Stability of At-risk Alcohol Use Screening Results in a General Population Sample

Andreas Staudt, Jennis Freyer-Adam, Ulrich John, Christian Meyer, and Sophie Baumann

Background: In combination with systematic routine screening, brief alcohol interventions have the potential to promote population health. Little is known on the optimal screening interval. Therefore, this study pursued 2 research questions: (i) How stable are screening results for at-risk drinking over 12 months? (ii) Can the transition from low-risk to at-risk drinking be predicted by gender, age, school education, employment, or past week alcohol use?

Methods: A sample of 831 adults (55% female; mean age = 30.8 years) from the general population was assessed 4 times over 12 months. The Alcohol Use Disorders Identification Test—Consumption was used to screen for at-risk drinking each time. Participants were categorized either as low-risk or at-risk drinkers at baseline, 3, 6, and 12 months later. Stable and instable risk status trajectories were analyzed descriptively and graphically. Transitioning from low-risk drinking at baseline to at-risk drinking at any follow-up was predicted using a logistic regression model.

Results: Consistent screening results over time were observed in 509 participants (61%). Of all baseline low-risk drinkers, 113 (21%) received a positive screening result in 1 or more follow-up assessments. Females (vs. males; OR = 1.66; 95% confidence intervals [95% CI] = 1.04; 2.64), 18- to 29-year-olds (vs. 30- to 45-year-olds; OR = 2.30; 95% CI = 1.26; 4.20), and those reporting 2 or more drinking days (vs. less than 2; OR = 3.11; 95% CI = 1.93; 5.01) and heavy episodic drinking (vs. none; OR = 2.35; 95% CI = 1.06; 5.20) in the week prior to the baseline assessment had increased odds for a transition to at-risk drinking.

Conclusions: Our findings suggest that the widely used time frame of 1 year may be ambiguous regarding the screening for at-risk alcohol use although generalizability may be limited due to higher-educated people being overrepresented in our sample.

Key Words: At-risk Drinking, Drinking Patterns, Trajectories, AUDIT-C, Public Health.

Brief alcohol interventions (BAIs) have been proven efficacious in reducing at-risk drinking in primary care populations (Alvarez-Bueno et al., 2015; Beyer et al., 2019). BAIs are a promising approach to promote public health (Heather, 2012) if they are implemented in combination with systematic routine screening for at-risk drinking.

The thresholds for at-risk drinking are 14 or more alcoholic drinks per week for men and 7 or more for women as well as 5 or more alcoholic drinks per single occasion for men and 4 or more for women (National Institute on Alcohol Abuse and Alcoholism, 2010). Established screening measures assess typical drinking behavior, often referring to time frames such as the past year (e.g., Alcohol Use Disorders Identification Test—Consumption; Bush et al., 1998). Although previous studies found alcohol consumption to be generally stable over time (de Vocht et al., 2016; Kerr et al., 2002; Knott et al., 2018), certain drinking patterns may be characterized by temporal variations (Sher et al., 2011), even within a short time such as 4 weeks (Staudt et al., 2018). Furthermore, seasonal peaks or lows in alcohol use have been observed (Knudsen and Skogen, 2015; Kushnir and Cunningham, 2014). An interference of these temporal variations on screening cannot be ruled out.

The effect of an individualized brief intervention delivered to those identified as at-risk drinkers through screening may be attenuated if it does not yield the "true" alcohol consumption but rather a biased snapshot of someone's drinking behavior. According to World Health Organization (WHO) recommendations (World Health Organization, 2017) and

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common practice in research (Beyer et al., 2019), at-risk drinkers are the sole target group for BAIs. With this approach, misclassification might lead to missing people in need for BAI, which is especially unfavorable since recent evidence has shown that alcohol consumption contributes to cancer risk even below the established threshold for at-risk drinking (Burton and Sheron, 2018).

In their most recent recommendation statement, the U.S. Preventive Services Task Force (2018) concluded that the optimal screening interval remains unknown. The German guideline "Screening, diagnosis and treatment of alcohol-related disorders" (AWMF, 2014) states that a screening interval of 1 or 2 years may be adequate and useful, simultaneously acknowledging insufficient evidence on the temporal stability of at-risk drinking in the general population. The lack of evidence refers in particular to intervals of less than 12 months. Among a representative sample of U.S. adults who were screened twice, 15% of low-risk alcohol users reported at-risk use 3 years later (Saitz et al., 2019). Annual screenings for alcohol misuse as part of routine care for U.S. veteran outpatients revealed that the probabilities of converting to a positive screening result after 1 year varied between 2 and 39%, depending on gender, age, and initial negative screening score (Lapham et al., 2014a). The latter study reported an average number needed to screen of 17 in order to identify 1 person converting from a negative to a subsequent positive screening result.

