Article

Prediction of Long-Term Outcomes in Young Adults with a History of Adolescent Alcohol-Related Hospitalization

Cornelius Groß1,*, Ludwig Kraus2,3, Daniela Piontek2, Olaf Reis4, Ulrich S. Zimmermann1, and the RISCA Group†

1Department of Psychiatry and Psychotherapy, University Hospital Carl Gustav Carus, Technische Universität Dresden, Dresden 01307, Germany, 2IFT Institut für Therapieforschung, Munich 80804, Germany, 3Centre for Social Research on Alcohol and Drugs, SoRAD, Stockholm University, Stockholm 10691, Sweden, and 4Clinic for Child and Adolescent Psychiatry, University Medicine of Rostock, Rostock 18147, Germany

*Corresponding author: Department of Psychiatry and Psychotherapy, University Hospital Carl Gustav Carus, Technische Universität, Fetscherstrasse 74, 01307 Dresden, Germany. Tel.: +49-351-458-3225; Fax: +49-351-458-5380; E-mail: cornelius.gross@uniklinikum-dresden.de

†The RISCA Group includes (in addition to the authors) Eva-Maria Bitzer, Heidi Kuttler, Matthias Paul, Stefanie Bumke and Hanna Pradel.

Received 26 November 2014; Revised 10 May 2015; Accepted 31 May 2015

Abstract

Aims: Empirical data concerning the long-term psychosocial development of adolescents admitted to inpatient treatment with alcohol intoxication (AIA) are lacking. The aim of this study was to identify the factors that, at the time of admission, predict future substance use, alcohol use disorders (AUD), mental health treatment, delinquency and life satisfaction.

Methods: We identified 1603 cases of AIA treated between 2000 and 2007 in one of five pediatric departments in Germany. These former patients were invited to participate in a telephone interview. Medical records were retrospectively analyzed extracting potential variables predicting long-term outcomes.

Results: Interviews were conducted with 277 individuals, 5–13 [mean 8.3 (SD 2.3)] years after treatment, with a response rate of 22.7%; of these, 44.8% were female. Mean age at the interview was 24.4 (SD 2.2) years. Logistic and linear regression models revealed that being male, using illicit substances and truancy or runaway behavior in adolescence predicted binge drinking, alcohol dependence, use of illicit substances and poor general life satisfaction in young adulthood, explaining between 13 and 24% of the variance for the different outcome variables.

Conclusions: This naturalistic study confirms that known risk factors for the development of AUD also apply to AIA. This finding facilitates targeted prevention efforts for those cases of AIA who need more than the standard brief intervention for aftercare.

INTRODUCTION

The prevalence of alcohol consumption and binge drinking in 12- to 17-year olds has declined in the 2000s in Germany except for a rise in the years 2007/2008 [Bundeszentrale für gesundheitliche Aufklärung (BZgA), 2014]. However, the reported number of adolescents admitted to inpatient treatment with alcohol intoxication (AIA) markedly increased in the same period. In the year 2000, 101 out of 100 000 individuals aged 10–20 years were hospitalized due to alcohol
intoxication. By 2012, this number more than tripled to 333 out of 100 000 individuals (Statistisches Bundesamt, 2014). A similar trend can also be observed for other European countries (Bitunjac and Saraga, 2009; Kuzelová et al., 2009; van Hool et al., 2010). Respective studies on AIA reported extensively on hospital admission rates, socio-demographics, sex differences, medical and laboratory variables, including blood alcohol concentration (BAC) levels, and drinking situations (Bouthoorn et al., 2011b; Shavit et al., 2012; Van Zanten et al., 2013). These studies, however, examined cross-sectional data only. Empirical data describing the long-term psychosocial development of AIA are lacking. Therefore, and within the context of increasing numbers of AIA, physicians, particularly pediatricians, are faced with the challenge of identifying patients at risk for later alcohol use disorders (AUD) and other adverse outcomes in an effort to optimize their decisions regarding appropriate interventions. Hence, the aim of the present study was to identify predictors for adverse developments that could be detected by physicians already at the time of hospital admission and to assess their predictive value by examining the long-term psychosocial development of AIA into young adults.

