

## Research Report

European  
Addiction  
Research

Eur Addict Res 2013;19:121–127

DOI: [10.1159/000342331](https://doi.org/10.1159/000342331)

Received: February 15, 2012

Accepted: August 5, 2012

Published online: November 23, 2012

# Screening Questionnaires for Problem Drinking in Adolescents: Performance of AUDIT, AUDIT-C, CRAFFT and POSIT

Hans-Jürgen Rumpf<sup>a</sup> Tim Wohlert<sup>b</sup> Jennis Freyer-Adam<sup>c</sup> Janina Grothues<sup>d</sup>  
Gallus Bischof<sup>a</sup>

<sup>a</sup>Department of Psychiatry and Psychotherapy, Research Group S:TEP, University of Lübeck, and <sup>b</sup>Department of Children and Adolescent Medicine, University of Lübeck, Lübeck, <sup>c</sup>Institute of Epidemiology and Social Medicine, University of Greifswald, Greifswald, and <sup>d</sup>AHG Klinik Schweriner See, Lüstorf, Germany

## Key Words

Screening, adolescents · Diagnostics · At-risk drinking · Alcohol dependence · Alcohol abuse · AUDIT · AUDIT-C · POSIT · CRAFFT

## Abstract

**Background/Aims:** Only rather few data on the validity of screening questionnaires to detect problem drinking in adolescents exist. The aim of this study was to compare the performance of the Alcohol Use Disorders Identification Test (AUDIT), its short form AUDIT-C, the Substance Module of the Problem Oriented Screening Instrument for Teenagers (POSIT), and CRAFFT (acronym for car, relax, alone, forget, family, and friends). **Methods:** The questionnaires were filled in by 9th and 10th graders from two comprehensive schools. All students received an interview using the alcohol section of the Composite International Diagnostic Interview. Alcohol abuse and alcohol dependence according to DSM-IV as well as episodic heavy drinking served as criteria to validate the screening instruments. **Results:** All 9th and 10th graders (n = 225) of both schools participated. No significant differences were found for areas under the receiver operating characteristic curves ranging from 0.810 to 0.872. Cron-

bach's alpha was satisfactory (0.77–0.80) but poor for CRAFFT (0.64). Different cut-offs are discussed. **Conclusions:** Considering validity as well as reliability, AUDIT, AUDIT-C and POSIT performed well; however, the POSIT is quite lengthy. AUDIT-C showed good psychometric properties and has clear advantages because of its brevity.

Copyright © 2012 S. Karger AG, Basel

## Introduction

For several reasons, screening questionnaires are widely used in detecting risky drinking or alcohol use disorders. The main purposes are case finding for interventions (in particular brief interventions), estimation of prevalence rates, or detection of alcohol problems as comorbid disorders. In adult samples, screening questionnaires have been shown to be more sensitive and specific compared to routine laboratory tests [1–4]. A study in adolescents found poor performance of biomarkers in detecting high alcohol consumption compared to interview data [5]. Widely used screening questionnaires developed for adults show mixed results in younger age groups. Whereas the CAGE (acronym for cut-down on drinking,

KARGER

Fax +41 61 306 12 34  
E-Mail [karger@karger.ch](mailto:karger@karger.ch)  
[www.karger.com](http://www.karger.com)

© 2012 S. Karger AG, Basel  
1022–6877/13/0193–0121\$38.00/0

Accessible online at:  
[www.karger.com/ear](http://www.karger.com/ear)

Hans-Jürgen Rumpf, PhD  
University of Lübeck, Center of Integrative Psychiatry – ZIP  
Department of Psychiatry and Psychotherapy, Research Group S:TEP  
Ratzeburger Allee 160, DE–23538 Lübeck (Germany)  
E-Mail [hans-juergen.rumpf@psychiatrie.uk-sh.de](mailto:hans-juergen.rumpf@psychiatrie.uk-sh.de)

angry about criticism, guilty feelings, and eye-opener) [6] was not sensitive and specific enough [7–9], the Alcohol Use Disorders Identification Test (AUDIT) [10] showed promising results [7–9, 11, 12].

