

# The Alcohol Use Disorders Identification Test: An Update of Research Findings

Duane F. Reinert and John P. Allen

**Background:** The Alcohol Use Disorders Identification Test (AUDIT) has been extensively researched to determine its capability to accurately and practically screen for alcohol problems.

**Methods:** During the 5 years since our previous review of the literature, a large number of additional studies have been published on the AUDIT, abbreviated versions of it, its psychometric properties, and the applicability of the AUDIT for a diverse array of populations. The current article summarizes new findings and integrates them with results of previous research. It also suggests some issues that we believe are particularly in need of further study.

**Results:** A growing body of research evidence supports the criterion validity of English version of the AUDIT as a screen for alcohol dependence as well as for less severe alcohol problems. Nevertheless, the cut-points for effective detection of hazardous drinking as well as identification of alcohol dependence or harmful use in women need to be lowered from the originally recommended value of 8 points. The AUDIT-C, the most popular short version of the AUDIT consisting solely of its 3 consumption items, is approximately equal in accuracy to the full AUDIT. Psychometric properties of the AUDIT, such as test-retest reliability and internal consistency, are quite favorable. Continued research is urged to establish the psychometric properties of non-English versions of the AUDIT, use of the AUDIT with adolescents and with older adults, and selective inclusion of alcohol biomarkers with the AUDIT in some instances.

**Conclusions:** Research continues to support use of the AUDIT as a means of screening for the spectrum of alcohol use disorders in various settings and with diverse populations.

**Key Words:** Alcohol Screening, Alcohol Use Disorders Identification Test, AUDIT, Hazardous Drinking, Alcohol Diagnosis.

SINCE OUR PREVIOUS review of the performance characteristics of the Alcohol Use Disorders Identification Test (AUDIT) (Reinert and Allen, 2002), a large number of important new studies have been published. Although many of the comments we offered earlier were tentative due to an insufficient amount research studies available at that time, results of the more recent investigations allow us to comment on the capabilities of the AUDIT with greater confidence.

The current update of research findings addresses the following issues:

- Psychometric properties of the AUDIT;
- Performance of the AUDIT across clinically relevant, but often neglected, subgroups to include women, adolescents, various ethnic groups, patients with collateral psychiatric problems, and non-English speaking subjects;

- The performance of the AUDIT as a screen for *hazardous drinking*, rather than *alcohol dependence* or *harmful use*;
- The performance of abbreviated versions of the AUDIT, especially the AUDIT-C (the AUDIT's 3 consumption items);
- Alternate modes of administration of the AUDIT; and
- Issues remaining in particular need of further study

To spare readers the burden of reviewing the earlier article as a prelude to this update, we begin each section of the current report by briefly summarizing our earlier observations and conclusions and proceed by modifying or expanding on those positions based on the most current studies. We have also abstracted entries from the table of the earlier review and entered them at the beginning of the comparable table presented here.

Although we do not reiterate the history of the development of the AUDIT, interested readers are directed to an excellent AUDIT test manual in English and Spanish that is available on line ([http://www.who.int/substance\\_abuse/activities/sbi/en/](http://www.who.int/substance_abuse/activities/sbi/en/)). Also now available is a companion handbook addressing how the AUDIT might be incorporated into brief intervention for alcohol problems (Babor and Higgins-Biddle, 2001).

## EXPANDED APPLICATIONS OF THE AUDIT

Despite the original intent of the developers of the AUDIT as a means of targeting primary care patients in

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Received for publication July 11, 2006; accepted October 4, 2006.

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DOI: 10.1111/j.1530-0277.2006.00295.x

need of alcohol interventions, the AUDIT has found several new applications, such as prediction of the alcohol withdrawal syndrome (Dolman and Hawkes, 2005; Reoux et al., 2002), web-based screening and intervention (e.g., Lieberman, 2003, 2005; Saitz et al., 2004), national and regional epidemiological studies (e.g., Fleming, 1996; Mendoza-Sassi and Beria 2003), and studies to estimate the prevalence of alcohol problems among medical and psychiatric patient populations (e.g., Davis et al., 2003; Fireman et al., 2005). The AUDIT is also increasingly being used with non-English speaking populations, a development clearly in keeping with the World Health Organization's original goal of constructing an alcohol screening measure that would have international applicability.

### RELIABILITY OF THE AUDIT

Over a broad range of diverse samples and settings the AUDIT has demonstrated a high degree of internal consistency. In a reliability generalization analysis of studies that appeared in 2000 or before, Shields and Caruso (2003) calculated a median reliability of 0.81, with a range of 0.59 to 0.91. Our examination of 18 studies published since 2002 (Bergman and Kallmen, 2002; Bischof et al., 2005; Carey et al., 2003; Chung et al., 2002; Gache et al., 2005; Gomez et al., 2005; Kelly et al., 2002, 2004; Kokotailo et al., 2004; Leonardson et al., 2005; Lima et al., 2005; Neumann et al., 2004; O'Hare et al., 2004; Pal et al., 2004; Rumpf et al., 2002; Selin, 2003; Shields et al., 2004; Tsai et al., 2005), yielded a comparable median reliability coefficient of 0.83, with a range of 0.75 to 0.97.

We previously had suggested that researchers evaluate the test-retest reliability of the AUDIT when it is scored dichotomously to classify patients as either positive or negative. Four recent studies have done so. Three of these (Dybek et al., 2006; Selin, 2003; and Rubin et al., 2006) were conducted with general population samples and reported  $\kappa$ s of 0.70, 0.86, and 0.89, respectively, at the standard cut-point of 8. Dybek et al. (2006) also reported a  $\kappa$  of 0.81 at a cut point of 5. (Concerning interpretation of the  $\kappa$  value, Landis and Koch (1977) recommend that  $\kappa$ s between 0.61 and 0.80 be interpreted as substantial agreement.) The fourth study examined the dichotomously scored AUDIT in prisoner sample (Maggia et al., 2004) and yielded an amazingly weak  $\kappa$  of 0.27. Rather than considering this as a flaw in the test, the authors interpreted their finding as likely due to the respondents' acute reaction to imprisonment as the AUDIT was administered on their day of arrival at the prison. When the AUDIT was re-administered 2 weeks later, 40% of the subjects changed categories with all moving to the AUDIT positive category. It is also, of course, possible that many of the subjects were initially unwilling to provide valid information. Because the content of the AUDIT is totally patent it can be easily feigned by those motivated to do so.

Evidence for the temporal reliability of the AUDIT among general population samples has also been con-

firmed by test-retest interclass correlations. Rubin et al. (2006) derived a coefficient of 0.87 among 102 participants from the general U.S. population who were screened by telephone 1 week apart. Bergman and Kallmen (2002) reported an interclass correlation of 0.93 among 61 participants from the general population in Sweden who responded by mail about 3 to 4 weeks after initial screening. Dybek et al. (2006) found an interclass correlation of 0.95 among 99 German general practice patients who were screened initially in person and then followed up approximately a month later by telephone.