The selection of predictor variables hypothesized to modulate the risk for later AUD and other negative psychosocial outcomes was largely guided by the evidence from previous longitudinal studies with school cohorts and other non-AIA samples. We focused our analysis on the following predictors: mental disorders (von Stumm et al., 2011; Wilens et al., 2011), broken home (Havlicek et al., 2013), use of illicit substances (Hicks et al., 2010), early drinking age (Pedersen and Skrondal, 1998; Pitkänen et al., 2005), truancy and runaway behavior (Tucker et al., 2011) and low level of response to alcohol (Schuckit et al., 1997, 2008). We hypothesized that the presence of these factors in AIA is associated with a higher prevalence of adverse outcomes in young adulthood.

Furthermore, in an earlier study based on medical records of AIA, it was shown that if patients drank alcohol ‘atypically’, i.e., to cope, alone or although the next day was a school/work day, these patients showed more risk factors for later development of AUD than patients who used alcohol ‘typically’, i.e. for fun together with friends at weekend parties (Gross et al., 2014). However, knowledge about whether these ‘atypical’ drinking patterns predict the development of future alcohol-related problems is scarce. Findings from a previous longitudinal study by Schelleman-Oftehansen et al. (2011) did not provide evidence of persistent problematic drinking behavior. Therefore, we hypothesized that ‘atypical’ drinking patterns in AIA will not sufficiently predict AUD in young adulthood.

To answer these questions, we investigated several outcomes in young adulthood. Besides AUD and substance use, we also focused on other psychosocial outcomes following a more holistic approach. Specifically, we were interested in the use of mental health treatment since it is known that AUD have a high rate of comorbidity with other mental health problems (Grant and Harford, 1995; Armstrong and Costello, 2002; Grant et al., 2004). Furthermore, we investigated delinquency as a possible psychosocial correlate of substance use (Ford, 2005; D’Amico et al., 2008), and we examined general life satisfaction as a more distal measure of psychosocial distress, assuming that this measure reflects the impact of all the above on the subjects’ overall well-being. We hypothesized that these outcomes can be predicted using routinely documented information during hospital treatment in standard pediatric care.

METHODS

Data were obtained from the retrospective study arm of the RISCA project (Risk and Protective Factors in the Context of Acute Alcohol Intoxication in Childhood and Adolescence; German: Risiko- und Schutzfaktoren nach Alkoholvergiftungen im Kindes- und Jugendalter).

Setting and recruitment

The design was a multisite retrospective cohort study. Adolescent patients who were treated for alcohol intoxication in one of the five pediatric hospitals at three centers in Germany between 1 January 2000 and 31 December 2007 were identified based on diagnosis at admission and date of birth. In Dresden, participants were recruited from the University Hospital Carl Gustav Carus, Municipal Hospital Dresden-Neustadt and HELIOS Hospital Pirna. Other centers were the Municipal Hospital Schwabing in Munich and the University Medicine of Rostock. Information regarding diagnosis and date of birth was derived from the patient administration system. Eligibility criteria included (i) age ≤17 years at the date of hospital admission, age ≥20 years at the time of study and an observation period between hospital admission and study participation of at least 5 years; (ii) principal or secondary diagnosis of alcohol intoxication or toxic effect of alcohol (ICD-10 diagnosis F10.0, T51.0, T51.9), which was double checked by reviewing the laboratory test results, i.e. confirming that BAC at admission was >0 mg%. All eligibility criteria had to be met. We systematically reviewed the medical records of eligible cases and collected the mailing addresses of patients. After requesting the most up-to-date addresses of the former patients from the local registration offices, a letter from the hospital that carried out treatment was sent to the former patients inviting them to participate in a study on ‘Health development following hospital treatment in adolescence’, which would include a standardized, computer-assisted telephone interview. The letter included detailed study information and an informed consent form on which former patients could indicate their interest or noninterest in participating in the study. Former patients could send their informed consent together with contact details to the study center using a prepaid return envelope. As informed by the letter, participants of the telephone interview would receive a reimbursement of 35 €. Once the study center received written informed consent including contact information, study staff contacted the participants and scheduled an appointment for the interview. In the case of nonresponses, a second invitation letter was sent after 2 weeks.