In addition, specific questionnaires have been developed for adolescents to account for differences in experiences, consequences or cognitions with respect to alcohol drinking in this age group. A rather comprehensive list can be found in Shields et al. [13]. Two of these specific instruments are CRAFFT (6 items; an acronym for car, relax, alone, family, friends, and trouble) [14, 15] and the Substance Use/Abuse Scale of the POSIT (17 items; Problem Oriented Screening Instrument for Teenagers) [16]. Both cover alcohol and drug problems but can easily be confined to alcohol alone by change of the wording. The reliability and validity could be confirmed in a couple of studies for CRAFFT [7, 8, 15, 17] and POSIT [8, 18–20]. One study compared AUDIT, CRAFFT, and POSIT in a sample of 14- to 18-year-old patients ( $n = 711$ ) of a hospital-based adolescent clinic and found the following results for sensitivity/specificity against DSM-IV diagnosis of alcohol dependence or abuse: AUDIT (cut-off 2) 0.88/0.81, CRAFFT (cut-off 1) 0.92/0.64, and POSIT (cut-off 1) 0.84/0.89 [8].

In general, there are only a few studies on screening instruments for alcohol problems in adolescents and nearly no studies from Europe. One study from Germany evaluated the CRAFFT by using the AUDIT as gold standard [21]. However, the AUDIT is a screening instrument too and therefore not appropriate for this purpose. Another study on the performance of CRAFFT using correlations with POSIT was done in France [22]. Taken together, both studies have not used adequate measures to validate the questionnaires.

Moreover, most studies have used alcohol abuse or alcohol dependence as criterion but not episodic heavy drinking and, among these studies, only one validated the AUDIT consumption (-C) for adolescents [23]. The AUDIT-C consists of the first three items of the AUDIT and proved as a short and valid questionnaire [11, 24].

The purpose of this paper is to give data on the validity of the screening instruments CRAFFT, POSIT, AUDIT and AUDIT-C against a gold standard of DSM-IV diagnoses of alcohol dependence and alcohol abuse as well as episodic heavy drinking in a sample of adolescents aged 14–18 recruited in a German comprehensive school. Further, appropriate cut-off points in this population shall be derived.

## Methods

Participants were recruited in two comprehensive schools in the northern German city of Lübeck. As a first step, aims of the study were presented to the School Supervisory Board of the Ministry of Education, Science, Research, and Culture of the federal state of Schleswig-Holstein where Lübeck belongs to. Comprehensive schools were selected because they cover a broad spectrum of students with respect to educational level and social background unlike other schools in the predominant tripartite school system of Germany. In the next step, enrolment of schools started. Lübeck has 210,000 inhabitants and three comprehensive schools. The largest two of them were asked to participate and agreed. The project was introduced to teachers in both schools. Assessments started in May, 2004 and ended in September, 2005. In both schools, all 9th and 10th graders were asked to participate (school 1:  $n = 91$ ; school 2:  $n = 134$ ), representing 2.9% of all students in both grades in Lübeck.

The study was introduced in detail to all students. They filled in the three screening questionnaires (AUDIT, POSIT and CRAFFT) in groups in their classrooms. Afterwards, at a special appointment, with each student a personal diagnostic interview was conducted using the alcohol section of the Munich-Composite International Diagnostic Interview (M-CIDI) [25].

The study was confirmed by the ethics committee of the University of Lübeck and the School Supervisory Board of the Ministry of Education, Science, Research, and Culture of the federal state of Schleswig-Holstein. All parents or legal guardians were asked to give written informed consent.

### Assessment

A well-proven German version of the AUDIT was used [26–28]. The AUDIT was developed by the World Health Organisation. Items are shown in table 1. Scores for the AUDIT range between 0 and 40, a cut-off of 8 points is considered to point at alcohol use disorders or risky drinking; however, appropriate cut points differ substantially in different samples [11]. In Germany, a cut-point of five showed best results [27, 28]. This is also true for the AUDIT-C. The AUDIT-C was calculated by using the first three items of the entire AUDIT. Psychometric properties of AUDIT and AUDIT-C are reviewed in Reinert and Allen [11, 29], Berner et al. [30], and Kriston et al. [31]. Findings with respect to the dimensionality of the AUDIT are mixed. Several studies have found two factors (consumption and consequences, see Reinert and Allen [7]). When developing the questionnaire, three factors (consumption, abuse, dependence) were intended. This structure could be found in a study by Rist, Glöckner-Rist and Demmel [32]. Nevertheless, using a sum score is the common scoring method for the AUDIT [11]. A recent study on the performance of the AUDIT in adolescents from Chile found as measures of reliability a Cronbachs Alpha of 0.83 and an intraclass correlation of 0.81 [12]. Areas under the receiver operating characteristic curves (AUROCs) were 0.90 for hazardous alcohol use, 0.78 for harmful consumption and 0.76 for alcohol dependence.

