Substance Use and Substance Use Disorders in a Community Sample of Adolescents and Young Adults: Incidence, Age Effects and Patterns of Use

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Key Words

Abstract
Objective: We present the prevalence and incidence rates of alcohol, nicotine, and illicit substance use, abuse, and dependence in a sample of German adolescents and young adults. Patterns of onset, cohort trends, and use of various substance classes are also analyzed. *Method:* A prospective longitudinal epidemiological study with a representative sample of adolescents and young adults (n = 3,021; baseline age range = 14–24 years) was conducted in Munich, Germany. Participants were assessed between 1995 and 1999 with the Munich-Composite International Diagnostic Interview. *Results:* Cumulative lifetime incidence (up to age 28) of any substance abuse or dependence was 43.8%, and 12-month prevalence of any substance abuse or dependence was 24.4%. The lifetime incidence of nicotine dependence was most frequent (24.8%), followed by alcohol abuse (19.3%) and alcohol dependence (9.2%); 61.7% endorsed the regular use of a substance for at least one circumscribed period during their lifetime. Age-specific incidence rates and age at onset of substance use disorders differed by age cohorts. Furthermore, nicotine dependence was significantly associated with illicit substance use disorders (HR = 2.6, 95% CI 1.7–4.0). An interactive relationship between age, age at onset of nicotine dependence, and subsequent onset of illicit substance use disorders was found. *Conclusions:* Since the baseline investigation in 1995, high incidence rates of substance use disorders and substance use have been observed in this young German sample. Especially younger cohorts report significantly earlier ages at onset of abuse and dependence. There also seems to be a trend towards a secondary age at onset peak of nicotine dependence after the onset of illicit drug use disorders. Further investigations are needed to study these patterns in younger samples. However, results emphasize the need for a combined prevention of illicit drugs and nicotine dependence.

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Introduction

Prevalence of Substance Use Disorders: Findings in the General Population

In the last three decades many epidemiological studies of substance use and substance use disorders have been conducted with adult and adolescent samples in the Unit-

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ed States and the European Union. Prevalence estimates vary depending on age, gender, or other sample characteristics, as well as by assessment strategies and definitions for substance use disorders. Using DSM-III-R criteria, Kessler et al. [1] reported lifetime prevalence estimates of 9.4% for alcohol abuse and 14.1% for alcohol dependence as well as 4.4% for drug abuse and 7.5% for drug dependence from the US National Comorbidity Survey in 1994. The 12-month estimates were lower with 7.2% for alcohol dependence and 2.5% for alcohol abuse whereas only 2.8% fulfilled criteria for drug dependence and 0.8% for drug abuse. A decade later the National Comorbidity Survey Replication found a different distribution of the abuse and dependence estimates based on DSM-IV criteria. 13.2% of the population fulfilled criteria for a lifetime diagnosis of alcohol abuse and a much lower proportion of 5.4% for alcohol dependence. The lifetime prevalence of drug abuse was 7.9% compared to 3.0% with drug dependence [2]. These higher rates of DSM-IV abuse were confirmed for the 12-month estimates with 3.1% diagnosed as having alcohol abuse and only 1.3% fulfilling criteria for dependence. Drug abuse was estimated with a 12-month prevalence of 1.4% and drug dependence with 0.4% [3]. 12-month estimates of nicotine dependence in the USA have been reported from the National Epidemiologic Survey on Alcohol and Related Conditions [4]. 12.8% of the population met criteria for a DSM-IV nicotine dependence.

European data about substance use disorders vary between countries. 12-month alcohol dependence estimates including all studies in the European Union and Norway with proven instruments and established criteria range from 0.4 to 14.5% in males and from 0.1 to 4.2% in females [5]. 12-month drug dependence was estimated between 0.3 and 2.9%. These rates however seem to be lower bound estimates when taking hidden populations into account [6].

Prevalence of Substance Use Disorders: Findings among Adolescents

A series of prospective and longitudinal studies with adolescent samples have shown that adolescence is the period that carries the highest risk of substance use onset. But comparisons are also difficult despite the use of standard criteria for abuse and dependence [7]. Some benchmark data for the USA for the ages 15–18 years can be drawn from the US National Comorbidity Survey. Warner et al. [8] found a lifetime prevalence of 9.7% for DSM-III-R alcohol abuse and dependence in this age group, whereas 6.2% met criteria for illicit substance abuse or

dependence. A more recent study using DSM-IV criteria for abuse and dependence reported lifetime prevalence estimates of 26% for substance abuse and 21.5% for substance dependence in a community sample of 18-year-olds in Colorado [9]. However, recent reports from the US Center for Disease Control and Prevention show that among adolescents nicotine and especially cannabis use seem to have declined slightly whereas rates for other drugs (e.g., cocaine) have been stable [10]. Yet the overall rate of illicit drug use in the USA is still very high, with about 50% of all adolescents having tried at least one illicit drug before finishing high school [11].

