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School-based programmes to reduce and prevent substance use in different age groups: What works for whom? Systematic review and meta-regression analysis

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HIGHLIGHTS

- All developmental periods offer different possibilities for prevention.
- Elementary school students benefit most from enhancing personal competencies.
- Targeting social norms is beneficial for early adolescents.
- In middle adolescence, universal programmes are not very effective.
- During late adolescence, opportunities for substance use prevention increase.

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ABSTRACT

Background: Findings from systematic reviews and meta-analyses about the effectiveness of school-based programmes to prevent or reduce substance abuse are inconclusive. We hypothesise that in order to be effective, programmes have to be aligned with the developmental stages of the intended target group (childhood, early, middle, or late adolescence). The present study provides an overview of universal and targeted programmes, while distinguishing four age groups and examining which intervention characteristics are the effective components for the respective groups.

Methods: Databases were searched for controlled studies of school-based programmes, evaluating their effectiveness on either smoking, alcohol or drug use. Multivariate meta-regression analysis was used to analyse the associations between effects and programme characteristics.

Results: Our meta-analysis evaluates 288 programmes with a total of 436,180 participants. The findings support our hypothesis that specific aspects of the school-based programmes are effective in some developmental stages, but not for other age groups. The differences in effectiveness are systematically related to psychological and cognitive needs and capacities.

Discussion: Our findings highlight the importance of considering a developmental perspective when designing and offering school-based prevention programmes. The various developmental stages offer different possibilities and opportunities for the reduction and prevention of substance use.

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1. Background

It is well established that substance use at a young age is associated with an elevated risk of substance use disorders later in life, mental health problems, which may entail a substantial disease burden, followed by significant social and economic costs (DeWit, Adlaf, Offord, & Ogborne, 2000; Gil, Wagner, & Tubman, 2004; Rehm et al., 2009). Hence, the need for effective prevention programmes is evident. A large range of preventive programmes has been launched with the objective to prevent youngsters from using tobacco, alcohol and drugs. As children spend a large part of their time at school, one important venue to reach large numbers of children and adolescents is through prevention programmes that are offered at schools.

Several systematic reviews and meta-analyses of substance use prevention programmes identified studies either demonstrating significant effects, or showing no effect at all (Faggiano et al., 2005; Foxcroft & Tsertsvadze, 2011; Norberg, Kezelman, & Lim-Howe, 2013; Cuijpers, 2002). It has been suggested that interactive delivery methods are superior (Faggiano et al., 2005; Foxcroft & Tsertsvadze, 2011; Norberg et al., 2013; Cuijpers, 2002), skill-based programmes are more effective than programmes on knowledge, attitudes and intentions (Faggiano et al., 2005; Foxcroft & Tsertsvadze, 2011; Norberg et al., 2013), and that multi-modal programmes outperform uni-modal programmes (Faggiano et al., 2005; Foxcroft & Tsertsvadze, 2011; Norberg et al., 2013). However, a clear pattern in programme characteristics that would distinguish studies with positive results from those with no effects has not yet been identified (Faggiano et al., 2005; Foxcroft & Tsertsvadze, 2011; Norberg et al., 2013).

One explanation for the inconclusive results might stem from the absence of a developmental perspective on substance use prevention and interventions. Although most programmes consider the age of substance use initiation as an appropriate timing of the programme, differences of psychological and cognitive needs and capacities of the intended target groups are usually not taken into account. However, during their development from children to adults, youngsters cycle through several developmental stages, which are all characterized by specific needs and possibilities. We suspect that substance use prevention programmes have to attune to these developmental needs in order to be effective.

1.1. Developmental perspective on substance use

The primary developmental challenge in elementary school is to translate the self-regulation learned at home to the school environment, and to master academic and social situations (Forehand & Wierson, 1994). Middle childhood is marked by great advances in learning and understanding. During this developmental stage, the cognitive abilities of children increase rapidly. Children become increasingly skilled at understanding logic and concrete information, begin to plan consciously, coordinate actions, and develop problem solving skills (Eccles, 1999; Forehand & Wierson, 1994; Masten et al., 1995). Children develop a clear understanding of right and wrong. Values and standards are

primarily influenced by parents and teachers, as they are the primary source of reinforcement (Forehand & Wierson, 1994). Children learn compliance with authority at home and at school, and learn to get along with peers (Masten et al., 1995). They begin to adjust to the needs of others in pursuit of mutual interests and form friendships that are increasingly concerned with loyalty and intimacy (Eccles, 1999; Rose-Krasnor, 1997). In addition, self-awareness develops dramatically. Children learn to reflect on their successes and failures, and start to compare themselves to classmates (Eccles, 1999; Wigfield & Eccles, 2000). As a result children's competence beliefs, subjective task values and general self-esteem change in the elementary school years (Wigfield & Eccles, 1994). In elementary school, substance use is rare and expectancies about the effects of substances are predominantly negative (Masten, Faden, Zucker, & Spear, 2008). Therefore, it is expected that substance use prevention in this developmental stage should not necessarily address the risks of substance use. Instead, it is expected that elementary school students will benefit most from programmes teaching them basic skills helping them master their primary developmental challenges.

The primary developmental task of early adolescence is the re-evaluation of the self and the emergence of identity (Forehand & Wierson, 1994). Early adolescents experience several biological, cognitive, and psychosocial changes that lead them to reappraise themselves and those around them. They have to adapt to their changing body, as they start to develop secondary sexual characteristics (Forehand & Wierson, 1994). At the same time, cognitive capacities develop dramatically. Early adolescents begin to develop the capacity to think abstractly, which allows them to think in a hypothetical manner and to evaluate multiple outcomes (Christie & Viner, 2005). Furthermore, the development of metacognitive abilities enables children to reflect on their own thoughts and behaviours (Eccles, 1999). Moral reasoning moves beyond a self-centred rule oriented level. Early adolescents develop an understanding of mutual benefits and shared norms (Forehand & Wierson, 1994). They become increasingly concerned with peer-relationships (Vartanian, 2000). That is, conformity to peers peaks during this developmental period, as social acceptance becomes more important (Forehand & Wierson, 1994). Early adolescents believe that others are always watching and evaluating them. This phenomenon is known as the 'imaginary audience' (Vartanian, 2000). At the same time, early adolescents believe that they are unique and invulnerable. This phenomenon is known as the 'personal fable' (Vartanian, 2000). These feelings help the early adolescent to perceive the self separately from family-ties, although parents remain an important source of reinforcement in this developmental stage (Forehand & Wierson, 1994). In addition, early adolescence is accompanied by profound environmental changes, as children make the transition to middle or secondary school. The new school environment is characterized by multiple classes and teachers, less individualized instructions, lower levels of teacher-student interactions, more stringent grading and comparative performance evaluations. Early adolescents spend significantly more time with peers and, as a result of frequent class changes, are exposed to larger numbers of peers (Windle et al., 2008). Although part of the normal development, these psychosocial and environmental changes increase the vulnerability for high risk behaviour such as substance use. The transition from childhood and elementary school to adolescence and secondary school is linked to shifting expectancies about the effects of substances from negative to more positive (Masten et al., 2008). It is generally assumed that the most effective method to prevent substance use in this stage is the social influence approach (Cuijpers, 2002; Newton, O'Leary-Barrett, & Conrod, 2013; Newton, Conrod, Teesson, & Faggiano, 2012). The main emphasis of this approach is to make students aware of the various social pressures to use substances in order to be psychologically prepared to resist these influences.

The primary developmental task of middle adolescence is the beginning of the separation and individuation from the family, with concurrent strivings for autonomy and independence (Forehand & Wierson, 1994). The relationships with parents change. Increased involvement with the peer group leads to a rejection of parental values (Palmonari, Kirchler, & Pombeni, 1991). Middle adolescents are increasingly capable of abstract thinking and organize complex thoughts about other people. Consequently they develop a greater understanding of other's feelings and perspectives (Forehand & Wierson, 1994). Adult perceptions of reality become viewed as simply one of many possible perspectives (Schulenberg & Maggs, 2002). Identity formation progresses as more time is spent with peers. Peers become the most consistent source of reinforcement as well as the source of information about values and beliefs (Forehand & Wierson, 1994). In addition, there are marked changes in the way middle adolescents value and weigh the relative costs and benefits of potentially risky behaviours. They become increasingly aware of potential benefits of substance use, and become less convinced of costs and risks (Schulenberg & Maggs, 2002). During adolescence, the brain undergoes considerable maturation. These changes are assumed to be responsible for great and rapid fluctuations in emotional states (Windle et al., 2008), and increased sensitivity to rewarding outcomes (Bava & Tapert, 2010). Reward-seeking behaviour culminates in middle adolescence (Steinberg, 2010), with the presence of peers resulting in a substantial increase in risk-taking behaviour (Steinberg, 2007) as approval by peers is believed to be rewarding in itself (Gunther Moor, Leijenhorst, Rombouts, Crone, & Molen, 2010). It is expected that substance use prevention is extremely difficult in this developmental stage, as middle adolescents are generally not open to adults' views. Peers are the primary source of reinforcement. Therefore, it is expected that the best results will be achieved by peer education.

The primary developmental tasks of late adolescence are the formation of identity, planning the future and acquisition of the necessary skills to make a successful transition into adulthood (Zarrett & Eccles, 2006). Late adolescents experience fundamental changes in their self-definition and identity. They actively explore alternative philosophies, behaviours and lifestyles (Schulenberg & Maggs, 2002). Late adolescents are less vulnerable to peer pressure than early and middle adolescents (Sumter, Bokhorst, Steinberg, & Westenberg, 2008). Individuality gains significance, and deviant behaviour and opinions are tolerated (Westenberg & Gjerde, 1999). In addition, late adolescents project further into the future, as their level of planning, realization and knowledge increases with age (Nurmi, 1991). Emotional reactivity and sensitivity for rewards diminish during late adolescence, while self-regulatory and impulse control capabilities further mature (Steinberg, 2010). These maturational processes are related to improvements in many aspects of executive functioning, such as planning, thinking ahead, response inhibition, simultaneous consideration of multiple sources of information, and more advanced self-regulation and impulse control (Steinberg, 2007; Steinberg, 2010). In late adolescence, relationships with parents usually improve, and the values of parents regain importance (Schulenberg & Maggs, 2002). Despite the diminished vulnerability to peer pressure and improvement of self-regulatory capabilities, late adolescence is characterized by the escalation of alcohol and drug use (Brown et al., 2008). For late adolescents, many social activities occur in drinking contexts and substance use becomes more and more normalized (Schulenberg & Maggs, 2002). It is expected that late adolescents benefit most from programmes addressing their individuality and future orientation.