The original CRAFFT was translated into German. Back translation and modifications in case of inconsistencies served as measures to ensure proper translation. The original CRAFFT consists of items shown in table 1. For the purpose of the present study, all words relating to drug use were deleted to cover solely alcohol drinking. In the translation of item number one, driving a car was added by riding a bicycle, a motor scooter or motorbike

**Table 1.** Items of AUDIT, CRAFFT\*, and POSIT\*

Item	Answer categories and scoring				
<b>AUDIT</b>	0	1	2	3	4
1. How often do you have a drink containing alcohol?	never	monthly or less	2–4 times a month	2–3 times a week	4 or more times a week
2. How many drinks containing alcohol do you have on a typical day when you are drinking?	1 or 2	3 or 4	5 or 6	7–9	10 or more
3. How often do you have 6 or more drinks on one occasion?	never	less than monthly	monthly	weekly	daily or almost daily
4. How often during the last year have you found that you were not able to stop drinking once you had started?	never	less than monthly	monthly	weekly	daily or almost daily
5. How often during the last year have you failed to do what was normally expected from you because of drinking?	never	less than monthly	monthly	weekly	daily or almost daily
6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	never	less than monthly	monthly	weekly	daily or almost daily
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	never	less than monthly	monthly	weekly	daily or almost daily
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	never	less than monthly	monthly	weekly	daily or almost daily
9. Have you or someone else been injured because of your drinking?	no		yes, but not in the last year		yes, during the last year
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	no		yes, but not in the last year		yes, during the last year
<b>CRAFFT</b>			No		Yes
1. Have you ever ridden a car driven by someone (including yourself) who was ‘high’ or had been using alcohol?			0		1
2. Do you ever use alcohol or drugs to relax, feel better about yourself, or fit in?			0		1
3. Do you ever use alcohol or drugs while you are by yourself, alone?			0		1
4. Do you ever forget things you did while using alcohol or drugs?			0		1
5. Do your family or friends ever tell you that you should cut down on your drinking or drug use?			0		1
6. Have you ever gotten into trouble while you were using alcohol or drugs?			0		1
<b>POSIT</b>			No		Yes
1. Do you get into trouble because you use drugs or alcohol in schools?			0		1
2. Have you accidentally hurt yourself or someone else while high on alcohol or drugs?			0		1
3. Do you miss out on activities because you spend too much money on drugs or alcohol?			0		1
4. Do you ever feel you are addicted to alcohol or drugs?			0		1
5. Have you started using more and more drugs and alcohol to get the effect you want?			0		1
6. Do you ever leave a party because there is no alcohol or drugs?			0		1
7. Do you have a constant desire for alcohol or drugs?			0		1
8. Have you had a car accident while high on drugs?			0		1
9. Do you forget things you did while high on alcohol or drugs?			0		1
10. During the past month have you ridden a car while you were drunk or high?			0		1
11. Does alcohol or drug use cause your moods to change quickly like from happy to sad or vice versa?			0		1
12. Do you miss school or arrive late for school because of your alcohol or drug use?			0		1
13. Do your family or friends ever tell you that you should cut down on your drinking or drug use?			0		1
14. Do you have serious arguments with friends or family members because of your drinking or drug use?			0		1
15. Does your alcohol or drug use ever make you do something that you would not normally do – like breaking rules, missing curfew, breaking the law, or having sex with someone?			0		1
16. Do you have trouble getting along with any of your friends because of your alcohol or drug use?			0		1
17. Do you ever feel you cannot control your alcohol or drug use?			0		1

\* For the purpose of the present study, all words related to drug use were deleted.

**Table 2.** Sample characteristics

	Female (n = 114)	Male (n = 111)	Total (n = 225)
Mean age $\pm$ SD, years	15.5 $\pm$ 0.84	15.5 $\pm$ 0.88	15.5 $\pm$ 0.81
Episodic heavy drinking only <sup>a</sup>	4.4%	5.4%	4.9%
Episodic heavy drinking <sup>b</sup>			
Current alcohol abuse	11.4%	22.5%	16.9%
Current alcohol dependence	3.5%	2.7%	3.1%
Any disorder	9.8%	15.1%	24.9%

<sup>a</sup> Without fulfilling criteria for alcohol abuse or alcohol dependence.

