What predicts incident use of cannabis and progression to abuse and dependence?

A 4-year prospective examination of risk factors in a community sample of adolescents and young adults

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Abstract

Objectives: To determine risk factors of incident onset of use, abuse and dependence of cannabis in a community sample of adolescents and young adults. **Methods:** Risk factors were examined in a prospective longitudinal design across 4 years in a representative sample (N=2446) aged 14-24 at the outset of the study (EDSP). Patterns of DSM-IV defined cannabis use, abuse and dependence were assessed with the Composite International Diagnostic Interview (M-CIDI). Potential risk factors were assessed at baseline. Incident cannabis use, abuse and dependence at second follow-up (on average 42 months after baseline) were the main outcome measures in this study. Associations were analyzed with logistic and negative binomial regressions. **Results:** Using 11 of a total of 56 variables examined, the predictive value of the final multiple logistic regression for incident cannabis use was moderately good (area under the ROC curve=0.78). Cannabis use frequency was predicted in the final model by 18 variables, cannabis abuse by two variables in the younger subsample and nine factors in the older group, and dependence by eight variables (dependence: ROC curve area=0.97). Incident cannabis use was predicted mainly by availability of drugs, peers' drug use, a more 'positive' attitude towards future drug use, and regular previous use of licit drugs, while cannabis dependence was predicted primarily by parental death before age 15, deprived socio-economic status, and baseline use of other illicit drugs. **Conclusion:** Different factors predict the onset or severity of cannabis use and the progression to abuse and dependence. In addition to well-documented risk factors such as peer group pressure, drug availability, and low self-esteem, findings suggest that family history (e.g. parental mental disorders, early parental death), and prior experiences with legal drugs play a significant role in the initiation of cannabis consumption and the transition to cannabis use disorders in adolescents and young adults. Findings suggest that early intervention and prevention might be improved by better targeted treatment.

Keywords: Cannabis; Adolescents; CIDI; Abuse; Dependence; Risk-factors; Prospective study

1. Introduction

Cannabis is the third most popular drug in the world (after alcohol and nicotine) and is most frequently used by adolescents as the first illicit drug (Kingery et al., 1999). The use of cannabis is increasing in developed countries (Bauman and Phongsavan, 1999; Ivis and Adlaf, 1999); in some parts of the world, cannabis use (at least experimental) could already be considered a normative life-event for adolescents and young adults as 40-50% of the population (USA, UK, Germany) or even more than that (New Zealand) have used

the drug (Anthony et al., 1994; Fergusson and Horwood, 2000; McGee et al., 2000; Perkonig et al., 1999; Smart and Ogborne, 2000; Sydow et al., 2001).

Knowledge of factors influencing the initiation and continuation of cannabis use is crucial for any preventive work, especially as cannabis possibly is a 'gateway drug' which can be followed by the use of other, more dangerous, illicit drugs (Kandel and Davies, 1992). Since the late 1970s, numerous studies about possible causes of cannabis use and abuse have been published. The domains investigated have ranged from bio-genetic influences to macro-environmental-societal influences (Newcomb and Felix-Ortiz, 1992). In a considerable number of both cross-sectional and prospective longitudinal studies, a large number of possible influential factors have been studied across all domains, with no factor or group of factors being successfully identified as accounting convincingly for the initiation of cannabis use and the development of various patterns of abuse. Studies about risk and protective factors are impaired by the following conceptual and methodological problems:

- 1) Although there have been various attempts to organize the known vulnerability, risk and protective factors for adolescents' drug use and abuse (Bry et al., 1982; Hansen and O'Malley, 1996; Hawkins et al., 1992; Jessor et al., 1995; Labouvie and McGee, 1986; Newcomb et al., 1986; Petraitis et al., 1995; Swadi, 1999) there is, at this point, no consensus about which of these vulnerability/risk topologies are the most appropriate.
- 2) There is agreement about defining the initiation/cessation of drug use but a lack of consensus with regard to the appropriate definition of other outcome measures (e.g. light, repeated, heavy use; abuse, dependence; misuse; harmful consequences).
- 3) Most studies have focused on cross-sectional categorical outcome measures (e.g. use vs no use), and have ignored multiple frequency and quantity measures and their empirical relationships in the statistical analyzes.
- 4) Most studies do not take into account cannabis use disorders although predictors of lifetime drug use differ from predictors of lifetime dependence (Warner et al., 1995).
- 5) Only a few studies have applied longitudinal designs that allow the prospective examination of risk factors prior to the development of first use of cannabis and the study of different stages of progression/decrease in drug use on the basis of a comprehensive set of potentially relevant vulnerability and risk variables (Fergusson and Horwood, 1997; Kandel et al., 1978; Newcomb, 1992; Jessor et al., 1995; McGee et al., 2000; Shedler and Block, 1990; Sieber and Angst, 1990).
- 6) Few such longitudinal studies are based on representative population samples and even fewer started in early adolescence before exposure to substances took place.

According to the risk factor typology of Hawkins et al. (1992) and Petraitis et al. (1995) the current state of research can be summarized by listing the following variables that predict initiation of cannabis use or frequency of use in adolescents and young adults (Bachman et al., 1998; Brook et al., 1999; Coffey et al., 2000; Fergusson and Horwood, 1997; Grunbaum et al., 2000; Hammer and Vaglum, 1990; Kandel and Faust, 1975; Kandel et al., 1992; Kosterman et al., 2000; McGee et al., 2000; Royo-Bordonada et al., 1997; Shedler and Block, 1990; Sieber and Angst, 1990; Van Etten et al., 1997; Wilsnack et al., 1997):

- 1) Socio-environmental variables (male gender, low socio-economic status in childhood, adverse lifeevents),
- 2) substance related variables (tobacco use, alcohol use, alcohol use disorder, attitudes toward drug use, drug use opportunities; peers' use of nicotine/cannabis),

3) intrapersonal variables such as personality attributes (psychological problems; low self-esteem, loneliness, high unconventionality/novelty seeking), psychopathology (mental/mood/anxiety disorders) and childhood factors (behavior problems, social incompetence, insecurity), and

4) interpersonal variables describing the current family (e.g. low family caring, low parental attachment, low identification with parents, leaving family home by age 18; father smoking), childhood family situation (not having been brought up by both parents, impaired parent-child relationship, conflict-filled family climate, sexual abuse, parental history of alcohol problems, parental illicit drug use).

Cannabis dependence and abuse is predicted by frequency and quantity of cannabis use, alcohol dependence, other drug use disorder (only for dependence), male gender (only for abuse), younger age, urban place of living (only for abuse) and major depression (only for dependence) (Grant and Pickering, 1999).