This slightly downward trend in the use of certain substances has not yet been observed in the European Union although rates from individual countries vary markedly. England (19.2%) and Spain (17.3%) appear to have the highest 12-month prevalence estimates for cannabis use among adolescents and young adults [12]. Other illicit substances do not rate higher than 5% in these countries. In Germany, a recent school survey revealed a lifetime prevalence of frequent nicotine use (>40 times) of 42.3% among 9th and 10th graders, 15 or 16 years old. More than 40% of these students reported frequent lifetime alcohol use (>40 times) and about 17% had used any illicit drug [13]. Although trends among adolescents have been closely monitored in many European Union countries, most study participants have been assessed with questionnaires in repeated cross-sectional studies. Epidemiological studies that employ standardized clinical interviews based on DSM-IV or ICD-10 criteria are still rare in studies of substance use among adolescent populations.

Objectives of This Study

We attempted to address this shortcoming of existing studies by conducting a 42-month prospective, longitudinal study of a randomly sampled German community cohort of adolescents and young adults. In this article, we follow up on prior studies that presented the baseline and initial follow-up data on the prevalence of use of specific substance classes and substance use disorders in German adolescents and young adults [14–16; www.asat-verbund. de]. We expand on previously published follow-up data on specific substances [17, 18] by reporting 42-month incidence, cumulative lifetime incidence, and 12-month prevalence of regular nicotine and alcohol use as well as repeated and regular illicit drug use and abuse, and dependence. Additionally, we explore patterns of onset, cohort trends for all classes of substances, and patterns of pure and multiple lifetime use.

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Methods

Sample and Overall Design

Data were collected as part of the Early Developmental Stages of Psychopathology (EDSP) study. The sample and design of this study have been described elsewhere [19, 20]. Briefly, the EDSP was designed to explore the prevalence and incidence, familial and other risk factors, comorbidity, and course of substance use and substance use disorders in a representative population sample of adolescents and young adults. The study is divided into three waves: the first was conducted in 1995 (baseline, with all 14- to 24-year-olds; n = 3,021); the second in 1996/1997 (with only subjects who were 14–17 years old at baseline; n = 1,228), and the third in 1998/1999 (again with all 14- to 24-year-olds at baseline; n = 2,548).

The representative community sample was randomly drawn from government registries in Munich, Germany. Because the study was designed as a longitudinal panel with special emphasis on early developmental stages, 14- and 15-year-olds were sampled at twice the probability of people aged 16–21 years, and 22- to 24-year-olds were sampled at half this probability. All participants provided informed consent. At baseline, a total of 3,021 interviews were completed, resulting in a response rate of 71%. The first follow-up was conducted on average 19.7 (range 15–25.6) months after baseline with a response rate of 88%. Only the younger cohort (14- to 17-year-olds at baseline) was included in this wave. The second follow-up was conducted in 1998/99, an average of 42 (range 34–50) months after baseline with a response rate of 84% of all baseline participants (n = 2,548). The study design was approved by the Ethics Committee of the Max Planck Society.

Sociodemographic characteristics of the baseline and follow-up samples have been published [20]. Briefly, at baseline, most of the respondents were attending school (89%) and living with their parents (98%); about 10% were in job training. The majority was classified as belonging to the middle class (61%). Noteworthy changes from baseline to the second follow-up were found for school (follow-up 42% attended school) and employment status (follow-up 24% were in job training programs and 12% were employed).

Instrument

In all three waves, the computer-assisted version of the Munich-Composite International Diagnostic Interview (M-CIDI) was used [21]. The M-CIDI allows the standardized assessment of a wide range of DSM-IV substance use and mental disorders along with information about onset, duration, and clinical and psychosocial severity. In all assessments the M-CIDI was supplemented by a separate respondents' booklet that included several scales and questionnaires for assessing psychological constructs relevant to the study. Detailed information on the validity and reliability of the M-CIDI has been presented elsewhere [22, 23]. Inter-rater reliability of the M-CIDI was fair to good, with Kappa values ranging from 0.64 (Yules Y = 0.80) to 0.78 (Yules Y = 0.82). Lifetime and 12-month diagnoses were generated at the baseline investigation. For the two follow-up investigations, the M-CIDI was modified to cover the 12-month period prior to the follow-up interview, as well as the remaining interval between the investigations. Additional questions about the course since the preceding investigation were included in a 12-month-interval version of the M-CIDI.