1.2. The present study

In the present study, we propose that rather than concentrating on the question what the best age or developmental stage is for prevention programming (Gottfredson & Wilson, 2003), the focus should be on finding out what characteristics of prevention programmes are most suitable for each of the respective developmental stages. The present study aims to provide an overview of the different universal and targeted

prevention programmes offered at school. However, unlike other reviews, we will distinguish different age groups in order to examine which characteristics of programmes are particularly effective for specific age groups with respect to the various developmental stages. More precisely, in order to evaluate the effectiveness of the different programmes, we will distinguish between programmes that aim at school age children (elementary school students); programmes targeting early adolescents (grade 6 and 7 students); programmes that aim at middle adolescents (grade 8 and 9); and those aiming at late adolescents (grade 10–12 students). Scrutinizing the age-specific effectiveness for different aspects of school-based prevention programmes can contribute to an increased understanding of what aspects are important at what age with respect to the various developmental stages. This information is crucially important for stakeholders such as prevention workers, teachers, health services, and policy makers who could utilise this knowledge to increase the effectiveness of preventive programmes.

2. Methods

2.1. Selection of studies

2.1.1. Inclusion and exclusion criteria

Studies were eligible for review when (a) examining programmes delivered in the school setting, (b) targeting elementary, middle or high school students, (c) evaluating behavioural outcomes in substance use (smoking, alcohol use and drug use) (d) comparing the intervention with a control condition, and (e) reporting sufficient data to calculate effect sizes.

2.1.2. Search strategy

Four databases (*PsycINFO*, *Pubmed*, *ERIC*, *and COCHRANE*) were searched for controlled studies of school-based programmes, which were evaluated on their effect on substance use. The search strategy is reported in Table 1. The computer search was restricted to studies published between January 1966 and April 2013. Studies listed in PsycINFO were retrieved by a combination of key words and text words referring to substance use and school-based programmes. Results of the computer search were limited by methodology and language (English, German and Dutch). This resulted in the identification of 2839 records. Pubmed was examined using MeSH terms related to substance use in combination with a title and abstract search for school-based programmes. Filters were used for methodology and language. This resulted in 1669 records. Results of the computer searches of PsycINFO and Pubmed were combined in Reference Manager. Removal of duplicates resulted in 3848 unique records. Studies registered in ERIC were retrieved by Thesaurus descriptors referring to substance use and Thesaurus descriptors referring to school-based programmes. Computer search of the ERIC database resulted in 951 records. Finally, COCHRANE was searched for evaluations of school-based programmes. Relevance of the records was evaluated manually, which resulted in 2 additional titles.

All studies identified by computer searches of the electronic databases were further examined by means of a stepwise screening process. The first step consisted of evaluating the relevance of the identified records based on the title of the publication. In total, 4801 titles were screened on relevance, resulting in the exclusion of 3426 records. The second step consisted of screening 1416 abstracts, resulting in the exclusion of 959 papers not meeting the inclusion criteria. The remaining publications were retrieved (32 publications were not available) and studied full-text. We also examined the reference lists of all publications of interest. This resulted in 5 additional titles. After studying all publications full text, 144 publications were excluded. Most of them were excluded because these publications provided insufficient data to calculate effect sizes. The remaining 286 publications were included in the analyses. These publications reported on 241 studies, evaluating the effects of 288 distinct programmes. Fig. 1 depicts the retrieval and selection process.

Table 1
Applied search strategy.

Database	Strategy	Search terms
PsycINFO	Keywords and text words referring to substance use	*Alcohol*, *drinking*, *drug use*, *drug abuse*, *drug misuse*, *illegal drug**, *drug prevention*, *tobacco*, *smoking*, *cannabis*, *substance use*, *substance abuse*, *substance misuse*, *risk behavior*, *risk behaviour*, *risk taking behavior*, *risk taking behaviour*
	Keywords and text words referring to school-based programmes	*School**, *classroom*, *classes*, *classical*, *college**, *course**, *educational program*, *school-based intervention AND Program**, *intervention**, *preventive*, *prevention*
	Limited by methodology	*control**, *rct*, *random**, *follow-up study*, *longitudinal study*, *prospective study*, *retrospective study*, *systematic review*, *meta-analysis*, *treatment outcome/clinical trial*
Pubmed	MeSH terms related to substance use	*Smoking/prevention and control*, *Marijuana smoking/prevention and control*, *Tobacco use disorder/prevention and control*, *substance-related disorders/prevention and control*, *Binge drinking/prevention and control*, *Alcohol Drinking/prevention and control*, *Smoking cessation*, *Risk-Taking*
	Title and abstract search for school-based programmes	*school*, *schools*, *schoolbased*, *school-based*, *schoolchild*, *schoolchildren*, *classroom*, *classes*, *classical*, *student*, *students*, *college*, *colleges*, *college students*, *college-students*, *course*, *courses AND program*, *programs*, *programmes*, *intervention*, *interventions*, *prevention*, *preventive*
	Filters were used for methodology	*controlled*, *random**, *rct*, *controlled clinical trial*, *evaluation studies*, *meta-analysis*, *randomized controlled trial*, *review*, *program evaluation*
ERIC	Thesaurus descriptors referring to substance use	*Smoking*, *Drinking*, *Substance Abuse*, *Drug Education*, *Alcohol Education*, *Alcohol Abuse*, *Drug Abuse*, *Marijuana*
	Thesaurus descriptors referring to school-based programmes	*College Students*, *Two Year College Students*, *High School Students*, *At Risk Students*, *Elementary School Students*, *College Freshmen*, *Graduate Students*, *Junior High School Students*, *Middle School Students*, *Minority Group Students*, *Undergraduate Students*, *Students*, *Secondary School Students AND Intervention*, *Health Promotion*, *Program Evaluation*, *Prevention*, *Program Effectiveness*
COCHRANE	Search terms	*school* AND intervention*, *school* AND prevention*, *classroom*, *lesson**

2.2. Data extraction

2.2.1. Dependent variables: substance use

The dependent variables used in this study were three different student behavioural outcomes: (a) smoking, (b) alcohol use, and (c) drug use. We included several measures, ranging from the number (or percentage) of participants using substances to the number of cigarettes smoked or alcoholic beverages consumed. If a single study reported multiple outcome measures per outcome category, these results were combined into a single effect size.

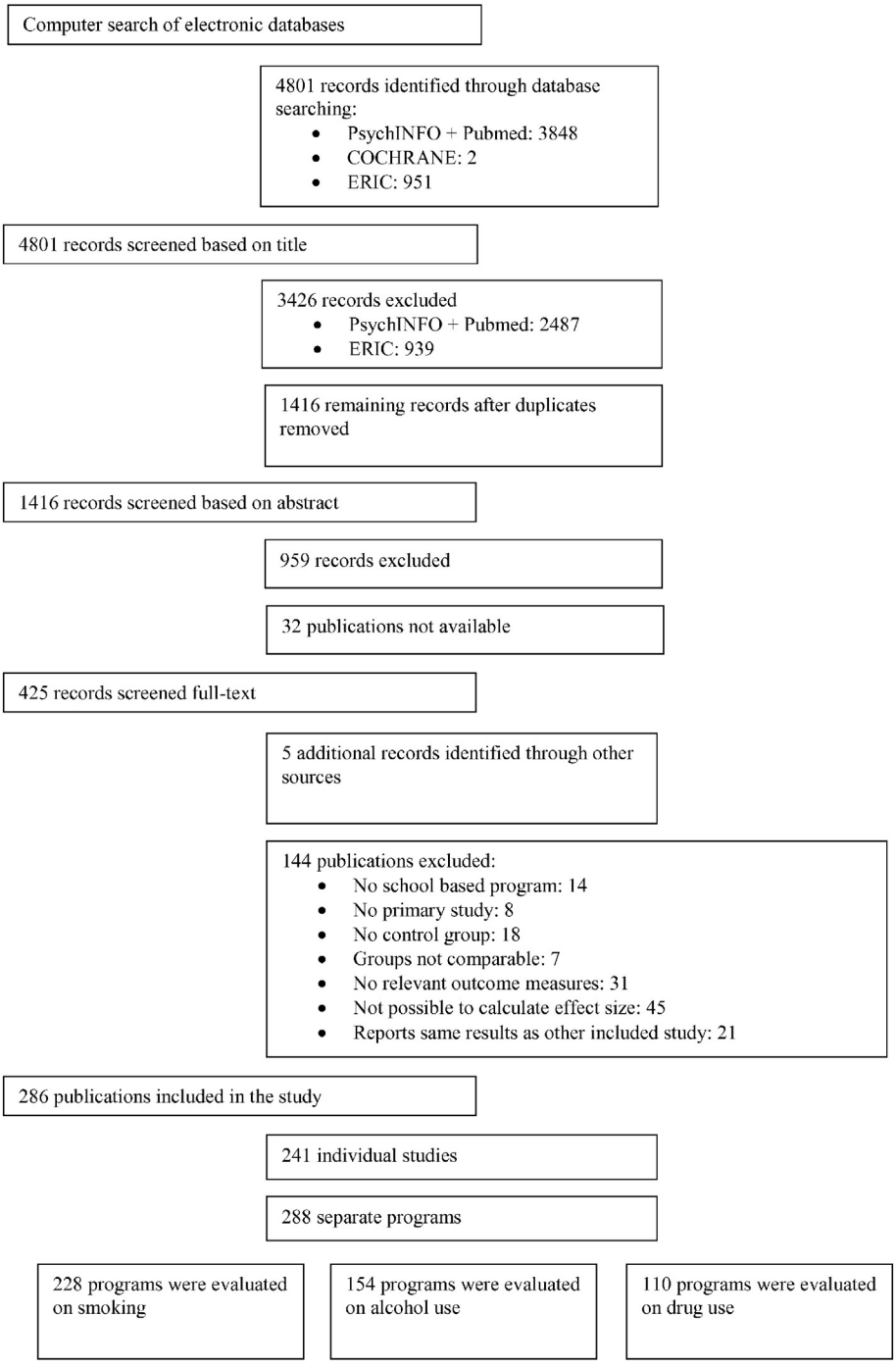

Fig. 1. Flow chart of retrieval and selection of studies.

