CUGE: A SCREENING INSTRUMENT FOR ALCOHOL ABUSE AND DEPENDENCE IN STUDENTS

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Abstract — Objectives: The prevalence of alcohol abuse on college campuses ranges from 7 to 17%. Frequent heavy drinkers place themselves and others at risk for a variety of adverse consequences and frequently remain undetected. Brief individual interventions result in a significant reduction on the number of drinks. Therefore, detection of students at risk is useful and desirable. The CUGE has been elsewhere described as a promising screening device for problem drinking in students. In order to determine the diagnostic value of this new questionnaire, we set up a validation study in a new and independent population of freshmen. Methods: A cross-sectional diagnostic study. Participants were college freshmen of the Katholieke Universiteit Leuven. All students received a questionnaire, containing the CUGE, being the test of interest, and the CIDI as the reference test. Results: The CUGE combines a very high sensitivity of 91% with a reasonable specificity of 76.3% in this validation group. Conclusions: The CUGE is an excellent screening device in this population of students. In addition, it is a short questionnaire with only yes or no questions. This makes the CUGE easily applicable as a part of broad routine questionnaires.

INTRODUCTION

Heavy drinking is a common phenomenon on college campuses (Myerholtz et al., 1998). Only recently, Knight et al. (2002) analysed over 14 000 students in the USA: 31% endorsed DSM-IV criteria for alcohol abuse and 6% for dependence. The DSM-IV criteria for problem drinking are listed in the Appendix. Another study among first year students from a Western European university found a lower but still substantial prevalence of 10.5% for alcohol abuse and 3.6% for alcohol dependence, using the same DSP-IV criteria (Aertgeerts et al., 2000).

Frequent heavy drinkers place themselves and others at risk for a variety of adverse consequences, such as getting into arguments, performing badly at school and driving under influence (Glicksman, 1988). From a large study in the USA, Hingson et al. (2002) estimated that in 1998 over 1400 students died from alcohol-related unintentional injuries and over 600 000 were hit or assaulted by another student who had been drinking. A recent study in Western Europe found that students who meet DSM-IV criteria of alcohol dependence, have a higher risk of failure in their first year of college (Aertgeerts and Buntinx, 2002).

The transition to college involves major individual and contextual change in every domain of life; at the same time, heavy drinking and associated problems increase during this transition (Schulenberg and Maggs, 2002). Many students, however, show a decline in drinking problems over the next following years (Marlatt et al., 1998).

Brief individual interventions that provide students with feedback regarding personal consumption, perceived drinking norms and alcohol related problems, result in a significant reduction of the number of drinks consumed per week at 6-week follow-up (Borsari et al., 2000). These interventions can even achieve long-term benefits, particularly on the negative consequences of drinking, as was shown in a randomized trial where students received a single session of individualized preventive intervention and were assessed annually for 4 years thereafter (Baer et al., 2001). In a previous study, Baer et al. (1992) found that a single hour of advice and feedback was nearly as effective as a 6-week class and discussion group. It has been suggested that brief interventions in a wide range of drinkers may have a greater impact on the population level of alcohol problems than intensive treatment programs for the smaller number of severely affected cases (Babor et al., 1999).

The combination of a relatively high prevalence, serious consequences and the availability of effective treatment make screening for high-risk students more important. The CAGE is one of the most widely used screening instruments (Maisto et al., 1995), but appears not to be a good predictor of drinking-related problems in college students (Kuzel et al., 1993; Heck and Williams, 1995; Clements, 1998). Additionally, the CAGE is relatively insensitive in white female populations (Bradley et al., 1998).

The CAGE has four questions: Have you ever felt you should cut down on your drinking? Have you ever been annoyed by others if they criticised on your drinking? Have you ever felt guilty about your drinking? Have you ever had a drink in the morning to get rid of a hangover?