The study and its protocol were approved by the ethics committee of the Dresden University of Technology (Technische Universität Dresden).

Predictors assessed in review of medical records and telephone interview

Medical records of all eligible cases, which included quantitative and qualitative data, were manually analyzed. This included narrative free text notes made by clinical staff. Data were extracted regarding patient characteristics (e.g. sex, age) and the following four predictor variables: (i) mental or behavioral disorders other than substance use disorders (SUD) such as major depression, anxiety disorders, or attention deficit and disruptive behavior disorders, coded dichotomously as present or not present, based on either medical diagnoses or documented reports by the patients or the parents; (ii) third party child custody (coded dichotomously as having a legal guardian other than parents or not); (iii) use of illicit substances (coded dichotomously as having ever used any illicit substances or not) and (iv) ‘atypical’ drinking patterns, i.e. drinking previously to a school/workday (absenseism), drinking alone and drinking to cope with conflicts. The extraction procedure for these three variables is described elsewhere (Gross et al., 2014).
The following predictor variables were assessed in the interview retrospectively: the onset of regular alcohol use by asking participants at which age they started to drink regularly, i.e., at least once a week or excessively on 2 consecutive days; truancy and runaway behavior by asking participants whether they had ever skipped school regularly or for a longer period, and whether they had ever run away from home overnight during their childhood or adolescence; low level of response to alcohol using the Self-Rating of the Effects of Alcohol (SRE) according to Schuckit et al. (1997) by asking participants when they started using alcohol during adolescence, and how many alcoholic drinks in the form of beer, wine, champagne, spirits or mixed drinks they needed (1) to begin to feel different (feel an effect), (2) to feel a bit dizzy or to begin to slur speech, (3) to walk in an uncoordinated manner and (4) to pass out or fall asleep unintentionally. The number of standard drinks reported for the four effects was summed. The housing situation of participants until their 18th birthday, which is the age of consent in Germany, was assessed by asking how many years they lived with only one parent until their 18th birthday, therefore, answers could range from 0 to 18.

Outcomes assessed in interview in young adulthood
Outcome measures in young adulthood were assessed in a telephone interview. The interviewers stated at the beginning of the interview that all the data collected remain confidential, that the participant can refuse to answer questions and that participation is completely voluntary. Each interview lasted on average 30 min and was conducted by one of four trained interviewers. Binge drinking was assessed by asking participants ‘On the past 30 days, on how many days have you drunk five or more drinks containing any alcohol on a single occasion?’ Responses were dichotomized to ‘never’ or ‘at least once’. Alcohol abuse and dependence in the past 12 months according to DSM-IV were assessed using the Munich Composite International Diagnostic Interview (M-CIDI; Wittchen and Pfister, 1997). Use of illicit substances was assessed by asking whether the participants had consumed cannabinoids, ecstasy, amphetamines, hallucinogens, cocaine, heroin and/or other drugs during the past 30 days. We assessed dichotomously the use of psychiatric or psychotherapeutic treatment in the past 12 months by asking participants whether or not they had been in inpatient or outpatient treatment due to mental or emotional problems irrespective of its cause. Delinquency (lifetime) was measured by asking participants whether they had ever been accused or convicted of one of the following offenses: theft, drug offense, violent crime or parole violation, resulting in a dichotomous variable. General life satisfaction was measured using the item ‘All things considered, how satisfied are you with your life in general?’ Answers could be given on an 11-point scale ranging from 0 ‘totally dissatisfied’ to 10 ‘totally satisfied’. This question was derived from the Socio-Economic Panel study (SOEP; Wagner et al., 2007).