Assessment of Substance Use and Substance Use Disorders

Sections B (nicotine), I (alcohol), and L (drugs) of the M-CIDI refer to substance use (frequency and quantity), as well as abuse and dependence as defined by DSM-IV [24]. These sections start with a screen for use of the substances, followed by questions on the frequency and quantity of use, and then symptoms of abuse and dependence. All sections close with questions regarding the onset, duration, and recency of use and symptoms. The respondents' booklet contained illustrative figures for different kinds of drinks that were used to help the respondent accurately report the quantity of alcohol use. In the drug section, the use of psychotropic prescription substances is assessed first. Further assessment is conducted if it appears that the participant has misused prescription drugs. For assessment of illicit substances, a list containing specific substances together with their 'street names' is presented that allows probing for 8 classes: cannabis, amphetamines, opioids, cocaine, phencyclidine, hallucinogens, inhalants, and sedatives/hypnotics/anxiolytics. An open category of any other substances and a category of polysubstance use are also included. Symptoms of DSM-IV abuse and dependence of illicit substances were only assessed if a substance had been used more than 4 times. The illicit drug use section was not administered to individuals who refused to respond openly. Inter-rater reliability of these CIDI sections is in the acceptable range (kappas = 0.55–0.64). Good agreement was found between clinician-assigned DSM-IV substance use diagnoses and those assigned according to the M-CIDI DSM-IV algorithms (Kappa = 0.86).

For each type of substance, we refer to the following categories used throughout this paper:

1 Regular alcohol use: at least 3 times per week over a period of at least 6 months during lifetime or in the last 12 months.
2 Harmful alcohol use: use of more than 40 g alcohol/day (females: >20 g/day) over any period of at least 6 months during lifetime or in the last 12 months.
3 Regular nicotine use: at least 4 weeks of daily use during lifetime.
4 Repeated use of illicit substances: use of illicit substances on 5 or more occasions (includes prescription drugs in case of misuse) during lifetime or in the last 12 months.
5 Regular use of illicit substances: in the period of heaviest use at least monthly use of illicit substances (includes prescription drugs in case of misuse) during lifetime or in the last 12 months.

We report lifetime prevalence at baseline, incidence rates covering the period between baseline and the second follow-up, cumulative incidence rates covering the whole lifetime period until the second follow-up, and the 12-month prevalence rate covering the 12 months before the second follow-up. For some analyses we also distinguish between pure and multiple (lifetime) use of substances. Multiple use is defined as use of more than one substance not necessarily during the same period.

Statistical Analysis

For those participants aged 14–17 years at baseline, the data in the present report are derived from the baseline, first follow-up, and second follow-up interviews. For those older than 17 years at baseline, data from the baseline and (second) follow-up interview were used. Because only the younger cohort has been contacted at the first follow-up their data were cumulated between baseline and the second interview to cover the same period (see also overall design).

Data were weighted to consider different sampling probabilities as well as systematic non-response at baseline. The Stata Software package was used for robust inference of weighted data [25]. Because 102 participants refused to openly answer questions on illicit substance use, analyses referring to illicit substances are based on 2,446 participants. Survival analyses were used to assess covariates of the age-specific cumulative incidence and the year of onset of substance use disorders. The curves were computed with the Kaplan Meier method and differences were assessed with hazard ratios (HRs) from Cox regression models. Constant factors were evaluated (e.g., age cohort; here the lifetime history was only considered through the maximum age of the younger cohort at the second follow-up = 21 years) as well as time-dependent factors (e.g., prior nicotine dependence and its age at onset as covariates of subsequent onset of alcohol use disorder). The assumption of the hazard ratio being independent of age was tested with Schoenfeld residuals [26]. If this assumption was violated we added an interaction term with age to the model. The model-based age-specific hazard ratio is given by $HR(age) = HR_{main\ effect} \cdot HR_{interaction\ with\ age}^{age}$. Whenever the age cohort and sex were not of explicit interest they were controlled for in stratified Cox regressions (i.e., different curves are calculated according to sex and age cohort before analyzing differences due to covariates of interest) [26].

Results

Prevalence and Incidence of Substance Use Disorders

The top half of table 1 shows the follow-up incidence and cumulative lifetime incidence rates for substance use disorders by classes of substances. 43.8% of the sample met criteria for any abuse or dependence during lifetime by the time of the second follow-up. Nicotine dependence was most common (24.8%); however, alcohol abuse was also relatively prevalent (19.3%) by the second follow-up as a result of a high incidence since baseline. 15% fulfilled criteria of dependence in the 12 months preceding the follow-up interview. The majority of them endorsed criteria for nicotine dependence (12.3%). Other 12-month dependence diagnoses are much lower (e.g. illicit drug dependence, 0.9%). Most of those with abuse had used alcohol (8.9%).

Prevalence and Incidence of Regular Substance Use

The bottom half of table 1 shows the follow-up incidence and cumulative lifetime incidence rate for several categories of regular substance use. Nearly 60% of the sample had been regular users of any substance at some point in their lives. 12-month rates of any regular use were also high with 47.8% in the year before the second follow-up assessment. Regular use of nicotine was most common (39.2%). About one third of the sample had been regular users of any substance in the past 12 months but had never met the criteria for dependence. Interestingly, regular illicit drug use was nearly as frequent as alcohol use in this group. 12-month rates of regular illicit drug use without abuse and dependence were higher than the respective rates for regular alcohol use (7.8 vs. 6.7%). This might indicate a tendency of a different use pattern with more binge drinking on the one hand and more continuous use of illicit substances on the other hand.