While regular screenings are highly desirable in order to reduce alcohol-related illness and disease (Rehm et al., 2016), the widespread dissemination of routine screening is challenged by resource and time constraints in settings relevant for BAI (Johnson et al., 2011). To save resources, information on optimal screening intervals is required. Investigating the stability of at-risk alcohol use screening within 1 year may shed some light on this issue.

Moreover, little is known on factors that predict change from a negative toward a positive screening result over time. The studies by Saitz et al. (2019) and Lapham et al. (2014a) identified male gender and younger age to be relevant in this respect. Among U.S. adults, gender and education predicted change in drinking patterns from age 53 to 64 (Molander et al., 2010). Cross-sectional research has shown that alcohol consumption varies by school education (Bloomfield et al., 2006) and employment status (Melchior et al., 2015; Popovici and French, 2013). It seems conceivable that these factors may also shape the longitudinal development of drinking but evidence in the general population is scarce. Furthermore, short periods of increased alcohol intake, for instance in the past week, in spite of a negative screening result may indicate a tendency toward at-risk drinking and add to the consideration when the next screening should take place. Therefore, this study aims to investigate: (i) how stable screening results for at-risk drinking are over the course of 12 months and (ii) if the transition from low-risk to at-risk drinking can be predicted by gender, age, school education, employment status, or past week alcohol use.

MATERIALS AND METHODS

Participants and Procedure

The sample comprises the control arm of a randomized controlled trial evaluating a computer-based BAI targeting the full spectrum of alcohol consumption (Baumann et al., 2018). The trial was prospectively registered at the German Clinical Trials Register (DRKS00014274) and approved by the responsible ethics committee of the respective university (protocol number BB 147/15).

Participants were proactively recruited in the waiting area of a municipal registry office in Germany. The registry office is the public authority for passport and vehicle admission issues and offers access to the general population. The recruitment strategy was 2-staged. All visitors appearing in the waiting area during our study period were approached by study assistants. Those aged between 18 and 64 years were asked to participate in a self-administered tablet-based survey that contained the eligibility screening for the subsequent trial. Persons who were already approached during an earlier visit, persons cognitively or physically incapable, persons with insufficient language or reading skills, and persons employed at the conducting research institute were excluded.

Persons reporting past-year alcohol consumption were eligible and asked to participate in the trial. Those who had no telephone or permanent address were excluded. After giving their written informed consent, participants were randomized to either receiving BAI or assessment only and received a voucher of 5 € in compensation for their participation. Simple randomization with individuals as units of randomization was applied (1:1 group allocation ratio). Participants were unaware of their individual group affiliation until they received BAI or not.

Recruitment took place from mid-April to mid-June 2018. Computer-assisted telephone interviews (CATIs) were conducted 3 (July to September 2018), 6 (October 2018 to January 2019), and 12 months (April to July 2019) after the baseline assessment by study assistants. After 10 failed telephone contacts, according questionnaires were sent out to participants by e-mail or mail. All participants received another voucher of 5 € that was sent per mail prior to the follow-up assessment at month 12. Study assistants responsible for recruitment, supervision of the baseline assessment, and the conduction of CATIs were blinded to the participants' group allocation.

Overall, 3,966 registry office visitors met the inclusion criteria for the PRINT eligibility screening (Fig. 1). Among those, 2,947 (74%) completed the screening assessment. Of 2,463 eligible persons, 1,646 (67%) participated in the PRINT trial. Those who were randomized to the assessment-only control group constitute the sample for our study (n = 831). Follow-up participation ranged between 81% (month 12) and 86% (month 3) in this group, whereas 614 control group participants (74%) completed all follow-up assessments.