2.2.2. Independent variables: context and content of the programme

Context and content of all included programmes were coded into several dichotomous variables, 1 if a feature was present and 0 if this was not the case. The first set of independent variables referred to the *focus* of the programme. Programmes were coded as (a) generic if they focused on a wide array of behaviours or problems, such as social emotional learning or a healthy lifestyle. Programmes were coded as (b) substance oriented if information on substance use was included in the programme. Programmes could be coded as both generic and substance oriented. If the programme targeted a single substance, such as smoking or alcohol use, the programme was coded as (c) one substance. Programmes coded as (d) universal targeted the general population, irrespective of risk status. Programmes coded as (e) selective targeted high-risk students, such as students from low socio economic backgrounds or students with behavioural problems. Programmes coded as (f) indicated targeted students who were already experimenting with substances.

The second set of independent variables addressed the *content* of the programmes. First, we constructed several variables related to skill training units often included in social emotional learning or mental health programmes, targeting (a) social skills, (b) problem solving or decision making skills, (c) self-control, (d) self-esteem, and (e) coping with stress and anxiety. Second, we constructed several variables referring to common elements in many substance use prevention

programmes, including (f) health education, (g) adjustment of the social norm concerning substance use, (h) refusal skills training, (i) making a public commitment not to use substances, and (j) offering healthy alternatives. Third, we constructed three variables referring to the theoretical background of the programmes, which were (k) a social influence approach, (l) principles of cognitive behavioural therapy and (m) the trans-theoretical model of behaviour change or stage theory by Prochaska and DiClemente (Prochaska & DiClemente, 1983). We constructed three variables addressing commonly applied strategies in order to obtain behaviour change which were (n) mentoring, (o) peer education, and (p) behavioural management by a parent or teacher by means of monitoring, defining rules and setting boundaries. Finally, as the influence of parents is expected to alter in adolescence, we coded whether (o) parents were involved in the programme.

2.2.3. Methodological covariates

In order to adjust for the influence of methodological features of the study, six methodological variables were constructed. Two variables were continuous variables, including (a) the year of publication and (b) the time in months between the delivery of the programme and the post-test. The other four variables were dichotomous variables, referring to study quality which assessment was based on the Cochrane Risk of Bias Tool (The Cochrane Collaboration, 2011). We coded (c) Randomization as 'yes', if a random component in the sequence generation process was described such as: referring to a random number table, a computer random number generator, coin tossing, shuffling cards or envelopes; throwing dice or drawing of lots. We coded (d) adequate handling of missing data as 'yes', if analyses were conducted according to the intention-to-treat principle, and less than twenty percent of the data was missing. We coded (e) free of selective reporting as 'yes', if all pre-specified substance use outcome measures were reported. Finally, (f) free of other bias was coded as 'yes', if the study appeared to be free of other sources of bias.

2.2.4. Coding reliability

Variables were coded separately by two independent researchers. The inter-rater reliability was outstanding. Kappa coefficients corrected for chance agreement ranged from 0.81 (problem solving or decision making skill training) to 1.00 (mentoring).

2.2.5. Calculation of effect sizes

For each comparison between a school-based programme and a control condition, we calculated one effect size (standardized mean difference, also known as Cohen's *d*) per outcome category (smoking, alcohol use and drug use) if corresponding outcome measures were available. Cohen's *d* was preferably calculated using the means and standard deviations of both the programme group and the control group (at post-test). If means and standard deviations were not reported, we used statistics that were reported for the test between the conditions (for instance *p* or *t*-value). In case of dichotomous outcomes, odds ratios were calculated, and these were converted to standardized effect sizes following Chinn (Chinn, 2000). All effect sizes were calculated by means of procedures implemented in the software programme Comprehensive Meta-Analysis (version 2.0; Biostat, Englewood, New Jersey). In our meta-analyses, effect sizes of zero indicated that there was no difference between the included programme and the control condition. Negative effect sizes indicated that students in the programme condition were less engaged in substance use than students in the control condition. According to Lipsey and Wilson (Lipsey & Wilson, 1993), a standardized effect size of less than −.32 corresponds to a small effect, effect sizes between −.32 and −.55 correspond to medium effect sizes and effect sizes larger than −.55 correspond to large effects.

3. Analysis

3.1. Unit of analysis

In this meta-analysis we distinguish between publications, studies, programmes and contrasts between programmes and comparator conditions. It is worth noting that a single publication can describe multiple studies, and a single study can be described in multiple publications. But what interests us most are the evaluations of preventive programmes, or rather the evaluations of the contrast between a preventive programme and a comparator (control) condition. After all, the effect sizes are related to contrast between programmes and their control conditions, and the effect sizes are the units of our analysis. Therefore, multiple programmes described in the same publication were coded and analysed separately. In the same vein, multiple publications evaluating the same contrast were combined in a single effect size.

3.2. Pooling effect sizes

Although it was the objective of our study to determine the overall effectiveness of school based prevention and intervention programmes on substance use, we did calculate several exploratory pooled effect sizes. Separate meta-analyses were conducted for different age groups, as we expected differential effects in accordance with different developmental stages. Programmes were therefore clustered in the four aforementioned age groups (i.e. elementary school students; early adolescents; middle adolescents; and late adolescents). As we included a wide variety of programmes, we expected considerable heterogeneity. Therefore, pooled effect sizes for each age group were calculated using the random-effects model, assuming that the included studies are drawn from populations of studies that may differ from each other not only due to sample error but also systematically (i.e. owing to a correlation between effect size and covariates such as intervention and population characteristics). The extent of heterogeneity was expressed in the I^2 statistic: a value of 0% indicated no heterogeneity, and larger values show increasing heterogeneity, with 25% classified as low, 50% classified as moderate and 75% classified as high (Higgins, Thompson, Deeks, & Altman, 2003).

3.3. Meta-regression analyses

The objective of our study was to determine 'what works best for whom'. This research question was addressed by means of meta-regression analysis. If the exploratory meta-analyses revealed heterogeneity in the effect of programmes across studies, meta-regression analysis was used to explain the heterogeneity in terms of programme characteristics. At first, we only included the variables concerning the programme components. Subsequently, we performed sensitivity analyses adjusting the analyses for the influence of the studies' methodological features. All analyses were performed in Stata (version 12; StataCorp, Texas) using the downloadable procedure "meta-reg".

4. Results

4.1. Descriptive characteristics of reviewed studies

The meta-analytical dataset was based on 241 studies evaluating 288 programmes involving 436,180 students aged between 4 and 21 years old. Table 2 summarizes some of the characteristics of the included studies. In the majority of the evaluations, the substance use outcome measures were collected within 3 months after the implementation of the programme (66%). For a small proportion of the evaluations, substance use outcome measures were not available in the first two years after the programme (7%). This was mostly the case with programmes targeting very young children. In the majority of the evaluations, a randomized design was used (73%). Most of the

Table 2
Descriptive characteristics of 288 school based programmes.

General publication features	*n*	%
Date of report		
1970–1979	4	1.4
1980–1989	40	13.9
1990–1999	61	21.2
2000–2009	144	50.0
2010–2013	39	13.5
Time between programme delivery and post-test		
< 3 months	190	66.0
3–6 months	50	17.4
7–12 months	19	6.6
13–24 months	10	3.4
> 24 months	19	6.6
Methodological characteristics		
Randomization	211	73.3
Adequate handling of missing data	53	18.4
Free of selective reporting	254	88.2
Free of other bias	153	53.1
Outcome categories		
Smoking	228	79.2
Alcohol use	154	53.5
Drug use	110	38.2
Age groups		
Elementary school students	56	19.4
Grade 6 and 7 students	125	43.4
Grade 8 and 9 students	62	21.5
Grade 10–12 students	45	15.7
Type of programme		
Universal programme	206	71.5
Selective programme	54	18.8
Indicated programme	28	9.7

evaluations also appeared free of selective reporting (88%) and slightly more than half of the evaluations appeared free of other biases as well (53%). Adequate handling of missing data was only present in the minority of the evaluations (18%).

Most programmes were evaluated in terms of their effect on smoking (79%), and half of the programmes evaluated their effect on alcohol use (53%). Evaluations on drug use are less common (38%). The majority of programmes are universal programmes (71%). Early adolescence (grade 6 and 7) appeared to be the most popular period for the evaluation of school-based programmes on substance use outcomes as 43% of the included programmes targeted this age group.

4.2. Universal prevention programmes

4.2.1. Meta-analyses of universal programmes for different age groups

Table 3 presents the results of the meta-analyses of universal programmes for each age group. Universal programmes for elementary school children demonstrated a small and statistically significant effect on smoking behaviour ($d = -.15$). Universal programmes for elementary school children also demonstrated a small significant effect on alcohol use ($d = -.14$). In addition, we found a small significant effect on drug use ($d = -.14$). Heterogeneity for programmes targeting elementary school students was between low and moderate (smoking $I^2 = 57\%$; alcohol use $I^2 = 38\%$; drug use $I^2 = 30\%$). Universal programmes for grade 6 and 7 students also demonstrated a small significant effect on smoking behaviour ($d = -.14$), alcohol use ($d = -.10$) and drug use ($d = -.14$). Heterogeneity for this age group was between moderate and high (smoking $I^2 = 81\%$; alcohol use $I^2 = 74\%$; drug use $I^2 = 59\%$). Universal programmes for grade 8 and 9 students demonstrated a small significant effect on smoking ($d = -.09$). However, no significant effects were found for alcohol use and drug use. Heterogeneity for this age group was between low and moderate for programmes evaluated on smoking ($I^2 = 38\%$) and between moderate and high for programmes evaluated on alcohol use ($I^2 = 59\%$) and drug use ($I^2 = 70\%$). Finally, no significant effects were found for universal programmes for the oldest age group. This was presumably due to the small number of studies in this age group, as effect sizes for smoking and alcohol use were larger than for other age groups. Heterogeneity was high for programmes evaluated on smoking ($I^2 = 76\%$) and drug use ($I^2 = 85\%$). For programmes evaluated on alcohol use, heterogeneity was between low and moderate ($I^2 = 44\%$).