### CONSTRUCT VALIDITY

Four additional studies since our previous review have examined the factor structure of the AUDIT (Bergman and Kallmen, 2002; Carey et al., 2003; Chung et al., 2002; Shields et al., 2004) and have substantially replicated the findings of earlier investigations. Although one study (Carey et al., 2003) supported the notion that the AUDIT is saturated by a single factor, the remaining 3 argued that a 2-factor solution is preferable, a *consumption factor* (items 1–3) and an *adverse consequences of drinking factor* (items 4–10). Bergman and Kallmen (2002) found a Cronbach's  $\alpha$  reliability coefficient of 0.69 and a test-retest reliability of 0.98 for the consumption factor items. Shields et al. (2004) found  $\alpha$ s of 0.74 and 0.81 for the scores on the same consumption factor in a clinical and a college student sample. These studies offer support to our previous position that the first 3 AUDIT items can be employed as a stand-alone screening measure when time or other resources do not permit administration of the full AUDIT (discussed as the AUDIT-C) (Bush et al., 1998).

### CRITERION VALIDITY OF THE AUDIT

The English language version of the AUDIT has rather consistently proven to be an accurate alcohol screen in various types of subjects and in widely varying settings. Table 1 summarizes the findings of relevant studies. Criteria for inclusion of a study in Table 1 are identical to those of our previous review: diagnosis of a recent (e.g., within the past year) alcohol problem; use of a standardized measure to establish the diagnosis; use of an English-language version of the AUDIT with standard wording and scoring; and use of 8 as a cut-point in determining sensitivity.

### PERFORMANCE OF THE AUDIT IN VARIOUS SUBGROUPS

#### *Women*

Our earlier review of studies on the effects of alternative possible cut points for the AUDIT indicated that the standard value of 8 consistently yielded lower sensitivities and higher specificities for women than for men. This phenomenon led us and others to believe that the cut-point should be lowered for female samples to a score of perhaps

**Table 1.** Alcohol Use Disorders Identification Test (AUDIT) Sens, Spec, PPPV, NPV, and AUC

Study	Subjects	Diagnostic measure	Sens	Spec	PPV	NPV	AUC
Isaacson et al. (1994)	U.S. inner city general medical clinic patients aged 18 to 84	DSM-III-R criteria alcohol abuse or dependence	0.96	0.96			
Cherpitel and Clark (1995)	U.S. emergency room patients aged 18+	ICD-10 criteria					
	Black	Harmful drinking					
	Male		0.93	0.78			
	Female		0.71	0.98			
	White						
	Male		0.93	0.79			
	Female		0.60	0.92			
	Black	Alcohol dependence					
	Male		0.90	0.79			
	Female		0.63	0.97			
Cherpitel (1995)	U.S. emergency room patients aged 18+	ICD-10 criteria					
	Total	Harmful drinking	0.85	0.88			0.86
	Male		0.93	0.77			0.85
	Female		0.72	0.97			0.82
	Black		0.88	0.89			0.88
	White		0.77	0.84			0.81
	Total	Alcohol dependence	0.83	0.89			0.85
	Male		0.91	0.80			0.85
	Female		0.66	0.97			0.79
	Black		0.85	0.90			0.86
White		0.76	0.88			0.83	
Bohn et al. (1995)	U.S. general medical/surgical patients and alcoholics in rehabilitation treatment	Hazardous drinkers ( $\geq 40$ g/d men or $\geq 20$ g/d women)	0.98	0.34			
MacKenzie et al. (1996)	UK admissions to acute medical unit of hospital aged 17+	Alcohol intake per week $\geq 14$ units women; $\geq 21$ units men	0.93	0.94	0.74		
Cherpitel (1997)	U.S. emergency room patients, aged 18+	ICD-10 and DSM-IV criteria for alcohol dependence					
	Jackson, MS						
	Black		0.93	0.89			0.91
	White		0.86	0.85			0.85
	Santa Clara, CA						
	Black		0.88	0.82			0.84
	White		0.92	0.80			0.86
	Jackson, MS						
	Black						
	Male		0.97	0.79			
	Female		0.81	0.97			
	White						
	Male		0.94	0.76			
	Female		0.75	0.92			
Santa Clara, CA							
Black							
Male		0.96	0.72				
Female		0.69	0.90				
White							
Male		1.00	0.73				
Female		0.71	0.90				
Skipsey et al. (1997)	U.S. drug dependent inpatients aged 18+	Hazardous drinking ( $\geq 40$ g/d for men; $\geq 20$ g/d women)	0.97	0.69	0.65		
Bradley et al. (1998)	Male U.S. Veterans Administration medical clinic patients	DSM-III-R alcohol dependence	0.91	0.84	0.87		
		Heavy drinking ( $\geq 5$ drinks/d or $\geq 14$ drinks/wk)	0.57	0.92			0.87
Bush et al. (1998)	Male U.S. Veterans Administration medical clinic patients	DSM-III-R alcohol dependence	0.66	0.86			0.78
		Heavy drinking $\geq 5$ drinks/d or $\geq 14$ drinks/wk)	0.59	0.91			0.88
		DSM-III-R alcohol abuse or dependence	0.71	0.85			0.81
		Heavy drinking and/or abuse or dependence	0.58	0.95			0.88

Table 1. (Continued)