<sup>b</sup> Participants with alcohol abuse or dependence not excluded.

in order to adapt this question to German conditions. In the first large-scale validation study, CRAFFT performed best using a cut-off of two points and yielded a sensitivity of 0.76 and a specificity of 0.94 in detecting problematic substance use, abuse or dependence [15]. In a second study comparing different screens to detect problematic alcohol use, a cut-point of one was chosen for CRAFT revealing a sensitivity of 0.92 and a specificity of 0.64 [8]. A study conducted in Singapore among men confirmed a cut-off of 1 for drug- or alcohol-related disorders [17]. In a test-retest study, an intra-class correlation of 0.92 was found [33].

The Substance Use/Misuse Scale of the POSIT was translated into German using the same procedure as described above. The original questionnaire contains items shown in table 1. Again, items were confined to alcohol by deleting all words related to drug use. In the translation of item number 8, car accident was added by accident with a bicycle, a motor scooter or motor-bike in order to adapt this question to German conditions. In a hospital-based adolescent clinic, the POSIT substance use scale reached a sensitivity of 0.84 and a specificity of 0.89 using the recommended cut-off of one point. Test-retest reliability for the POSIT was 0.77 [19]. In a meta-analytic study, a mean Cronbach's alpha of 0.86 could be observed [13].

Alcohol dependence according to DSM-IV [34] was assessed by the M-CIDI, the German version of the CIDI [35]. This interview is fully structured and provides computer-generated diagnosis of alcohol dependence and alcohol abuse. For alcohol use disorders according to M-CIDI, test-retest reliability has been found to be excellent [36]. Alcohol consumption was assessed by using the quantity-frequency questions of the M-CIDI. Frequency of alcohol consumption was assessed by using the following categories: almost daily, 3–4 times per week, 1–2 times per week, 1–3 times per month, less often than monthly. Then, participants were asked about the typical amount consumed per day. Quantity assessment was supported by a visual aid showing typical alcoholic beverages. One standard drink was converted into 9 g of pure alcohol. The quantity-frequency assessment of the M-CIDI showed excellent test-retest reliability [36]. Episodic heavy drinking was defined as 40 g pure alcohol for women and 50 g for men at least once per month.

#### Data Analysis

The concurrent validity of the screening questionnaires was assessed by calculating sensitivity (rate of correctly identified in-

dividuals having the respective disorder) and specificity (rate of correctly identified individuals not having the respective disorder). In addition, positive and negative predictive values are shown giving estimates on the probability that a positive/negative test result concurs with having/having not the disorder. Receiver operating characteristic (ROC) curves and the respective areas under the curves (AUROCs) were calculated. AUROCs give an estimate on the performance of the questionnaire across all scores. This is useful as a general validity measure of a screening tests; however, no information is given on how the screening device performs at specific cut-offs. Differences between AUROCs were tested for statistical significance using additional calculations based on  $\chi^2$  statistics following a formula published by McClish [37]. Cronbach's alpha was used to assess internal consistency. All analyses were done with SPSS 17.0. Appropriate cut-offs were chosen by inspection of sensitivities and specificities.

## Results

The total sample consisted of 225 participants (50.7% female). All students could be included resulting in a response rate of 100%. Mean age was 15.4 years (SD 0.81; range 14–18; table 2). Of the sample, 3.1% fulfilled DSM-IV criteria for current alcohol dependence (last 12 months) and 16.9% for alcohol abuse (but not for dependence). In total, 14.7% met criteria for episodic heavy drinking and 4.9% did so without having dependence or abuse. In sum, 24.9% had dependence, abuse or episodic heavy drinking.

AUROCs for the four screening measures are displayed in table 3. For different criteria, results range between 0.810 and 0.872. Results are lowest for POSIT when looking at any criterion or alcohol use disorders. No significant differences between tests could be found. Sensitivity and specificity for different cut-offs are given in table 4.

Cronbach's alpha as a measure of internal consistency was 0.77 for AUDIT, 0.80 for AUDIT-C, 0.79 for POSIT, and 0.64 for CRAFFT. Positive/negative predictive values in detecting any disorder are 0.55/0.92 for AUDIT with 6 points as cut-off, 0.56/0.90 for AUDIT-C with 5 points as cut-off, 0.49/0.94 for CRAFFT with 2 points as cut-off, and 0.51/0.89 for POSIT with 3 points as cut-off.