This paper is based on our previous papers about cannabis related results in our sample of more than 3000 adolescents and young adults that reported baseline prevalence and age of onset characteristics of cannabis use and examined the stability and incidence of cannabis use over time (Perkonig et al., 1999; Sydow et al., 2001). We also analyzed covariates of cannabis use progression from baseline to first follow-up (20 months later) in the younger subsample of N=1228 participants. In addition to well-documented risk factors such as peer group drug use, immediate availability of drugs, low self-esteem and competence, these findings suggest that family history of substance use disorders and prior experiences (including dependence) with legal drugs play a significant role in the early developmental stages of cannabis consumption, in our subsample of 14-17-yearold respondents (Höfler et al., 1999).

The purpose of this paper is to investigate prospectively over 4 years the relative contribution of various vulnerability, risk and protective factors in the total sample of respondents aged 14-24 at the outset of the study. The factors (all assessed at baseline/t0) examined are consistent with existing typologies about the type of influence (Hawkins et al., 1992; Petraitis et al., 1995): socio-environmental variables, substance related variables, intrapersonal variables assessing personality and psychopathology, trauma and childhood mental problems, and interpersonal/family variables assessing current family situation and developmental family factors.

The following questions will be examined for participants who completed the entire follow-up period:

- 1) Which factors (assessed at baseline t0) predict incident cannabis use in former baseline non-users at second follow-up (t2), 4 years later?
- 2) Which t0-factors predict cumulative follow-up frequency of cannabis use at second follow-up (t2) in former non-users?
- 3) Which t0-factors predict progression to cannabis abuse at follow-up (t2) in those who were baseline cannabis users without cannabis use disorder?
- 4) Which t0-factors predict progression to cannabis dependence at follow-up (t2) in those who were baseline cannabis users without cannabis use disorder?

In a multifaceted analysis we examine the relative contribution of these variables – assessed at baseline – to the prediction of incident cannabis use, abuse and dependence.

2. Methods

The Early Developmental Stages of Psychopathology Study (EDSP) (Lieb et al., 2000; Perkonig et al., 1999; Wittchen et al., 1998) explores the prevalence, incidence, comorbidity, risk factors, protective factors and 4-year course of mental disorders, with specific emphasis on substance-use disorders, in a representative general population sample. The study is divided into three waves, the first conducted in 1995 (t0), the second in 1996-97 (t1: only the younger cohort was assessed), and the third in 1998-99 (t2: again with the total sample).

2.1. Baseline sample and follow-up investigations

The sample was drawn randomly from the 1994 government registries of residents in metropolitan Munich. A total of 3021 participants aged 14-24 years (birth cohorts 1970-1981) were successfully interviewed at baseline, resulting in a response rate of 71%. Since the study was designed with a special interest in early stages of substance use disorders, 14-15-year-olds were sampled at twice the probability of 16-21- and 22-24- year-olds were sampled at half the probability. At baseline, almost three-quarters of the participants were students, 36% at the secondary level and 26% at university level, and 20% of the participants were employed. Nearly two-thirds (62%) were living with their parents, 23% were living alone, and 12% were living with their partner/spouse. The majority of the respondents were classified as middle class (59%), reflecting the population of Munich.

Two follow-up investigations were completed after the initial baseline assessment, covering an overall period of 42 months (range: 34-50 months). The first follow-up (t1) was conducted in 1996-1997 and was confined to the younger subsample (aged 14-17 at baseline); 1228 interviews were completed, giving a follow-up response rate of 88%. The second follow-up (t2) included all baseline respondents and was conducted in 1998-99, an average of 42 months after the baseline investigation (range 34-50 months); the response rate was 83% (N=2548). Of these, 102 participants did not want to respond to questions about illicit drug use at t0, t1 or t2. Therefore, our dataset is N=2446 with regard to the longitudinal development of cannabis use/abuse across 3.5 years: 1101 participants in the younger cohort (aged 14-17 at baseline, born between 1977 and 1981), and 1345 in the older cohort (aged 18-24 at baseline, born between 1970 and 1977). Data from all three assessments are used in this paper. Noteworthy changes in sociodemographic characteristics from baseline to second follow-up were found only for school/employment status (t2: secondary school: 13%, employed: 36%) and living arrangements (with parents: 40%; with partner: 23%).

2.2. Measures

Face-to-face computer-assisted interviews were administered by professional health interviewers and clinical psychologists at baseline and at the two follow-ups. Diagnostic assessments (t0-t1-t2) were based on the Munich version of the Composite International Diagnostic Interview (M-CIDI; Lachner et al., 1998). At baseline, lifetime and past 12-month substance use, substance use disorders and other mental disorders were assessed according to DSM-IV criteria. In both follow-up investigations, substance use and diagnoses during the follow-up period(s) and for the previous 12 months were evaluated. The M-CIDI is an updated version of the World Health Organisation's CIDI version 1.2 (WHO-CIDI; World Health Organisation, 1990), which incorporates questions to cover DSM-IV (American Psychiatric Association, 1994) and ICD-10 criteria. The reliability

and procedural validity of the MCIDI have been established (Lachner et al., 1998; Reed et al., 1998). The assessment of cannabis use, abuse and dependence have been comprehensively described elsewhere (Perkonig et al., 1998).

2.3. Vulnerability, risk and protective factors

The factors examined (see Table 1) are consistent with Hawkins et al.'s (1992) topology. They were all assessed at baseline (t0).

2.4. Outcome measures

- 1) Cannabis use during the 3.5-year follow-up interval among baseline non-users (use vs. no use).
- 2) Frequency of cannabis use in the follow-up period among baseline non-users (defined as the number of times when cannabis was consumed).
- 3) DSM-IV defined cannabis abuse during the follow-up period among baseline cannabis users without disorder (abuse vs. no use disorder).
- 4) DSM-IV defined cannabis dependence during the follow-up period among baseline cannabis users without dependence (dependence vs. no dependence).

2.5. Statistical analyses

As our primary interest was to depict predictors of cannabis use and of abuse/dependence, we first depict crude associations between predictor and outcome variables while adjusting only for age and gender effects. Then, final multiple models were created to identify the predictors that may be independently associated with the use or abuse of cannabis.

Associations with binary outcomes are based on odds ratios (OR) from logistic regressions. Associations with the outcome 'cannabis use frequency' are based on incidence rate ratios (IRR; mean ratio of the outcome) from negative binomial regressions. Negative binomial regressions are useful for count variables with so-called overdispersion (resulting, for example, from correlated events; Cox, 1983; Lawless, 1987). Since the negative binomial regression is a model for variables with integer values 0,1, ... and every incident cannabis user per definition has used cannabis at least once, we used the number - 1 as outcome. Further, as the follow-up time varies, the IRR are based on the frequencies divided by the length of the follow-up interval by considering the follow-up period as exposure time in the NBREG procedure of Stata.

