change in the mediators, which is unlikely.

Tests of significance were not corrected for multiple testing, using a Bonferroni adjustment. This increased the risk that some results may have arisen by chance. However, this correction has been criticized for being too conservative and for leading to Type II error [35e37]. Moreover, consistency between the observed mediating mechanisms and the theoretical model underpinning the development of the curriculum speaks against an important role of chance.

Implications

Our study suggests that positive attitudes toward drugs, normative perceptions of use among peers, and refusal skills might explain most of the effectiveness of interventions based on social influence. On the other hand, targeting other mediators, such as beliefs or knowledge, may not contribute to the effectiveness of such programs. These results should be taken into account to create cost-effective interventions.

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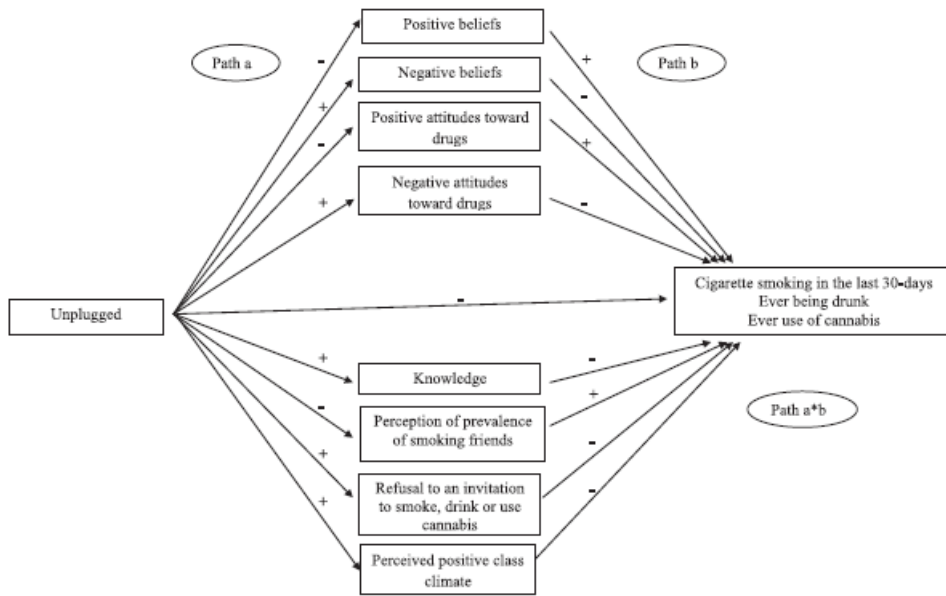
Path a: effect of the intervention on targeted mediators
Path b: effect of targeted mediators on substance use
Path a*b: mediation effect of targeted mediators

Figure 1. Conceptual model of mediation.