Study	Subjects	Diagnostic measure	Sens	Spec	PPV	NPV	AUC
Cherpitel (1998)	U.S. emergency room patients	ICD-10 and DSM-IV criteria for harmful alcohol use/abuse or alcohol dependence					
	Black	Alcohol dependence	0.88	0.82			
	White/Other		0.91	0.82			
	Black	Harmful use/abuse or dependence	0.69	0.89			
	White/Other		0.72	0.88			
	Black	Alcohol dependence					
	Male		0.96	0.72			
	Female		0.69	0.90			
	White/Other						
	Male		0.96	0.74			
	Female		0.74	0.91			
	Black	Harmful use/abuse or dependence					
	Male		0.79	0.80			
	Female		0.54	0.95			
Clements (1998)	U.S. university students recruited in classrooms	DSM-IV alcohol dependence	0.74	0.92	0.55	0.97	
Dawe et al. (2000)	Australian patients with schizophrenia aged 18+	ICD-10 and DSM-IV criteria for alcohol abuse or dependence	0.87	0.90			
Maisto et al. (2000)	U.S. outpatients with severe mental illness aged 18+	DSM-IV criteria for Alcohol abuse or dependence	0.90	0.70	0.32	0.98	
McCann et al. (2000)	U.S. adults evaluated for attention-deficit/hyperactivity disorder	DSM-IV criteria for alcohol abuse or dependence	0.77	0.82	0.45	0.95	
Cherpitel (2001)	U.S. emergency department and primary care patients	ICD-10 and DSM-IV criteria for alcohol dependence					
	Black emergency dept pts		0.93	0.94			
	Black primary care patients		0.67	0.97			
Gordon et al. (2001)	U.S. primary care patients	≥16 drinks/wk for men ≥12 drink/wk for women	0.76	0.92			
Hearne et al. (2002)	Medical teaching hospital patients in Ireland	DSM-IV criteria for alcohol abuse or dependence	0.89	0.91			
Moore et al. (2002)	U.S. Primary care patients aged 60 years or older	LEAD					
		Any alcohol problem	0.28	1.00			
		ICD-10 and DSM-IV criteria for any hazardous or harmful use	0.75	0.89			
Knight et al. (2003)	U.S. hospital-based clinic patients aged 14 to 18 years	DSM-IV criteria					
		Problem use, i.e., one or more alcohol-related problem but does not reach diagnostic threshold	0.24	1.00			0.92
		Abuse or dependence	0.54	0.97			0.91
		Dependence	0.75	0.94			0.95
Philpot et al. (2003)	UK referrals to psychiatry service aged 65+ years	≥21 (men)/14 (women) units per week	0.69	0.96			0.96
		≥42 (men)/28 (women) units per week	0.78	0.92			
Kelly et al. (2004)	U.S. emergency department patients aged 18 to 20 years	DSM-IV criteria for alcohol abuse or dependence	0.87	0.65	0.60	0.88	0.85
Kokotailo et al. (2004)	U.S. college students aged 18 to 23 years	DSM-III-R past year alcohol problem TLFB for high-risk drinking over 28 days High-risk drinking, i.e., males ≥57 drinks or ≥4 binge (≥5 drinks) occasions over 28 days; females ≥29 drinks or ≥4 binge (≥4 drinks) occasions over 28 days	0.68	0.75			0.79
			0.82	0.78			0.87
Cook et al. (2005)	U.S. young persons, aged 15 to 24 years, attending a sexually transmitted disease clinic	DSM-IV criteria for any alcohol use disorder	0.82	0.72	0.59	0.89	0.84
Adewuya (2005)	University students in Nigeria	ICD-10 criteria					
		Harmful alcohol use	0.77	0.97	0.70	0.98	0.95
		Alcohol dependence	1.00	0.87	0.16	1.00	0.99

Table 1. (Continued)

Study	Subjects	Diagnostic measure	Sens	Spec	PPV	NPV	AUC
Coulton et al. (2006)	UK male primary care patients	DSM-IV criteria Binge drinking $\geq 8$ units alcohol/d					
		Hazardous alcohol use	0.69	0.98	0.95	0.86	0.94
		Monthly binge consumption	0.66	0.97	0.91	0.84	0.96
		Weekly binge consumption	0.75	0.90	0.71	0.92	0.94
Seale et al. (2006)	U.S. primary care patients	Alcohol dependence	0.84	0.83	0.41	0.97	0.94
		At-risk drinking	0.46	0.94			
		Current AUD	0.43	0.95			
		Any AUD or at-risk drinking	0.44	0.97			

Sens, sensitivity, the percentage of individuals with the defined problem who score at or above a cutoff of 8; Spec, specificity, the percentage of individuals without the defined problem who score 7 or below on the AUDIT; PPV, positive predictive value: the probability that a person has the defined problem granted that the individual has a score at or above 8 on the AUDIT; NPV, negative predictive value: the probability that a person does not have the defined problem granted that the individual has a score of 7 or below on the AUDIT; AUC, area under the curve: receiver operating curve plots sensitivities against the test's false positive rates (1-specificity) at multiple possible cut-points. The area under the curve thus summarizes the test's discriminatory power; LEAD, longitudinal evaluation, done by experts, employing all available data (Moore et al., 2000); TLFB, timeline follow-back (Sobell and Sobell, 1992); AUD, alcohol use disorder.

5 or 6. Since the previous review and as reflected in Table 1 stronger additional support has been marshaled for doing so. Bradley et al. (2003), for example, found that among female VA patients even a cut-point as low as 3 yielded sensitivity of 0.77 and specificity of 0.79 for diagnoses of alcohol abuse or of alcohol dependence and that an even lower cut-point of 2 might be employed for identifying hazardous drinkers (sensitivity, 0.87; specificity, 0.71). Several non-English European studies (Gache et al., 2005; Gual et al., 2002; Neumann et al., 2004) provide further evidence that 5 may be the best cut-point for identifying at-risk drinking among females, with sensitivities ranging from 0.73 to 0.82.

### Ethnicity

We had also tentatively concluded that there was little evidence that the accuracy of the AUDIT varies with ethnicity. In a recent study, Cook et al. (2005) found that the AUDIT performed slightly better among whites than blacks in a young adult sample. Although the AUDIT's performance has been weaker among blacks in some studies (Cherpitel, 1998; Cherpitel and Bazargan, 2003; Cherpitel and Clark, 1995), in others the AUDIT performed equally well among blacks and whites (see Cherpitel, 1997) or even as slightly more accurate among blacks in identifying harmful use (Cherpitel, 1995). Cherpitel and Bazargan (2003) found that the AUDIT and the 6-item RAPS4-QF performed similarly for alcohol dependence, but that the RAPS4-QF was more sensitive than the AUDIT for blacks, Hispanics and males in an emergency department setting.

Although the AUDIT has generally performed well among Mexican Americans (Steinbauer et al., 1998; Volk et al., 1997), evidence suggests that low acculturation among this ethnic group may diminish the AUDIT's performance (Cherpitel, 1999; Cherpitel and Borges, 2000). Cherpitel (1999) found higher sensitivities and lower spec-

ificities for highly acculturated Hispanic emergency room patients versus those less Anglo-acculturated.

A single study (Cherpitel et al., 2005) conducted in 2 different regions of Poland found that the translated AUDIT performed differently by region, with sensitivities being much lower than expected at the standard cut-point of 8. At both sites the RAPS-QF was more sensitive for both males and females, but less specific, than the AUDIT using the standard cut-point. This highlights the need to consider regional or cultural differences in selecting effective screens and cut-points. To appropriately establish these, further targeted research would be necessary.

With these few noted exceptions, recent studies continue to lead to the general conclusion that the AUDIT's performance does not differ widely for various ethnic groups, at least in studies using the English version of the AUDIT. Adewuya (2005), for example, determined a sensitivity of 0.77 and a specificity of 0.97 in identifying high-risk or harmful drinking in Nigerian university students, values quite close to those derived by Kokotailo et al. (2004) for identifying high-risk drinking among U.S. university students (sensitivity, 0.82; specificity, 0.78).

### Adolescents

Although originally developed for alcohol screening of adults, the AUDIT might also be appropriate for adolescents. In our last review we noted that only one study had examined the AUDIT's validity against diagnostic criteria in this age group (Chung et al., 2000). In this study 3 items in the AUDIT had been modified to make the scale more relevant for this age group. At a cut-point of 4, the AUDIT produced a favorable sensitivity of 0.94 as well as a rather acceptable specificity of 0.80. More recently, Knight et al. (2003) examined the performance of the originally worded AUDIT in a sample of 14- to 18-year-old patients receiving care in a hospital-based clinic and observed that at a cut-point of 2 was optimum for identifying any alco-

hol problem (sensitivity, 0.88; specificity, 0.81) and that 3 points could be recommended as a cut-point for identifying abuse or dependence. Resulting sensitivities were 0.88 and 1.00 and specificities of 0.77 and 0.73, respectively.