Response
The investigation identified 1603 cases of alcohol intoxication during the period of 2000–2007. Of those, 580 (36.2%) were identified in the three participating pediatric hospitals in Dresden, and 490 (30.6%) and 533 (33.3%) cases in the two participating hospitals in Munich and Rostock, respectively. At the end of the recruitment process, 277 participants were interviewed. Excluding neutral nonresponse, the overall response rate was 22.7%. The response rates for the three study centers were 26.8% (Dresden), 17.9% (Munich) and 22.2% (Rostock) and did not differ significantly ($\chi^2 (2) = 1.77, P = 0.41$). The recruitment process is depicted in Figure 1.

Sample selectivity
We investigated the potential selectivity of the interview sample by comparing the data of medical records of interview participants and nonparticipants. Since subjects not receiving the study invitation letter, e.g., because their address was unknown, had no chance to express their interest in participating, they were considered neutral nonresponse cases and were not included in the selectivity analysis. A binary logistic regression was run to predict interview participation. This analysis revealed that being female was the only significant predictor of interview participation (see Table 1): a greater proportion of participants than nonparticipants were women (44.8%, $n = 124$ vs. 37.7%, $n = 303$).
Table 1. Results of the multivariate logistic regression analysis to predict interview participation (n = 1017)

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Interview participation, OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (female vs. male)</td>
<td>1.46 (1.08–1.96)†</td>
</tr>
<tr>
<td>Age at admission</td>
<td>1.07 (0.95–1.20)</td>
</tr>
<tr>
<td>Absenteism</td>
<td>0.77 (0.53–1.11)</td>
</tr>
<tr>
<td>Drinking to cope/alone</td>
<td>0.95 (0.57–1.58)</td>
</tr>
<tr>
<td>Mental disorder (other than SUD)</td>
<td>1.18 (0.73–1.92)</td>
</tr>
<tr>
<td>Third party child custody</td>
<td>0.72 (0.37–1.39)</td>
</tr>
<tr>
<td>Experience with illicit substances</td>
<td>1.23 (0.78–1.93)</td>
</tr>
<tr>
<td>Nagelkerke R²</td>
<td>0.02</td>
</tr>
</tbody>
</table>

OR, odds ratio; CI, confidence interval.
†Data of n = 204 had to be excluded from the selectivity analysis since the medical records were not available to us in these cases.

Statistical analysis
In the first step, we explored all contents of the medical records and systematically extracted all variables that might possibly predict later development of AUD, substance use and other psychosocial outcomes. Since not all variables were systematically documented in the medical records, we only included variables in our analyses that were available in >70% of the medical records. In the next step, variables that correlated at least moderately with each other were merged in an effort to restrain the number of predictors due to our limited sample size. This included the predictor variables ‘drinking alone’ and ‘drinking to cope’ (r = 0.56) and the predictor variables ‘truancy’ and ‘runaway behavior’ (r = 0.42), which were merged into two dichotomous variables. Linear and logistic regression analyses were used to model the relationship between predictor variables and outcomes, whereby all predictor variables were entered simultaneously in the models. To control for observation period, both the patient’s age at admission and his or her age at interview were included in all regression analyses. The variable ‘sex’ was used as covariate in all analyses. Imputation techniques were not implemented. Post hoc power analyses for non-significant predictor variables were performed using G*Power (Faul et al., 2009), and all other statistical analyses were performed using IBM SPSS Statistics Version 21 (SPSS, Inc., Chicago, IL).

RESULTS
Of the 277 interviewed participants, 44.8% were female, the mean age at the time of the interview was 24.4 years (SD 2.2; range 20–30 years) and 43.3% held a Fachabitur or Abitur degree (German degrees of higher secondary school, usually after 12 or 13 years of schooling). The mean age at hospital admission was 15.5 years (SD 1.2; range 10–17 years), and the mean observation period between hospital admission and date of interview was 8.3 years (SD 2.3; range 5–13 years). The mean BAC at admission was 154.1 mg% (SD 53.0).