Measures

At-risk Drinking. At each assessment, the *Alcohol Use Disorders Identification Test—Consumption* (AUDIT-C; Bush et al., 1998) was applied to screen for at-risk drinking. The AUDIT-C consists of 3 items asking for the typical frequency of alcohol consumption, the typical quantity when alcohol is consumed, and the typical frequency of heavy episodic drinking (HED). The HED item was adapted to current recommendations for low-risk drinking (National Institute on Alcohol Abuse and Alcoholism, 2010) asking how often women had 4 or more and men had 5 or more alcoholic drinks on a single occasion (Higgins-Biddle and Babor, 2018). No reference period was specified, which means that the items were identical for all points of measurement. Participants were informed about the size of alcoholic standard drinks. A drink was defined as 0.25 to 0.3 l beer, 0.1 to 0.15 l wine or sparkling wine, or 4cl spirits. This information was

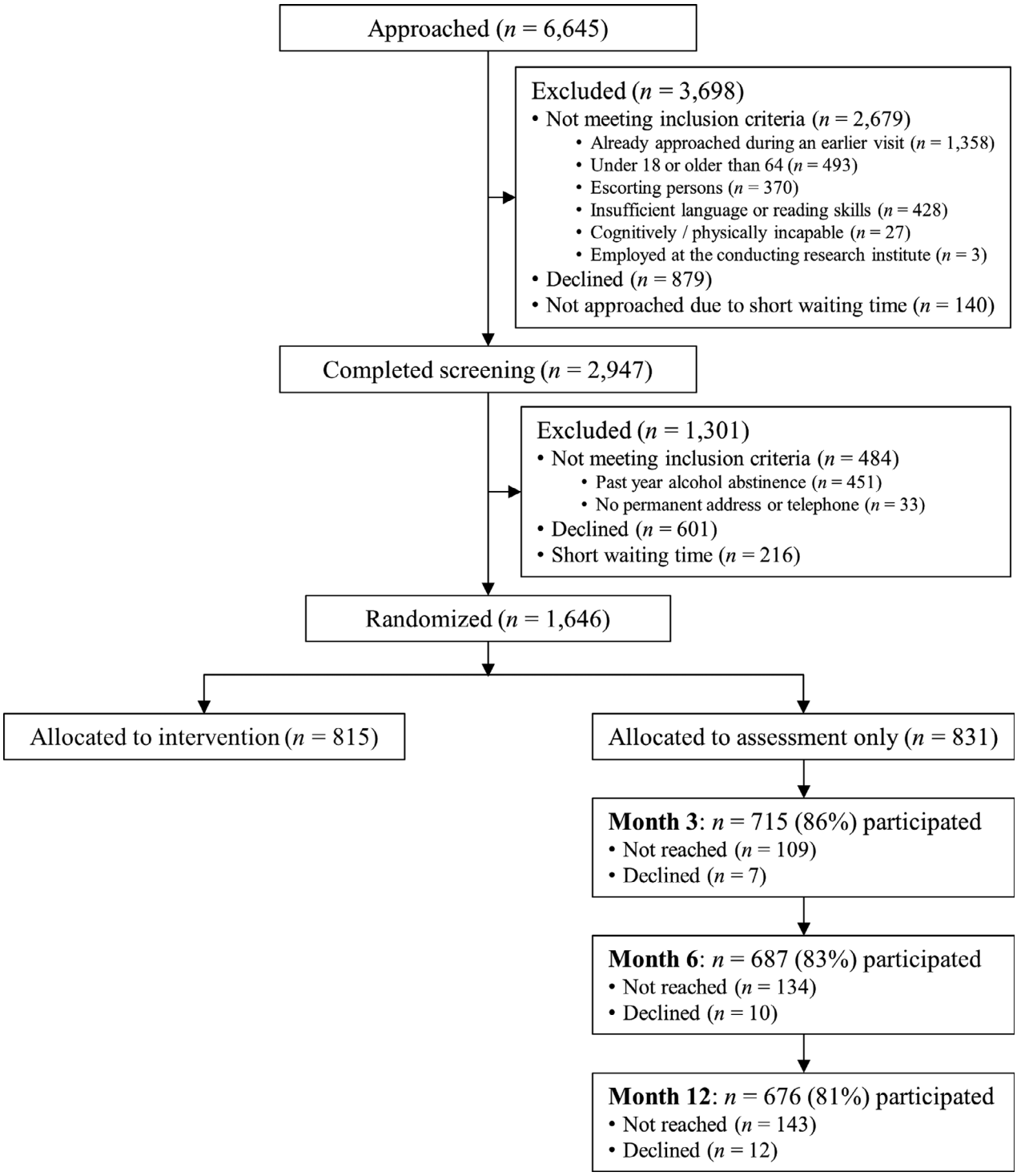

Fig. 1. Flow chart of participants.