Table 3 also presents the content and context of all included programmes. Although there are some differences between the included programmes for different age groups, there are more similarities. The majority of all programmes focused on substances. However, programmes containing skill training units related to social emotional learning were also present in each age group. The most commonly applied general skills training was based on problem solving or decision-making skills training. The majority of programmes in all age groups included health education. Refusal skills training was also very common. The most common theoretical orientation of the programmes for most age groups was the social influence approach, with the exception of alcohol and drug use prevention programmes for grade 10–12 students which are mostly based on the trans-theoretical model of change.

4.2.2. Meta-regression analyses of universal programmes for smoking

Table 4 presents the results of the meta-regression analyses of universal programmes. For elementary school students, effectiveness on smoking behaviour is predicted by generic programmes ($B = -.23$; $p = 0.01$), social skills training ($B = -.13$; $p = 0.04$), self-control training ($B = -.23$; $p = 0.01$), problem solving skills training ($B = -.10$; $p = 0.06$) and focusing on healthy alternatives for substance use ($B = -.15$; $p = 0.05$). All programme components are associated with stronger effects. Sensitivity analyses attested that all predictors remain significant after controlling for the methodological quality of the studies (results not shown).

Effectiveness of universal programmes for grade 6 and 7 students (early adolescence) is predicted by self-control training ($B = -.12$; $p = 0.02$), problem solving or decision making skills training ($B = -.13$; $p = 0.01$), adjustment of the social norm ($B = -.08$; $p = 0.03$), focusing on healthy alternatives ($B = -.25$; $p = 0.01$), peer education ($B = -.09$; $p = 0.08$), and the involvement of parents in the programme ($B = -.10$; $p = 0.02$). The components are all related to stronger effects. Sensitivity analyses demonstrate that all predictors remain significant after controlling for study quality (results not shown).

For grade 8 and 9 students (middle adolescence), there were no significant predictors of the effectiveness on smoking behaviour.

Effectiveness of universal programmes for grade 10–12 students (late adolescence) is predicted by self-control training ($B = -.23$; $p = 0.09$), adjustment of the social norm ($B = -.23$; $p = 0.02$), and peer education ($B = -.74$; $p = 0.01$). All components are related to larger reductions in smoking behaviour. Sensitivity analyses demonstrate that all predictors remain significant after controlling for study quality (results not shown). However, the influence of peer education is based on a single study and firmer conclusions require more data.

4.2.3. Meta-regression analyses of universal programmes for alcohol use

For elementary school students, effectiveness on alcohol use is predicted by self-control training ($B = -0.15$; $p = 0.04$), problem solving or decision making skills training ($B = -0.11$; $p = 0.05$), applying techniques from cognitive behavioural therapy ($B = -0.13$; $p = 0.02$), and behavioural management by a parent or teacher ($B = -0.20$; $p = 0.08$). All programme components are related to stronger effects. Sensitivity analysis demonstrates that the predictors remain significant after controlling for study quality (results not shown).

Effectiveness of universal programmes for grade 6 and 7 students (early adolescence) is predicted by self-control training ($B = -0.14$; $p = 0.01$), problem solving or decision making skills training ($B = -0.09$; $p = 0.03$), refusal skills training ($B = 0.07$; $p = 0.01$), focusing on healthy alternatives ($B = -0.14$; $p = 0.02$), applying

Table 3
Characteristics of all included universal programmes.

	Smoking				Alcohol use				Drug use			
	Grade 1–5 students	Grade 6 and 7 students	Grade 8 and 9 students	Grade 10–12 students	Grade 1–5 students	Grade 6 and 7 students	Grade 8 and 9 students	Grade 10–12 students	Grade 1–5 students	Grade 6 and 7 students	Grade 8 and 9 students	Grade 10–12 students
Meta-analysis statistics												
Number of programmes	36	91	33	9	22	56	23	6	11	39	14	6
Overall effect size: Cohen's *d*	−.15	−.14	−.09	−.15	−.14	−.10	.01	−.22	−.14	−.14	−.06	−.07
95% Confidence interval	−.21 to −.08	−.20 to −.09	−.13 to −.06	−.36 to .06	−.21 to −.08	−.15 to −.05	−.06–.07	−.48–.04	−.28 to −.01	−.20 to −.08	−.22–.09	−.26–.13
Heterogeneity: I^2 -statistic	57%	81%	38%	76%	38%	74%	59%	85%	30%	59%	70%	44%
95% Confidence interval	38–71%	76–84%	5–59%	54–88%	0–63%	66–80%	35–74%	68–93%	0–66%	41–71%	47–82%	0–78%
Characteristics included programmes	*n* (%)	*n* (%ss)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Focus												
Generic programme	10 (28%)	6 (7%)	6 (18%)	2 (22%)	7 (32%)	6 (11%)	6 (26%)	2 (33%)	4 (36%)	3 (8%)	5 (36%)	2 (33%)
Content												
Skills training units												
Social skills	18 (50%)	26 (29%)	12 (36%)	3 (33%)	15 (68%)	20 (36%)	13 (57%)	1 (17%)	6 (55%)	18 (46%)	8 (57%)	3 (50%)
Problem solving/decision making skills	23 (64%)	41 (45%)	22 (67%)	7 (78%)	17 (77%)	29 (52%)	18 (78%)	6 (100%)	7 (64%)	23 (59%)	11 (79%)	5 (83%)
Self-control	11 (31%)	19 (21%)	5 (15%)	3 (33%)	9 (41%)	14 (25%)	4 (17%)	4 (67%)	4 (36%)	12 (31%)	4 (29%)	4 (67%)
Self-esteem	15 (42%)	20 (22%)	7 (21%)	2 (22%)	12 (55%)	19 (34%)	4 (17%)	–	6 (55%)	14 (36%)	3 (21%)	2 (33%)
Coping with stress/anxiety	8 (22%)	13 (14%)	8 (24%)	3 (33%)	8 (36%)	12 (21%)	8 (35%)	2 (33%)	3 (27%)	10 (26%)	6 (43%)	3 (50%)
Common elements substance use prevention												
Health education	29 (81%)	87 (96%)	27 (82%)	8 (89%)	16 (73%)	54 (96%)	19 (83%)	5 (83%)	7 (64%)	37 (95%)	11 (79%)	6 (100%)
Adjustment of the social norm	13 (37%)	51 (56%)	15 (45%)	5 (56%)	5 (23%)	29 (52%)	4 (17%)	4 (67%)	4 (36%)	23 (59%)	1 (7%)	3 (50%)
Refusal skills training	20 (56%)	74 (81%)	15 (45%)	5 (56%)	15 (68%)	37 (66%)	10 (43%)	2 (33%)	8 (73%)	30 (77%)	4 (29%)	3 (50%)
Making a public commitment	3 (8%)	21 (23%)	9 (27%)	3 (33%)	–	6 (11%)	4 (17%)	1 (17%)	–	7 (18%)	1 (7%)	1 (17%)
Offering healthy alternatives	8 (22%)	9 (10%)	12 (36%)	1 (11%)	5 (23%)	10 (18%)	7 (30%)	–	4 (36%)	9 (23%)	3 (21%)	–
Theoretical background												
Social influence approach	20 (56%)	78 (86%)	19 (58%)	4 (44%)	13 (59%)	48 (86%)	13 (57%)	1 (17%)	7 (64%)	32 (82%)	3 (21%)	2 (33%)
Principles cognitive behavioural therapy	13 (36%)	17 (19%)	8 (24%)	2 (22%)	12 (55%)	15 (27%)	10 (43%)	2 (33%)	5 (45%)	12 (31%)	7 (50%)	3 (50%)
Transtheoretical model of change	–	6 (7%)	4 (12%)	3 (33%)	–	4 (7%)	3 (13%)	4 (67%)	–	5 (13%)	2 (14%)	3 (50%)
Applied strategies												
Mentoring	–	2 (2%)	–	–	–	3 (5%)	–	–	–	2 (5%)	–	–
Peer education	1 (3%)	16 (18%)	10 (30%)	1 (11%)	–	8 (14%)	3 (13%)	–	–	4 (10%)	1 (7%)	1 (17%)
Behavioural management by parent/teacher	6 (17%)	16 (18%)	3 (9%)	–	5 (23%)	18 (32%)	4 (17%)	–	4 (36%)	9 (23%)	1 (7%)	–
Context												
Parents involved	11 (31%)	30 (33%)	8 (24%)	1 (11%)	6 (27%)	25 (45%)	6 (26%)	2 (33%)	5 (45%)	15 (38%)	4 (29%)	1 (17%)

Table 4
Results of meta-regression analyses of universal programmes.