Table 1
Measures and their psychometric properties

Measure	Question and items	Answers	Cronbach α (at baseline and posttest)
Tobacco use	How many times (if any) have you smoked cigarettes during the past 30 days?	0	
Drunkenness	How many times (if any) have you been drunk from drinking alcoholic beverages in your lifetime?	1–2	
		3–5	
Cannabis use	How many times (if any) have you used marijuana or hashish in your lifetime?	6–9	
		10–19	
		20–29	
		≥ 30	
Positive attitudes toward drugs	Here are some statements that people have made about illegal substances. How much do you agree with the following opinions on drugs? Using drugs can be a pleasant activity. Using drugs is fun. Many things are much more risky than trying drugs. Drugs help people to have experience life in full. The police should not be annoying young people who are trying drugs.	4-points Likert scale: Strongly agree (= 4) Agree (= 3) Disagree (= 2) Strongly disagree (= 1)	.70–.79
Negative attitudes toward drugs	A young person should never try drugs. Everyone who tries drugs eventually regrets it. The laws about drugs should be made stronger. Drug use is one of the biggest evils in the country. Schools should teach about the real hazards of taking drugs To experiment with drugs is to give away control of your life.	4-point Likert scale: Strongly agree (= 1) Agree (= 2) Disagree (= 3) Strongly disagree (= 4)	.78–.82
Positive beliefs: tobacco	How likely is that each of the following would happen to you if you smoke cigarettes in the next month? Feel more relaxed Have more fun Be more popular Be more confident and outgoing	4-point Likert scale: Very likely (= 4) Likely (= 3) Unlikely (= 2) Very unlikely (= 1)	.78–.80
Negative beliefs: tobacco	Get into trouble with parents Have problems with my friends Become an addict Have money problems	4-point Likert scale: Very likely (= 1) Likely (= 2) Unlikely (= 3) Very unlikely (= 4)	.66–.67
Positive beliefs: alcohol	Feel more relaxed Have more fun Be more popular Forget my troubles Be more confident and outgoing	4-point Likert scale: Very likely (= 4) Likely (=3) Unlikely (= 2) Very unlikely (= 1)	.82–.84
Negative beliefs: alcohol	Do badly in school Get into trouble with parents Have problems with my friends Become an addict Have money problems	4-point Likert scale: Very likely (= 1) Likely (= 2) Unlikely (= 3) Very unlikely (= 4)	.82–.84
Positive beliefs: cannabis	Feel more relaxed Have more fun Be more popular Be more confident and outgoing	4-point Likert scale: Very likely (= 4) Likely (= 3) Unlikely (= 2) Very unlikely (= 1)	.84–.86
Negative beliefs: cannabis	Get into troubles with police Have problems in school Get into trouble with parents Have problems with my friends Become an addict Have money problems	4-point Likert scale: Very likely (= 1) Likely (= 2) Unlikely (= 3) Very unlikely (= 4)	.86–.87
Knowledge about tobacco	Mark whether you think it is correct or not: Nicotine is the substance in cigarettes that causes lung cancer. One needs to smoke several cigarettes per day during many years to become addicted.	Yes No Don't know (Correct answer = 1; wrong = 0).	
Knowledge about alcohol	Women have lower tolerance to alcohol than men. It takes about half an hour to eliminate from the body the amount of alcohol contained in a can of strong beer.		
Knowledge about cannabis	Smoking marijuana does not cause physical dependence. High consumption of hash or marijuana decreases the production of sexual hormones.		
Refusal skills: tobacco	You and the same friend are studying hard for an important test at school the day after. Both of you feel stressed and need to calm down. Your friend suggests a cigarette would help, and offers one. Do you accept?	4-point Likert scale: Very likely (= 4) Likely (= 3) Unlikely (= 2) Very unlikely (= 1)	
Refusal skills: alcohol	The day after, you both pass the test, and feel that it is now time to celebrate. You still have some pocket money left, and the liquor store is nearby. Would you buy some alcohol (beer, wine) to celebrate?		
Refusal skills: cannabis	You and your best friend are at a party where you meet new people, and you feel you really want to get to know them. Someone offers to smoke hash together. Your friend accepts. Do you?		
Perception of number of friends who use	When you answer this question, think about the friends with whom you spend most of your leisure time. How many of them smoke cigarettes? How many of them get drunk? How many of them use marijuana or other drugs?	None Less than half About half More than half All of them I don't know	
Class climate	How much do you agree with the following descriptions of your school? The students in my class enjoy being together. Most of the students in my class are kind and helpful. Other students accept me as I am.	4-point Likert scale: Strongly agree (= 1) Agree (= 2) Disagree (= 3) Strongly disagree (= 4)	.68–.74

Table 2

Standardized effects (β and standard errors) of Path a, Path b, and Path a*b of multilevel multiple mediation model on youth cigarettes use in the past 30 days (controlling for age, gender, and baseline levels of mediators and outcome), short-term follow-up