displayed as a note on the tablet screen or read out loud by study assistants during the telephone interviews. The AUDIT-C sum score was calculated, and cutoff scores of ≥4 for women and ≥5 for men were used (Reinert and Allen, 2007) to indicate at-risk drinking. The AUDIT-C had shown very good sensitivity and acceptable specificity in detecting at-risk drinking in the general population (Dawson et al., 2005; Rumpf et al., 2002).

In order to quantify the stability of screening results, the individual risk status (low risk/at risk) was generated for every point of measurement. Based on this, consistent (same risk status over time) and inconsistent trajectories (change of risk status over time) were determined. Trajectories were coded as "stable" when there was no change in risk status and at least 1 follow-up where participants provided information on their alcohol consumption. Trajectories were

coded as "changed once" when there was exactly 1 change in risk status over time and "fluctuating" when there was more than 1 change. Those who did not complete any follow-up assessment were coded as "lost to all follow-ups."

Predictors. Gender, age, school education, employment status, and university student status were assessed at baseline. Participants were asked to indicate their highest educational degree: 12 or more, 10 to 11, and 9 or less years of school education. Employment status was assessed by full-time employed, part-time employed, education (still going to school, university students, and occupational retraining), unemployed, and others (retiree, homemaker, or similar). In addition, participants were asked if they are currently enrolled at a university (no/yes). In order to prevent very small cell sizes in the joint distribution, employment was reduced to 2 categories (full- or part-time employed/currently not employed). Age was dummy-coded and grouped into 3 categories: 18 to 29, 30 to 45, and 46 to 64 years of age.

Past week alcohol use was assessed at baseline using *Timeline Followback* (Sobell and Sobell, 1992). Participants were asked to indicate the number of alcoholic drinks they had on each of the 7 days prior to the assessment. The same note about the size of an alcoholic standard drink as for the AUDIT-C was displayed on the tablet screen (see above). Based on the information provided, 2 indicators of past week alcohol use were generated: the number of drinking days (less than 2 days/2 days or more) and HED (no/yes) which was defined as having had 4 or more alcoholic drinks for women and 5 or more alcoholic drinks for men on any day in the past week.

Statistical Analysis

Depicting Stability of Screening Result. The stability of screening for at-risk drinking was evaluated: (i) by descriptive statistics given as proportions of consistent and inconsistent risk status trajectories and (ii) by plotting longitudinal trajectories using the R package *LongCatPlot* (Tueller et al., 2016) in RStudio (RStudio Team, 2015). All other analyses were conducted with Stata 14.2 (StataCorp., 2015).

Predicting Transitions From Low-Risk to At-risk Drinking. To test whether the transition from negative to positive screening result can be predicted by gender, age, school education, employment status, or past week alcohol use, binary logistic regression analysis was applied. The outcome was at-risk drinking at any follow-up assessment. Results are given as odds ratios (OR) with 95% confidence intervals (95% CI). Participants who already reported at-risk drinking at baseline and those who did not complete any follow-up were excluded from the model. Thus, the sample size was reduced to 491 (59% of those allocated to the assessment-only control group). Chi-square tests were used to compare the sample for the logistic regression model with those who had to be excluded from the model regarding sociodemographic characteristics. To control for potential confounding effects of the time of recruitment, a sensitivity analysis was conducted with the weeks of recruitment entered as additional dummy-coded predictors.

Handling of Missing Values. There were no missing data at baseline as the tablet computers did not allow for skipping items without providing an answer to the respective question, and there was no data loss due to technical reasons. Missing values due to nonparticipation in the follow-up assessments were considered in the determination of risk status trajectories as well as in *LongCatPlot* that provides the possibility to explicitly plot missing states. For the logistic regression model, 49 baseline low-risk drinkers had to be excluded because they did not provide any follow-up data.