Among under-age drinkers being seen in an emergency department, Kelley et al. (2002) found that the AUDIT surpassed the TWEAK and the CAGE in differentiating problem drinkers from nonproblem drinkers. In a similar setting, Kelly et al. (2004) found that in older adolescents (18–20 years) the optimal cut-point for identifying an alcohol use disorder was 10. A new screen, the RUFT-Cut, produced similar sensitivities as the AUDIT and was preferred by the authors for emergency department use because of its brevity and its ease of scoring (Kelly et al., 2004).

#### *Older Adults*

Previously we had suggested that, due to disappointing specificities, the AUDIT might not be particularly useful for the elderly. Two recent studies (Moore et al., 2002; Philpot et al., 2003) which reported, respectively, the patients' mean age being 74.3 years (range 60–93 years) and 71.1 years (SD = 6.7), continue to highlight this problem. Although the AUDIT and the AUDIT-PC (a 5-item abbreviated version of the AUDIT discussed in detail below) performed better than the CAGE (Philpot et al., 2003) or the SMAST-G among elderly patients (Moore et al., 2002), the overall accuracy of the AUDIT was still low and thus leads us to concur with Reid et al. (2003) that, until a better screening instrument is developed [or until the AUDIT's item content or cut point are modified as needed] for this segment of the population, it is probably wise to use multiple methods for screening for at-risk and harmful drinking.

#### *Psychiatric Patients*

Screening for alcohol problems in severely mentally ill with the AUDIT has also attracted research attention. In our last review we reported on 2 well-designed criterion validity studies indicating that the AUDIT might function effectively in those suffering from severe and persistent disorders, such as schizophrenia, delusional disorders, acute psychosis, major depression, bipolar disorder, severe anxiety, and somatization disorders. Since then, 2 additional studies (Carey et al., 2003; O'Hare et al., 2004) have supported this belief. Among psychiatric patients in India suffering from a variety of severe chronic disorders, Carey et al. (2003) reported that the AUDIT distinguished those with a primary diagnosis of an alcohol disorder from those with primary psychiatric diagnoses. Against the criterion of a single-item clinician-rated index of alcohol use disorder, O'Hare et al. (2004) reported a sensitivity of 0.71 and a specificity of 0.95 at the usual cut-point of 8. Both studies also reported that the AUDIT exhibited good psychometric properties when used in this population, with internal reliability coefficients in the mid-90s.

## SCREENING FOR HAZARDOUS DRINKING

Our previous review had urged additional research to determine how effectively the AUDIT could identify *hazardous drinking* (at risk for physical and/or psychological harm) because few studies had as yet been done to assess this as opposed to screening for *harmful use or alcohol dependence* and because an original goal in development of the AUDIT was early identification of hazardous drinking (Saunders et al., 1993). No fewer than 8 studies have since investigated the AUDIT's ability in this regard and all have yielded encouraging findings. Not surprisingly, nearly all of these projects concluded by recommending a cut-point below the standard value of 8 to screen for alcohol-problems of lower intensity than alcohol dependence or abuse.

Three of these investigations were conducted in primary care or general practice settings (Dybek et al., 2006; Gache et al., 2005; Gual et al., 2002) and each determined that the best cut-point for women to identify both hazardous and harmful use was 5. Sensitivities ranged from 0.96 to 0.73 and specificities from 0.96 to 0.88. Recommended cut-points for identifying hazardous drinking in men ranged from 5 to 7. Dybek et al. (2006) found that at a cut-score of 5 sensitivity was 0.97 and specificity, 0.84. Gual et al. (2002) argued for 7 as the best cut-point for men (sensitivity, 0.87; specificity, 0.81). Gache et al. (2005) recommended 6 as the cut score for men (sensitivity, 0.86; specificity, 0.74) for identifying hazardous drinking.

In a general population sample, Rumpf et al. (2002) urged use of a cut point of 5 as optimal for identifying at-risk drinkers (sensitivity, 0.77; specificity, 0.80). The cut-point of 5 was also seen as optimal for identifying high-risk drinkers among college students in Nigeria (Adewuya, 2005) and yielded a sensitivity of 0.94 and a specificity of 0.92. A slightly higher cut-off value of 6 was suggested by Kokotailo et al. (2004) for detecting high-risk drinking among U.S. college students (sensitivity, 0.91; specificity, 0.60).

In an emergency room study, Neumann et al. (2004) opined that because resources are at high premium in this context devoting time for false positives is not efficient and, therefore, that the standard cut-point for men of 8 is adequate (sensitivity, 0.75; specificity, 0.84) for identifying any alcohol use disorder. Nevertheless, this research team felt that the cut-point for women should be lowered to 5 (sensitivity, 0.84; specificity, 0.81). The single study that we found on teenagers recommended a cut-point of 2 to identify an alcohol related problem (sensitivity, 0.88; specificity, 0.81) (Knight et al., 2003).

## ABBREVIATED VERSIONS OF THE AUDIT

The full 10-item AUDIT with its multidimensional scoring for each item has been called "cumbersome" for use in some settings where rapidity of scoring, as well as accuracy, is important (Hearne et al., 2002). This has led some researchers, when sensitivities and specificities are similar, to favor screens with fewer dichotomously scored