Data were weighted by applying the Huber-White sandwich matrix (Royall, 1986) for robust estimates of standard errors within the LOGISTIC procedure of the Stata software package (StataCorp., 1999). For the association analyses all quantitative covariates were divided by their standard deviation to improve the comparability of the OR. These standardized OR describe the increase in odds per increase by one standard deviation in the covariate. Among all covariates a combined backward/forward stepwise selection procedure was conducted (SW procedure in Stata). With regard to multiple logistic regressions of incident cannabis use (yes or no; frequency of use) and abuse we started with the model containing all covariates and omitted factors with a P-value smaller than 0.05 (Wald x2-test). Additionally, factors that already were omitted were allowed to be re-added when the P-value was smaller than 0.01. But with regard to dependence we could take into account only those categorical variables which had significant effects in the

crude associations (and all dimensional risk factors) because of the small N. For qualitative covariates with more than two categories the P-value refers to the model where all dummy variables of a covariate are either jointly added or omitted. After this procedure, the adequacy of the model was tested with the link test (Pregibon, 1980). Hereby, the outcome is regressed on the linear predictor (linear combination of covariates and regression coefficients) as well as the squared linear predictor. The effect of the squared term is considered to be an indicator of a misspecification of the model, e.g. by disregarded interactions – conditional on the selection of covariates.

The predictive value of the model was assessed by the area under the ROC-curve (Kraemer et al., 1999) based on the model probabilities, which can be regarded as the probability that an incident cannabis (ab)use case has a greater predicted probability from the model to be an incident case than a non-incident case.

We conducted analyses with 47 independent categorical variables and nine dimensional variables. With regard to all four questions studied, there were insignificant results for 10 categorical predictor variables assessed at baseline (marital status; alcohol use before age 15; any affective disorder; trauma through sexual abuse; parental attitudes towards alcohol; alcohol problems of mother/father/other relatives; siblings' problems with illicit substances; anxiety problems of father).

3. Results

3.1. Predictors for first cannabis use in former non-users

3.1.1. Crude associations

Table 2 informs about crude associations between categorical variables (assessed at baseline) and follow-up cannabis use (continuous non-users compared to incident users) among baseline non-users of cannabis. Significant predictive associations were found for male gender, easy availability of drugs, cannabis offered at school or from friends, baseline peer drug use, prior use of alcohol and nicotine (at baseline, before age 15), more positive attitude to future drug use, alcohol and nicotine use disorders, other mental disorders (except anxiety and affective disorders), other trauma (except sexual abuse), a not very good relationship to mother, maternal affective problems, grandparental problems with alcohol, a positive parental attitude towards nicotine, not having grown up with both parents, and parental divorce before 15 years of age.

As can be seen in Table 3, six of the dimensional variables were associated significantly with incident cannabis use. Among the respondents, the following were predictors of incident use: younger age, higher behavioral inhibition (BI) during childhood (fear factor, assessed retrospectively), a higher SCL-90 global severity index (GSI), more daily hassles (DH), low selfcontrol and coping skills (KV) and a higher score of stressful life-events (MEL).

3.1.2. Multiple model

Significant as well as non-significant crude associations were used in the multiple model. The multiple logistic regression (Table 4) reveals that it is sufficient to regress incident cannabis use on 11 variables. Male gender, younger age, regular alcohol use, smoking before age 15, other mental disorders, more positive attitudes toward future drug use, easy

availability of drugs, peer drug use, childhood BI (fear factor), having a 'not very good' relationship to his/her mother and having grown up without one or both parents all were associated with incident cannabis use during the 4-year follow-up interval. The final model fits the data well ($P=0.80$ of the linktest). The predictive value was moderately good with an area of 0.78 under the ROC curve.

3.2. Predictors for the extent of cannabis use in former non-users

3.2.1. Crude associations

Thirteen categorical variables, assessed at baseline, were significantly related to the outcome 'frequency of cannabis use' at second follow-up (Table 5). Associated with a higher use frequency were: male gender, employment (as opposed to school, university or training), easy availability of drugs, drugs offered in school or by friends, peer drug use, smoking and use of other illicit drugs except cannabis (at baseline, before age 15), and more positive attitudes toward future drug use. Protective factors were grandparental alcohol problems, parental problems with illicit drugs and parental death before age 15.

The frequency of cannabis use was significantly associated with only one of the dimensional variables, namely age ($IRR=0.75$), decreasing by the factor 0.68-0.83 per year of age.

3.2.2. Multiple model

The multiple negative binomial regression (Table 6) reveals that cannabis use frequency at follow-up among baseline non-users of cannabis is significantly associated with 18 variables, assessed at baseline. A higher frequency of cannabis consumption is associated with male gender, a deprived financial situation, employment (as compared to attending school), easy availability of drugs, peer drug use, consumption of other illicit drugs at baseline, and maternal affective problems. A decreased risk for high cannabis consumption can be found among older participants, those with a rural place of residence, and those with more positive life-events. Surprisingly, decreased risk also occurs among those who describe regular alcohol use at baseline, higher BI during childhood (social factor), substance use problems in the family (parental problems with illicit drug use, medication; grandparental alcohol problems), problematic parental attitudes toward drugs (medication) and parental mental problems (maternal anxiety, paternal affective problems). It is remarkable that most of the foregoing significant factors differed from those that predicted cannabis use incidence, and only four factors were identical (age, gender, availability of drugs, regular alcohol use). The model is in line with the data ($P=0.73$).

3.3. Predictors of progression into cannabis abuse in former users of cannabis without use disorder

3.3.1. Crude associations

Tables 7 and 8 depict the crude associations of categorical and dimensional variables associated with DSM-IV defined cannabis abuse and dependence. Progression from use without disorder into cannabis abuse was associated with only five of the analyzed 47 categorical risk variables (Table 7): male gender, lower socio-economic status, 5+

cannabis use at baseline, more positive attitude toward future drug use and illicit substance (other than cannabis) abuse or dependence at baseline.

Cannabis abuse is associated with only two of the dimensional scores (Table 8): age (decreased risk with advancing age) and self-control and coping skills (KV).

3.3.2. Multiple model

The multiple logistic regression reveals that cannabis abuse (without dependence) at follow-up in baseline users of cannabis without disorder is associated with three variables, assessed at baseline, indicating an increased risk (male gender, a more positive attitude toward future drug use, DSM-IV illicit drug use disorder) and three protective variables (higher age, anxiety disorder, availability of alcohol at home). Because the final model did not fit the data very well ($P=0.02$ of the linktest) we conducted further analyzes on interaction effects. We found nine significant inter actions with age. For eight covariates the association increased significantly with increasing age (alcohol use disorder, not very good relationship to father, bad financial situation, peer drug use, behavior inhibition: social factor, DH, SCL-90 GSI, self-esteem/VK); for one covariate the association decreased with increasing age (positive life events/MEL).