RESULTS

Sample Characteristics

The sample encompassed 831 participants, among them 460 (55%) were females (Table 1). The mean age was 30.8 years (SD = 10.8 years). The majority (n = 557; 67%) had 12 or more years of school education. One-fourth (n = 225; 27%) had 10 to 11 and 49 (6%) had 9 or less years of school education. Current employment was indicated by 525 participants (63%). Two hundred and ninety-nine participants (36%) reported to be university students.

Stability of Screening Status

At baseline, 291 participants (35%) received a positive screening result for at-risk drinking. The proportions of low-risk and at-risk drinkers at months 3, 6, and 12 are displayed in the upper part of Table 2, for the overall sample, and broken down by baseline low-risk and baseline at-risk drinkers.

Among those with a negative screening result at baseline (n = 540), 378 (70%) remained low-risk drinkers throughout the study period (lower part of Table 2). At-risk drinking in at least 1 follow-up assessment was reported by 113 (21%) baseline low-risk drinkers encompassing 45 (8%) who transitioned to a positive subsequent screening result once and 68 (13%) with fluctuating risk status.

Among those with a positive screening result at baseline (n = 291), 131 (45%) reported consistent at-risk drinking over time (lower part of Table 2). In 71 participants (24%), a transition to low-risk drinking was observed, and 67 (23%) revealed a fluctuating risk status. Patterns and proportions of these categorical trajectories are depicted in Fig. 2, sorted by baseline risk status.

Predicting Transitions From Low-risk to At-risk Drinking

The transition from negative screening result at baseline to a positive subsequent screening result at any follow-up was significantly predicted by gender, age, and past week alcohol

Table 1. Sample Characteristics

	n	%
Females	460	55
Age-groups		
18- to 29-year-olds	478	58
30- to 45-year-olds	246	30
46- to 64-year-olds	107	13
School education		
9 or less years	49	6
10 to 11 years	225	27
12 or more years	557	67
Currently employed (full-time or part-time)	525	63
University students	299	36
Two or more drinking days in the past week	467	56
HED in the past week	174	21

HED, heavy episodic drinking. n = 831.

Table 2. Stability of At-risk Alcohol Use Screening Over 12 Months According to AUDIT-C

	Month 3		Month 6		Month 12	
	Low risk	At risk	Low risk	At risk	Low risk	At risk
Baseline low-risk drinkers	396 (86%)	64 (14%)	404 (89%)	48 (11%)	396 (89%)	47 (11%)
Baseline at-risk drinkers	73 (29%)	182 (71%)	84 (36%)	151 (64%)	86 (37%)	147 (63%)
Overall	469 (66%)	246 (34%)	488 (71%)	199 (29%)	482 (71%)	194 (29%)

	Risk status trajectories			
	Stable	Changed once	Fluctuating	Lost to all follow-ups
Baseline low-risk drinkers	378 (70%)	45 (8%)	68 (13%)	49 (9%)
Baseline at-risk drinkers	131 (45%)	71 (24%)	67 (23%)	22 (8%)
Overall	509 (61%)	116 (14%)	135 (16%)	71 (9%)

All cells are *n* (%). The sample sizes are $n = 540$ baseline low-risk drinkers and $n = 291$ baseline at-risk drinkers. The differences in the distribution of risk status trajectories between baseline low-risk drinkers and baseline at-risk drinkers are statistically significant ($\chi^2 = 67.4$; $p < 0.001$).