Programme characteristic	Substance[a]	Elementary		Early adolescence		Middle adolescence		Late adolescence	
		B	*p*	*B*	*p*	*B*	*p*	*B*	*p*
Generic programme	Smoking	**−.23**	**0.01**	.04	0.63	.02	0.84	.07	0.63
	Alcohol use	−.12	0.17	.05	0.50	.02	0.84	−.03	0.82
	Drug use	−.19	0.34	−.12	0.33	.01	0.93	.15	0.25
Social skills	Smoking	**−.13**	**0.04**	−.04	0.33	.04	0.53	−.01	0.91
	Alcohol use	−.09	0.12	−.03	0.50	.05	0.34	−.06	0.69
	Drug use	−.18	0.14	**−.13**	**0.03**	−.06	0.48	−.16	0.28
Self-control	Smoking	**−.23**	**0.01**	**−.12**	**0.02**	−.01	0.91	**−.23**	**0.09**
	Alcohol use	**−.15**	**0.04**	**−.14**	**0.01**	−.05	0.63	**−.20**	**0.02**
	Drug use	**−.35**	**0.06**	**−.20**	**0.01**	−.09	0.34	−.12	0.34
Problem solving	Smoking	**−.10**	**0.06**	**−.13**	**0.01**	−.01	0.83	−.01	0.93
	Alcohol use	**−.11**	**0.05**	**−.09**	**0.03**	.03	0.61	**−.16**	**0.03**
	Drug use	−.17	0.11	**−.13**	**0.03**	−.02	0.73	.00	0.98
Self-esteem	Smoking	.00	0.98	.06	0.27	.03	0.69	−.03	0.86
	Alcohol use	−.03	0.68	.00	0.96	−.10	0.36	–	–
	Drug use	−.13	0.25	−.10	0.11	.02	0.89	−.15	0.65
Coping with stress	Smoking	.02	0.77	.03	0.65	.06	0.43	.07	0.56
	Alcohol use	−.03	0.65	−.03	0.56	.03	0.72	−.12	0.40
	Drug use	−.04	0.78	−.09	0.24	−.05	0.56	−.05	0.71
Health education	Smoking	.04	0.58	.05	0.44	.08	0.24	.04	0.66
	Alcohol use	−.06	0.38	−.03	0.59	.08	0.21	**−.19**	**0.05**
	Drug use	.01	0.97	.01	0.95	.10	0.37	.08	0.54
Refusal skills	Smoking	−.01	0.85	−.01	0.77	−.01	0.91	−.10	0.38
	Alcohol use	−.00	0.94	**.07**	**0.08**	**.14**	**0.02**	**−.41**	**0.01**
	Drug use	−.10	0.33	−.01	0.81	−.01	0.90	.01	0.95
Social norm	Smoking	−.09	0.16	**−.08**	**0.03**	−.02	0.74	−.06	0.53
	Alcohol use	−.04	0.63	−.05	0.24	.00	0.97	**−.23**	**0.02**
	Drug use	.02	0.83	−.07	0.21	−.08	0.62	.14	0.27
Public commitment	Smoking	.01	0.93	−.06	0.26	−.02	0.82	.10	0.38
	Alcohol use[b]	–	–	−.10	0.19	**.17**	**0.08**	−.06	0.74
	Drug use	–	–	**−.15**	**0.06**	−.06	0.72	−.12	0.44
Healthy alternatives	Smoking	**−.15**	**0.05**	**−.25**	**0.01**	−.00	0.97	.18	0.26
	Alcohol use	−.07	0.45	**−.14**	**0.02**	.08	0.30	–	–
	Drug use	−.08	0.48	−.08	0.25	.00	0.98	–	–
Social influence approach	Smoking	−.00	0.99	−.02	0.61	−.01	0.83	−.07	0.57
	Alcohol use	−.04	0.50	.01	0.84	.07	0.24	**−.57**	**0.01**
	Drug use	−.11	0.29	−.03	0.56	−.09	0.46	−.15	0.65
Principles cognitive behaviour therapy	Smoking	−.11	0.11	−.09	0.11	.03	0.66	−.19	0.24
	Alcohol use	**−.13**	**0.02**	**−.17**	**0.01**	.09	0.14	**−.32**	**0.01**
	Drug use	−.13	0.27	**−.18**	**0.01**	−.05	0.53	−.16	0.25
Transtheoretical model	Smoking	–	–	−.02	0.86	.15	0.12	.07	0.54
	Alcohol use	–	–	−.09	0.36	.06	0.63	−.00	0.98
	Drug use	–	–	−.04	0.69	.04	0.82	.06	0.58
Mentoring	Smoking	–	–	.02	0.92	–	–	–	–
	Alcohol use	–	–	−.15	0.23	–	–	–	–
	Drug use	–	–	**−.43**	**0.01**	–	–	–	–
Peer education	Smoking	−.22	0.35	**−.09**	**0.08**	.03	0.65	**−.74**	**0.01**
	Alcohol use[b]	–	–	**.12**	**0.06**	.03	0.81	-	-
	Drug use	–	–	.07	0.52	.11	0.60	−.12	0.21
Behavioural management	Smoking	−.13	0.25	−.03	0.60	.09	0.43	–	–
	Alcohol use	**−.20**	**0.08**	**−.12**	**0.01**	.11	0.23	–	–
	Drug use	−.10	0.50	−.09	0.15	.13	0.44	–	–
Parents involved	Smoking	−.09	0.27	**−.10**	**0.02**	.01	0.93	.10	0.61
	Alcohol use	−.14	0.12	**−.09**	**0.02**	.05	0.49	**−.29**	**0.02**
	Drug use	.01	0.91	−.05	0.39	.15	0.15	.12	0.52

[a] Smoking is evaluated in 169 programmes; alcohol use in 107 programmes and drug use in 70 programmes.
[b] No longer significant after controlling for methodological variables.

techniques from cognitive behavioural therapy ($B = -0.17$; $p = 0.01$), peer education ($B = 0.12$; $p = 0.06$), behavioural management by a parent or teacher ($B = -0.12$; $p = 0.01$), and parental involvement ($B = -0.09$; $p = 0.02$). Most predictors are related to favourable effects. Adverse effects are found refusal skills training and peer education. Sensitivity analysis revealed that all predictors remain significant after controlling for study quality (results not shown).

For grade 8 and 9 students (middle adolescence), effectiveness of universal programmes is predicted by refusal skills training ($B = 0.14$; $p = 0.02$) and making a public commitment not use substances ($B = 0.17$; $p = 0.08$). However, both predictors are related to adverse effects. After controlling for study quality, making a public commitment not to use substances is no longer significant (results not shown).

Effectiveness of universal programmes for grade 10–12 students (late adolescence) is predicted by self-control training ($B = -0.20$; $p = 0.02$), problem solving or decision making skills training ($B = -0.16$; $p = 0.03$), health education on the interference of substance use with personal goals ($B = -0.19$; $p = 0.05$), refusal skills training ($B = -0.41$; $p = 0.01$), programmes based on a social influence approach ($B = -0.57$; $p = 0.01$), applying techniques from cognitive behavioural therapy ($B = -0.32$; $p = 0.01$), and the involvement of parents in the programme ($B = -0.29$; $p = 0.02$). All components are related to larger reductions in alcohol use. Sensitivity analysis showed that the influence of all predictors essentially remains unaltered after controlling for study quality (results not shown).

Table 5
Characteristics of all included programmes targeting high risk students.

	Smoking				Alcohol use				Drug use			
	Grade 1–5 students	Grade 6 and 7 students	Grade 8 and 9 students	Grade 10–12 students	Grade 1–5 students	Grade 6 and 7 students	Grade 8 and 9 students	Grade 10–12 students	Grade 1–5 students	Grade 6 and 7 students	Grade 8 and 9 students	Grade 10–12 students
Meta-analysis statistics												
Number of programmes	11	15	8	25	13	12	9	13	13	10	6	11
Overall effect size: Cohen's *d*	−.09	−.12	−.25	−.35	.00	−.10	−.13	−.32	−.10	−.08	−.24	−.21
95% confidence interval	−.25–.08	−.16 to −.07	−.56–.05	−.48 to −.21	−.17–.16	−.15 to −.04	−.30–.03	−.55 to −.08	−.27–.08	−.12 to −.04	−.53–.04	−.37 to −.06
Heterogeneity: I^2-statistic	69%	39%	85%	75%	77%	45%	60%	79%	81%	0%	46%	68%
95% confidence interval	42–83%	0–67%	72–92%	64–83%	62–86%	0–72%	17–81%	66–88%	68–88%	0–62%	0–79%	40–83%
Characteristics included programmes	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Focus												
Generic programme	8 (73%)	1 (7%)	3 (38%)	–	8 (62%)	1 (8%)	5 (56%)	–	9 (69%)	2 (20%)	5 (83%)	–
Content												
Skills training units												
Social skills	8 (73%)	12 (80%)	5 (63%)	11 (44%)	8 (62%)	8 (67%)	4 (44%)	4 (31%)	9 (69%)	9 (90%)	4 (67%)	5 (45%)
Problem solving/decision making skills	8 (73%)	13 (87%)	8 (100%)	25(100%)	9 (69%)	11 (92%)	7 (78%)	12 (92%)	10 (77%)	10(100%)	4 (67%)	11(100%)
Self-control	5 (45%)	8 (53%)	6 (75%)	15 (60%)	5 (38%)	5 (42%)	6 (67%)	5 (38%)	7 (54%)	5 (50%)	4 (67%)	5 (45%)
Self-esteem	4 (36%)	8 (53%)	5 (63%)	5 (20%)	4 (31%)	4 (33%)	3 (33%)	–	2 (15%)	5 (50%)	3 (50%)	1 (9%)
Coping with stress/anxiety	2 (18%)	7 (47%)	2 (25%)	18 (72%)	2 (15%)	4 (33%)	–	5 (38%)	3 (23%)	3 (30%)	–	5 (45%)
Common elements substance use prevention												
Health education	4 (36%)	13 (87%)	2 (25%)	16 (64%)	6 (46%)	10 (83%)	4 (44%)	7 (54%)	7 (54%)	7 (70%)	1 (17%)	5 (45%)
Adjustment of the social norm	3 (27%)	7 (47%)	2 (25%)	4 (16%)	5 (38%)	8 (67%)	–	1 (8%)	7 (54%)	5 (50%)	–	–
Refusal skill training	3 (27%)	11 (73%)	3 (38%)	7 (28%)	5 (38%)	6 (50%)	2 (22%)	1 (8%)	6 (46%)	6 (60%)	1 (17%)	1 (9%)
Making a public commitment	–	1 (7%)	–	3 (12%)	–	–	–	–	–	–	–	–
Offering healthy alternatives	2 (18%)	1 (7%)	4 (50%)	10 (40%)	2 (15%)	1 (8%)	2 (22%)	1 (8%)	2 (15%)	1 (10%)	1 (17%)	1 (9%)
Theoretical background												
Social influence approach	4 (36%)	13 (87%)	3 (38%)	11 (44%)	6 (46%)	10 (83%)	3 (33%)	1 (8%)	6 (46%)	7 (70%)	2 (33%)	1 (9%)
Principles cognitive behavioural therapy	7 (64%)	8 (53%)	4 (50%)	16 (46%)	7 (54%)	5 (42%)	6 (67%)	6 (46%)	8 (62%)	4 (40%)	3 (50%)	5 (45%)
Transtheoretical model of change	–	1 (7%)	1 (13%)	20 (80%)	–	3 (25%)	3 (33%)	12 (92%)	–	1 (10%)	1 (17%)	9 (82%)
Applied strategies												
Mentoring	5 (45%)	1 (7%)	–	–	5 (38%)	1 (8%)	–	–	5 (39%)	1 (10%)	–	–
Peer education	2 (18%)	1 (7%)	1 (13%)	1 (4%)	2 (15%)	1 (8%)	–	–	2 (15%)	–	–	–
Behavioural management by parent/teacher	8 (73%)	–	3 (38%)	–	9 (69%)	2 (17%)	3 (33%)	2 (15%)	9 (69%)	–	2 (33%)	2 (18%)
Context												
Parents involved	8 (73%)	3 (20%)	2 (25%)	2 (8%)	9 (69%)	5 (42%)	2 (22%)	3 (23%)	8 (62%)	3 (30%)	1 (17%)	3 (27%)

4.2.4. Meta-regression analyses of universal programmes for drug use

For elementary school students, effectiveness on drug use is predicted by self-control training ($B = -0.35$; $p = 0.06$). Sensitivity analyses demonstrated no changes after controlling for study quality.