Therefore, we split the sample by age-group and conducted separate multiple logistic regressions: in the younger group (14-17 years at baseline) only two variables predicted progression into abuse: male gender (OR=4.6; CI=1.1-18.8) and a baseline cannabis use of five times or more (OR=5.3, CI=1.8-15.8). This final model fits the data well ($P=0.28$ of the linktest) and had a moderately good predictive value (ROC curve area=0.74).

In contrast, nine factors predicted progression into abuse in the older subsample (18-24 years at baseline): the risk was increased for male gender (OR=8.9, CI=1.6-48.3), more positive attitudes toward future drug use (OR=4.6, CI=1.5-14.0), drug disorder at baseline (OR=85.2, CI=10.4-700.9), grandparental alcohol problems (OR=4.0, CI=1.2-13.5) and a not very good relationship to father (OR=4.8, CI=1.2-18.6). Surprisingly, a not very good relationship to mother had a protective effect (OR=0.2, CI=0.1-0.7), as did anxiety disorder (OR=0.2, CI=0.0-0.8), living arrangement (not with parents: OR=0.2, CI=0.1-0.8) and availability of alcohol at home (OR=0.2, CI=0.1-0.7). This model, too, fit the data well ($P=0.63$ of the linktest) and had a good predictive value (ROC curve area=0.89).

3.4. Predictors of progression into cannabis dependence in former users of cannabis without use disorder

3.4.1. Crude associations

Six dimensional variables, assessed at baseline, predicted cannabis dependence at follow-up (Table 7): the risk is increased for those with a deprived socioeconomic situation (low education, low social status, bad financial situation), for baseline users of other illicit drugs, and those who experienced parental death before the age of 15. Surprisingly, availability of alcohol at home had a protective effect. Although the OR could not be determined, it is remarkable that none of the 12 participants who had developed a cannabis dependence at follow-up had had a 'very good' relationship with their fathers at baseline.

Cannabis dependence is associated with five dimensional variables (Table 8): age, higher BI at childhood (social and fear factor), a higher SCL-90 GSI, and lower self-esteem (VK).

3.4.2. Multiple model

A different set of variables predicted cannabis dependence as compared to abuse at follow-up in baseline users of cannabis without disorder. Eight risk factors contributed significantly to the multiple logistic regression (Table 9): an increased risk is associated primarily with parental death before the age of 15 (OR=39.7), a deprived socio-economic situation (social class, financial situation), baseline use of other illicit drugs except cannabis, indicators of mental instability (low self-esteem/VK, SCL-90 GSI) and younger age. Male gender did not reach significance. Surprisingly, low self-control and coping skills had a protective effect (this is valid only in the multiple model; the trend is reversed in the crude associations). The final model fits the data well ($P=0.93$ of the linktest) and had a very good predictive value, with an area of 0.97 under the ROC curve.

4. Discussion

The aim of this paper was to examine prospectively the relative contribution of various risk factors to incident cannabis use and to progression to abuse and dependence in a representative population sample. We studied more than 3000 14-24-year-old adolescents and young adults (ages at the outset of the study) in Munich, Germany, over a follow-up period of 4 years. Special features of the study were the use of standardized interviews to assess substance-use patterns, and the inclusion of family history data concerning parental psychopathology and childhood developmental factors. Before discussing our findings in more detail, some limitations should be mentioned:

- a) Our findings were obtained in a sample of 14-24-year-olds living in Munich, a metropolitan area with a relatively high quality of life, low unemployment and crime rates. Thus, direct comparisons with other age groups and areas characterized by a higher degree of social problems must be made with caution.
- b) In order to reduce the complexity of the analysis, the manner in which some of the variables might have changed between baseline and follow-up was not specifically taken into account. For instance, the availability of drugs as well as the respondents' peer group might have changed during follow-up. This will probably yield lower bound estimates of predictive power since the baseline predictors might be viewed as imprecise measures of underlying varying traits to which the results of misclassification theory apply (Gladen and Rogan, 1979).
- c) We have studied a sample from multiple age cohorts who were assessed on risk factors and cannabis use at different ages. Therefore, from the analyzes presented here we cannot conclude on specific risk factors for specific narrowly defined age groups or birth cohorts. But in order to take the heterogeneity of age at baseline into account we also looked for potential different associations according to age by adding the concerning interaction term to each model. In most cases, we did not find that associations differed by age.

With these limitations in mind, we can conclude (see Table 10, which summarizes the results):

1) In spite of substantial differences in sampling, assessment, outcome definition and statistical methods used, the effects of many of the core variables identified in previous longitudinal studies of adolescent and young adult cannabis users in other populations (Clayton, 1992; Kandel and Davies, 1992; Newcomb, 1992) were by and large confirmed in the present study, in that they were significantly associated with incident cannabis use.

2) Our results suggest that predictors of incident cannabis use often differ from predictors of cannabis use disorders according to DSM-IV. Similar to the results of Grant and Pickering (1999), abuse and dependence were predicted in our study through male gender, younger age, and other drug use disorder – but in contrast to them we did not find significant effects for alcohol dependence or depression.

3) Familial influences were of considerable importance in our study. While several studies also found that growing up without both parents (or early parental divorce) is a risk factor for incident use of cannabis, we were to our knowledge the first to show that early parental death is a risk factor for progression to cannabis dependence among former users without disorder. Parental and grandparental mental disorders and substance use problems and attitudes toward the use of substances were also of importance. But, while maternal depression increased the risk of a higher cannabis use frequency, other indicators of a problematic family history with regard to substance use decreased that risk.

4) Of 56 independent variables studied, 10 categorical predictor variables assessed at baseline had no significant impact on cannabis use patterns. In contrast to other researchers we did not find any effect for trauma through sexual abuse (Wilsnack et al., 1997). Alcohol use before age 15 and alcohol problems of mother/father/other relatives did not have an effect, but regular alcohol use at baseline and alcohol use disorder and – surprisingly – grandparental alcohol problems had an impact. Further, marital status, affective disorder, parental attitudes toward alcohol, siblings' problems with illicit substances and anxiety problems of the father did not influence cannabis use patterns in our sample.