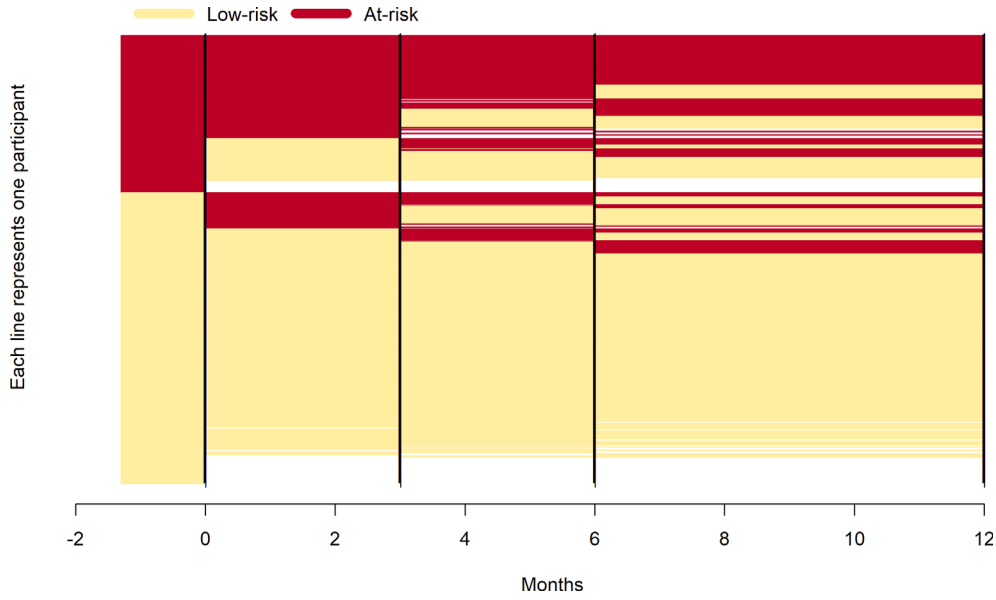

Fig. 2. At-risk alcohol use screening status according to AUDIT-C over time. Every participant is represented by 1 horizontal line that is divided into 4 subsections. These correspond to baseline screening result, and screening result at month 3, at month 6, and at month 12 (from **left** to **right**). Each **vertical black line** represents 1 assessment. The length of each horizontal subsection corresponds to the duration for which the respective screening is valid. The baseline status is narrowed. The different states are represented by different colors (low-risk drinking = **yellow**/at-risk drinking = **red**). White segments indicate missing values.

use. Females had 66% higher odds for transitioning to at-risk drinking than males (OR = 1.66; 95% CI = 1.04; 2.64), and 18- to 29-year-olds had 2.3-fold odds compared to 30- to 45-year-olds (OR = 2.30; 95% CI = 1.26; 4.20). Reporting 2 or more drinking days (vs. less than 2 drinking days; OR = 3.11; 95% CI = 1.93; 5.01) as well as HED in the past week (vs. none; OR = 2.35; 95% CI = 1.06; 5.20) more than doubled the odds for transitioning to at-risk drinking. The sensitivity analysis revealed that the time of recruitment did not predict the transition from low-risk drinking at baseline to at-risk drinking at any follow-up assessment. Moreover, the addition of time of recruitment as predictor did not alter the magnitude or statistical significance of the above-mentioned coefficients (Table 3).

DISCUSSION

Following an alcohol-using adult general population sample over 12 months, our study revealed 2 main findings. First, 30% of participants showed changes in alcohol use screening status, regardless whether they were low-risk or at-risk drinkers at baseline. Second, transitioning to at-risk drinking, which occurred in 21% of baseline low-risk drinkers, was more likely for females, young adults, and those with 2 or more drinking days and HED in the week prior to baseline.

One in 3 persons did not maintain their initial screening status and revealed times of low-risk and at-risk drinking within 1 year. On the other hand, the majority of people in

Table 3. Logistic Regression Model Predicting the Transition From Baseline Low-risk Drinking to At-risk Drinking at Any Follow-up Assessment

	Constant low-risk drinking *n* (%)	Transition to at-risk drinking *n* (%)	Odds ratio	95% CI	*p*-value
Gender					
Males	183 (80%)	47 (20%)	1.00		
Females	195 (75%)	66 (25%)	1.66	1.04; 2.64	0.033
Age-groups					
18- to 29-year-olds	191 (72%)	73 (28%)	2.30	1.26; 4.20	0.007
30- to 45-year-olds	130 (86%)	21 (14%)	1.00		
46- to 64-year-olds	57 (75%)	19 (25%)	1.72	0.83; 3.58	0.147
School education					
9 or less years	18 (75%)	6 (25%)	1.00		
10 to 11 years	112 (78%)	31 (22%)	1.05	0.36; 3.07	0.930
12 or more years	248 (77%)	76 (23%)	1.05	0.37; 2.99	0.924
Employment status					
Currently not employed	125 (73%)	47 (27%)	1.00		
Currently employed	253 (79%)	66 (21%)	0.71	0.43; 1.19	0.192
University student status					
Currently not enrolled	257 (77%)	75 (23%)	1.00		
Currently enrolled	121 (76%)	38 (24%)	0.70	0.39; 1.27	0.245
Drinking days in the past week					
Less than 2 days	229 (85%)	40 (15%)	1.00		
Two or more days	149 (67%)	73 (33%)	3.11	1.93; 5.01	<0.001
HED in the past week					
No HED	361 (79%)	98 (21%)	1.00		
HED	17 (53%)	15 (47%)	2.35	1.06; 5.20	0.036

HED, heavy episodic drinking.