**Table 2.** Abbreviated Versions of the AUDIT: Sens, Spec, PPV, NPV, and AUC

Study	Subjects	Diagnostic measure	Cut point	Sens	Spec	PPV	NPV	AUC
<i>AUDIT-C (AUDIT items 1, 2, and 3)</i>								
Gordon et al. (2001)	Primary care patients in U.S. Males and females	Hazardous drinking ( $\geq 16$ drinks/wk for men; $\geq 12$ drink/wk for women)	$\geq 4$ $\geq 5$	0.98 0.94	0.66 0.82			
Rumpf et al. (2002)	General population in Germany Males and females	DSM-IV criteria and risk drinking						
		Risk drinking	$\geq 4$	0.94	0.65			0.87
		>280 g men, >168 g women	$\geq 5$	0.74	0.83			
		Current misuse	$\geq 4$	0.83	0.62			0.79
			$\geq 5$	0.56	0.81			
		Dependence	$\geq 4$	0.96	0.62			0.93
			$\geq 5$	0.88	0.81			
		Any criteria	$\geq 4$	0.93	0.66			0.88
			$\geq 5$	0.74	0.85			
Dawson et al. (2005a)	NESARC sample general population in U.S. Males and females With any mood disorder in past year	DSM-IV criteria for						
		Dependence	$\geq 4$	0.89	0.72			0.89
			$\geq 5$	0.80	0.83			
		Any AUD	$\geq 4$	0.81	0.76			0.86
			$\geq 5$	0.70	0.86			
		Any AUD or risk drinking, i.e., either 1) weekly $\geq 14$ standard drinks for men; $\geq 7$ for women; or 2) daily $\geq 4$ drinks for men, $\geq 3$ drinks for women, once a month or more often	$\geq 4$ $\geq 5$	0.83 0.70	0.89 0.98			0.94
	Males and females with anxiety disorder, past year	Dependence	$\geq 4$	0.88	0.72			0.89
			$\geq 5$	0.80	0.83			
		Any AUD	$\geq 4$	0.83	0.77			0.88
			$\geq 5$	0.72	0.87			
		Any AUD or risk drinking	$\geq 4$	0.84	0.91			0.95
			$\geq 5$	0.67	0.98			
	Males and females with personality disorder	Dependence	$\geq 4$	0.91	0.69			0.89
			$\geq 5$	0.85	0.80			
		Any AUD	$\geq 4$	0.84	0.74			0.87
			$\geq 5$	0.75	0.84			
		Any AUD or risk drinking	$\geq 4$	0.86	0.88			0.95
			$\geq 5$	0.75	0.97			
Dawson et al. (2005b)	NESARC sample general population in U.S. Males and females	DSM-IV criteria for						
		Dependence	$\geq 4$	0.91	0.69			0.89
			$\geq 5$	0.85	0.80			
		Any AUD	$\geq 4$	0.84	0.74			0.87
			$\geq 5$	0.75	0.84			
		Any AUD or risk drinking	$\geq 4$	0.86	0.88			0.95
			$\geq 5$	0.75	0.97			
Tsai et al. (2005)	Chinese medically hospitalized patients in Taiwan Males and females	ICD-10 criteria for Harmful use	$\geq 4$	0.90	0.77	0.77	0.90	0.92
			$\geq 5$	0.87	0.85	0.83	0.88	0.86
		Dependence	$\geq 4$	0.94	0.49	0.25	0.98	
			$\geq 5$	0.94	0.58	0.29	0.98	
Seale et al. (2006)	Primary care patients in U.S. Males and females	At risk drinking	$\geq 4$	0.85	0.77			
			$\geq 5$	0.65	0.89			
		Current AUD	$\geq 4$	0.74	0.70			
			$\geq 5$	0.61	0.89			
		Any AUD or risk drinking	$\geq 4$	0.76	0.80			
			$\geq 5$	0.63	0.92			

Table 2. (Continued)

Study	Subjects	Diagnostic measure	Cut point	Sens	Spec	PPV	NPV	AUC
Bush et al. (1998)	Veterans Affairs medical clinic patients in United States	Heavy drinking $\geq 5$ drinks/d or $\geq 14$ drinks/wk)	$\geq 4$	0.91	0.70			0.89
			$\geq 5$	0.73	0.88			
	Males	DSM-III-R criteria for alcohol abuse or dependence	$\geq 4$	0.79	0.56			
		Heavy drinking and/or abuse or dependence	$\geq 5$ $\geq 4$	0.67 0.86	0.76 0.72			
Aertgeerts et al. (2001)	General practice patients, Belgium Males	DSM-III-R criteria for abuse or dependence	$\geq 5$ $\geq 5$	0.68 0.78	0.90 0.75	0.33	0.96	
Gual et al. (2002)	Primary care patients in Spain Males	Risk drinking $\geq 280$ g for males and/or met criteria for hazard or harmful drinking, general practitioner diagnosis	$\geq 4$ $\geq 5$	1.00 0.92	0.53 0.74	0.60 0.72		0.91
		DSM IV criteria for						
Dawson et al. (2005a)	NESARC general population in U.S. Males with any mood disorder in past year	Dependence	$\geq 4$ $\geq 5$	0.91 0.87	0.60 0.71			0.86
		Any AUD	$\geq 4$ $\geq 5$	0.84 0.79	0.65 0.77			0.83
		Any AUD or risk drinking, i.e., either 1) weekly $\geq 14$ standard drinks for men; $\geq 7$ for women; or 2) daily $\geq 4$ drinks for men, $\geq 3$ drinks for women, once a month or more often	$\geq 4$	0.89	0.81			0.94
		Dependence	$\geq 5$ $\geq 4$	0.83 0.90	0.95 0.58			0.86
		Any AUD	$\geq 5$ $\geq 4$ $\geq 5$	0.85 0.88 0.80	0.70 0.65 0.76			0.84
		Any AUD or risk drinking	$\geq 4$ $\geq 5$	0.91 0.83	0.83 0.96			0.95
	Males with any personality disorder	Dependence	$\geq 5$ $\geq 4$	0.83 0.94	0.71 0.59			0.88
		Any AUD	$\geq 5$ $\geq 4$ $\geq 5$	0.91 0.88 0.81	0.71 0.65 0.71			0.85
		Any AUD or risk drinking	$\geq 4$ $\geq 5$	0.91 0.85	0.83 0.96			0.95
		Dependence	$\geq 5$ $\geq 4$	0.94 0.58	0.58			0.87
		Any AUD	$\geq 5$ $\geq 4$ $\geq 5$	0.89 0.88 0.79	0.72 0.63 0.77			0.83
		Any AUD or risk drinking	$\geq 4$ $\geq 5$	0.99 0.91	0.79 0.95			0.98
Gual et al. (2002)	Primary care patients in Spain Females	Risk drinking $\geq 168$ g and/or met criteria for hazard or harmful drinking, general practitioner diagnosis	$\geq 3$ $\geq 4$	0.91 0.91	0.52 0.68	0.15 0.21		0.96
		DSM-IV criteria for						
Bradley et al. (2003)	Veteran Affairs patients in U.S. Females	Past year hazardous drinking and/or active DSM-IV alcohol abuse or dependence	$\geq 3$ $\geq 4$	0.60 0.38	0.96 0.98			0.91
		DSM-IV criteria for						
Dawson et al. (2005a)	NESARC general population in U.S. Females with any mood disorder in past year	Dependence	$\geq 3$	0.93	0.66			0.90
		Any AUD	$\geq 4$ $\geq 3$ $\geq 4$	0.86 0.88 0.77	0.80 0.70 0.82			0.88
		Any AUD or risk drinking, i.e., either 1) weekly $\geq 14$ standard drinks for men; $\geq 7$ for women; or 2) daily $\geq 4$	$\geq 3$	0.91	0.82			0.95



Table 2. (Continued)