As the CAGE performs less in students and women, a new screening device was constructed: the CUGE (Aertgeerts et al., 2000). The authors found better test characteristics in their cohort of college students with the CUGE than when using the CAGE. This adjustment of the CAGE was done by replacing one item of the CAGE by an item of the CIDI, which was used as the reference test and classifies subjects according to DSM-IV criteria. The authors noticed that one question of the CIDI was extremely sensitive for diagnosing alcohol abuse and dependence: ‘being under the influence of alcohol in a situation where it increases your chances of getting hurt, for example, when riding a bicycle or driving a car’.

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also found before that ‘driving under influence’ was a significant factor in college students for diagnosing alcohol problems (Heck, 1991). In this initial study by Aertgeerts et al. the sensitivity (proportion of true positives among the diseased), specificity (proportion of true negatives among the not-diseased), and diagnostic odds ratio were 93.6%, 88.9%, and 116.9, respectively. The positive predictive value (PPV, the proportion of true positives of the group of test positives), was 57.9% and the negative predictive value (NPV, the proportion of the true negatives of the group of test negatives) was 99%. The positive likelihood ratio (LR+, sensitivity/specificity) and negative likelihood ratio (LR−, 1 – sensitivity/specificity) were 8.4 and 0.07, respectively.

Because the CUGE is as short and easy to answer as the CAGE — yes or no on four questions — this opens new perspectives for the screening of alcohol abuse and dependence in students. However, as a new test mostly performs best in the population in which it has been designed (Charlson et al., 1987; Sackett and Haynes, 2002), its results had to be confirmed in an independent population. Therefore we set up a validation study in a second and independent population of college freshmen in order to confirm the diagnostic value of the CUGE for screening for problem drinking in students.

METHODS

Subjects

Eligible subjects were all college freshmen at the Katholieke Universiteit Leuven (Belgium). At the beginning of their studies, all students are offered a physical examination by the university Department of Adolescent Medicine. All students attending this examination are asked to fill in a routine questionnaire about their medical history, alcohol and smoking habits, and use of medication. This questionnaire was independent from our questionnaire and was not related to the study.

Students examined between October 2, 2000 and May 30, 2001, were asked to participate in our study. They were orally informed about the study by the attending nurse. Additionally, each questionnaire contained an informed consent form with more details about the study and the assurance that collaboration with the study was voluntary and data processing would be anonymous and kept confidential.

The study questionnaire contained the CUGE, the CIDI and several questions about physical and mental health. Students were blinded to the results of the different items at any stage. All questionnaires were identified with a code and students were asked to give the routine and the study questionnaires to the study nurse before going to the physician.

Students in medicine or dental surgery are routinely not examined by the Department of Adolescent Medicine but by the Occupational Health Services, because these students have working experience with patients early during their training. The data collection procedure was similar for them as for their colleague students.

The study was approved by the Ethical Committee of the medical faculty of the Katholieke Universiteit Leuven.

Instruments

The CIDI is a standardized diagnostic interview for assessing mental disorders according to the criteria of the Diagnostic and Statistical Manual, fourth edition (DSM-IV). It has been validated internationally (Robins et al., 1988). We used the CIDI as an auto-questionnaire, derived from the paper and pencil version 2.1; this version differs only from the original paper and pencil version in use of language, being Dutch instead of English. Although this version is not validated, the questions are similar to the Dutch computerized version, developed by the WHO–CIDI training and reference centre in Amsterdam. We used the 12 month version which identifies alcohol abuse and dependence during the last 12 months; in this population of freshmen it is more appropriate than the lifetime version. It classifies subjects as alcohol dependent, alcohol abuser or normal. We classified a student as being a problem drinker if he or she complied with the criteria for either alcohol abuse or dependence.

The CUGE questionnaire is a short screening instrument, consisting of four questions. Three questions are similar as in the CAGE, only the second one (originally: ‘have people ever annoyed you by criticising your drinking?’) has been replaced by ‘Have you ever been under the influence of alcohol in a situation where it increased your chances of getting hurt?’ Possible answers are ‘yes’ or ‘no’. In our primary analysis, we required at least one positive answer for a positive CUGE test result. Additionally, we repeated our analyses for the other possible cut-points.