Predictors: descriptive statistics
Descriptive statistics for the predictor variables are depicted in Table 2.

Outcomes: descriptive statistics
Of the 277 interviewed participants, 44.8% reported binge drinking in the past 30 days, whereby 29.2% reported binge drinking on 1–3 days and 15.5% on 4 or more days in the past 30 days. The criteria for alcohol abuse and dependence according to DSM-IV were met by 12.6 and 19.9%, respectively. A total of 18.8% affirmed having consumed at least one illicit substance category in the past 30 days. Cannabis was the most common with 17% using this substance, followed by amphetamines (2.5%), cocaine and hallucinogens (each 1.8%), other substances (1.4%), and ecstasy and heroin (each 0.4%). Regarding mental health treatment, 10.8% of the participants reported having been in psychiatric or psychotherapeutic treatment in the past 12 months, whereby 7.6% of the sample affirmed having been in outpatient, 0.7% in inpatient and 2.5% in out- and inpatient treatments during the respective period. Delinquency was affirmed by 36.1% of the sample, whereby theft was affirmed by 23.1%, violent crime by 19.1%, drug offense by 7.9% and parole violation by 2.2% of the sample. Participants scored on average 7.6 (SD 1.6; range 0–10) on general life satisfaction.

Prediction of outcomes
Linear and binary logistic regression analyses revealed that having used illicit substances in adolescence and reporting truancy and runaway behavior in adolescence significantly predicted four and being male three of seven outcome variables. A lower age at admission predicted subsequent use of illicit substances, those who were in child custody reported lower general life satisfaction, and a lower age of onset of regular alcohol use and a higher number of years that a youth lived with only one parent until 18th birthday were related to delinquency at follow-up. All other predictor variables were not significantly associated with outcome variables (see Table 3).

DISCUSSION
In the present multisite cohort study, we retrospectively identified predictor variables for the long-term psychosocial development of adolescents who were hospitalized due to acute alcohol intoxication. We found that being male and experience with illicit substances in adolescence predicted binge drinking, alcohol dependence and a poorer general life satisfaction in later life. In addition, use of illicit substances in adolescence also predicted use of illicit substances in young adulthood. Furthermore, we found that truancy and runaway behavior in childhood or adolescence positively predicted alcohol abuse, mental health treatment, and delinquency and negatively predicted general life satisfaction in young adulthood. The findings of this study highlight the importance of deviant behaviors like truancy and runaway behavior in adolescence. Based on the literature, it is apparent that truancy and runaway behavior are associated with various other risk behaviors in adolescence and that affected young people are particularly vulnerable to a negative health development. For example, in the study by...
Table 3. Results of multivariate logistic and linear regression analyses predicting binge drinking, DSM-IV alcohol abuse and dependence, use of illicit substances, mental health treatment, delinquency and general life satisfaction with all predictor variables entered simultaneously in the models