The sample size for this model was $n = 491$. A lower proportion of university students ($\chi^2 = 6.7$, $p = 0.009$) and a different age distribution ($\chi^2 = 9.8$, $p = 0.007$) were found among those included in the logistic regression model compared to those excluded.

our sample showed a consistent screening status over time replicating findings from previous longitudinal studies regarding the overall stability of drinking (de Vocht et al., 2016; Kerr et al., 2002; Knott et al., 2018). For the assessment of typical alcohol consumption, reference periods such as the past 12 months are recommended (Greenfield and Kerr, 2008). Based on our findings, such a period may include transitions from low-risk to at-risk drinking (or vice versa). This might make it more difficult for respondents to answer accurately and might amplify recall bias. Moreover, the results of singular screenings may have limited temporal validity. Suppose a person is screened for at-risk drinking during a routine visit to the general practitioner and reports low-risk alcohol consumption. Following the WHO recommendations (World Health Organization, 2017), that person would not receive any form of intervention. There are currently no evidence-based recommendations on when the next screening should take place (AWMF, 2014; U.S. Preventive Services Task Force, 2018). As long as regular screenings are not carried out consistently, this result might stand for an indefinite period of time, in which phases of at-risk drinking might occur undetected.

Within 1 year, a person can consume alcohol on different and clinically relevant intensity levels, which poses a challenge to the identification of BAI targets through screening. Two approaches might be conceivable in this context to tap the full potential of BAI. Either systematic screenings could be repeated on a regular basis, or the target group for BAIs could be expanded to include a wider spectrum of alcohol use. Both suggestions face scarce resources in practice (Johnson et al., 2011), and rescreening everyone within 12 months may not be useful since the majority of people drink alcohol without great fluctuations over time. Computer-based brief interventions might be a cost-saving alternative to provide large groups with individualized alcohol prevention, possibly tailored to an individual's drinking behavior and regardless if the thresholds for at-risk drinking are exceeded. However, this might just be a starting point for discussions about future directions in BAI practice, which should be informed by thorough weighing of epidemiological data, expected intervention effects, and cost–benefit considerations (e.g., Heather, 2012).

Less than half of those who reported at-risk drinking at baseline did so in all follow-up assessments. It may be tempting to assume that at-risk drinking is a temporary phenomenon in some people and prone to spontaneous remission, hence questioning the need for action. In our view, this conclusion must be treated with utmost caution, though. For one thing, research participation effects (McCambridge et al., 2014) may be responsible for the fact that not all of those with a positive screening result at baseline consistently reported at-risk drinking throughout the study period. The mere attention participants and their alcohol consumption received by being part of a randomized controlled trial may have triggered behavior change. Reduction of alcohol consumption in BAI control groups that do not contain any active ingredient besides repeated assessments has been documented (Bischof et al., 2012; Jenkins et al., 2009). Socially

desirable responding could also play a role in this respect (Davis et al., 2010). However, research participation effects may also be considered for transitions in the opposite direction, from low-risk to at-risk drinking.

Apart from that, short periods of increased alcohol intake are also relevant for health. Recent evidence revealed that alcohol consumption may contribute to different cancers even below the established threshold for low-risk drinking (Burton and Sheron, 2018). The dichotomous conceptualization of at-risk and low-risk drinking may not be adequate in light of this new evidence. While the evidence mainly refers to average daily consumption, part of the alcohol-attributable burden comes from HED. In fact, drinking patterns may be unstable or fluctuating due to varying frequencies of HED. These instances of heavy drinking do not only harm the cardiovascular system (Roerecke and Rehm, 2010) but also increase the risk for injuries and accidents (Taylor et al., 2010).