The CUGE

Have you ever felt you should cut down on your drinking?
Have you ever been under the influence of alcohol in a situation where it increased your chances of getting hurt, for example, when riding a bicycle, driving a car or operating a machine?
Have you ever felt bad or guilty about your drinking?
Have you ever had a drink in the morning to get rid of a hangover?

Analysis

The screening characteristics of the CUGE were tested in this cross-sectional study using the alcohol module of the CIDI as the reference standard. It classifies subjects following DSM-IV criteria of alcohol abuse and alcohol dependence (see Appendix). Problem drinkers are defined as all subjects with alcohol abuse or alcohol dependence. From 1 to 4 positive answers were used as the cut-off points for interpretation of the CUGE.

We calculated sensitivity, specificity, positive (PPV) and negative predictive value (NPV), and the likelihood ratio of a positive (LR+) and a negative test result (LR−), as well as the diagnostic odds ratio (OR) with a 95% confidence interval (95% CI). Analyses were performed with Epi-info 6.0 (Center for Disease Control, Atlanta, GA) software (Dean et al., 1994).

RESULTS

In total 3140 freshmen attended the routine medical examination of the 3860 that were invited. 2808 of them were asked to participate in the study; the reason for not asking participation was absence of the study-nurse. Of all students who were asked to participate, 2699 agreed. The response ratio was 96.1%. Reasons for declining the study were lack of time, dyslexia or not interested.
40.4% of the subjects were male, 59.6% were female. Mean age was 18.7 years. The vast majority did not smoke: 81.2%. There are no data on ethnicity, but 99.1% of the students had Belgian nationality.

The prevalence of problem drinking was 10.4% (95% CI: 9.3–11.6) or 281 students. The prevalence of alcohol abuse was 7.4% (201 students); 80 additional students met the criteria of alcohol dependence, this was 3.0% of the study population.

Stratifying for gender, the prevalence for men is now 19.8% and for women 3.9%. 829 students tested positive (30.7%) on the CUGE with a cut-off point of 1. The sensitivity for detecting problem drinking (alcohol abuse and dependence) was 91.4%. The specificity was 76.3%. The positive and negative predictive value for problem drinking were 31% and 98.7%. The likelihood ratio was 3.86 for a positive test result (LR+) and 0.11 for a negative test result. All diagnostic characteristics for alcohol abuse and dependence are shown in Table 1.

Comparing these results with the results of the initial study by Aertgeerts et al. (2000), both sensitivity and specificity of the CUGE for problem drinking are now lower than in the original population of college freshmen: 91.4% vs 93.6% and 76.3% vs 88.9%, respectively. However, we also found a lower prevalence of problem drinking than in the initial study of Aertgeerts et al.: 10.4% vs 14.1%.

Compared to the results of the CAGE in the first population, the sensitivity of the CUGE in our study is remarkably higher but its specificity is lower: 91.4% vs 42.9% and 76.3% vs 87.7%, respectively (Table 5).