<table>
<thead>
<tr>
<th></th>
<th>Binge drinking</th>
<th>DSM-IV alcohol abuse</th>
<th>DSM-IV alcohol dependence</th>
<th>Use of illicit substances</th>
<th>Mental health treatment</th>
<th>Delinquency</th>
<th>General life satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td><strong>Sex (female vs. male)</strong></td>
<td>0.50 (0.28–0.88)*</td>
<td>0.72 (0.30–1.74)</td>
<td>0.36 (0.17–0.77)**</td>
<td>0.54 (0.26–1.12)</td>
<td>2.29 (0.85–6.15)</td>
<td>0.97 (0.52–1.81)</td>
<td>0.15*</td>
</tr>
<tr>
<td><strong>Age at admission</strong></td>
<td>0.95 (0.75–1.21)</td>
<td>1.23 (0.83–1.83)</td>
<td>0.95 (0.70–1.28)</td>
<td>0.66 (0.49–0.89)**</td>
<td>1.18 (0.76–1.83)</td>
<td>1.03 (0.80–1.35)</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Age at interview</strong></td>
<td>0.91 (0.80–1.03)</td>
<td>0.85 (0.69–1.05)</td>
<td>0.90 (0.76–1.06)</td>
<td>0.94 (0.80–1.10)</td>
<td>0.98 (0.80–1.22)</td>
<td>1.02 (0.89–1.17)</td>
<td>−0.10</td>
</tr>
<tr>
<td><strong>Predictors assessed in medical records</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absenteeism</td>
<td>1.78 (0.83–3.84)</td>
<td>1.05 (0.36–3.09)</td>
<td>1.57 (0.64–3.83)</td>
<td>0.79 (0.29–2.16)</td>
<td>1.10 (0.37–3.31)</td>
<td>0.84 (0.36–1.94)</td>
<td>0.08</td>
</tr>
<tr>
<td>Drinking to cope/alone</td>
<td>0.69 (0.25–1.95)</td>
<td>0.51 (0.11–2.39)</td>
<td>0.47 (0.13–1.74)</td>
<td>0.42 (0.10–1.78)</td>
<td>0.43 (0.08–2.22)</td>
<td>0.54 (0.18–1.60)</td>
<td>0.002</td>
</tr>
<tr>
<td>Mental disorder (other than SUD)</td>
<td>1.00 (0.38–2.60)</td>
<td>1.31 (0.39–4.37)</td>
<td>0.70 (0.21–2.29)</td>
<td>0.33 (0.08–1.41)</td>
<td>1.53 (0.45–5.30)</td>
<td>1.65 (0.61–4.45)</td>
<td>−0.02</td>
</tr>
<tr>
<td>Third party child custody</td>
<td>0.40 (0.10–1.57)</td>
<td>1.72 (0.37–8.07)</td>
<td>0.87 (0.18–4.28)</td>
<td>0.95 (0.16–5.53)</td>
<td>2.17 (0.44–10.66)</td>
<td>2.97 (0.71–12.52)</td>
<td>−0.24**</td>
</tr>
<tr>
<td>Experience with illicit substances</td>
<td><strong>4.24 (1.59–11.30)</strong></td>
<td><strong>1.15 (0.30–4.35)</strong></td>
<td><strong>8.19 (2.82–23.76)</strong></td>
<td><strong>6.76 (2.32–19.74)</strong></td>
<td><strong>1.83 (0.50–6.70)</strong></td>
<td><strong>1.89 (0.70–5.10)</strong></td>
<td>−0.19***</td>
</tr>
<tr>
<td><strong>Predictors assessed in interview</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age of onset of regular alcohol use</td>
<td>0.98 (0.85–1.14)</td>
<td>0.83 (0.66–1.05)</td>
<td>0.97 (0.80–1.16)</td>
<td>1.02 (0.86–1.22)</td>
<td>1.11 (0.91–1.35)</td>
<td>0.80 (0.68–0.95)*</td>
<td>−0.05</td>
</tr>
<tr>
<td>Truancy/runaway</td>
<td>0.70 (0.40–1.22)</td>
<td>4.59 (1.78–11.83)**</td>
<td>0.92 (0.46–1.85)</td>
<td>0.93 (0.47–1.86)</td>
<td>5.31 (1.76–16.01)**</td>
<td>2.76 (1.53–4.99)**</td>
<td>−0.16*</td>
</tr>
<tr>
<td>SRE</td>
<td>1.000 (1.000–1.001)</td>
<td>1.001 (1.000–1.002)</td>
<td>1.001 (1.000–1.001)</td>
<td>1.000 (0.998–1.001)</td>
<td>1.001 (1.000–1.002)</td>
<td>1.001 (1.000–1.002)</td>
<td>−0.05</td>
</tr>
<tr>
<td>Years living with only one parent until 18th birthday</td>
<td>1.03 (0.99–1.07)</td>
<td>0.97 (0.91–1.04)</td>
<td>1.05 (1.00–1.10)</td>
<td>1.02 (0.97–1.07)</td>
<td>0.97 (0.89–1.04)</td>
<td>1.08 (1.03–1.12)**</td>
<td>−0.12</td>
</tr>
</tbody>
</table>