## Discussion

To our knowledge, this is the first European study comparing the performance of AUDIT, AUDIT-C, CRAFFT and POSIT for adolescent alcohol problems by using a valid gold standard to estimate the performance

**Table 3.** AUROCs for AUDIT, AUDIT-C, POSIT, and CRAFFT

	Episodic heavy drinking (n = 33) <sup>a</sup>		Current alcohol abuse (n = 38) or dependence (n = 7)		Any criterion (n = 56)	
	AUROC	95% CI	AUROC	95% CI	AUROC	95% CI
AUDIT	0.855	0.784–0.927	0.857	0.805–0.908	0.848	0.791–0.904
AUDIT-C	0.872	0.797–0.946	0.850	0.796–0.905	0.853	0.795–0.911
POSIT	0.816	0.736–0.896	0.827	0.761–0.892	0.806	0.739–0.872
CRAFFT	0.810	0.736–0.884	0.859	0.809–0.909	0.838	0.782–0.849

<sup>a</sup> Participants with alcohol abuse or dependence not excluded.

of the questionnaires. All screening tools showed satisfactory validity with AUROCs ranging from 0.81 to 0.87 for episodic heavy drinking, current alcohol abuse/alcohol dependence or any of these criteria. On grounds of the performance according to AUROCs no differences between the screening questionnaires could be observed. According to reliability, all questionnaires except CRAFFT (Cronbach's alpha: 0.64) showed satisfactory internal consistency with Cronbach's alpha between 0.77 and 0.80.

The cut-off of 5 for AUDIT which showed good results in Germany yields a high sensitivity of 0.86 but a rather low specificity of 0.71 for any criterion. A cut-point of six seems to be more appropriate (sensitivity and specificity 0.79 each). For AUDIT-C, 5 points perform quite well; however, the sensitivity of 0.73 is a bit lower compared to the full AUDIT. Using the POSIT with the recommended cut-off of 1 results in very high sensitivity (0.93) but very low specificity (0.45). Using 3 points as threshold yields more balanced values (0.70/0.78). This is also true for CRAFFT in detecting any of the respective alcohol problems. Using 1 or more points as cut-off revealed a very high sensitivity of 0.96, but an unacceptable low specificity of 0.49. Using 2 points still shows high sensitivity (0.88) and an improved specificity of 0.70, 3 points instead dampens the sensitivity significantly (0.54). Choosing a cut-off always depends on the purpose of the screening and the consequences of false-positive or false-negative results. The inspection of the performance of the respective questionnaires at different cut-offs gives no clear solution, however, 6 or 7 for AUDIT, 5 for AUDIT-C, 3 for POSIT, and 2 for CRAFFT seem rather appropriate.

The POSIT was by far the most comprehensive questionnaire covering 17 items. However, the number of items is not justified by the performance of this question-

**Table 4.** Sensitivity and specificity for AUDIT, AUDIT-C, POSIT, and CRAFFT

Cut-off	Episodic heavy drinking (n = 33) <sup>a</sup>		Current alcohol abuse (n = 38) or dependence (n = 7)		Any criterion (n = 56)	
	sensitivity	specificity	sensitivity	specificity	sensitivity	specificity
<b>AUDIT</b>						
5	0.91	0.65	0.89	0.68	0.86	0.71
6	0.85	0.73	0.84	0.77	0.79	0.79
7	0.85	0.76	0.80	0.79	0.75	0.81
8	0.82	0.83	0.71	0.84	0.66	0.86
<b>AUDIT-C</b>						
4	0.94	0.59	0.89	0.66	0.88	0.64
5	0.85	0.77	0.76	0.78	0.73	0.81
6	0.82	0.85	0.67	0.86	0.64	0.89
<b>POSIT</b>						
1	0.94	0.41	0.96	0.43	0.93	0.45
2	0.82	0.60	0.84	0.64	0.79	0.65
3	0.82	0.74	0.73	0.76	0.70	0.78
4	0.64	0.84	0.62	0.87	0.55	0.88
<b>CRAFFT</b>						
1	0.94	0.43	10.0	0.47	0.96	0.49
2	0.91	0.63	0.91	0.67	0.88	0.70
3	0.58	0.85	0.62	0.89	0.54	0.89

<sup>a</sup> Participants with alcohol abuse or dependence not excluded.

naire, neither when looking at validity or reliability. The AUDIT-C is the most economic screening tool covering three items. Its performance does not differ from the other devices when AUROCs, sensitivity and specificity as well as Cronbach's alpha are taken into account. The low internal consistency of the CRAFFT weakens the performance of this questionnaire. Therefore, taken together,

the AUDIT-C seems to be a good choice for most purposes, especially when brief instruments are desired.