Age-Specific Incidence Rates of Abuse and Dependence
Effects of Different Age Cohorts

One hypothesis of our examination was that age at onset and age-specific incidence rates of abuse and dependence would differ by age cohorts. Younger cohorts should have higher age-specific and cumulative incidence rates and an earlier age at onset. To examine these effects of age we compared the age-specific incidence rates of those 14–17 years old at baseline to those 18–24 years old at baseline. The younger cohort was 18–21 years old in 1999 and the older cohort 22–28 years old. Figure 1 shows the curves for these two cohorts by age at onset of alcohol, nicotine, and illicit drug use disorders until the age of 21 years, the highest age in the younger cohort. The highest cumulative rates were found for alcohol abuse and dependence in both cohorts. Yet the age-specific incidence differs significantly by age cohort across all substance classes (alcohol: HR = 0.7, 95% CI 0.6–0.8; nicotine: HR = 0.7, 95% CI 0.6–0.8; illicit substances: HR = 0.5, 95% CI 0.4–0.7). The most pronounced cohort difference was observed among those with illicit substance use disorders, in that cumulative incidence rates were doubled in the younger cohort. Furthermore, the median age at onset was between 1 and 3 years earlier in members of the younger cohort, which was a significant trend across all substance classes. This finding was slightly more pronounced for nicotine dependence (alcohol: HR = 1.4, 95% CI 1.2–1.5; nicotine: HR = 1.6, 95% CI 1.3–1.8; illicit substances: HR = 1.2, 95% CI 1.0–1.5).

Sequelae of Onsets of Substance Use Disorders

We also tested the hypothesis that an earlier age at onset of nicotine dependence would be associated with a higher risk of onset of another substance use disorder. This hypothesis was not supported with respect to alcohol abuse or dependence. However, individuals with prior nicotine dependence had an elevated overall risk for subsequent illicit substance use disorder (HR = 2.6, 95% CI 1.7–4.0). Subsequent onset of illicit substance use disorders did not depend on age (χ^2 (1) = 0.57, p = 0.45) or age at onset of nicotine dependence (HR = 0.9 per year, 95%

Table 1. Cumulated lifetime incidence and 12-month prevalence rates of substance use and substance use disorders in the EDSP sample at second follow-up

Diagnostic and substance user groups	Lifetime prevalence at baseline[1]			Incidence between baseline and second follow-up[1,2]			Cumulative lifetime incidence at second follow-up[1]			12-month prevalence at second follow-up[1]		
	n	%	95% CI	n	%	95% CI	n	%	95% CI	n	%	95% CI
Any abuse or dependence	596	28.6	26.6–30.7	451	21.3	19.3–23.3	1,047	43.8	41.6–46.0	607	24.4	22.5–26.3
Any abuse or dependence w/o nicotine dependence	371	18.0	16.3–19.9	390	16.4	14.8–18.2	761	31.5	29.5–33.6	399	15.5	14.0–17.2
Any dependence	434	21.1	19.3–23.1	268	10.8	9.5–12.3	702	29.7	27.7–31.8	368	15.0	13.4–16.6
Any dependence w/o nicotine dependence	143	7.5	6.1–8.6	106	4.1	3.3–5.1	249	11.0	9.7–12.6	100	3.9	3.2–4.9
Any abuse	256	12.2	10.7–13.7	332	13.2	11.8–14.8	574	23.1	21.3–25.0	289	10.8	9.5–12.2
Any alcohol abuse or dependence	332	15.9	14.3–17.7	382	15.0	13.5–16.7	714	28.5	26.6–30.6	362	13.6	12.2–15.2
Alcohol dependence	119	6.0	5.0–7.2	96	3.5	2.8–4.3	215	9.2	8.0–10.6	86	3.3	2.6–4.1
Alcohol abuse	213	9.9	8.6–11.4	302	11.1	9.9–12.6	499	19.3	17.6–21.1	245	8.9	7.7–10.2
Nicotine dependence	380	17.7	16.0–19.5	235	8.7	7.5–10.0	615	24.8	23.0–26.8	318	12.3	11.0–13.9
Illicit drug abuse or dependence	97	4.3	3.5–5.3	123	4.4	3.7–5.4	220	8.6	7.4–9.9	112	3.9	3.2–4.8
Illicit drug dependence	38	1.8	1.3–2.6	33	1.3	0.9–1.9	71	3.1	2.4–4.0	22	0.9	0.5–1.4
Illicit drug abuse	65	2.8	2.2–3.7	104	3.7	3.0–4.6	166	6.3	5.3–7.4	83	2.8	2.2–3.5
Any regular use	903	42.9	40.6–45.1	517	28.5	26.1–31.0	1,420	59.1	56.9–61.3	1,183	47.8	45.6–50.0
Any regular use w/o dependence	480	22.2	20.4–24.2	367	15.7	14.1–17.5	728	29.8	27.8–31.9	828	33.4	31.4–35.5
Any regular use w/o abuse and dependence	390	18.0	16.3–19.8	268	11.1	9.7–12.6	509	21.1	19.4–23.0	683	2.0	14.0–17.2
Regular alcohol use[3]	340	18.0	16.2–19.9	271	12.3	10.8–13.9	611	28.1	26.1–30.1	318	14.5	13.0–16.2
Regular alcohol use[3] w/o dependence	257	13.6	12.0–15.3	216	9.8	8.5–11.3	456	20.9	19.1–22.8	238	10.7	9.4–12.2
Regular alcohol use[3] w/o abuse and dependence	178	9.2	7.9–10.7	126	5.1	4.2–6.1	272	12.8	11.3–14.4	141	6.7	5.6–7.9
Regular w/o harmful use, dependence	165	8.6	7.4–10.0	127	6.1	5.0–7.3	261	12.2	10.7–13.8	194	9.0	7.8–10.4
Harmful alcohol use[4]	151	8.2	7.0–9.6	165	6.8	5.8–8.0	316	14.4	12.9–16.1	109	4.8	3.9–5.8
Regular nicotine use[5]	760	34.2	32.1–36.3	447	19.7	17.8–21.6	1,207	47.1	44.9–49.3	1,035	39.2	37.1–41.4
Regular nicotine use w/o dependence	380	16.5	14.9–18.2	311	9.4	8.3–10.6	592	22.3	20.5–24.1	721	27.1	25.2–29.0
Repeated illicit drug use[6]	358	17.9	16.2–19.8	424	17.6	15.9–19.3	782	32.3	30.3–34.5	396	14.7	13.2–16.2
Regular illicit drug use[7]	262	12.6	11.2–14.3	226	8.3	7.2–9.5	488	19.9	18.2–21.7	305	11.0	9.8–12.4
Regular illicit drug use w/o dependence	225	10.9	9.5–12.4	206	7.4	6.4–8.5	419	16.9	15.3–18.6	283	10.2	9.0–11.5
Regular illicit drug use w/o abuse and dependence	171	8.6	7.4–10.0	149	4.7	3.9–5.5	294	12.3	10.9–13.8	211	7.8	6.7–9.0