Study	Subjects	Diagnostic measure	Cut point	Sens	Spec	PPV	NPV	AUC
		drinks for men, ≥ 3 drinks for women, once a month or more often	≥ 4 ≥ 3	0.78 0.91	0.94 0.65			0.91
	Females with any anxiety disorder, past year	Dependence	≥ 4 ≥ 3	0.85 0.87	0.79 0.68			0.89
		Any AUD	≥ 4 ≥ 3	0.76 0.82				0.95
		Any AUD or risk drinking	≥ 3 ≥ 4	0.92 0.77	0.80 0.94			0.90
	Females with any personality disorder	Dependence	≥ 3 ≥ 4	0.92 0.86	0.65 0.80			0.88
		Any AUD	≥ 3 ≥ 4	0.88 0.76	0.68 0.82			0.94
		Any AUD or risk drinking	≥ 3 ≥ 4	0.92 0.76	0.79 0.92			0.90
Dawson et al. (2005b)	NESARC general population in U.S. Females Past-year drinkers	DSM-IV criteria for	≥ 3 ≥ 4	0.92 0.85	0.67 0.81			0.87
		Dependence	≥ 3 ≥ 4	0.87 0.74	0.69 0.83			0.96
		Any AUD	≥ 3 ≥ 4	0.96 0.81	0.80 0.93			
		Any AUD or risk drinking	≥ 3 ≥ 4	0.96 0.81	0.60 0.95	0.29 0.73		0.93
<i>AUDIT-PC (AUDIT items 1, 2, 4, 5, and 10)</i>		Any ICD-10 alcohol disorder or hazardous drinking, i.e., 3 to 7 drinks daily for men (2–5 women) or ≥ 7 drinks ≥ 3 times/wk for men (≥ 5 drinks, women)	≥ 3 ≥ 5	0.96 0.79	0.60 0.95			
Piccinelli et al. (1997)	Primary care patients in Italy Males and females							
Aertgeerts et al. (2001)	General practice patients in Belgium Males	DSM-III-R alcohol abuse or dependence	≥ 5 ≥ 6 ≥ 7	0.68 0.58 0.46	0.84 0.92 0.96	0.40 0.52 0.63	0.94 0.93 0.92	0.83
	Females		≥ 5 ≥ 6 ≥ 7	0.50 0.39 0.28	0.93 0.97 0.99	0.26 0.41 0.57	0.98 0.97 0.97	
Philpot et al. (2003)	Elderly referrals to community-based psychiatry service in United Kingdom Over 65 years of age Males and females	≥ 21 drinks/wk for males, ≥ 14 for females	≥ 5 ≥ 5	0.80 0.78	0.95 0.91	0.67 0.39		0.96
		≥ 42 drinks/wk for males, ≥ 28 for females	≥ 5	0.75	0.97	0.83		
		Clinical case (both high consumption and alcohol-related disorders)	≥ 5	0.98	0.91	0.59	1.00	0.97
Gomez et al. (2005)	Primary care patients in Spain Males and females	280 g alcohol/wk for men, 168 g alcohol/wk for women	≥ 5	0.98	0.91	0.59	1.00	0.97
<i>AUDIT-3 (AUDIT item 3 only)</i>								
Gordon et al. (2001)	Primary care patients in Italy Males and females	≥ 16 drinks/wk for men, ≥ 12 drinks/wk for women	≥ 1 ≥ 2	0.89 0.73	0.65 0.90			
Matano et al. (2003)	Highly educated employees in U.S. Males and females	Binge drinking, i.e., ≥ 5 drinks/ occasion for men, ≥ 4 drinks/ occasion for women	≥ 1	0.73	0.93			
Gomez et al. (2005)	Primary care patients in Spain Males and females	280 g alcohol/wk for men, 168 g alcohol/wk for women	≥ 1	0.83	0.91	0.55	0.98	0.89
<i>AUDIT-4 (AUDIT items 1, 2, 3, and 10)</i>								
Gual et al. (2002)	Primary care patients in Spain	Risk drinking ≥ 280 g alcohol and/or met criteria for hazard or harmful drinking, general practitioner diagnosis	≥ 6	0.87	0.78	0.74		

Table 2. (Continued)

Study	Subjects	Diagnostic measure	Cut point	Sens	Spec	PPV	NPV	AUC
	Males		≥ 7	0.83	0.89	0.85		0.92
			≥ 8	0.68	0.94	0.90		0.95
	Females	Risk drinking ≥168 g and/or met criteria for hazard or harmful drinking	≥ 4	1.00	0.68	0.23		
			≥ 5	0.73	0.96	0.61		
			≥ 6	0.54	1.00	1.00		
<i>FAST (AUDIT items 3, 5, 8, and 10)</i>								
Hodgson et al. (2002)	Males and females in United Kingdom Fracture clinic	Screened positive (≥8) for alcohol problem on the full AUDIT	≥ 1 <sup>a</sup>	0.94	0.89			
	Primary care		≥ 1 <sup>a</sup>	0.91	0.95			
	Dental hospital		≥ 1 <sup>a</sup>	0.97	0.91			
	Accident and emergency		≥ 1 <sup>a</sup>	0.94	0.94			
Hodgson et al. (2003)	Accident and emergency department patients in United Kingdom males and females	Screened positive (≥8) for alcohol problem on the full AUDIT	≥ 1 <sup>a</sup>	0.93	0.88			
Gomez et al. (2005)	Primary care patients in Spain Males and females	280 g alcohol/wk for men, 168 g alcohol/wk for women	≥ 3	0.80	0.94	0.63	0.97	0.93

<sup>a</sup>The FAST is scored dichotomously, either positive or negative. For a description of two possible scoring strategies, see Hodgson et al. (2002, 2003).

Sens, sensitivity, the percentage of individuals with the defined problem who score at or above a cutoff of 8; Spec, specificity, the percentage of individuals without the defined problem who score 7 or below on the AUDIT; PPV, positive predictive value: the probability that a person has the defined problem granted that the individual has a score at or above 8 on the AUDIT; NPV, negative predictive value: the probability that a person does not have the defined problem granted that the individual has a score of 7 or below on the AUDIT; AUC, area under the curve: receiver operating curve plots sensitivities against the test's false positive rates (1-specificity) at multiple possible cut-points. The area under the curve thus summarizes the test's discriminatory power; LEAD, longitudinal evaluation, done by experts, employing all available data; TLFB, timeline follow-back; AUD, alcohol use disorder.

items than the AUDIT, such as the RAPS (Cherpitel, 1998), CUGE (Aertgeets et al., 2000), Five-Shot Aertgeets et al., 2001), CAGE (Hearne et al., 2002), RUFT-Cut (Kelley et al., 2004), or RAPS4-QF (Cherpitel and Bazaragan, 2003; Cherpitel et al., 2005). Abbreviated versions of the AUDIT may also serve to meet this practical need.

The AUDIT-C has generated substantial research activity since our previous review, while other short variations of the AUDIT have drawn comparatively minimal attention. In addition to the AUDIT-C, other abbreviated versions that we have found are the AUDIT-PC, AUDIT-3, the AUDIT-4, and the Fast Alcohol Screening Test (FAST; see Table 2).

In our last review we noted that the *AUDIT-PC* (AUDIT items 1, 2, 4, 5, and 10) was identified by logistic regression as highly predictive of an ICD-10 diagnosis of dependence, harmful, and hazardous use (Piccinelli et al., 1997) but that in a subsequent study (Aertgeets et al., 2001) it produced much lower sensitivity and specificity among males than the full AUDIT. Since then, an additional study found that the *AUDIT-PC* performed comparably to the full AUDIT in detecting hazardous drinkers in a primary care setting (Gomez et al., 2005). This may be due to the *AUDIT-PC*'s inclusion of 2 of the 3 consumption items as well as 3 of the adverse consequences AUDIT items. Among elderly psychiatric patients (Philpot et al., 2003) the *AUDIT-PC* was also reported as approximately equal in screening capability as the full AUDIT.