It might be argued that the assessment of alcohol screening measures in the classroom leads to answers biased by social desirability. Although the CIDI-interviews were conducted at a special appointment in a face-to-face format, a response set leading to dissimulation may have occurred as well. Nationwide data reveal that in 2004, 23% of adolescents aged 14–17 showed episodic heavy drinking, in 2005, the proportion was 19% [38]. This was slightly lower in our study (14.7%). Compared to a general population study in adolescents aged 14–24, our proportion of alcohol dependence is lower (6.2% compared to 3.1%), of alcohol abuse higher (9.7% compared to 16.9%) [39]. Differences might be due to different age ranges in the latter study and to regional differences in all studies [40]. Taken together, dissimulation cannot be ruled out but seems not to be very pronounced.

In general, high prevalence rates in young cohorts have been critically discussed. Data show that structured interviews tend to overestimate dependence due to high proportions of agreement to criteria like ‘tolerance’ or ‘withdrawal’ [41] as well as ‘drinking larger amount or for longer than intended’ and ‘time spent for recovering’ [42]. This might be due to misinterpretations of specific items and might have been the case in our study as well. Besides rather high proportions of dependence in this young age group (3.1%), the prevalence for alcohol abuse (16.9%) was very high. There have been a lot of epidemiological data questioning the validity and reliability of alcohol abuse in DSM-IV [43]. This was one of the arguments to giving up the distinction between abuse and dependence in proposals for the 5th revision of DSM [44]. Future studies are necessary to analyse the performance of screening devices on grounds of the proposed new definition of alcohol use disorders in DSM-5.

## References

- 1 Beresford TP: Alcoholism assessment on an orthopaedic surgery service. *J Bone Joint Surg* 1982;64:730–733.
- 2 Beresford TP, Blow FC, Hill E, Lucey MR: Comparison of CAGE questionnaire and computer-assisted laboratory profiles in screening for covert alcoholism. *Lancet* 1990;336:482–485.
- 3 Bernadt MW, Mumford J, Taylor C, Smith B, Murray RM: Comparison of questionnaire and laboratory tests in the detection of excessive drinking and alcoholism. *Lancet* 1982; ii:325–329.
- 4 Aertgeerts B, Buntinx F, Ansoms S, Fevery J: Screening properties of questionnaires and laboratory tests for the detection of alcohol abuse or dependence in a general practice population. *Br J Gen Pract* 2001;51:172–173.
- 5 Comasco E, Nordquist N, Leppert J, Oreland L, Kronstrand R, Alling C, Nilsson KW: Adolescent alcohol consumption: biomarkers PEth and FAEE in relation to interview and questionnaire data. *J Stud Alcohol Drugs* 2009;70:797–804.
- 6 Ewing JA: Detecting alcoholism: the CAGE questionnaire. *J Am Med Assoc* 1984;252: 1905–1907.
- 7 Cook RL, Chung T, Kelly TM, Clark DB: Alcohol screening in young persons attending a sexually transmitted disease clinic. Comparison of AUDIT, CRAFFT, CAGE, instruments. *J Gen Intern Med* 2005;20:1–6.
- 8 Knight JR, Sherritt L, Harris SK, Gates EC, Chang G: Validity of brief alcohol screening tests among adolescents: a comparison of the AUDIT, POSIT, CAGE, and CRAFFT. *Alcohol Clin Exp Res* 2003;27:67–73.

A strength of this paper is the response rate of 100%. This is important because studies in adolescents require parental consent. A re-analysis of two studies could show that this can lead to substantial self-selection bias towards a lower risk sample [45]. Another strength is the use of a diagnostic interview (M-CIDI) as gold standard to validate the screening results. One weakness is that the items of M-CIDI might underestimate episodic heavy drinking because participants are asked about the amount of alcohol consumed on a typical day. No additional question on excess alcohol intake was included. In addition, information on socioeconomic status of parents would have been useful but has not been assessed in this study in order not to jeopardize high acceptance from school authority as well as students. Another limitation is that our study comes from two comprehensive schools from Germany and caution is necessary with respect to the representativity of our results.

Future studies should shed light on the dimensionality of AUDIT, POSIT and CRAFFT. Furthermore, it might be useful to combine quantity–frequency items like those used in AUDIT-C with adolescent specific items on cognitions or consequences like those in POSIT or CRAFFT.

## Acknowledgement

The study is part of the Research Collaboration on EARly substance use INTERvention (EARLINT). EARLINT was supported by grants from the German Ministry of Education and Research (BMBF).

## Disclosure Statement

The authors declare no conflicts of interest.