Effectiveness of universal programmes for grade 6 and 7 students (early adolescence) is predicted by social skills training ($B = -0.13$; $p = 0.03$), self-control training ($B = -0.20$; $p = 0.01$), problem solving or decision making skills training ($B = -0.13$; $p = 0.03$), making a public commitment not to use substances ($B = -0.15$; $p = 0.06$), applying techniques from cognitive behavioural therapy ($B = -0.18$; $p = 0.01$), and mentoring ($B = -0.43$; $p = 0.01$). These predictors are all related to superior effects. After controlling for study quality, all predictors remain significant (results not shown).

There were no significant predictors of effectiveness of programmes for grade 8 and 9 students (middle adolescence).

For grade 10–12 students (late adolescence), programme effectiveness is predicted by self-control training ($B = -0.23$; $p = 0.09$) and adjustment of the social norm ($B = -0.23$; $p = 0.02$). Sensitivity analysis demonstrates that the model remains marginally significant after controlling for study quality (results not shown).

4.3. Prevention programmes for high-risk students

4.3.1. Meta-analytic results of programmes targeting high-risk students

Table 5 presents the results of the meta-analyses of all included programmes targeting high-risk students stratified by age group.

Table 6
Results of meta-regression analyses of programmes targeting high risk students.

Programme characteristic	Substance[a]	Elementary		Early adolescence		Middle adolescence		Late adolescence	
		B	*p*	*B*	*p*	*B*	*p*	*B*	*p*
Generic programme	Smoking[b]	.12	0.27	.05	0.82	**−.29**	**0.07**	–	
	Alcohol use	.05	0.68	−.07	0.82	−.07	0.67	–	
	Drug use	−.11	0.20	−.03	0.85	−.13	0.31	–	
Social skills	Smoking	.19	0.10	**.20**	**0.04**	.12	0.36	.11	0.30
	Alcohol use	.04	0.75	.03	0.79	−.09	0.61	.07	0.63
	Drug use	.03	0.76	.06	0.51	−.08	0.56	.04	0.72
Self-control	Smoking	−.17	0.19	−.09	0.31	−.10	0.37	**−.35**	**0.01**
	Alcohol use	−.14	0.22	−.07	0.43	−.13	0.14	**−.64**	**0.01**
	Drug use	**−.18**	**0.04**	−.05	0.53	−.14	0.23	**−.34**	**0.01**
Problem solving	Smoking	.11	0.44	.05	0.68	−.07	0.65	−.16	0.18
	Alcohol use	.11	0.39	−.03	0.83	−.03	0.83	−.18	0.14
	Drug use	.20	0.11	.15	0.24	.04	0.79	.03	0.79
Self-esteem	Smoking	.19	0.17	.10	0.34	−.02	0.90	−.15	0.31
	Alcohol use	.05	0.72	.09	0.48	−.09	0.58	–	
	Drug use	−.08	0.59	.03	0.73	−.12	0.41	−.11	0.61
Coping with stress	Smoking	**.31**	**0.07**	−.04	0.65	**−.58**	**0.01**	**−.19**	**0.01**
	Alcohol use	.22	0.30	.05	0.74	–	–	.07	0.56
	Drug use	.08	0.51	.07	0.55	–	–	.07	0.50
Health education	Smoking[b]	**.25**	**0.06**	.06	0.49	−.10	0.63	−.14	0.13
	Alcohol use	**.33**	**0.01**	.12	0.21	.13	0.35	.12	0.26
	Drug use	**.25**	**0.01**	**.17**	**0.04**	−.09	0.78	**.17**	**0.08**
Refusal skills	Smoking	.16	0.25	.07	0.42	−.25	0.13	−.11	0.37
	Alcohol use	**.24**	**0.04**	.04	0.71	.11	0.63	.12	0.58
	Drug use	**.24**	**0.01**	**.13**	**0.07**	−.42	0.20	**.29**	**0.05**
Social norm	Smoking[b]	.16	0.24	.09	0.36	−.28	0.26	**−.30**	**0.06**
	Alcohol use	**.23**	**0.05**	.02	0.84	–	–	.03	0.90
	Drug use	**.18**	**0.03**	.08	0.36	–	–	–	
Public commitment	Smoking	–		−.07	0.80	–	–	–	0.66
	Alcohol use	–		–	–	–	–	–	
	Drug use	–		–	–	–	–	–	
Healthy alternatives	Smoking	.25	0.19	−.02	0.94	−.17	0.38	**−.25**	**0.02**
	Alcohol use	.11	0.58	−.05	0.86	.24	0.30	.17	0.48
	Drug use	−.11	0.49	−.17	0.46	−.14	0.73	.05	0.82
Social influence approach	Smoking	**.27**	**0.03**	.11	0.19	−.16	0.41	−.15	0.14
	Alcohol use	**.29**	**0.01**	.11	0.23	.16	0.39	.16	0.46
	Drug use	**.24**	**0.01**	**.13**	**0.09**	−.15	0.50	**.29**	**0.06**
Principles cognitive behaviour therapy	Smoking[b]	.13	0.29	−.01	0.92	**−.36**	**0.04**	−10	0.24
	Alcohol use	.02	0.89	.00	0.98	−.07	0.60	.01	0.94
	Drug use	−.05	0.56	−.02	0.84	**−.34**	**0.05**	.02	0.84
Transtheoretical model	Smoking	–		.06	0.78	−.24	0.57	−.13	0.10
	Alcohol use	–		−.06	0.74	−.15	0.29	**−.23**	**0.01**
	Drug use	–		−.01	0.97	−.25	0.46	**−.17**	**0.06**
Mentoring	Smoking	.05	0.75	.03	0.91	–	–	–	
	Alcohol use	−.06	0.68	−.08	0.79	–	–	–	
	Drug use	−.12	0.30	−.18	0.42	–	–	–	
Peer education	Smoking[b]	.09	0.57	.11	0.63	−.84	0.16	**−.73**	**0.04**
	Alcohol use	−.01	0.97	.13	0.59	–	–	–	
	Drug use	.06	0.67	–		–	–	–	
Behavioural management	Smoking	.09	0.38	–		.23	0.13	–	
	Alcohol use	.03	0.73	.12	0.48	.10	0.44	**−.82**	**0.01**
	Drug use	**−.15**	**0.06**	–		−08	0.53	**−.50**	**0.01**
Parents involved	Smoking	.13	0.24	.19	0.17	−.28	0.18	.17	0.42
	Alcohol use	.04	0.72	.08	0.50	.09	0.63	**−.35**	**0.05**
	Drug use	−.14	0.12	−.11	0.40	−.32	0.16	−.12	0.37

[a] Smoking is evaluated in 59 programmes, alcohol use in 47 programmes and drug use in 40 programmes.
[b] No longer significant after controlling for methodological variables.

Programmes for high-risk elementary school children did not demonstrate a significant effect on smoking behaviour, alcohol use or drug use. Heterogeneity was between moderate and high (smoking $I^2 = 69\%$; alcohol use $I^2 = 77\%$; drug use $I^2 = 81\%$). Programmes for grade 6 and 7 students demonstrated a small significant effect on smoking behaviour ($d = -.12$), alcohol use ($d = -.10$), and drug use ($d = -.08$). Heterogeneity for programmes evaluated on smoking and alcohol use was between low and moderate (smoking $I^2 = 39\%$; alcohol use $I^2 = 45\%$). Programmes on drug use showed no residual variation. No significant effects were found for programmes for grade 8 and 9 high-risk students. This was presumably due to the small number of studies for this age group, as effect sizes were larger than was the case for the younger age groups. Heterogeneity for this age group was between moderate and high (smoking $I^2 = 85\%$; alcohol use $I^2 = 60\%$; drug use $I^2 = 46\%$). Finally, programmes for high-risk students in the oldest age group demonstrated a medium significant effect on smoking behaviour ($d = -.35$) and alcohol use ($d = -.32$). In addition, we found a small significant effect on drug use ($d = -.21$). Heterogeneity was high (smoking $I^2 = 75\%$; alcohol use $I^2 = 79\%$; drug use $I^2 = 68\%$).

Table 5 also presents the content and context of all included programmes. The included programmes targeting high-risk students for different age groups were less similar than the included universal programmes. Programmes for high-risk elementary school children were mostly generic programmes, targeting social skills and problem solving or decision-making skills, based on principles of cognitive behavioural therapy. Most of the programmes for the youngest age group involved parents. The majority of programmes targeting high-risk students in the older age groups focused on substances. Most of these programmes involved several skill training units related to social emotional learning, of which problem solving or decision making skills training was the most common. Programmes targeting grade 6 and 7 high-risk students (early adolescence) mostly included health education and refusal skills training and applied a social influence approach. In the oldest age group (late adolescence) programmes were mostly based on the trans-theoretical model of change.

4.3.2. Meta-regression analyses of programmes for smoking in high-risk students

Table 6 presents the results of the meta-regression analyses for programmes targeting high-risk students. For high-risk elementary school students, effectiveness on smoking behaviour is predicted by teaching student to cope with stress and anxiety ($B = 0.31$; $p = 0.07$), health education ($B = 0.25$; $p = 0.06$), and applying a social influence approach ($B = 0.27$; $p = 0.03$). These programme components, however, are all related to adverse outcomes. After controlling for study quality, the influence of health education is no longer significant (results not shown).

Effectiveness of programmes for high-risk grade 6 and 7 students (early adolescence) is predicted by social skills training ($B = 0.20$; $p = 0.04$). The programme component is related to less favourable outcomes. Sensitivity analysis demonstrates that the influence of social skills training remains significant after controlling for study quality (results not shown).