Nagelkerke $R^2$ 0.13 0.20 0.19 0.16 0.20 0.24 0.18
Corr. $R^2$ 0.14

To control for observation period, both the patient’s age at admission and his or her age at interview were included in all regression analyses. Since the differences between the odds ratios for SRE are only slightly different, they are displayed with three digits.

OR, odds ratio; CI, confidence interval.

* $P < 0.05$.

** $P < 0.01$.

*** $P < 0.001$.

a In previous 30 days.

b In previous 12 months.

c Lifetime.
Mounteney et al. (2010) truants reported a higher frequency of alcohol consumption and higher levels of binge drinking and alcohol-related problems compared with their peers. Also, a representative German survey among ninth graders showed that truancy significantly predicted binge drinking (Donath et al., 2012). In a longitudinal study, young adults who ran away from home during adolescence were more likely to report depressive symptoms and drug dependence (Tucker et al., 2011). Although our data are not suitable for examining reasons for experiencing an alcohol-related hospital admission, the high rate of participants reporting truancy and runaway behavior in adolescence gives a clue for future research to investigate causes for this finding.

Our study identified illicit substance use in AIA as a predictor for substance use and alcohol dependence later in life. This result is comparable with previous studies, which showed that particularly the combined use of alcohol and drugs seems to be associated with a higher risk in this patient population. For example, Chun et al. (2010) demonstrated in a cross-sectional study that adolescent patients who used alcohol and cannabis had more psychosocial risk factors than patients who only used alcohol. In a longitudinal study in male conscripts, Stenbacka (2003) found that the combined use of alcohol and cannabis in adolescence predicted alcohol abuse and drug abuse in adulthood. Additionally, we found that the use of illicit substances in adolescence was associated with a lower general life satisfaction in young adulthood, which is in line with previous research (Bogart et al., 2006). One possible explanation for this finding is that adolescent illicit substance use is often associated with other problematic behaviors, which in turn are risk factors themselves for later problematic behaviors (Brook et al., 2002; Fergusson et al., 2002).

In a retrospective analysis of medical records of a German sample of AIA, Groß et al. (2014) found that drinking to cope, drinking alone and drinking even though the following day was a school/work day (‘atypical’ drinking) were associated with various risk factors for a later AUD. In the present study, we were unable to identify these ‘atypical’ drinking patterns as significant predictors for future adverse outcomes. This is in line with the results of a cross-lagged panel study of Dutch adolescents by Schelleman-Offermans et al. (2011) where coping motives showed no predictive value for heavy episodic drinking. The authors argue that in ‘wet’ drinking cultures, such as in Germany, social motives tend to predict heavy drinking, and in contrast, in less ‘wet’ drinking cultures, coping motives predict heavy drinking. This reasoning could also explain our findings.

Another often-discussed risk factor for binge drinking and the development of AUD in adulthood is an early age at onset of regular alcohol use (Kraus et al., 2000; Pitkänen et al., 2003; Guttmannova et al., 2012; Rossow and Kuntsche, 2013). In the present study, however, the age of onset of regular alcohol use only predicted delinquency in young adulthood, but neither AUD nor binge drinking. One reason for this absent association might be the relatively low variance in age of onset, which makes it more difficult to detect statistically significant associations. This low variance in turn was probably caused by the retrospective assessment over a relatively long observation period.