Mediator	Path a		Path b		Path a*b	
	β (SE)	p Value	β (SE)	p Value	β (SE)	p Value
Whole sample (n = 6,972), direct effect: β −.014, SE .008, p = .092						
Positive attitudes toward drugs	−.041 (.020)	.038	.075 (.014)	.000	−.003 (.002)	.070
Negative attitudes toward drugs		n.s.	.025 (.011)	.022		n.s.
Positive beliefs toward tobacco	−.044 (.021)	.034		n.s.		n.s.
Negative beliefs toward tobacco	−.029 (.017)	.086		n.s.		n.s.
Knowledge about tobacco	.049 (.021)	.022		n.s.		n.s.
Refusal skills for tobacco	−.030 (.015)	.040	.280 (.016)	.000	−.008 (.004)	.040
Perception of number of friends who smoke	−.051 (.020)	.010	.071 (.009)	.000	−.004 (.002)	.016
Perception of positive class climate	−.047 (.021)	.022		n.s.		n.s.
No smokers (n = 4,511), direct effect: n.s.						
Positive attitudes towards drugs		n.s.	.101 (.027)	.000		n.s.
Negative attitudes towards drugs		n.s.	.048 (.020)	.014		n.s.
Positive beliefs tobacco	−.039 (.021)	.064		n.s.		n.s.
Negative beliefs tobacco		n.s.		n.s.		n.s.
Knowledge about tobacco	.056 (.022)	.010	−.035 (.015)	.018	−.002 (.001)	.070
Refusal skills tobacco	−.028 (.017)	n.s.	.289 (.027)	.000		n.s.
Perception of number of smokers friends	−.047 (.022)	.032	.069 (.015)	.000	−.003 (.002)	.058
Perception of positive class climate	−.062 (.023)	.006		n.s.		n.s.
Smokers (n = 2,461), direct effect: β −.027, SE .014, p = .062						
Positive attitudes towards drugs	−.075 (.027)	.006	.075 (.020)	.000	−.006 (.003)	.044
Negative attitudes towards drugs		n.s.		n.s.		n.s.
Positive beliefs tobacco		n.s.		n.s.		n.s.
Negative beliefs tobacco	−.040 (.023)	.084		n.s.		n.s.
Knowledge about tobacco		n.s.	.041 (.015)	.006		n.s.
Refusal skills tobacco	−.041 (.023)	.066	.324 (.018)	.000	−.013 (.007)	.066
Perception of number of smokers friends	−.055 (.026)	.038	.130 (.018)	.000	−.007 (.003)	.044
Perception of positive class climate		n.s.		n.s.		n.s.

Model fit. Total sample: $\chi^2 (84) = 741.154$; comparative fit index = .96; root mean square error of approximation = .033, standardized root-mean-square residual = .061. No smokers: $\chi^2 (75) = 315.548$; comparative fit index = .95; root mean square error of approximation = .027; standardized root-mean-square residual = .039. Smokers: $\chi^2 (84) = 343.310$; comparative fit index = .96; root mean square error of approximation = .035; standardized root-mean-square residual = .050. n.s. = not significant; SE = standard error.

Table 3

Standardized effects (β and standard errors) of Path a, Path b, and Path a*b, of multilevel multiple mediation model on youths' ever being drunk (controlling for age, gender, and baseline levels of mediators and outcome), short-term follow-up

Mediator	Path a		Path b		Path a*b	
	β (SE)	p Value	β (SE)	p Value	β (SE)	p Value
Whole sample (n = 6,972), direct effect: n.s.						
Positive attitudes toward drugs	−.040 (.019)	.036	.126 (.017)	.000	−.005 (.003)	.046
Negative attitudes toward drugs		n.s.	.027 (.015)	.078		n.s.
Positive beliefs toward alcohol	−.038 (.018)	.040	.037 (.012)	.002	−.001 (.001)	.096
Negative beliefs toward alcohol		n.s.	.069 (.014)	.000		n.s.
Knowledge about alcohol	.153 (.017)	.000		n.s.		n.s.
Refusal skills alcohol	−.032 (.018)	.072	.151 (.016)	.000	−.005 (.003)	.078
Perception of number of drunk friends		n.s.	.067 (.010)	.000		n.s.
Perception of positive class climate	−.047 (.021)	.022	.022 (.010)	.034		n.s.
Never drunk lifetime (n = 5,295), direct effect: n.s.						
Positive attitudes toward drugs		n.s.	.128 (.023)	.000		n.s.
Negative attitudes toward drugs		n.s.	.034 (.020)	.096		n.s.
Positive beliefs toward alcohol		n.s.	.039 (.019)	.040		n.s.
Negative beliefs toward alcohol		n.s.	.057 (.020)	.004		n.s.
Knowledge about alcohol	.164 (.020)	.000		n.s.		n.s.
Refusal skills for alcohol		n.s.	.206 (.021)	.000		n.s.
Perception of number of drunk friends		n.s.	.077 (.013)	.000		n.s.
Perception of positive class climate	−.045 (.021)	.034	.035 (.015)	.018		n.s.
Ever drunk lifetime (n = 1677), direct effect: n.s.						
Positive attitudes toward drugs	−.091 (.030)	.002	.159 (.030)	.000	−.015 (.008)	.008
Negative attitudes toward drugs	−.069 (.030)	.020		n.s.		n.s.
Positive beliefs toward alcohol	−.084 (.028)	.004	.072 (.024)	.002	−.006 (.003)	.038
Negative beliefs toward alcohol		n.s.	.131 (.022)	.000		n.s.
Knowledge about alcohol	.128 (.029)	.000		n.s.		n.s.
Refusal skills for alcohol	−.055 (.030)	.068	.132 (.025)	.000	−.007 (.004)	.094
Perception of number of drunk friends	−.059 (.031)	.044	.087 (.022)	.000	−.005 (.003)	.076
Perception of positive class climate	−.049 (.030)	n.s.		n.s.		n.s.