Our findings may support the idea of selective rescreening. In line with previous studies (Lapham et al., 2014a; Saitz et al., 2019), adults below 30 years of age were more likely to transition from low-risk drinking at baseline to at-risk drinking. Permissive social norms toward alcohol consumption are prevalent among young adults (Garnett et al., 2015) making this group susceptible to at-risk drinking. Health behaviors may be of secondary importance in a phase of life where circumstances are changing fundamentally, for instance by starting a vocational or university training. Canadian students showed fluctuating drinking in their first year at university (Tremblay et al., 2010) lending support to the potential explanation that the unequally distributed workload over the semester may account for the age effect. However, being a university student did not increase the odds for transitioning to at-risk drinking in our sample.

We found females to be more likely to transition from low-risk drinking at baseline to at-risk drinking at any follow-up assessment, contradicting findings in adults from the general population (Saitz et al., 2019) and veteran outpatients (Lapham et al., 2014a). There is no unequivocal evidence that females change their alcohol use more often than males (Knudsen and Skogen, 2015; Staudt et al., 2018); if anything, age-related decreases in alcohol use seem to be more marked among females (Molander et al., 2010). Our finding may be explained by the decision for a lower AUDIT-C cutoff value for females which was intended to account for the gender-specific thresholds for low-risk drinking (National Institute on Alcohol Abuse and Alcoholism, 2010). As a result, a similar increase in alcohol consumption might lead to the AUDIT-C threshold for at-risk drinking being exceeded in females, but not in males.

People reporting 2 or more drinking days and HED in the week prior to the negative screening were more than twice as likely to transition to at-risk drinking. While recent drinking may not necessarily reflect typical drinking (Greenfield and Kerr, 2008), assessing past week alcohol use in addition to screening may be a valuable source of information. Discrepancies may be an indication of fluctuating drinking patterns, for example, indicating a typical drinking frequency of "2 to 4 times a month" on the first AUDIT-C item while reporting 2 or more drinking days in the past week. Our findings do not allow us to derive explicit recommendations for practice, but they do show that there may be certain groups of individuals who are more likely to transition to at-risk drinking following a negative screening result in the past, and may thus be eligible for selective rescreening.

Four limitations of our study must be considered. First, the data are based on self-reports only. Transitions between low-risk and at-risk drinking might partly be due to reliability issues since our study featured repeated screenings (Lapham et al., 2014b) with different modes of administration (Bowling, 2005). The prerequisite for reliable comparisons is measurement invariance of the AUDIT-C, which has been established across different groups (Moehring et al., 2018) but not yet across repeated measurements. Thus, measurement error might be responsible for part of the instability of low-risk and at-risk drinking. Second, selection bias is likely. It is well known that university students show drinking habits (Karam et al., 2007) and exhibit social norms toward alcohol consumption (Wicki et al., 2010) that may differ substantially from those who are not connected to the university setting. There are at least 2 reasons why higher-educated individuals and university students were overrepresented in our sample compared to the general population in Germany. Among the 59,382 inhabitants of the city where our study was conducted (Statistical Office of the Federal State of Mecklenburg-Western Pomerania, 2019) in 2018, 10,247 were university students (University of Greifswald, 2020). In addition, higher-educated people are more prone to participate in trials on health behaviors (e.g., Freyer-Adam et al., 2016; Ludden et al., 2015). Thus, generalizability of our findings is limited to 18- to 64-year-old citizens of a university town in Germany. Third, as alcohol intake can vary substantially over sociodemographic and socioeconomic strata, there may be subgroup-specific trajectories of low-risk and at-risk drinking over time. However, small sample sizes (e.g., $n = 107$ people at age 46 to 64 or $n = 49$ people with 9 or less years of school education) precluded subgroup analyses with sufficient statistical power. Fourth, this study is a secondary analysis of control group data of a randomized controlled trial. Therefore, the study was originally not designed to scrutinize the stability of screening for at-risk drinking. It may be argued that 3 to 6 months between assessments are too long to capture all relevant fluctuations in people's alcohol intake. Short-term transitions between low-risk and at-risk drinking may have been missed. Future studies may be able to explore these trajectories using a finer-grained assessment schedule in order to get a more detailed picture about the stability of low-risk and at-risk drinking over time.

To conclude, our study revealed that 1 in 3 individuals reported both times of low-risk drinking and at-risk drinking within 1 year. However, the majority had a consistent screening status over time. We were able to identify factors

that predict transitions from low- to at-risk drinking. Future research could attempt to reconcile these findings with the practice of BAI and new evidence that no level of alcohol consumption improves health (Burton and Sheron, 2018).

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interests.

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