Considering the outcome prevalence rates in our study, our results show that 29.2% of the participants reported binge drinking on 1–3 days and 15.5% on 4 or more days in the past 30 days. Alcohol dependence was identified in 20%, 13% met criteria for an alcohol abuse diagnosis in young adulthood and 19% reported use of illicit substances in the past 30 days. Furthermore, participants scored on average 7.6 (SD 1.6; range 0–10) on general life satisfaction. When these data are compared with the results of epidemiological studies in the general population, it becomes apparent that AIA are at an elevated risk for later AUD. Results of the Epidemiological Survey of Substance Abuse (ESA) in the general population in Germany show a prevalence of DSM-IV alcohol dependence and alcohol abuse within the previous 12 months of 6.1 and 4.1% for ages 21–24 years and 4.6 and 4.0% for ages 25–29 years, respectively (Pabst et al., 2013). Also, the prevalence of illicit substance use within the previous 30 days seems to be elevated in young adults who experienced an alcohol-related hospital admission in adolescence: using a representative sample of young adults and adolescents in Germany, the Drug Affinity Study reported a prevalence of 5.8% for the age group of 18–25 years (BZgA, 2012). However, the score of general life satisfaction found in our study was similar to the average score in general population (Baird et al., 2010), and also our results regarding binge drinking were similar to findings from the ESA study (Pabst et al., 2013).

To interpret our results, we emphasize the following limitations of this naturalistic study. First, we assessed potential sample selectivity effects particularly due to the relatively high rate of nonresponders. This analysis revealed that our sample may have oversampled women but appears to be representative for the population of AIA regarding the other factors listed in Table 1. Second, the post hoc power of the variables in Table 3, which did not significantly predict outcomes, was low (≤0.60) at an α level of 0.05. Therefore, these null results should be interpreted with caution. Third, the fact that medical records were analyzed in retrospect implies that the source to define predictor variables was constrained to the information that was routinely documented in standard pediatric care. Quality of such documentation varied over time and over centers, which is why information on some important variables was documented in too few cases to be analyzed as a predictor, such as laboratory measures of liver enzyme activity or parental socioeconomic status. Routine documentation in different centers also implied that the relevant information was not necessarily recorded in the same way for each individual. For example, in some records, the fact that a patient never used illegal substances was explicitly mentioned and could be used for our evaluation, while in other cases we were unable to find any information concerning substance use and therefore could not include such a patient into analyses of substance use. Fourth, it is possible that predictor variables assessed retrospectively are subject to recall bias, e.g. for age of onset of regular alcohol use, truancy and runaway behavior in adolescence, SRE and living with only one parent until 18th birthday. Fifth, we did not examine possible social consequences of problematic drinking in adolescence or young adulthood, e.g. dropout from college or unemployment. This would be interesting from a socioeconomic perspective, bearing in mind the background of increased numbers of AIA in Germany (Statistisches Bundesamt, 2014).

This is the first study to our knowledge that tested the predictive value of hypothesized risk variables for AUD and other outcomes in AIA. Our results show that predicting long-term outcomes in AIA is difficult. The parameters typically documented in routine pediatric in-patient care provide insufficient help to predict future health development. This becomes clear when considering the values of explained variance in the regression models predicting outcomes, which only lay between 13 and 24%. However, we observed high odds ratios, e.g. of 8.2 for illicit substance use to predict alcohol dependence, and 4.6 and 5.3 for truancy/runaway behavior to predict alcohol abuse and mental health treatment, respectively. We suggest that these variables should be systematically asked for when taking histories in AIA and considered for clinical decision making about psychosocial interventions following hospital treatment. Identifying more strong predictors is needed to provide decision-making basis for clinical care of AIA. In this context, the RISCA study group is currently developing a short questionnaire assessing risk and protective factors for a healthy development of AIA, based on a bedside interview with AIA.
of this questionnaire is to identify adolescents who have an elevated level of risk for future developmental hazards.

**FUNDING**

This work was supported by grant No. BIA5-2511DSM220 from the German Federal Ministry of Health (Bundesministerium für Gesundheit).

**CONFLICT OF INTEREST STATEMENT**

L.K. and D.P. declare having received a grant from Lundbeck GmbH for a research project on alcohol epidemiology not related to this study.

**REFERENCES**