Our last review reported that only one study (Gordon et al., 2001) had been undertaken with the *AUDIT-3*. The *AUDIT-3* includes the single AUDIT item that inquires how frequently the respondent had consumed 6 or more drinks on a single occasion. In identifying hazardous drinkers, the *AUDIT-3* produced a rather low sensitivity of 0.51, but a specificity of 1.00, at a cut-point of 1. Subsequently, Gomez et al. (2005) found that the *AUDIT-3* performed satisfactorily in a primary care setting in detecting hazardous drinkers (sensitivity, 0.83; specificity, 0.91). Matano et al. (2003) determined that for identifying binge drinkers among highly educated employees the *AUDIT-3*, in fact, was actually much more accurate (sensitivity, 0.73; specificity, 0.93) than the full AUDIT (sensitivity 0.35; specificity, 0.98) or the *CAGE* (sensitivity, 0.67; specificity, 0.84). Nevertheless, this research team concluded that a more precise and reasonable method for identifying binge drinkers would be to simply ask them a direct question about the largest number of drinks they had consumed on a single occasion. The potential clinical utility of the *AUDIT-3* is highlighted by the National Institute on Alcohol Abuse and Alcoholism (NIAAA's) latest alcohol screening guide (NIAAA, 2005) recommending that clinicians use this item as one of the initial screening questions, and even lowering the number of drinks queried to a more conservative 5 drinks per occasion for men and 4 for women.

The *AUDIT-4* and the *FAST* have been derived since our last review. The *AUDIT-4*, consisting of items 1, 2, 3, and 10

of the AUDIT, was used in a single study (Gual et al., 2002). For men, at a cut-point of 7 for the full AUDIT and the AUDIT-4, the AUDIT-4 demonstrated near identical screening accuracy (sensitivity, 0.83; specificity, 0.89 for AUDIT-4 and sensitivity, 0.87; specificity 0.81 for the full AUDIT) for identifying risky drinking. For women, at a cut-point of 5 for both scales, the AUDIT-4 and the full AUDIT yielded identical sensitivity and specificity levels (sensitivity, 0.73; specificity, 96) for detecting at-risk drinking.

We found 2 studies that employed the FAST (Hodgson et al., 2002, 2003), a 4-item scale consisting of item 3 (modified for men by increasing the number of drinks on 1 occasion to 8) as well as items 5, 8, and 10 from the original AUDIT. Unfortunately, these researchers validated the abbreviated scale only against the full AUDIT rather than also against an independent, formal alcohol diagnosis or hazardous drinking criterion. Gomez et al. (2005) used a modified version of the FAST (maintaining the original wording of item 3 for both men and women) and found that it performed less adequately in a primary care setting than either the AUDIT-C or AUDIT-PC. However, this study did not use the scoring strategy recommended by Hodgson et al., 2002, 2003).

As noted earlier, the *AUDIT-C*, consisting of the first 3 items of the AUDIT (the consumption factor items), has generated wide research interest (see Table 2). We stated in our last review that Bradley et al. (1998) had determined test-retest reliabilities over a 3-month interval ranging from 0.65 to 0.85. Since our review, Bergman and Kallmen (2002) reported a test-retest reliability of 0.98 over a 3 to 4 week interval, providing further evidence for the temporal stability of the *AUDIT-C*.

We have found 4 recent studies reporting internal consistencies of the *AUDIT-C*. Three of the reliability coefficients found were at an acceptable level, ranging from 0.69 to 0.91 (Bergman and Kallmen, 2002; Gomez et al., 2005; Tsai et al., 2005). Rumpf et al. (2002), however, observed a rather low 0.56 coefficient in a general German subject pool selected by random sampling and interviewed at their homes by lay volunteers.

Sensitivities of the *AUDIT-C* seem to be higher for dependence than for lower intensity alcohol problems (see Table 2), perhaps due to the more pronounced and more specifically demarcated nature of dependence.

On the basis of inspection of sensitivities and specificities at various cut-points reported in Table 2, we believe that for males, a cut-point 4 would probably be the appropriate choice if the goal were to identify hazardous drinking and false positives were not a critical issue. However, the cut-point of 5 would be preferable if the purpose of the screening were to identify those likely to be diagnosed with any alcohol use disorder. Among females the *AUDIT-C* seems to perform nearly as well as in males, provided that a lower cut-point is used. A cut-point of 3 would seem to be more suitable for detecting hazardous drinking; 4 for diagnosable disorders.

Although the *AUDIT-C* does appear to perform well in women at the lower cut-point, additional research on a gender-specific abbreviated version would be welcomed. Bradley et al. (2003) found that a modified (lowering to 4 the number of drinks inquired about in item 3) version of the *AUDIT-C* performed better for women at a cut-point of 2, than did the standard version of the *AUDIT-C*. As Dawson et al. (2005b) noted, additional research would help clarify whether a modified version would perform better or worse in identifying problem drinking among women.

Given the results of the large general-population sample of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) study (Dawson et al., 2005a, b), it does not appear that the *AUDIT-C* is substantially affected by collateral psychopathology (see Table 2).

Based on the few currently available non-English studies with medical samples, it seems that the translated versions of the *AUDIT-C* perform well. Additional studies using translated versions of the *AUDIT-C* will be important in clarifying its utility among various cultural and ethnic groups.

In 2 studies (Aertgeerts et al., 2001; Bush et al., 1998) using the *AUDIT-C* with males, sensitivities were lower than in other studies (see Table 2). One possible explanation for this is the relatively high percentage of elderly patients in these 2 projects (just over 35% above the age of 60 years in the former and 83% in the latter). Dawson et al. (2005b) also found lower specificities in those 65 or older, 0.77 at a cut-point of 4 and 0.52 at 5, for any alcohol use disorder, as contrasted with other sensitivities ranging from 0.82 to 0.87 at 4 and 0.67 to 0.78 at 5 in other age groups. These results are consistent with the similar problem of accuracy with the full AUDIT among the elderly that we noted above and in our earlier review.

#### PSYCHOMETRIC PROPERTIES OF NON-ENGLISH VERSIONS OF THE AUDIT

English language journals have published a number of studies since our last review in which the AUDIT was administered in languages other than English. We were able to locate studies done in Brazil, France, Germany, India, Poland, Spain, Sweden, Taiwan, and Vietnam. Eleven studies (Bergman and Kallmen, 2002; Bischof et al., 2005; Carey et al., 2003; Gache et al., 2005; Gomez et al., 2005; Lima et al., 2005; Neumann et al., 2004; Pal et al., 2004; Rumpf et al., 2002; Selin, 2003; Tsai et al., 2005) examined internal reliability coefficients of the translated AUDIT and the derived coefficients varied from 0.75 to 0.94, with a median value of 0.82. Non-English versions of the AUDIT to date have consistently shown acceptable reliabilities. Two studies have also examined temporal reliabilities dichotomously at the usual cut-point of 8 and found that the German and Swedish versions are quite stable, with  $\kappa$ s of 0.86 (Dybek et al., 2006) and 0.69 (Selin, 2003).