Model fit. Total sample: $\chi^2 (84) = 717.911$; comparative fit index = .96; root mean square error of approximation = .033; standardized root-mean-square residual = .059. No drinkers: $\chi^2 (75)$ 427.78; comparative fit index = .95; root mean square error of approximation = .030; standardized root-mean-square residual = .043. Drinkers: $\chi^2 (84) = 269.39$; comparative fit index = .96; root mean square error of approximation = .036; standardized root-mean-square residual = .053. n.s. = not significant; SE = standard error.

Table 4
Standardized effects (β and standard errors) of Path a, Path b, and Path a*b, of multilevel multiple mediation model on youths' ever-use of cannabis (controlling for age, gender, and baseline levels of mediators and outcome), short-term follow-up

Mediator	Path a		Path b		Path a*b	
	β (SE)	p Value	β (SE)	p Value	β (SE)	p Value
Whole sample (n = 6,972), direct effect: β −.018; SE .011; p = .090						
Positive attitudes toward drugs	−.041 (.021)	.044	.121 (.016)	.000	−.005 (.003)	.060
Negative attitudes toward drugs		n.s.	.042 (.012)	.000		n.s.
Positive beliefs toward cannabis	−.050 (.019)	.006		n.s.		n.s.
Negative beliefs toward cannabis		n.s.	.044 (.012)	.000		n.s.
Knowledge about cannabis	.137 (.022)	.000		n.s.		n.s.
Refusal skills for cannabis	−.033 (.019)	.074	.180 (.016)	.000	−.006 (.003)	.078
Perception of number of friends who use	−.042 (.020)	.034	.048 (.008)	.000	−.002 (.001)	.048
Perception of positive class climate	−.047 (.021)	.022		n.s.		n.s.
Never–users lifetime (n = 6,358), direct effect: β −.025; SE .001; p = .090						
Positive attitudes toward drugs		n.s.	.149 (.022)	.000		n.s.
Negative attitudes toward drugs		n.s.	.039 (.020)	.050		n.s.
Positive beliefs toward cannabis	−.045 (.019)	.014		n.s.		n.s.
Negative beliefs toward cannabis		n.s.	.060 (.019)	.002		n.s.
Knowledge about cannabis	.141 (.023)	.000		n.s.		n.s.
Refusal skills for cannabis		n.s.	.217 (.025)	.000		n.s.
Perception of number of friends who use	−.035 (.019)	.066	.053 (.011)	.000	−.002 (.001)	.084
Perception of positive class climate	−.053 (.021)	.012		n.s.		n.s.
Ever-users lifetime (n = 614), direct effect: n.s.						
Positive attitudes toward drugs	−.137 (.047)	.004	.106 (.054)	.026		n.s.
Negative attitudes toward drugs	−.111 (.051)	.030	.094 (.042)	.050	−.010 (.006)	.096
Positive beliefs toward cannabis	−.085 (.048)	.076		n.s.		n.s.
Negative beliefs toward cannabis		n.s.		n.s.		n.s.
Knowledge about cannabis	.130 (.050)	.010	.054 (.030)	.070	.007 (.004)	.090
Refusal skills for cannabis		n.s.	.247 (.046)	.000		n.s.
Perception of number of friends who use	−.081 (.048)	.094	.109 (.036)	.002		n.s.
Perception of positive class climate		n.s.		n.s.		n.s.

Model fit. Total sample: χ^2 (84) = 896.618; comparative fit index = .95; root mean square error of approximation = .037; standardized root-mean-square residual = .071. No smokers: χ^2 (75) = 547.823; comparative fit index = .95; root mean square error of approximation = .031; standardized root-mean-square residual = .052. Smokers: χ^2 (84) = 174.555; comparative fit index = .96; root mean square error of approximation = .042; standardized root-mean-square residual = .070.
n.s. = not significant; SE = standard error.