[1] Unweighted number, weighted percent, 95% confidence interval.

[2] Substance use categories excluding diagnostic subgroups (e.g. any regular use without dependence) are defined as incidence of use in this category never fulfilling criteria for the diagnosis under consideration until baseline or second follow-up. The cumulated rates in these categories are lower than the summarized numbers of baseline and incident cases because a person with substance use until baseline can be counted in these categories despite abuse or dependence in the follow-up period.

[3] Regular alcohol use: at least three times per week over a period of at least 6 months (lifetime until the second follow-up).

[4] Harmful alcohol use (males: use of >40 g alcohol/day; females: >20 g/day) over a period of at least about 6 months.

[5] Regular nicotine use: daily use of nicotine for at least 4 weeks.

[6] Repeated illicit drug use: the use at least 5 times of any illicit drug.

[7] Regular illicit drug use: 5 times or more and at least once a month during the period of heaviest use.

CI 0.6–1.9). However, an age × age at onset interaction term was significant in predicting the subsequent onset of illicit drug use disorder (χ^2 (1) = 4.80, p = 0.03). Later onset of nicotine dependence co-occurred with an increased risk of illicit substance use disorders up to 21 years. After that age, hazard ratios decreased with the later onset of nicotine dependence ($HR_{main\ effect}$ = 33.67 · $HR_{interaction\ with\ age}$ = 0.85^{age}, 95% CI 0.78–0.92).