Table 1. Diagnostic characteristics of the CUGE

<table>
<thead>
<tr>
<th>Cut-off of 1</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
<th>LR+</th>
<th>LR−</th>
<th>Odds ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem</td>
<td>91.4 (87.4–94.3)</td>
<td>76.3 (74.6–78.0)</td>
<td>31.0 (27.9–34.3)</td>
<td>98.7 (98.1–99.2)</td>
<td>3.86 (3.57–4.19)</td>
<td>0.11 (0.08–0.16)</td>
<td>34.54 (22.8–54.0)</td>
</tr>
<tr>
<td>drinking</td>
<td>Abuse</td>
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<tr>
<td></td>
<td>91.5 (86.6–94.8)</td>
<td>76.3 (74.6–78.0)</td>
<td>24.3 (21.4–27.6)</td>
<td>99.1 (98.5–99.4)</td>
<td>3.86 (3.56–4.20)</td>
<td>0.11 (0.07–0.17)</td>
<td>39.41 (20.6–59.94)</td>
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<td></td>
<td>Dependence</td>
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<td></td>
<td>91.2 (82.3–96.1)</td>
<td>76.3 (74.6–78.0)</td>
<td>11.3 (9.0–14.1)</td>
<td>99.6 (99.2–99.8)</td>
<td>3.85 (3.49–4.26)</td>
<td>0.11 (0.06–0.23)</td>
<td>33.64 (16.1–79.6)</td>
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<td></td>
<td>Cut-off of 2</td>
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<tr>
<td>Problem</td>
<td>39.5 (33.7–45.5)</td>
<td>95.0 (94.1–95.9)</td>
<td>48.1 (41.5–54.7)</td>
<td>93.1 (92.0–94.1)</td>
<td>7.96 (6.34–9.98)</td>
<td>0.64 (0.58–0.70)</td>
<td>12.5 (9.2–16.9)</td>
</tr>
<tr>
<td>drinking</td>
<td>Abuse</td>
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<tr>
<td></td>
<td>32.3 (26.0–39.3)</td>
<td>95.0 (94.1–95.9)</td>
<td>31.5 (28.4–42.5)</td>
<td>96.4 (93.4–95.3)</td>
<td>6.51 (5.00–8.49)</td>
<td>0.71 (0.65–0.78)</td>
<td>9.15 (6.4–12.9)</td>
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<td></td>
<td>Dependence</td>
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<tr>
<td></td>
<td>57.5 (46.0–68.3)</td>
<td>95.0 (94.1–95.9)</td>
<td>27.7 (21.2–35.3)</td>
<td>98.5 (97.9–99.0)</td>
<td>11.58 (8.96–14.97)</td>
<td>0.71 (0.65–0.85)</td>
<td>25.9 (15.5–43.2)</td>
</tr>
</tbody>
</table>

Table 2. Diagnostic characteristics of the CUGE in women

<table>
<thead>
<tr>
<th>Cut-off of 1</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
<th>LR+</th>
<th>LR−</th>
<th>Odds ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem</td>
<td>86.9 (75.8–94.2)</td>
<td>84.9 (83.1–86.7)</td>
<td>18.9 (14.5–23.9)</td>
<td>99.4 (99.0–99.7)</td>
<td>5.77 (4.95–6.74)</td>
<td>0.15 (0.08–0.29)</td>
<td>37.4 (16.9–86.3)</td>
</tr>
<tr>
<td>drinking</td>
<td>Abuse</td>
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<tr>
<td></td>
<td>88.1 (74.4–96.0)</td>
<td>84.9 (83.1–86.7)</td>
<td>14.0 (10.0–18.7)</td>
<td>99.6 (99.1–99.9)</td>
<td>5.85 (4.97–6.89)</td>
<td>0.14 (0.06–0.32)</td>
<td>41.8 (15.5–122.2)</td>
</tr>
<tr>
<td></td>
<td>Dependence</td>
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<td></td>
<td>84.2 (60.4–96.6)</td>
<td>84.9 (83.1–86.7)</td>
<td>6.6 (3.8–10.4)</td>
<td>99.9 (99.3–100.0)</td>
<td>5.60 (4.45–7.03)</td>
<td>0.19 (0.07–0.53)</td>
<td>30.1 (8.7–103.9)</td>
</tr>
<tr>
<td></td>
<td>Cut-off of 2</td>
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<tr>
<td>Problem</td>
<td>31.1 (19.9–44.3)</td>
<td>97.3 (96.4–98.1)</td>
<td>31.7 (20.3–45.0)</td>
<td>97.2 (97.2–98.0)</td>
<td>11.5 (7.12–18.6)</td>
<td>0.71 (0.60–0.84)</td>
<td>16.3 (8.7–30.2)</td>
</tr>
<tr>
<td>drinking</td>
<td>Abuse</td>
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</tr>
<tr>
<td></td>
<td>28.6 (15.7–44.6)</td>
<td>97.3 (96.4–98.1)</td>
<td>22.6 (12.3–36.2)</td>
<td>98.0 (97.2–98.7)</td>
<td>10.6 (6.0–18.6)</td>
<td>0.73 (0.61–0.89)</td>
<td>14.4 (6.9–30.0)</td>
</tr>
<tr>
<td></td>
<td>Dependence</td>
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<tr>
<td></td>
<td>36.8 (16.3–61.6)</td>
<td>97.3 (96.4–98.1)</td>
<td>14.6 (6.1–27.8)</td>
<td>99.1 (98.6–99.6)</td>
<td>13.6 (7.0–26.4)</td>
<td>0.65 (0.46–0.92)</td>
<td>21.0 (7.87–55.9)</td>
</tr>
</tbody>
</table>
The good test performance in women is remarkable: comparing with previously found sensitivities of 38–50% for the CAGE (Bradley et al., 1998) the CUGE has a much higher sensitivity in this population: 87%.