It is encouraging that a growing number of studies using a non-English version of the AUDIT are reporting its

performance against criteria of at-risk drinking and formal alcohol use disorders. However, at this time we agree with a large number of researchers (e.g., Cherpitel et al., 2005; Pal et al., 2004; Rumpf et al., 2002; Tsai et al., 2005) who suggest that more research needs to be done among particular ethnic, cultural, gender, and national language groups before one can confidently determine optimal cut points for the AUDIT in various settings and circumstances.

#### ALTERNATE MODES OF ADMINISTRATION

Our earlier review included a single study (Chan-Pensley, 1999) which determined that a computerized version of the AUDIT worked as well as the standard paper-and-pencil administration. Neumann et al. (2004) has now offered additional support for this view, reporting satisfactory correlations for the 2 modes of administration (Spearman  $\rho$ : men 0.69; women, 0.76) in an emergency room setting. They also suggested that the effectiveness of computer screening will likely depend more on educational and age factors than on dimensions of culture or ethnicity. Butler et al. (2003) found that computer-assisted screening was nearly as effective in identifying hazardous and harmful drinking as standard administration of the AUDIT, except that it may tend to underestimate problem drinking in a Spanish-speaking population.

We discovered a small number of studies on web-based administration of the AUDIT (Kypri et al., 2004; Lieberman, 2003, 2005; Saitz et al., 2004) and a single study that considered a computerized automated telephone screening (Rubin et al., 2006). These new technologies were well-received by study participants and hold promise for reaching a broader population for alcohol screening, alcohol education, and brief intervention. In the single study in which the effectiveness of the web-based screening and brief intervention was evaluated for effectiveness, the reduction in hazardous drinking among university students over the study's 6 week duration was also encouraging (Kypri et al., 2004).

#### AUDIT ISSUES IN PARTICULAR NEED OF FURTHER RESEARCH

In updating our review of the AUDIT, it was gratifying to see that the AUDIT continues to stimulate a high degree of research activity. We feel that such efforts are fully warranted as identifying alcohol problems and targeting interventions to those in need of them is critically important in enhancing public health. The primary virtues of the AUDIT as an alcohol screen are the meticulous process followed in its development, focus on the recent past, and cross-cultural applicability. That an abbreviated version of the AUDIT, the AUDIT-C consisting of only three items, performs well is a further strength as this should facilitate screening for alcohol problems where constraints on time are especially stringent. An emergency department context comes particularly to mind as do inclusion of

alcohol screening in integrated health risk appraisal surveys or large scale screening in nonmedical settings.

Since our earlier review much more has been learned about the AUDIT's performance. The evidence for selecting a lower score in using the AUDIT to screen for alcohol dependence or harmful use in women is preponderant and consistent. Clinicians and researchers would do well to employ a value of 5 or 6 rather than the originally recommended AUDIT cut point of 8. Although an expressed original goal of the AUDIT was to identify hazardous drinking, i.e., drinking problems less severe than diagnosable disorders of alcohol dependence or abuse, at the time of our earlier review of the literature very few studies had considered this potential capability. Several investigations on the issue have recently been conducted and all support the AUDIT's ability to do this if a lower cut point is adopted. It appears that this optimal value is probably 5. National Institute on Alcohol Abuse and Alcoholism's latest alcohol screening guide (NIAAA, 2005) suggests an even more conservative value of 4 as the trigger for clinicians to consider advising female patients about the risks of alcohol misuse.

Overall, the various types of validity and reliability characterizing a screening test are very favorable for the AUDIT. Exploring its accuracy with non-English speaking samples has become an increasingly popular research topic and results to date are quite encouraging.

A few issues on the AUDIT particularly merit future research attention. We would especially urge further investigation on use of the AUDIT with teenagers and college-age adults as these groups are at high vulnerability for alcohol problems, especially involving "binge" or episodic heavy drinking. Alternative alcohol screening measures for the 2 groups are typically quite long and minimally studied. If validated in these age groups, the full AUDIT and the AUDIT-C would be welcomed by the practitioner community. Similarly the AUDIT's performance among older adults is disappointing. Part of this may be due to the diminished alcohol tolerance in the elderly and, if so, perhaps a lower cut point for the full AUDIT and the AUDIT-C might improve the situation. It may also be that the AUDIT performs poorly in this age group because the item content of the AUDIT may not capture the consequences of drinking by the elderly as in other age groups. Perhaps also, response style might differ as a function of age. The reasons are, of course, speculative but the poorer performance of the AUDIT among older populations seems to be fairly consistent across studies.

The investigation conducted by Maggia et al. (2004) cited above raises a fundamental issue on the AUDIT and other self-report alcohol screening instruments. It will be recalled that this study was conducted with prisoners and that the AUDIT demonstrated a very low test-retest reliability coefficient of 0.27. Curiously on retest, nearly half of the subjects' scores on the AUDIT increased to above the cut point, thereby placing them in the alcohol problem

category. As an overt content screening measure, the validity of the AUDIT is entirely a function of the respondent's ability and willingness to provide accurate information on his or her use of alcohol and its effects. Future studies might consider combining the AUDIT with alcohol biomarkers to screen for problems in individuals with AUDIT scores that are open to question. A thought-provoking study suggesting the potential value of using biomarkers in conjunction with the AUDIT was conducted by Hermansson et al. (2000). In a routine occupational health exam study using at-risk drinking as a criterion this research group found that 18% of the subjects were positive on either the AUDIT or carbohydrate deficient transferrin, a highly specific alcohol biomarker. If the AUDIT had served as the sole predictive measure, only 11% of the subjects would have screened positive.

We also recommend additional research on issues that may influence the validity of responses to the AUDIT. One issue that deserves further research is the question of the influence of item sequence. Bischof et al. (2005) found that items presented at the beginning tend to receive higher values. We agree with this research team that additional research could help clarify if asking consumption questions first affects the validity of responses to alcohol-symptom questions. Another applied question that deserves attention is the effect of mode of presentation. In some settings, such as emergency departments, the AUDIT is often administered orally rather than by pencil and paper or computer. Studies that examine the implications of alternative modes of presentation of AUDIT items on the validity of patient responses would also be welcomed.

## CONCLUSIONS

The AUDIT was designed for the World Health Organization to screen for hazardous as well as harmful drinking in various cultural settings. Research consistently confirms the validity of the English version, with sensitivities and specificities comparable to and generally exceeding those of other alcohol screening methods (Allen et al., 1995). The AUDIT and its shorter version, the AUDIT-C, are psychometrically sound, brief, easy to score, relatively free of cultural bias, and available without royalty fee. The strengths of the AUDIT suggest that it can be used with confidence in a variety of settings and that it will stimulate continued research enthusiasm.

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