Regular Use of Different Substance Classes by Age Cohorts

We further analyzed patterns and frequencies of pure (only one substance) and multiple (more than one substance) substance use. Figure 2 shows the cumulative lifetime incidences of the different subgroups of regular substance users by combinations of substances for the two different age cohorts. Pure lifetime nicotine users were the most frequent in the younger (14.9%) and older cohort
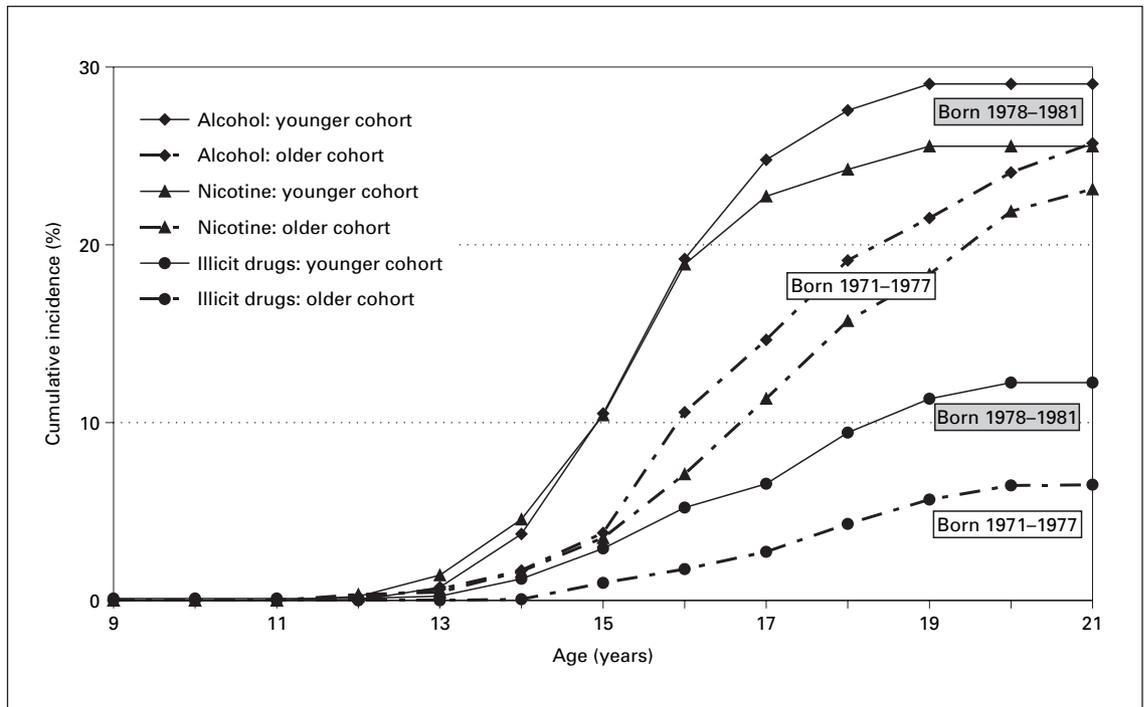
Fig. 1. Onset and age-specific incidence of abuse and dependence by substance class and birth cohort until the age of 21 years.
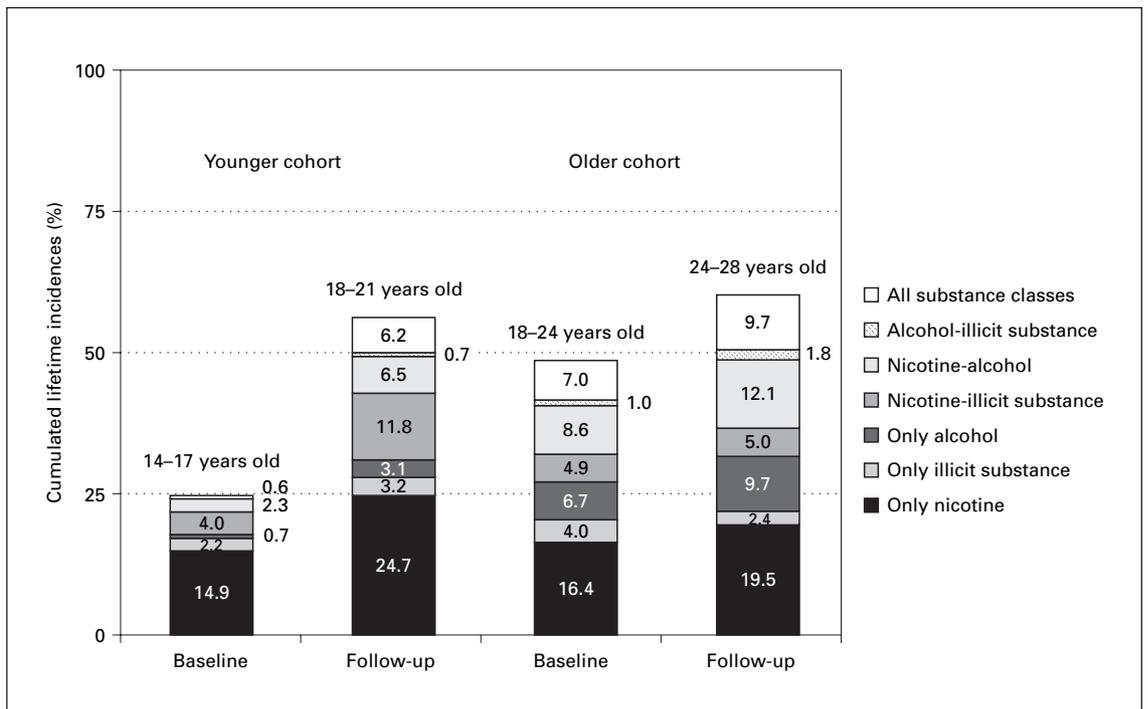