According to the risk factor typologies which guided our study (Hawkins et al., 1992; Petraitis et al., 1995) we can conclude (see Table 10):

With regard to sociodemographic factors, our study, consistent with most others, found that male gender predicted incident cannabis use and abuse (but did not reach significance for dependence). Older age generally had a preventive effect with regard to cannabis use, abuse and dependence. Incident cannabis use was not predicted by the other sociodemographic variables researched, but cannabis use frequency and dependence were. People with a less advantaged socio-economic situation (measured by socio-economic status, financial situation, and education) were at a greater risk of developing higher cannabis use and dependence. In most U.S. studies, individuals with a low educational level and those who had dropped out of the education system were found to be particularly at risk (Warner et al., 1995).

As in numerous previous publications (Coffey et al., 2000; Dembo et al., 1979; Spencer, 1985; Newcomb and Bentler, 1986; Kandel and Andrews, 1987; Kosterman et al., 2000; Maddahian et al., 1988; Needle et al., 1988; Brook et al., 1990), the key role of easy availability of drugs, as well as the influence of the peer group, was confirmed. The availability of drugs and peers' drug use predict cannabis use but not the development of use disorders. Similarly, licit drug use predicts cannabis use initiation and frequency

(Coffey et al., 2000; Kosterman et al., 2000) but not abuse and dependence. Use of other illicit drugs at baseline predicts dependence. Participants' attitude toward future drug use is of relevance for the incidence of cannabis use, as has been found in other studies (Kosterman et al., 2000), and also for progression to abuse.

In contrast to previous analyses of our younger subsample (Höfler et al., 1999), we did not find a significant effect for a history of nicotine and alcohol disorders in the multiple logistic regressions. But illicit drug (other than cannabis) use disorders predicted abuse in the older subsample, while anxiety disorder had a protective effect in this subgroup. Affective disorders did not have a significant impact in the multiple models.

Various personality constructs indicating mental problems in childhood (BI: social and fear factor) and at the time of the baseline assessment (high degree of psychopathological symptoms, low self-esteem; low self-control and coping skills) were found to be powerful risk factors for incident cannabis use, use frequency and use disorders. While most of these effects implied a greater risk for participants with higher indicators of mental problems, higher BI (social factor) in childhood and more frequent positive life-events were protective with regard to cannabis use frequency and, surprisingly, low self-control and coping skills were protective with regard to progression to dependence (only in the multiple model, not in the crude associations).

One remarkable finding of our study is the important role of interpersonal/family factors. Participants with a 'very good' relationship to their mother at baseline were at a lower risk of developing incident cannabis use compared to those with a less positive relationship. But the same variable also predicted an increased risk for developing cannabis abuse in the older subgroup, while a very good relationship to father had a protective effect. This result is somewhat puzzling and needs replication in further studies. But it is in line with family studies that indicate that 'the same' paternal and maternal behavior can have different implications for children and that a very close parent-child relationship can be a strength as well as an indicator of a problematic dynamic of the marital system, creating a parent-child coalition (Cowan and McHale, 1996; Katz and Gottman, 1996). Additionally, none of the participants who developed a cannabis dependence had had a 'very good' relationship to his/her father at baseline. Not growing up with both parents increased the risk of incident cannabis use but not of use frequency or use disorders. Parental death before age 15 predicted cannabis use frequency (decreased risk in the crude associations!) and was, at the same time, the most powerful predictor of the transition into dependence (OR=39.7). Availability of alcohol at home reduced the probability of developing a cannabis use disorder in the older subsample. (Possibly it could predict alcohol use disorders instead.)

Results about familial substance and mental problems were somewhat mixed: maternal affective problems increased the risk of higher cannabis use frequency, but all other factors (paternal affective problems, maternal anxiety problems, parental and grandparental substance use problems) and positive parental attitudes toward medication had a protective effect with regard to cannabis use frequency (and no effect on cannabis use disorders except for grandparental alcohol problems, which increased the risk for progression into abuse in the older subsample). So, it seems that adolescents and young adults who acknowledge that certain substance use problems run in their family tend to use cannabis in a more reserved way compared to others. Similarly, persons who have lost their parents in childhood seem to sense their vulnerability and tend to use cannabis less

frequently than those with living parents – as if they ‘knew’ that they are at a very high risk of developing a cannabis dependence.

To conclude, the multi-factorial interplay of vulnerability and risk factors in the initiation of cannabis use was confirmed in this sample of adolescents and young adults using a multiple logistic model. The findings underline the view that while only one factor (age) is relevant for all four questions under consideration (incident cannabis use, use frequency, incident abuse, incident dependence), predictors of incident cannabis use mostly differ from predictors of abuse or dependence. For example, early parental death predicts lower cannabis use frequencies but at the same time very high risks for developing a cannabis dependence (OR=39.7). Males have higher risks for incident cannabis use, higher use frequencies and abuse, but the gender effect did not reach significance for dependence.

Our results have important implications for the intervention of drug use, abuse and dependence: it seems that appropriate intervention targets differ depending on when in the stage of substance use the intervention occurs. According to our results, primary prevention to prevent cannabis use should focus on availability of drugs, peers’ drug use, adolescents attitude toward drug use and on relatively common familial problems (impaired relationship to one’s parents, growing up without both parents), while different factors are important with regard to high risk primary prevention of abuse and dependence among cannabis users. The prevention of cannabis dependence should for example focus on adolescents and young adults who suffer from early parental death, live under deprived socio-economic conditions, have used already other illicit drugs, have a high degree of psychopathological symptoms, and a low self-esteem. This complexity might help explain why successful primary preventions have been so difficult to develop.

Table 1
Vulnerability, risk and protective factors assessed (all assessed at baseline/t0)