- 9 Chung T, Colby SM, Barnett NP, Rohsenow DJ, Spirito A, Monti PM: Screening adolescents for problem drinking: Performance of brief screenings against DSM-IV alcohol diagnoses. *J Stud Alcohol* 2000;61:579–587.
- 10 Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG: *The Alcohol Use Disorders Identification Test: Guidelines for Use in Primary Care*, ed 2. Geneva, World Health Organization, 2001.
- 11 Reinert DF, Allen JP: The Alcohol Use Disorders Identification Test: An update of research findings. *Alcohol Clin Exp Res* 2007;31:185–199.
- 12 Santis R, Garmendia ML, Acuna G, Alvarado ME, Arteaga O: The Alcohol Use Disorders Identification Test AUDIT as a screening instrument for adolescents. *Drug Alcohol Depend* 2009;103:155–158.
- 13 Shields AL, Campfield DC, Miller CS, Howell RT, Wallace K, Weiss RD: Score reliability of adolescent alcohol screening measures: a meta-analytic inquiry. *J Child Adolesc Substance Abuse* 2008;17:75–97.
- 14 Knight JR, Shrier LA, Bravender TD, Farrell M, Vander Bilt J, Shaffer HJ: A new brief screen for adolescent substance abuse. *Arch Pediatr Adolesc Med* 1999;153:591–596.
- 15 Knight JR, Sherritt L, Shrier LA, Harris SK, Chang G: Validity of the CRAFFT substance abuse screening test among adolescent clinic patients. *Arch Pediatr Adolesc Med* 2002;156:607–614.
- 16 Rahdert ER (ed): *The Adolescent Assessment/Referral System Manual*. Washington, US Department of Health and Human Services (PHS) Alcohol, Drug Abuse, and Mental Health Services Administration, 1991.
- 17 Subramaniam M, Cheok C, Verma S, Wong J, Chong SA: Validity of a brief screening instrument-CRAFFT in a multiethnic Asian population. *Addict Behav* 2010;35:1102–1104.
- 18 Latimer WW, O'Brien MS, McDouall J, Toussova O, Floyd LJ, Vazquez M: Screening for 'substance abuse' among school-based youth in Mexico using the Problem Oriented Screening Instrument (POSIT) for Teenagers. *Substance Use Misuse* 2004;39:307–329.
- 19 Knight JR, Goodman E, Pulerwitz T, Durrant RH: Reliability of the Problem Oriented Screening Instrument for Teenagers (POSIT) in adolescent medical practice. *J Adolesc Health* 2001;29:125–130.
- 20 Kim Y: Korean version of the revised Problem-Oriented Screening Instrument for Teenagers Substance Use/Abuse scale: a validation study. *J Soc Serv Res* 2010;36:37–45.
- 21 Tossmann P, Kasten L, Lang P, Struber E: Determination of the concurrent validity of the CRAFFT-D-a screening instrument for problematic alcohol consumption. *Z Kinder-Jugendpsychiatr Psychother* 2009;37:451–459.
- 22 Karila L, Legleye S, Beck F, Corruble E, Falissard B, Reynaud M: Validation of a questionnaire to screen for harmful use of alcohol and cannabis in the general population: CRAFFT-ADOSPA. *Presse Méd* 2007;36:582–590.
- 23 Kelly TM, Donovan JE, Chung T, Bukstein OG, Cornelius JR: Brief screens for detecting alcohol use disorder among 18–20 year old young adults in emergency departments: comparing AUDIT-C, CRAFFT, RAPS4-QF, FAST, RUFT-Cut, and DSM-IV 2-item scale. *Addict Behav* 2009;34:668–674.
- 24 Bush K, Kivlahan DR, McDonnell MB, Fihn SD, Bradley KA: The Audit Alcohol Consumption Questions AUDIT-C. An effective brief screening test for problem drinking. *Arch Intern Med* 1998;158:1789–1795.
- 25 Wittchen H-U, Beloch E, Garczynski E, Holly A, Lachner G, Perkonig A, Vodermaier A, Vossen A, Wunderlich U, Ziegglängsberger S: Münchener Composite International Diagnostic Interview (M-CIDI), version 2.2. München, Max-Planck-Institut für Psychiatrie, 1995.
- 26 Rumpf H-J, Meyer C, Hapke U, John U: Deutsche Version des Alcohol Use Disorders Identification Test (AUDIT); in Glöckner-Rist A, Rist F (eds): *Elektronisches Handbuch zu Erhebungsinstrumenten im Suchtbereich (EHES) version 10*. Mannheim, <http://www.psy.uni-muenster.de/institut1/ehes/startseite.htm>, Zentrum für Umfragen, Methoden und Analysen, 2001.
