

ASSESSMENT AND DETECTION

Validation and Comparison of Alcohol-Screening Instruments for Identifying Hazardous Drinking in Hospitalized Patients in Taiwan

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Abstract — Aim: The aim of this study was to validate the Mandarin Chinese version of different screening instruments and compare their performances for identifying hazardous drinkers in Taiwan. **Methods:** We compared the performance of the Mandarin Chinese versions of AUDIT, AUDIT-C (AUDIT items 1, 2 and 3), AUDIT-4 (AUDIT items 1, 2, 3 and 10), AUDIT-3 (AUDIT item 3), TWEAK, SMAST and CAGE to detect hazardous drinking in hospitalized patients in Taiwan. The results of the test instruments were blindly compared with the reference standard Schedule for Clinical Assessments in Neuropsychiatry (SCAN). **Results:** Of 404 patients evaluated, 100 were identified as having a hazardous drinking pattern. All screening instruments showed acceptable sensitivities (ranging from 85 to 93%) and specificities (ranging from 72 to 92%), but AUDIT and its short forms performed consistently better than the other instruments. **Conclusions:** The Mandarin Chinese versions of AUDIT and its derivatives perform well in screening hospitalized Taiwanese patients for hazardous drinking.

INTRODUCTION

The apparent increased prevalence over the past five decades of alcohol-use disorders, that is alcohol abuse and alcohol dependence, is an important public health issue in Taiwan (Liu and Cheng, 1998). Hazardous drinking (also referred to as *problem, heavy, at-risk* or *excessive* drinking) (Reid *et al.*, 1999) is a pattern of drinking that puts people at increased risk for an overt alcohol-use disorder, with all the attendant physical, legal, psychosocial and economic costs (Dawson and Archer, 1993; National Institute on Alcohol Abuse and Alcoholism, 1995; Wechsler *et al.*, 1994). The prevalence of alcohol-related problems identified in patients in general hospitals, ranging from 7.4% to 28% (Schneekloth *et al.*, 2001), is higher than that in community surveys. This is not particularly surprising, as people with alcohol-use disorders often seek help only when they are ill, whether or not their illness is alcohol related. Hospitalization thus provides a window of opportunity for early identification of and brief interventions for people whose drinking may put them at risk. In the busy clinical setting, however, medical staff often do not recognize a hazardous drinking pattern unless there are obvious physical or psychosocial effects related to alcohol abuse. Many studies have found that less than a third of such individuals are identified in general hospitals (Wu *et al.*, 2006), and we found that only 5–10% of patients were referred to the psychiatric service for further evaluation and treatment. (In Taiwan, individuals with alcohol-use disorders are generally referred to a psychiatrist for management.) Failure to identify these problems in hospitalized patients is exceedingly costly in terms of both morbidity and expense. It is increasingly recognized that people with hazardous drinking patterns may be responsive to early intervention before an overt alcohol-use disorder develops. As a consequence, screening, early recognition and brief interventions for hazardous drinking before irreversible complications set in is a potentially effective sec-

ondary prevention (Adams *et al.*, 1996; Cherpitel, 1995; Volk *et al.*, 1997).

A wealth of screening instruments have been validated for detecting alcohol-related problems in various clinical settings, including questionnaires that can be self-administered or used by an interviewer. The most widely used are the 4-item CAGE, 25-item Michigan Alcoholism Screening Test (MAST) or the shorter 13-item SMAST, TWEAK and the Alcohol Use Disorder Identification Test (AUDIT) (Fiellin *et al.*, 2000). MAST, SMAST and CAGE are good for detecting lifetime alcohol problems but do not assess pre-symptomatic hazardous drinking patterns. TWEAK, a combination of selected items from the MAST and CAGE, was originally developed for the detection of hazardous drinking during pregnancy (Russell *et al.*, 1994). AUDIT, designed by the World Health Organization (WHO), has good validity in detecting current hazardous drinking patterns as well as more severe alcohol-related problems (Fiellin *et al.*, 2000; Reinert and Allen, 2002, 2007). These instruments were all developed in the West and therefore need to be translated and validated for use in other populations. The ethnic Chinese constitute a plurality of the world's population, so valid alcohol-screening instruments are extremely important. Taiwan is situated 100 miles off the southeast coast of China and has a population of 23 million. Most Taiwanese are ethnic Chinese who emigrated from China many years ago. Mandarin (a dialect originating in northern China) is the official language in Taiwan (Liu *et al.*, 2005). Thus far, Kuo *et al.* had validated the Mandarin Chinese version of CAGE for identifying alcohol abuse or dependence among hospital inpatients (Kuo *et al.*, 1999). Tsai *et al.* recommended cutoff points for the full AUDIT and for the first three questions (AUDIT-Consumption or AUDIT-C) based on a study of identifying harmful or dependent drinkers among inpatients (Tsai *et al.*, 2005). Nevertheless, no studies have compared the performance of the Mandarin Chinese versions of CAGE, TWEAK, SMAST,