**DISCUSSION**

The aim of screening is to find every possible case and to avoid too many false positives, which may lead to inappropriate treatment. Therefore, a screening device should have a very high sensitivity and a specificity as high as possible in order to minimize the number of false positive results.

In this confirmation study, the CUGE has a very high sensitivity: 91% at a cut-off of one positive answer. The specificity is lower but acceptable for an initial screening instrument: 76.3%.

A student with a positive CUGE test has one chance in three of having an alcohol problem, be it abuse or dependence (PPV 31%). This means that a number of students will test false positive, being 69% of those screening positive (1-PPV) or 21.2% of the total population (proportion of false positives in the CUGE: 76.3%).

Using a higher cut-off point of two, sensitivity drops to 34.4–48.0%, while specificity rises to 95.0%. This no longer corresponds to the goal of screening because too many students would test false negative.

Combining a very high sensitivity with a reasonable specificity at a cut-off of 1, the CUGE is an excellent screening device in this population of students. Compared to the CAGE, the questionnaire from which the CUGE has been derived, the CUGE is more suitable for screening in students as its sensitivity is much higher (Table 5). It is even accurate in women, a subpopulation in which other screening instruments perform less well, e.g. the CAGE, or where other instruments have to be used with adjusted cut-off points: AUDIT and TWEAK (Heck and Williams, 1995; O’Hare and Tran, 1997; Bradley et al., 1998). The AUDIT is a questionnaire which has been developed by the WHO. It is a 10 item scale, much longer than the CUGE, and has four possible answers for each question from 0 to 4, giving a maximum possible score of 40 (Fleming et al., 1991; Saunders et al., 1993; O’Hare et al., 1999). The AUDIT screens for current harmful and hazardous alcohol use and the CUGE for lifetime alcohol problems; still, the CUGE has very good test characteristics in this population using a reference test for alcohol problems in the last 12 months. In previous research, the CUGE performed even better than the AUDIT (Aertgeerts et al., 2000), with a sensitivity of 93.6% compared to 80.2% and a specificity of 88.9% vs 77.8%, respectively.

In this study, some of the diagnostic characteristics of the CUGE are lower than in the first study. This was expected, as a test almost always performs best in the population in which it has been designed (Charlson et al., 1987). The test performs well, however, in this confirmation study in a similar, but totally new and different cohort. The decrease of the PPV will additionally be caused by the lower prevalence of problem drinking in the second cohort. Considering the higher prevalence recently described in Northern American universities, different test characteristics can occur in that population.

This study was conducted in a Western European university; students are on average 19 years old and 59.6% are female. We believe that our results of test accuracy of the CUGE can be generalized to other college students in Western Europe, on condition that the prevalence of problem drinking is not substantially different. It is likely that results are different in other continents with different cultural characteristics. Further research is needed to validate the CUGE cross-culturally and in other student age groups. No extrapolation of our test results should be made to other groups of adolescents or young people.