- 27 Rumpf H-J, Hapke U, Meyer C, John U: Screening for alcohol use disorders and at-risk drinking in the general population: psychometric performance of three questionnaires. *Alcohol Alcohol* 2002;37:261–268.
- 28 Dybek I, Bischof G, Grothues J, Reinhardt S, Meyer C, Hapke U, John U, Broocks A, Hohagen F, Rumpf HJ: The reliability and validity of the Alcohol Use Disorders Identification Test (AUDIT) in a German general practice population sample. *J Stud Alcohol* 2006;67:473–481.
- 29 Reinert DF, Allen JP: The Alcohol Use Disorders Identification Test (AUDIT): a review of recent research. *Alcohol Clin Exp Res* 2002;26:272–279.
- 30 Berner MM, Kriston L, Bentele M, Harter M: The Alcohol Use Disorders Identification Test for detecting at-risk drinking: a systematic review and meta-analysis. *J Stud Alcohol Drugs* 2007;68:461–473.
- 31 Kriston L, Holzel L, Weiser AK, Berner MM, Harter M: Meta-analysis: are 3 questions enough to detect unhealthy alcohol use? *Ann Intern Med* 2008;149:879–888.
- 32 Rist F, Glöckner-Rist A, Demmel R: The Alcohol Use Disorders Identification test revisited: establishing its structure using nonlinear factor analysis and identifying subgroups of respondents using latent class factor analysis. *Drug Alcohol Depend* 2009;100:71–82.
- 33 Levy S, Sherritt L, Harris SK, Gates EC, Holder DW, Kulig JW, Knight JR: Test-retest reliability of adolescents' self-report of substance use. *Alcohol Clin Exp Res* 2004;28:1236–1241.
- 34 American Psychiatric Association: *Diagnostic and Statistical Manual of Mental Disorders*, ed 4, international version. Washington, American Psychiatric Association, 1995.
- 35 Robins LN, Wing J, Wittchen HU: The Composite International Diagnostic Interview: an epidemiological instrument suitable for use in conjunction with different diagnostic systems and in different cultures. *Arch Gen Psychiatry* 1988;45:1069–1077.
- 36 Wittchen H-U, Lachner G, Wunderlich U: Test-retest reliability of the computerized DSM-IV version of the Munich-Composite International Diagnostic Interview (M-CIDI). *Soc Psychiatry Psychiatr Epidemiol* 1998;33:568–578.
- 37 McClish DK: Combining and comparing area estimates across studies or strata. *Med Decision Making* 1991;12:274–279.
- 38 Bundeszentrale für gesundheitliche Aufklärung: *Entwicklung des Alkoholkonsums bei Jugendlichen unter besonderer Berücksichtigung der Konsumgewohnheiten von Alkoholkonsumenten. Eine Befragung der Bundeszentrale für gesundheitliche Aufklärung. Kurzbericht*. Köln, Bundeszentrale für gesundheitliche Aufklärung, 2005.
- 39 Holly A, Türk D, Nelson CB, Pfister H, Wittchen H-U: Prävalenz von Alkoholkonsum, Alkoholmissbrauch und -Abhängigkeit bei Jugendlichen und jungen Erwachsenen. *Z Klin Psychol* 1997;26:171–178.
- 40 Meyer C, Rumpf H-J, Hapke U, John U: Regionale Unterschiede in der Prävalenz risikanten Alkoholkonsums: Sekundäranalyse des Gesundheitsurvey Ost-West. *Gesundheitswesen* 1998;60:486–492.
- 41 Caetano R, Babor TF: Diagnosis of alcohol dependence in epidemiological surveys: an epidemic of youthful alcohol dependence or a case of measurement error? *Addiction* 2006;101:111–114.
- 42 Pabst A, Kraus L, Piontek D, Baumeister SE: Age differences in diagnostic criteria of DSM-IV alcohol dependence among adults with similar drinking behaviour. *Addiction* 2011;107:331–338.
- 43 Hasin D, Paykin A, Endicott J, Grant B: The validity of DSM-IV alcohol abuse: drunk drivers versus all others. *J Stud Alcohol* 1999;60:746–755.
- 44 American Psychiatric Association: *DSM-5 Development*, 2012, <http://www.dsm5.org/ProposedRevisions/Pages/Substance-RelatedDisorders.aspx>; accessed October 31, 2012.
- 45 Rojas NL, Sherritt L, Harris S, Knight JR: The role of parental consent in adolescent substance use research. *J Adolesc Health* 2008;42:192–197.