For high-risk grade 8 and 9 students (middle adolescence), effectiveness on smoking behaviour is predicted by generic programmes ($B = 0.29$; $p = 0.07$), teaching students how to cope with stress and anxiety ($B = -0.58$; $p = 0.01$), and applying techniques from cognitive behavioural therapy ($B = -0.36$; $p = 0.04$). Generic programmes are related to less favourable outcomes, while teaching students how to cope with stress and anxiety and applying techniques from cognitive behavioural therapy are related to larger reductions in smoking behaviour. After controlling for study quality, the negative influence of generic programmes is no longer significant (results not shown).

The programmes' effectiveness for high-risk grade 10–12 students (late adolescence) is predicted by self-control training ($B = -0.35$; $p = 0.01$), teaching students how to cope with stress and anxiety ($B = -0.19$; $p = 0.01$), altering the social norm regarding substance use ($B = -0.30$; $p = 0.02$), and peer education ($B = -0.73$; $p = 0.04$). All programme components are related to larger reductions in smoking behaviour. After controlling for study quality, altering the social norm regarding substance use and peer education are no longer significant (results not shown).

4.3.3. Meta-regression analyses of programmes for alcohol use in high-risk students

For high-risk elementary school students, effectiveness on alcohol use is predicted by health education ($B = 0.33$; $p = 0.01$), refusal skills training ($B = 0.24$; $p = 0.04$), altering the social norm regarding substance use ($B = 0.23$; $p = 0.05$), and applying a social influence approach ($B = 0.29$; $p = 0.01$). All these programme components, however, are related to less favourable outcomes. Sensitivity analysis demonstrates that all predictors remain significant after controlling for study quality (results not shown).

There were no significant predictors of effectiveness of programmes for grade 6 and 7 (early adolescence) and grade 8 and 9 students (middle adolescence).

Effectiveness of programmes for grade 10–12 students (late adolescence) is predicted by self-control training ($B = -0.64$; $p = 0.01$), programmes based on the Transtheoretical model of behaviour change ($B = -0.23$; $p = 0.01$), behavioural management by a parent or teacher ($B = -0.82$; $p = 0.01$), and the involvement of parents ($B = -0.35$; $p = 0.05$). The programme components are all related to larger reductions in alcohol use. Sensitivity analysis demonstrates that all predicators remain significant after controlling for study quality (results not shown).

4.3.4. Meta-regression analyses of programmes for drug use in high-risk students

For high-risk elementary school students, effectiveness on drug use is predicted by self-control training ($B = -0.18$; $p = 0.04$), health education ($B = 0.25$; $p = 0.01$), refusal skills training ($B = 0.24$; $p = 0.01$), altering the social norm regarding substance use ($B = 0.18$; $p = 0.03$), and applying a social influence approach ($B = 0.24$; $p = 0.01$). Self-control training is related to larger effects on drug use. All other programme components are related to less favourable outcomes. Sensitivity analysis demonstrates that all predictors remain significant after controlling for study quality (results not shown).

For grade high-risk 6 and 7 students (early adolescence), effectiveness on drug use is predicted by health education ($B = 0.17$; $p = 0.04$), refusal skills training ($B = 0.13$; $p = 0.07$), and applying a social influence approach ($B = 0.13$; $p = 0.09$). All programme components are related to less favourable outcomes. After controlling for study quality, all predictors remain significant (results not shown).

For grade high-risk 8 and 9 students (middle adolescence), effectiveness on drug use is best predicted by applying principles from cognitive behavioural therapy ($B = -0.34$; $p = 0.05$), which is related to larger reductions in drug use. Sensitivity analysis demonstrates that the model remains significant after controlling for study quality.

Programme effectiveness for grade 10–12 students (late adolescence) is predicted by self-control training ($B = -0.34$; $p = 0.01$), health education ($B = 0.17$; $p = 0.08$), applying a social influence approach ($B = 0.29$; $p = 0.06$), programmes based on the Transtheoretical model of behaviour change ($B = -0.17$; $p = 0.06$), behavioural management by a parent or teacher ($B = -0.50$; $p = 0.01$). Self-control training, programmes based on the Transtheoretical model and behavioural management by a parent or teacher are related to larger reductions in drug behaviour. Health education and applying a social influence approach are related to less positive results. Sensitivity analysis demonstrates that all predictors remain significant after controlling for study quality (results not shown).

5. Discussion

This study reports on a series of meta-analyses and meta-regression analyses of school-based programmes evaluated on smoking, alcohol use or drug use. We included a total of 241 studies reporting on 288 programmes involving 436,180 students, and tested whether different substance use prevention strategies have differential effects for different age groups (elementary school, early adolescence, middle adolescence, and late adolescence). Most programmes concentrated on smoking (79%), more than half of the programmes were directed at alcohol use (53%), and about 38% of the programmes at drug use. The majority of programmes were universal (71%). Early adolescence (grade 6 and 7) appeared the most popular period for the evaluation of school-based programmes on substance use outcomes, 43% of the included programmes targeted this age group. We observed a great amount of heterogeneity in the effectiveness of the programmes targeting different age groups, which is in accordance with our expectations. In addition, we found differences in the components contributing to the effectiveness of programmes for each of the different age groups. There were a few substance use prevention strategies that appeared significant in all developmental stages, with the exception of middle adolescence. In universal programmes self-control training, problem solving skills training, and techniques from cognitive behavioural therapy appeared beneficial for the majority of students. In programmes for high risk students, programmes with a social influences approach, refusal skills training, and health education, were related to adverse results in the majority of high risk students. For most substance use prevention strategies, however, we found differential effects for the different developmental stages. Many of these findings can be subscribed to changes in biological, cognitive, emotional and social development as well as to changes in the physical and social environment that take place in childhood and adolescence. Below we will summarize the main findings for each developmental period and we discuss the findings in the light of the hypotheses stemming from the most important developmental changes per stage.

5.1. Programmes aimed at elementary school children

We expected that elementary school students would benefit most from programmes teaching them basic skills, helping them master academic and social situations, which are the primary developmental challenges of this developmental stage. In addition, we expected that elementary school programmes should not necessarily address substances, as substance use is rare and outcome expectancies are predominantly negative. Our results confirmed both hypotheses. The analyses of universal programmes revealed that generic programmes, teaching basic skills such as social skills, self-control and problem solving skills, and healthy behaviours are most benificial for elementary school students. Typical substance use prevention strategies, such as health education, preparing student for social pressures to use substances and refusal skills training were not effective. The analyses of programmes for high risk students suggested that drawing the attention to substance use can even be harmful in this developmental stage, as several substance use prevention strategies addressing substances were related to adverse outcomes in high risk students. Based on the overall effect sizes it can be concluded that in elementary school, universal programmes appear more effective than programmes targeting high-risk students.

5.2. Programmes aimed at early adolescents

It was expected that early adolescents would benefit most from programmes based on the social influence approach. This appeared not to be the case. The social influence approach in itself was not related to the effectiveness of universal programmes and marginally related to adverse outcomes in high risk students. Refusal skills training was marginally related to adverse outcomes of universal programmes as well as programmes for high risk students. Our results suggest that early adolescents will not refrain from using substances because they are aware of social pressures and psychologically prepared to resist them. However, in addition to preparing students for social pressures to use substances, most social influence programmes also have a social norm component (Cuijpers, 2002; Newton et al., 2012). The objective of this social norm component is to correct misperceptions of peers' substance use and acceptance-levels. There are various methods to adjust social norms regarding substance use, such as norm-focused discussion groups, feedback regarding peers' actual and perceived substance use (normative feedback), and the use of role models. Several of these social norm strategies, such as normative feedback, stimulating students to make a public commitment not to use substances, mentoring and peer education were related to positive results of universal programmes. The finding that social norm strategies were related to positive results in early adolescents, while preparing students for peer pressure was not, does fit in with the most important developmental changes in early adolescence. Early adolescents become increasingly concerned with peer-relationships and social acceptance. Therefore, instructing students not to conform to their peers while conformity peaks in this developmental stage might be less advisable. Instead, teaching students that substance use is not normal and that the majority of early adolescents do not use substances, does fit in with the normal development. Our findings suggest that the involvement of parents can also be an effective substance use prevention strategy in early adolescence. This finding is also consistent with developmental theory. Although early adolescents spend significantly less time with their parents and peers become more important, parents remain a significant influence in their children's lives (Forehand & Wierson, 1994; Windle et al., 2008). Finally, our findings suggest that the enhancement of basic skills, such as self-control and decision making skills, is not only beneficial for elementary school students, but is related to positive results in early adolescents as well. In early adolescence, universal programmes and programmes targeting high-risk students have rather similar effects.

5.3. Programmes aimed at middle adolescents

It was hypothesised that middle adolescence is an extremely difficult period for substance use prevention. Our findings are partly supportive of this hypothesis. Universal programmes were not very effective as indicated by the relatively low effect-sizes overall, although programmes targeting high-risk students are promising. High-risk students benefit most from programmes based on the principles of cognitive behavioural therapy, teaching students to cope with stress and anxiety. Although our findings imply that behavioural change in middle adolescence is possible, this appears only achievable with individuals already demonstrating substance use (problems), who are willing to change. Universal prevention however, appears difficult and none of the selected substance use prevention strategies were related to more favourable results. We expected that peer education might be a promising substance use prevention strategy, as middle adolescents attune their values and beliefs predominantly on their peers. Our results did not confirm such a positive influence of peer education. However, we did find a negative influence of refusal skills training, which is in line with the characteristics of middle adolescence. Focusing on the danger of peer influences on substance use might not be very beneficial, as middle adolescents are extremely oriented on the needs, expectations, and opinions of their peers. Reward-seeking behaviour culminates in middle adolescence (Steinberg, 2010), and approval by peers is believed to be rewarding in itself (Gunther Moor et al., 2010).