Domain	Measure	Reference
<i>Socioenvironmental variables</i>		
Age at baseline	M-CIDE: sociodemographic section	
Gender	M-CIDE: sociodemographic section	
Marital status	M-CIDE: sociodemographic section	
Living arrangement (alone, with parents/partner)	M-CIDE: sociodemographic section	
Education (low, intermediate, high)	M-CIDE: sociodemographic section	
Employment status	M-CIDE: sociodemographic section	
Socioeconomic status (low, middle, high)	M-CIDE: sociodemographic section	
Financial situation	M-CIDE: sociodemographic section	
Place of residence (urban, rural)	M-CIDE: sociodemographic section	
<i>Substance related variables</i>		
Availability of drugs	M-CIDE: substance section	
Peers' drug intake	M-CIDE: substance section	
Use of alcohol	M-CIDE: substance section	
Use of nicotine	M-CIDE: substance section	
Use of cannabis ^a	M-CIDE: substance section	
Onset of cannabis use before age 15 ^a	M-CIDE: substance section	
Use of other illicit drugs	M-CIDE: substance section	
Onset of alcohol use before age 15	M-CIDE: substance section	
Onset of nicotine use before age 15	M-CIDE: substance section	
Onset of illicit drug use before age 15	M-CIDE: substance section	
Attitudes toward future drug use	M-CIDE: substance section	
<i>Intrapersonal variables: childhood personality</i>		
Behavioral inhibition during childhood: social/fear	Retrospective Self-Report of Inhibition (RSRI) (BI)	Reznick et al., 1992
<i>Intrapersonal variables: current personality</i>		
Self-control and coping skills	Skala z. Erfassung d. Problembewältigungskompetenz (KV)	Perkonig and Wittchen, 1995a
Self esteem	Vergleich von Kompetenzen Skala (VK)	Lachner and Wittchen, 1995
Psychiatric symptom distress	Symptom-Checklist-90-Revised (SCL-90-R)	Derogatis, 1986
Trauma: childhood sexual abuse	M-CIDE: at least one DSM-IV qualifying trauma	
Trauma: any other	M-CIDE: at least one DSM-IV qualifying trauma	
Life-events	Münchener Ereignis Liste Kurzfassung (MEL)	Maier-Diewald et al., 1983
Daily stressors/hassles	Daily Hassles Scale (DH)	Perkonig and Wittchen, 1995b
<i>Intrapersonal variables: current mental disorders</i>		
Alcohol use disorder (DSM-IV)	M-CIDE: substance section	
Nicotine dependence (DSM-IV)	M-CIDE: substance section	
Illicit drug use disorder (DSM-IV)	M-CIDE: substance section	
Anxiety disorder (DSM-IV)	M-CIDE: anxiety disorder section	
Affective disorder (DSM-IV)	M-CIDE: affective disorder section	
Any other mental disorder (DSM-IV)	M-CIDE: somatoform/eating disorder section	
<i>Interpersonal/family variables: developmental factors</i>		
History of substance use problems in parents	M-CIDE: family history section	
History of alcohol use problems in parents	M-CIDE: family history section	
History of alcohol use problems in grandparents	M-CIDE: family history section	
History of anxiety problems in parents	M-CIDE: family history section	
History of affective problems in parents	M-CIDE: family history section	
Growing-up with/without both parents	M-CIDE: family history section	
Divorce of parents before age 15	M-CIDE: family history section	
Maternal/paternal death before age 15	M-CIDE: family history section	
<i>Interpersonal/family variables: current situation</i>		
Actual relationship to mother	M-CIDE: family history section	
Actual relationship to father	M-CIDE: family history section	
Parental attitude toward legal and illegal drugs	M-CIDE: family history section	
Siblings' illicit drug use	M-CIDE: family history section	
Availability of alcohol and medication at home	M-CIDE: family history section	

^a Cannabis use (at baseline) variables were included only in the analyses referring to progression to cannabis abuse/dependence.

Table 2

Categorical predictors of follow-up cannabis use among baseline non-cannabis users ($N = 1723$) who either continued to be non-users or started cannabis use in the follow-up period: crude associations

		Incident cannabis use at follow-up (t1-t2)			
		No ($N = 1319$) %w	Yes ($N = 404$) %w	OR ¹	95% CI
Gender	Male vs. female	42.7	57.6	1.8*	(1.4–2.3)
Availability of drugs	Easy vs. difficult	46.7	67.7	2.5*	(1.9–3.4)
Drugs offered at school or by friends	2+ times vs. less often	15.1	22.3	2.0*	(1.4–2.9)
Peers' drug intake	Yes vs. no	24.2	50.4	2.7*	(2.1–3.5)
Regular smoking	Yes vs. no	17.2	22.9	2.0*	(1.5–2.9)
Smoking before age 15	Yes vs. no	2.6	7.2	2.7*	(1.7–4.3)
Regular alcohol use	Yes vs. no	30.2	30.0	2.0*	(1.4–2.8)
Attitude towards no future drug use	No/partial vs. total agreement	5.1	19.0	4.0*	(2.7–5.9)
Any alcohol use disorder	Yes vs. no	7.6	11.7	2.2*	(1.4–3.6)
Nicotine dependence	Yes vs. no	6.7	10.1	2.1*	(1.3–3.4)
Other mental disorders	Yes vs. no	11.0	15.7	2.2*	(1.5–3.3)
Other trauma	Yes vs. no	14.6	20.0	1.5*	(1.1–2.2)
Relationship to mother	Other vs. very good	44.2	57.2	1.5*	(1.1–1.9)
Parental attitude towards nicotine	Negative	67.5	62.0	1.0	
	Positive	11.8	16.0	1.5*	(1.1–2.2)
	Different	20.7	22.0	1.2	(0.9–1.6)
Grandparental problems with alcohol	Yes vs. no	6.9	10.2	1.6*	(1.0–2.6)
Mother affective problems	Yes vs. no	24.5	29.1	1.6*	(1.2–2.1)
Growing up without both parents	Yes vs. no	13.9	18.6	1.5*	(1.1–2.2)
Parental divorce before age 15	Yes vs. no	14.6	22.2	1.6*	(1.2–2.2)

%w, weighted percent; OR, odds ratio; CI, confidence interval; OR¹, controlled by age and gender. The contrast categories are not reported because their values are evident; in the gender row e.g. only percentages for males are given. The OR for the contrast categories is defined as 1 (e.g. for female gender, difficult availability of drugs). The following risk factors did not reach significance and are not depicted in Table 2: education, employment, marital status, living arrangement, place of residence, socio-economic status, financial situation; taking other drugs, drug use before age 15, alcohol use before age 15; anxiety disorder, substance use disorder, any affective disorder; trauma through sexual abuse; relationship to father, parental attitudes towards medication/alcohol, alcohol problems of mother/father/other relatives, availability of alcohol at home, parental substance/medication use problem, siblings' problems with illicit substances, father affective/anxiety problem, mother anxiety problem, parental death before age 15.

* $P < 0.05$.

Table 3

Dimensional predictors of follow-up cannabis use among baseline non-cannabis users ($N = 1723$) who either continued to be non-users or started cannabis use in the follow-up period: crude associations

		Incident cannabis use at follow-up (t1-t2)			
		No ($N = 1319$) mean	Yes ($N = 404$) mean	OR ^{a,b}	95% CI
Age		19.6	17.4	0.8*	(0.8–0.9)
Behavioral inhibition/childhood (BI social)		2.3	2.3	1.1	(0.9–1.2)
Behavioral inhibition/childhood (BI fear)		1.8	1.9	1.4*	(1.3–1.6)
SCL-90 GSI		0.3	0.4	1.3*	(1.1–1.4)
Daily hassles (DH score)		2.0	2.1	1.3*	(1.2–1.5)
Self control and coping skills (KV score)		0.7	0.9	1.4*	(1.2–1.6)
Self-esteem (VK score)		2.9	2.9	1.0	(0.9–1.1)
Life events (MEL positive)		17.9	15.4	1.0	(0.9–1.2)
Life events (MEL stressful)		5.3	5.3	1.1*	(1.0–1.3)

OR, odds ratio; CI, confidence interval. High scores indicate problematic values of the variable (e.g. high GSI of SCL-90, low self-esteem).