Fig. 2. Cumulative incidence rates of specific patterns of pure and multiple regular lifetime substance use at baseline and follow-up by age cohort.
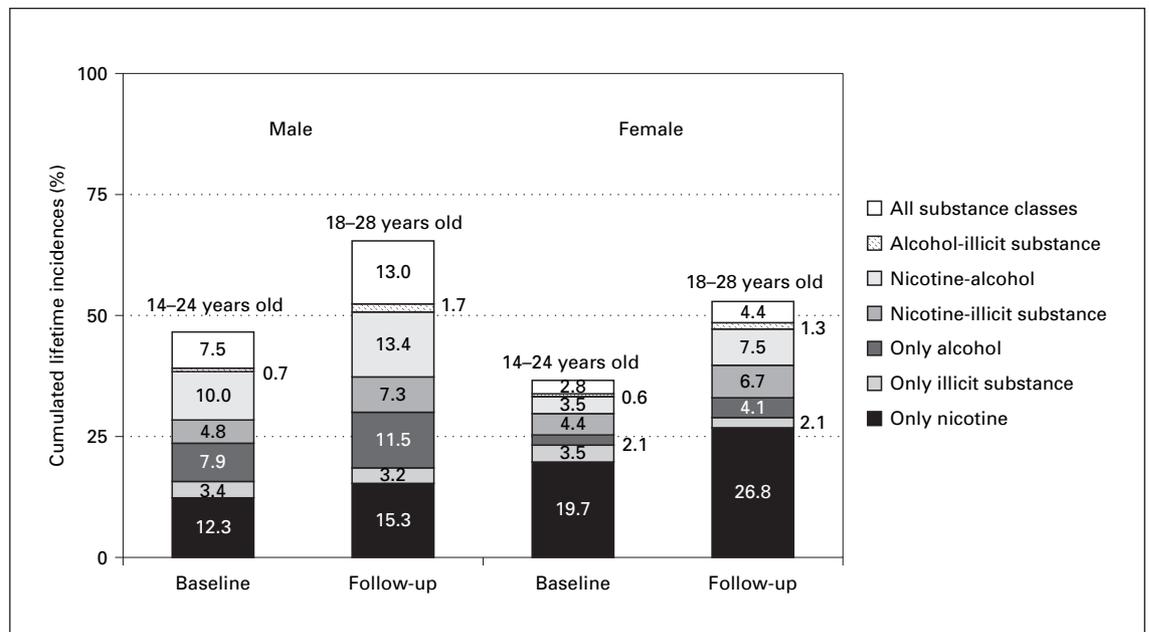
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Fig. 3. Cumulative incidence rates of specific patterns of pure and multiple regular lifetime substance use at baseline and follow-up by gender.

(16.4%) at baseline. At follow-up the cumulative incidence of pure regular nicotine use had nearly duplicated in the younger cohort (24.7%) in contrast to the older cohort (19.5%). Furthermore nicotine and illicit drug use was nearly three times higher in the younger cohort at the second follow-up (11.8%). In the older cohort more participants used alcohol regularly, particularly among those who had also used other substances. Interestingly, despite the significantly higher rates of alcohol abuse and dependence in the younger cohort until the age of 21 years (fig. 1), there were more regular pure users of alcohol and regular multiple users of alcohol and other substances in the older cohort.

Regular Use of Different Substance Classes by Gender
The analysis on pure and multiple regular lifetime use was also conducted separately for males and females as shown in figure 3. Pure nicotine use had the highest cumulative lifetime incidence at both assessment times among females (19.7 and 26.8%) and males (12.3 and 15.3%). However, rates of pure illicit drug use were low among both. As opposed to females (4.4%), multiple use of all three classes of substances was a more frequent use pattern at follow-up among males (13.0%). Alcohol, which also contributes to this group, seems to account for most of the gender differences.

Discussion

Prevalence and Incidence of Abuse and Dependence
The current investigation represents the only longitudinal epidemiological study of a representative population sample of European adolescents using standardized clinical interviews to assess DSM-IV substance abuse and dependence of all substance classes. The importance of utilizing standard diagnostic criteria for substance abuse and dependence has often been discussed [27, 28], but prior to the current study has not been accomplished in the European monitoring system of substance use or in studies of adolescents. The key finding of the present study is the high incidence of substance abuse and dependence since the baseline investigation and the resulting high cumulative lifetime incidence rates at the second follow-up assessment. This finding is important because substance use care is limited [29].

The extent of abuse and dependence in our sample, as well as the frequency of repeated and regular use, is concerning. Nearly 1 in 4 met criteria for a diagnosis of a substance use disorder in the past 12 months, and 15% met criteria for substance dependence. Almost half of all adolescents and young adults used substances regularly in the past 12 months. Repeated use of illicit substances (>5 times) is as frequent as regular alcohol use and the