5.4. Programmes aimed at late adolescents

We expected that late adolescents would benefit most from programmes addressing their individuality and future orientation, as

the primary developmental tasks of late adolescence are the formation of identity, planning the future, and the acquisition of all skills necessary to make a successful transition to adulthood. Our findings concerning universal programmes are predominantly in line with these expectations. As opposed to early and middle adolescents, late adolescents do benefit from universal programmes based on a social influences approach teaching refusal skills. As late adolescents are less oriented on the needs, expectations and opinions of their peers, it makes sense that programmes applying a social influence approach and programmes teaching refusal skills are effective in this specific developmental period. During this period, adolescents want to develop their own identity. Programmes that assist them to do so are therefor likely to connect well. Health education on the interference of substance use with personal goals is also an effective substance use prevention strategy in universal programmes, which is in accordance with late adolescents' future orientation. In addition, basic skill training such as self-control and problem solving or decision making skills training appears effective as well, which is in line with the developmental task of acquiring the necessary skills for the transition to adulthood. Finally, the involvement of parents can result in more positive outcomes as well, which is consistent with the improved parent-adolescent relationships. Our findings concerning programmes for high risk students are partially in line with our expectations. Corresponding to our results of universal programmes, high risk late adolescents do benefit from self-control training and the involvement of parents. Unlike our findings of universal programmes, high risk late adolescents do not benefit from a social influences approach or refusal skills training. These substance use prevention strategies are even counterproductive. It could be that in these high risk late adolescents, who are already heavily experimenting with substance use, substance use has become part of their identity. For these high risk students, programmes based on the Transtheoretical model of behaviour change appear more appropriate.

5.5. Strengths and limitations

This study has some important strengths. Although there are several reviews and meta-analyses available on the effectiveness of substance use prevention and interventions, none of these studies considers the effectiveness of these programmes while taking into account the different developmental stages. Most available studies report whether (a certain type of) substance use prevention is effective and some of these studies also discuss programme characteristics contributing to effectiveness. Our study, however, does not only examine what works, but also *what* works for *whom*. The combination of meta-analytic techniques and a developmental perspective on substance use is innovative, and results in interesting recommendations to improve the effectiveness of substance prevention and interventions. Other strengths of our study are the systematic search strategies, the coding of programme characteristics by two independent researchers with outstanding inter-rater reliability, and sensitivity analyses in order to adjust for methodological features of the reviewed studies.

This study has also some limitations that should be considered. In our study, we based our conclusion on the results of meta-regression analyses. Meta-regression analysis is the meta-analytical equivalent of regression analysis in primary studies, which helps to gain understanding in factors contributing to programme outcome. Because our conclusions are based on regression coefficients expressing the strength of a substance use prevention strategy on behavioural outcomes, some caution is warranted with making conclusions about causality. However, our study only included controlled studies with longitudinal data, in which the utilization of the substance use prevention strategies were antecedent to the measurement of behavioural outcomes, strengthening etiological inference. Another limitation of our research strategy is that the conclusions were only based on the variables that were included in the analyses. It is always possible that the variability in programme effects is related to an unmeasured variable. This limitation, however, is not unique for meta-regression analysis. Another limitation of our study is the fact that we based our analyses on a description of the content and context of the programmes, but good programmes may have been described poorly. We were only able to code a certain substance use prevention strategy or methodological feature as present if it was reported somewhere. We are aware that characteristics that are not reported, are not always absent and vice versa. However, it is not possible to analyse information that is not provided. Finally, we excluded a large number of studies due to the fact that we were not able to calculate effect sizes. Considering the magnitude of our study, we were not able to contact all authors of studies with missing data. Exclusion of these studies, however, could have influenced our findings.

6. Conclusions

To summarize, our study demonstrates that it makes good sense to adopt a developmental perspective when designing and offering preventive interventions for substance use in youngsters. All developmental periods offer different possibilities for the prevention or reduction of substance use fitting in with the primary developmental tasks and changes defining each developmental stage.

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Contributors

SO designed the study and developed the search strategies. SO and JL extracted and coded the data. SO conducted the analyses in collaboration with FS. SO and RO wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

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Appendix A. Supplementary data

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References

Bava, S., & Tapert, S. F. (2010). Adolescent brain development and the risk for alcohol and other drug problems. *Neuropsychology Review, 20*, 398–413.

Brown, S. A., McGue, M., Maggs, J., Schulenberg, J., Hingson, R., Swartzwelder, S., ... Murphy, S. (2008). A developmental perspective on alcohol and youths 16 to 20 years of age. *Pediatrics, 121*(Suppl. 4), S290–S310.

Chinn, S. (2000). A simple method for converting an odds ratio to effect size for use in meta-analysis. *Statistics in Medicine, 19*, 3127–3131.

Christie, D., & Viner, R. (2005). Adolescent development. *British Medical Journal, 330*, 301–304.

Cuijpers, P. (2002). Effective ingredients of school-based drug prevention programs. A systematic review. *Addictive Behaviors, 27*, 1009–1023.

DeWit, D. J., Adlaf, E. M., Offord, D. R., & Ogborne, A. C. (2000). Age at first alcohol use: a risk factor for the development of alcohol disorders. *American Journal of Psychiatry*, *157*(5), 745–750.
Eccles, J. S. (1999). The development of children ages 6 to 14. *The Future of Children*, 30–44.
Faggiano, F., Vigna-Taglianti, F. D., Versino, E., Zambon, A., Borraccino, A., & Lemma, P. (2005). School-based prevention for illicit drugs' use. *Cochrane Database of Systematic Reviews*, CD003020.
Forehand, R., & Wierson, M. (1994). The role of developmental factors in planning behavioral interventions for children: Disruptive behavior as an example. *Behavior Therapy*, *24*(1), 117–141.
Foxcroft, D. R., & Tsertsvadze, A. (2011). Universal school-based prevention programs for alcohol misuse in young people. *Cochrane Database of Systematic Reviews*, CD009113.
Gil, A. G., Wagner, E. F., & Tubman, J. G. (2004). Associations between early-adolescent substance use and subsequent young-adult substance use disorders and psychiatric disorders among a multiethnic male sample in South Florida. *American Journal of Public Health*, *94*(9), 1603.
Gottfredson, D. C., & Wilson, D. B. (2003). Characteristics of effective school-based substance abuse prevention. *Prevention Science*, *4*(1), 27–38.
Gunther Moor, B., Leijenhorst, L. v., Rombouts, S. A. R. B., Crone, E. A., & Molen, M. W. v. (2010). Do you like me? Neural correlates of social evaluation and developmental trajectories. *Social Neuroscience*, *5*, 461–482.
Higgins, J. P. T., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *British Medical Journal*, *327*, 557–560.
Lipsey, M. W., & Wilson, D. B. (1993). The efficacy of psychological, educational and behavioural treatment. *American Psychologist*, *48*, 1181–1209.
Masten, A. S., Coatsworth, J. D., Neemann, J., Gest, S. D., Tellegen, A., & Garmezy, N. (1995). The structure and coherence of competence from childhood through adolescence. *Child Development*, *66*(6), 1635–1659.
Masten, A. S., Faden, V. B., Zucker, R. A., & Spear, L. P. (2008). Underage drinking: a developmental framework. *Pediatrics*, *121*, 235–251.
Newton, N. C., Conrod, P., Teesson, M., & Faggiano, F. (2012). School-based alcohol and other drug prevention. *Drug abuse and addiction in medical illness* (pp. 545–560). New York: Springer.
Newton, N. C., O'Leary-Barrett, M., & Conrod, P. J. (2013). Adolescent substance misuse: neurobiology and evidence-based interventions. *Behavioral neurobiology of alcohol addiction* (pp. 685–708). Berlin Heidelberg: Springer.
Norberg, M. M., Kezelman, S., & Lim-Howe, N. (2013). Primary prevention of cannabis use: A systematic review of ranodmized controlled trials. *PloS One*, *8*, e53187.
Nurmi, J. E. (1991). How do adolescents see their future? A review of the development of future orientation and planning. *Developmental Review*, *11*(1), 1–59.
Palmonari, A., Kirchler, E., & Pombeni, M. L. (1991). Differential effects of identification with family and peers on coping with developmental tasks in adolescence. *European Journal of Social Psychology*, *21*(5), 381–402.
Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: toward an integrative model of change. *Journal of Consulting and Clinical Psychology*, *51*, 390–395.
Rehm, J., Mathers, C., Popova, S., Thavorncharoensap, M., Teerawattananon, Y., & Patra, J. (2009). Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *The Lancet*, *373*(9682), 2223–2233.
Rose-Krasnor, L. (1997). The nature of social competence: A theoretical review. *Social Development*, *6*(1), 111–135.
Schulenberg, J. E., & Maggs, J. L. (2002). A developmental perspective on alcohol use and heavy drinking during adolescence and the transition to young adulthood. *Journal of Studies on Alcohol. Supplement*, *14*, 54–70.
Steinberg, L. (2007). Risk taking in adolescence. New perspectives from brain and behavioral science. *Current Directions in Psychological Science*, *16*, 55–59.
Steinberg, L. (2010). A dual systems model of adolescent risk-taking. *Developmental Psychobiology*, *52*, 216–224.
Sumter, S. R., Bokhorst, C. L., Steinberg, L., & Westenberg, P. M. (2008). The developmental pattern of resistance to peer influence in adolescence: Will the teenager ever be able to resist? *Journal of Adolescence*, *32*, 1009–1021.
The Cochrane Collaboration. (2011). *Cochrane handbook for systematic reviews of interventions version 5.1.0.*
Vartanian, L. R. (2000). Revisiting the imaginary audience and personal fable constructs of adolescent egocentrism: A conceptual review. *Adolescence*, *35*, 639–661.
Westenberg, P. M., & Gjerde, P. F. (1999). Ego development during the transition from adolescence to young adulthood: A 9-year longitudinal study. *Journal of Research in Personality*, *33*, 233–252.
Wigfield, A., & Eccles, J. S. (1994). Children's competence beliefs, achievement values, and general self-esteem change across elementary and middle school. *The Journal of Early Adolescence*, *14*(2), 107–138.
Wigfield, A., & Eccles, J. S. (2000). Expectancy–value theory of achievement motivation. *Contemporary Educational Psychology*, *25*(1), 68–81.
Windle, M., Spear, L. P., Fuligni, A. J., Brown, J. D., Pine, D., Smith, G. T., et al. (2008). Transitions into underage and problem drinking: Developmental processes and mechanisms between 10 and 15 years of age. *Pediatrics*, *121*, 273–289.
Zarrett, N., & Eccles, J. (2006). The passage to adulthood: Challenges of late adolescence. *New Directions for Youth Development*, *2006*(111), 13–28.