^a Controlled by age and gender.

^b Values standardized (except age).

* $P < 0.05$.

Table 4

Multiple logistic regression of cannabis use incidence at t1/t2 in former non-users ($N = 1717$)

		OR ^{a,b}	95% CI
Gender	Male	1.9*	(1.4–2.7)
Age		0.8*	(0.8–0.8)
Regular alcohol use	Yes	1.7*	(1.2–2.4)
Behavioral inhibition/childhood	Fear	1.2*	(1.1–1.4)
Other mental disorders	Yes	1.9*	(1.2–3.0)
Smoking before 15	Yes	1.8*	(1.1–3.1)
Attitude towards no future drug use	No/partial agreement	2.8*	(1.8–4.4)
Peers' drug intake	Yes	1.8*	(1.3–2.4)
Did not grow up with both parents	Yes	1.5*	(1.0–2.2)
Availability of drugs	Easy	1.7*	(1.2–2.3)
Relationship to mother	Not very good	1.5*	(1.1–2.0)

OR, odds ratio; CI, confidence interval.

^a Controlled by age and gender.

^b Metric variables standardized (except age).

* $P < 0.05$.

Table 5

Categorical predictors of a higher frequency of cannabis use among incident users ($N = 393$): crude associations

	Frequency of use		
	Mean	IRR ^{a,b}	95% CI
<i>Gender</i>			
Male	51.8	2.6*	(1.5–4.5)
Female	15.9	1.0	
<i>Employment</i>			
School	50.8	1.0	
University	4.8	0.8	(0.3–2.4)
Training	9.1	0.4	(0.2–1.2)
Employed	11.5	3.6*	(1.0–12.6)
Other	15.8	1.3	(0.4–4.0)
<i>Availability of drugs</i>			
Difficult	24.5	1.0	
Easy	42.3	2.4*	(1.5–4.0)
<i>Drugs offered at school or by friends</i>			
No/1–2 times	35.7	1.0	
More often	39.6	2.4*	(1.3–4.5)
<i>Peers' drug intake</i>			
No	28.8	1.0	
Yes	44.1	1.9*	(1.2–3.1)
<i>Taking other drugs</i>			
No	34.3	1.0	
Yes	107.4	7.5*	(2.9–19.5)
<i>Drug use before age 15</i>			
No	34.3	1.0	
Yes	252.3	4.2*	(1.3–13.7)
<i>Regular smoking</i>			
No	32.8	1.0	
Yes	49.2	2.2*	(1.2–4.1)
<i>Smoking before age 15</i>			
No	31.4	1.0	
Yes	103.6	2.6*	(1.3–5.0)
<i>Attitude toward no future drug use</i>			
Total agreement	32.4	1.0	
No/partial agreement	54.0	2.9*	(1.6–5.4)
<i>Grandparental alcohol problem</i>			
No	39.5	1.0	
Yes	10.8	0.4*	(0.2–0.9)
<i>Parental problems with illicit drugs</i>			
No	36.7	1.0	
Yes	3.9	0.1*	(0.0–0.2)
<i>Parental death before age 15</i>			
No	36.9	1.0	
Yes	22.6	0.3*	(0.2–0.7)

IRR, incidence rate ratio; CI, confidence interval; Mean, average number of times cannabis was consumed. The following risk factors did not reach significance and are not depicted in Table 5: socio-economic status; education, financial situation, living arrangement; marital status; place of residence; alcohol use before age 15, regular alcohol use; affective/anxiety disorder, alcohol use disorder, nicotine dependence, substance use disorder, other mental disorders, trauma through sexual abuse, other trauma; parental attitudes towards medication/nicotine/alcohol, relationship to mother/father; availability of alcohol at home; mother/father affective problem, mother anxiety problem, alcohol problems of mother/father/other relatives; parental problems with medication; siblings' problems with illicit substances, anxiety problems of father, growing up without both parents, parental divorce before age 15.

^a Controlled by age and gender.

^b Values standardized (except age).

* $P < 0.05$.

Table 6
Multiple logistic regression of cannabis use frequency at t1/t2 in former non-users (*N* = 404)

		IRR ^{a,b}	95% CI
Gender	Male	3.3*	(2.3–4.7)
Age		0.7*	(0.7–0.8)
Parental illicit drug use problem	Yes	0.1*	(0.0–0.4)
Employment status	Employed	3.1*	(1.0–9.3)
	Other	4.4*	(1.7–11.3)
Parental attitude toward medication	Positive	0.6*	(0.4–0.8)
Mother affective problems	Yes	3.0*	(1.9–4.7)
Financial situation	Bad	4.0*	(1.8–9.1)
Place of residence	Rural	0.6*	(0.4–1.0)
Availability of drugs	Easy	1.8*	(1.2–2.8)
Life events (MEL)	Positive	0.7*	(0.6–0.8)
Peer drug use	Yes	1.6*	(1.1–2.2)
Taking other drugs	Yes	7.6*	(2.8–20.7)
Parental problems with medication	Yes	0.5*	(0.3–1.0)
Behavioral inhibition/childhood	Social	0.6*	(0.5–0.7)
Mother anxiety problems	Yes	0.6*	(0.4–0.9)
Regular alcohol use	Yes	0.4*	(0.3–0.6)
Grandparental alcohol problem	Yes	0.5*	(0.3–0.9)
Father affective problems	Yes	0.4*	(0.2–0.6)

IRR, incidence rate ratio; CI, confidence interval.

^a Controlled by age and gender.

^b Metric variables standardized (except age).