use of illicit substances in regular intervals is twice as high as harmful alcohol use. Comparisons of these findings with those of other studies are difficult due to variable sample characteristics; however, it is worthwhile to note some discrepancies. For example, Warner et al. [8] reported lower rates of substance abuse and dependence in a younger US cohort. When our findings regarding 18-year-olds are compared to those of the same age group reported by Young et al. [9], dependence estimates in our German sample are higher for nicotine dependence and alcohol dependence. While results on nicotine dependence should be interpreted somewhat cautiously, as decreased rates of teen smoking have been reported in recent surveys [30], there remains a higher rate of alcohol dependence in our sample which might be due to the higher rates of alcohol use in Germany compared to other countries [5]. Only illicit drug abuse and dependence appear more frequently in the US samples, although levels of repeated illicit drug use are comparable. On the other hand, compared to other European surveys (e.g., questionnaire surveys), our estimates of regular substance use are higher [12]. There could be methodological reasons for these differences; for instance, questionnaire-based studies may underestimate substance use compared to studies that employ face-to-face interviews. The presence of true regional differences in substance use might also explain the discrepancies among findings of various studies. Cultural influences could be responsible for different substance use patterns (e.g. the amount and specific type of substance) as well as for specific response patterns [5] in questionnaires and interviews on substance use problems. For example, the higher rates of drug abuse and dependence might be associated with different use patterns or different amounts of the active agent on the one hand in the US and underreporting of symptoms in European countries on the other hand. Nevertheless these questions should also be addressed in further studies directly comparing data with identical instruments.

Cohort Trends and Patterns of Use

We also reported significantly higher rates of abuse and dependence in younger age cohorts born after 1978. Such significant age cohort effects on the use of alcohol, illicit drugs, and nicotine, as well as a trend toward earlier ages at onset of use, have also been observed in several other studies [31]. However, there were few prior reports of cohort effects on age at onset and age-specific incidence of abuse and dependence. One exception was the finding of Grant et al. [32] that an earlier age at onset of drug use predicts drug abuse and the development of alcohol dependence. We explored this kind of association with nicotine dependence as a predictor for the onset of other substance use disorders.

We found no significant associations of nicotine dependence with later alcohol abuse or dependence; however, nicotine dependence was associated with a higher risk of illicit drug abuse and dependence. But this association was qualified by consideration of age at onset of nicotine dependence. Among those with nicotine dependence a later age at onset co-occurred with an increased risk for illicit substance use disorders in younger age groups up to 21 years. This could be associated with earlier ages at onset of drug use disorders among younger age cohorts and a modified pattern of nicotine use. More detailed analyses of these data revealed that younger age groups with illicit drug use disorders also had a significant risk for secondary nicotine dependence. Furthermore, our analysis of pure and multiple regular lifetime use of psychotropic substances showed that lifetime regular nicotine-illicit drug users are the most frequent group in the younger cohort and the second most frequent group among females. Because the use of cannabis is not independent of nicotine use this could also be a pathway to nicotine dependence in younger cohorts. Therefore, primary and secondary prevention of illicit drug use should include nicotine dependence among risk groups. On the other hand, as incidence rates of primary nicotine use increase after the age of 13 years, very early preventive strategies are needed. Findings from other countries on decreased prevalence rates of nicotine use and dependence indicate that such preventive strategies might be effective.

Limitations

This study has a number of strengths, including the standardized assessment of DSM-IV abuse and dependence with a structured interview, the longitudinal design, and the representative community sample; however, some limitations should be noted. First, the findings are based on self-reported use and symptoms, which requires accurate recall of onset, amount, and symptoms associated with substance use. Recall bias may be present, although it might be less severe given the use of a young sample and close follow-up periods. Second, results regarding cohort trends of abuse and dependence might be a byproduct of response bias associated with age- and substance-specific trends in reporting symptoms of abuse or dependence [33]. Third, longitudinal studies are associated with attrition during follow-up periods that also can be a source of bias. In our study we found no selective

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attrition among those with alcohol or illicit drug disorders, but a slightly higher rate of nicotine dependence among non-responders was observed. Estimates for nicotine dependence might therefore reflect lower bound estimates. Despite the possibility of attrition-related bias, it is important to note that the overall response rate of this follow-up is relatively high with 84% of the baseline sample carried through the 42-month follow-up period. Fourth, there is still an ongoing discussion about diagnostic criteria of dependence for specific substances, especially cannabis. This investigation could not address this question; however, in another paper we were able to show that regular cannabis use was associated with the development of a dependence syndrome [34]. Therefore we think that the use of diagnostic criteria in this study is justified although further studies are needed. Finally, it should be noted that this community sample is comprised of a relatively well-educated and economically endowed urban population. Estimates might not be representative of Germany as a whole or of other European regions. For comparisons across regions and countries more studies with the methodology of personal interviews and standardized criteria are necessary especially among adolescents. They can complement those large-scale surveys with questionnaires adding findings based on standardized clinically relevant criteria from personalized interviews.

In conclusion, results from the present study indicate high rates of substance use disorders in adolescents and young adults of this German region that are comparable to estimates from US studies, though rates pertaining to specific substances differ across the two countries. We found a significant trend toward earlier ages at onset of substance use disorders in younger cohorts, which may be partly responsible for the high rates of illicit drug abuse and dependence we encountered. Early primary prevention of nicotine use and secondary prevention of nicotine dependence should be one major focus to reduce the risk for development of other substance use disorders in adolescents.

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