### Table 3. Diagnostic characteristics of the CUGE in men

<table>
<thead>
<tr>
<th>Cut-off of 1</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
<th>LR+</th>
<th>LR−</th>
<th>Odds ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem drinking</td>
<td>92.9 (88.6–96.0)</td>
<td>61.0 (57.5–64.2)</td>
<td>37.0 (32.9–41.3)</td>
<td>97.2 (95.4–98.4)</td>
<td>2.37 (2.17–2.60)</td>
<td>0.12 (0.07–0.19)</td>
<td>20.4 (11.6–36.6)</td>
</tr>
<tr>
<td>Abuse</td>
<td>92.8 (87.5–96.4)</td>
<td>61.0 (57.5–64.2)</td>
<td>30.0 (25.7–34.1)</td>
<td>97.9 (96.3–99.0)</td>
<td>2.37 (2.16–2.61)</td>
<td>0.12 (0.07–0.21)</td>
<td>20.1 (10.8–37.5)</td>
</tr>
<tr>
<td>Dependence</td>
<td>93.2 (83.5–98.1)</td>
<td>61.0 (57.5–64.2)</td>
<td>14.1 (10.8–18.0)</td>
<td>99.2 (98.1–100.0)</td>
<td>2.38 (2.14–2.65)</td>
<td>0.11 (0.04–0.29)</td>
<td>21.4 (7.7–59.4)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cut-off of 2</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
<th>LR+</th>
<th>LR−</th>
<th>Odds ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem drinking</td>
<td>41.0 (34.4–48.0)</td>
<td>90.8 (88.6–92.6)</td>
<td>52.4 (44.5–60.2)</td>
<td>86.1 (83.7–88.3)</td>
<td>4.45 (3.41–5.80)</td>
<td>0.65 (0.58–0.73)</td>
<td>6.8 (4.8–9.7)</td>
</tr>
<tr>
<td>Abuse</td>
<td>32.0 (24.7–40.0)</td>
<td>90.8 (88.6–92.6)</td>
<td>38.3 (29.8–47.3)</td>
<td>88.2 (85.9–90.3)</td>
<td>3.47 (2.54–4.74)</td>
<td>0.75 (0.67–0.84)</td>
<td>4.6 (3.09–6.94)</td>
</tr>
<tr>
<td>Dependence</td>
<td>64.4 (50.9–76.5)</td>
<td>90.8 (88.6–92.6)</td>
<td>32.5 (24.1–41.8)</td>
<td>97.4 (96.0–98.4)</td>
<td>5.26 (5.26–9.26)</td>
<td>0.28 (0.19–0.55)</td>
<td>17.8 (10.0–31.7)</td>
</tr>
</tbody>
</table>

### Table 4. Diagnostic characteristics of each item of the CUGE (sensitivity/specificity)

<table>
<thead>
<tr>
<th>Sens/spec (%)</th>
<th>Problem drinking</th>
<th>Abuse</th>
<th>Dependence</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Cut down'</td>
<td>97/94</td>
<td>90/94</td>
<td>69/94</td>
</tr>
<tr>
<td>'Driving under influence'</td>
<td>86/84</td>
<td>89/84</td>
<td>79/84</td>
</tr>
<tr>
<td>'Guilty'</td>
<td>30/92</td>
<td>25/92</td>
<td>43/92</td>
</tr>
</tbody>
</table>
who are not college students, without validation in this new population. Secondly, studies in which the CUGE is compared to other screening instruments could give information on the cost-effectiveness of the various instruments.

Finally, the CUGE is not only a valid and reliable screening device, it is also a short questionnaire which is very easy to answer with only yes or no. This makes the CUGE easily applicable as part of broad routine questionnaires in college students. Due to the nature of the CUGE — screening — it should only be used in conditions where subjects who test positive are offered further testing, and if necessary, treatment.

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REFERENCES


APPENDIX

DSM-IV Alcohol Abuse (one or more criteria for over 1 year)
Role Impairment (e.g. failed work or home obligations)
Hazardous use (e.g. driving while intoxicated)

Legal problems related to alcohol use
Social or interpersonal problems due to alcohol
DSM-IV Alcohol Dependence (three criteria for over 1 year)
Tolerance (increased drinking to achieve same effect)
Alcohol withdrawal signs or symptoms
Drinking more than intended
Unsuccessful attempts to cut down on use
Excessive time related to alcohol (obtaining hangover)
Impaired social or work activities due to alcohol
Use despite physical or psychological consequences