**P* < 0.05.

Table 7
Categorical predictors of progression to cannabis abuse or dependence in baseline cannabis users without disorder (*N* = 632): crude associations

		Diagnostic status at t1/t2			Abuse vs. no diagnosis		Dependence vs. no dependence	
		No diagnosis (<i>N</i> = 567) %w	Abuse (<i>N</i> = 53) %w	Dependence (<i>N</i> = 12) %w	OR ^a	95% CI	OR ^a	95% CI
Gender	Male vs. female	54.3	87.5	71.7	6.7*	(2.6–17.1)	2.2	(0.6–7.6)
Education	Lower vs. high/medium	10.9	18.2	45.2	1.2	(0.5–2.8)	4.5*	(1.2–17.3)
Socio-economic status	Low vs. not low	7.2	12.1	42.2	3.3*	(1.0–10.7)	21.9*	(5.3–90.2)
Financial situation	Bad vs. not bad	9.6	14.2	40.0	1.9	(0.6–6.0)	9.4*	(2.3–38.5)
Taking other drugs	Yes vs. no	21.2	22.6	35.8	1.8	(0.8–4.1)	4.2*	(1.2–15.0)
Cannabis use	5+ vs. 1–4	39.0	49.8	46.2	2.2*	(1.1–4.5)	2.3	(0.8–6.8)
Attitude toward no future drug use	No/partial vs. total agreement	52.5	80.5	86.7	3.4*	(1.4–7.8)	4.3	(0.9–21.4)
Substance disorder	Yes vs. no	0.7	4.7	0.0	22.4*	(2.2–225.3)		
Availability of alcohol at home	Yes vs. no	85.3	77.2	57.4	0.4	(0.2–1.0)	0.2*	(0.1–0.8)
Parental death before age 15	Yes vs. no	3.9	2.7	21.3	1.1	(0.2–8.0)	13.2*	(2.0–86.3)

%w, weighted percent; OR, odds ratio; CI, confidence interval. The following risk factors reached significance neither for abuse nor for dependence and are not depicted in Table 7: living arrangement, marital status, place of residence, employment; alcohol use before age 15, availability of drugs, drugs offered at school or by friends, peers' drug intake, cannabis use before age 15, other drug use before age 15, regular smoking, smoking before age 15, regular alcohol use; anxiety/affective disorder, alcohol use disorder, nicotine dependence, other mental disorders, trauma through sexual abuse, other trauma; parental attitude toward medication/nicotine/alcohol, relationship to mother, alcohol problem of mother/father/grandparents/other relatives, parental substance/medication use problem, siblings' problems with illicit substances; mother/father affective problem, mother/father anxiety problem, growing up without both parents, parental divorce before age 15.

^a Controlled by age and gender.

**P* < 0.05.

Table 8
Dimensional predictors for the progression to abuse or dependence at t1/t2 in baseline cannabis users without disorder (*N* = 632): crude associations

		Diagnostic status at t1/t2			Abuse vs. no diagnosis		Dependence vs. no dependence	
		No diagnosis (<i>N</i> = 567) mean	Abuse (<i>N</i> = 53) mean	Dependence (<i>N</i> = 12) mean	OR ^{a,b}	95% CI	OR ^{a,b}	95% CI
Age		20.8	18.7	17.1	0.8*	(0.7–0.8)	0.6*	
Behavioral inhibition/childhood (BI social)		2.3	2.3	2.5	1.0	(0.7–1.5)	1.7*	(1.1–2.6)
Behavioral inhibition/childhood (BI fear)		1.9	1.9	2.2	0.9	(0.6–1.3)	1.8*	(1.1–2.8)
SCL-90 GSI		0.4	0.4	0.8	0.9	(0.6–1.4)	1.6*	(1.1–2.4)
Daily hassles (DH score)		2.1	2.1	2.2	1.2	(0.8–1.6)	1.3	(0.6–2.9)
Self-control and coping skills (KV score)		1.0	1.2	1.3	1.4*	(1.1–1.9)	1.4	(0.9–2.1)
Self-esteem (VK score)		2.8	2.8	3.1	1.1	(0.8–1.5)	2.0*	(1.3–3.4)
Life events (MEL positive)		19.2	14.6	12.8	0.7	(0.5–1.0)	0.7	(0.3–1.9)
Life events (MEL stressful)		7.5	6.6	6.1	1.0	(0.6–1.5)	0.9	(0.4–2.0)

OR, odds ratio; CI, confidence interval.

^a Controlled by age and gender.

^b Values standardized (except age).

**P* < 0.05.

Table 9
Multiple logistic regression of cannabis dependence at t1/t2 in baseline
cannabis users without disorder ($N = 630$)

		OR ^{a,b}	95% CI
Gender	Male	4.3	(1.0–18.7)
Age		0.4*	(0.3–0.6)
Self-esteem (VK score)		1.9*	(1.1–3.2)
Socio-economic status	Lower	24.2*	(7.0–83.8)
Financial situation	Bad	7.1*	(1.7–29.4)
Taking other illicit drugs	Yes	7.1*	(1.8–28.2)
SCL-90 GSI		1.7*	(1.1–2.8)
Parental death before age 15	Yes	39.7*	(7.2–218.9)
Self-control and coping skills (KV score)		0.4*	(0.2–0.9)

OR, odds ratio; CI, confidence interval.

^a Controlled by age and gender.

^b Metric variables standardized (except age).

* $P < 0.05$.

Table 10
Summary of the significant results: predictors for the incidence of cannabis use, for the extent of use and predictors of progression to cannabis abuse
or dependence (multiple logistic regressions)

	Incidence of cannabis use OR ^a	Cannabis use frequency IRR ^{a,b}	Abuse vs. no diagnosis OR ^a	Dependence vs. no dependence OR ^a
<i>Socioenvironmental variables</i>				
Older age	–	–	–	–
Male gender	+	+	+	
Employment: employed/other (vs. school)		+		
Low socio-economic status				+
Bad financial situation		+		+
Living arrangement: not with parents			Older: –	
Rural place of residence (vs. city)		–		
<i>Substance related variables</i>				
Easy availability of drugs	+	+		
Peers use drugs	+	+		
Cannabis use: 5+ times	– – – ^c	– – – ^c	Younger: +	
Taking other illicit drugs		+		+
Smoking before age 15	+			
Regular alcohol use	+	–		
More positive attitude toward future drug use	+		Older: +	
<i>Intrapersonal variables</i>				
Any anxiety disorder			Older: –	
Illicit drug abuse/dependence			Older: +	
Other mental disorders	+			
Behavioral inhibition/childhood (BI social)		–		
Behavioral inhibition/childhood (BI fear)	+			
High degree of psychopathological symptoms				+
Low degree of self-esteem				+
Low self-control and coping skills				–
More frequent positive life events		–		
<i>Interpersonal variables: family</i>				
Not very good relationship to mother	+		Older: –	
Not very good relationship to father			Older: +	
Availability of alcohol at home			Older: –	
Positive parental attitudes toward medication		–		
Grandparental alcohol problem		–	Older: +	
Parental problems with medication		–		
Parental problem with illicit drugs		–		
Mother affective problems		+		
Father affective problems		–		
Mother anxiety problems		–		
Growing up without both parents	+			
Parental death before age 15				+

Only predictors that reached significance ($P < 0.05$) in the multiple logistic regressions are included. +, indicates an increased risk; –, a decreased risk.

^a Controlled by age and gender.

^b Values standardized (except age).

^c Variable not included in the analyses.

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