AUDIT, AUDIT-C, AUDIT-4 (a combination of AUDIT questions 1, 2, 3, 10) and AUDIT-3 (AUDIT question 3 as a single screening tool) in a Chinese population. The aims of this study were to compare those tests in hospitalized patients in Taiwan and determine appropriate cutoff points for identifying hazardous drinking.

SUBJECTS AND METHODS

Subjects

This research was conducted in a general hospital in Taipei, a city located in northern Taiwan with 6 million inhabitants. Subjects eligible for the study included all patients aged 18–65 who were admitted to medical or surgical wards (~600 beds) during a 3-month period. Patients were excluded if they were too ill to be interviewed. The study was approved by the Mackay Memorial Hospital Institutional Review Board. Eligible patients were told that the purpose of the study was to survey health-related habits. Participants were assured of confidentiality and were asked to sign the informed consent.

Instruments

All screening instruments studied had already been translated into Chinese, but these versions have not necessarily been validated in Taiwan. CAGE, designed to identify patients with alcohol dependence at any time in their life, is a mnemonic for four questions (Ewing, 1984; King, 1986; Mayfield *et al.*, 1974). SMAST contains 13 true–false statements regarding lifetime alcohol use and related medical and psychosocial problems (Barry and Fleming, 1993; Rumpf *et al.*, 1997). TWEAK is a mnemonic similar to CAGE but also assesses tolerance. This instrument has been validated for women as well as men (Chan *et al.*, 1993). AUDIT is a 10-item scale (with possible scores ranging from 0 to 40) designed by the WHO to detect current hazardous drinking based on three aspects: alcohol intake, dependence and adverse consequences (Reinert and Allen, 2002). Several subsets of AUDIT have been used. AUDIT-C comprises the first three questions from the full AUDIT assessing the amount and frequency of alcohol intake. AUDIT-4 adds to these three questions the final question from the full AUDIT that asks if anyone has ever suggested the individual should reduce their drinking (Gual *et al.*, 2002). AUDIT-3 uses only the third question to assess alcohol misuse, ‘How often do you have 6 or more drinks on one occasion?’ (Bradley *et al.*, 2007).

Diagnostic criteria and definitions

Patterns of alcohol use may be represented on a spectrum from non-drinking through moderate, safe consumption and on to hazardous drinking, abuse or dependence. Abuse and dependence obviously occur in individuals with hazardous drinking. However, there are people with hazardous drinking who do not yet have overt abuse or dependence but are at risk for them. The exact definition of this drinking pattern has been stated differently in various populations. In the absence of an agreed standard and for the purpose of comparing our results with other studies, we adapted the criteria of Bohn *et al.* (1995) in which ‘hazardous drinkers’ were defined as men drinking >40 g daily or women >20 g daily or at least weekly consumption of more than six drinks on a single occasion. Alcohol

abuse and alcohol dependence are defined by the DSM-IV criteria (American Psychiatric Association, 1994). As noted above, for convenience we sometimes grouped these two categories together using the term alcohol-use disorder.

Reference standard

The reference standard against which the results of each of the screening instruments were measured was the alcohol-related section of the Schedule for Clinical Assessments in Neuropsychiatry (SCAN) version 2.1 (WHO), a semi-structured diagnostic interview to evaluate psychopathology and behavior associated with neuropsychiatric disorders. The Chinese version of SCAN has been validated for psychiatric assessment in Taiwan (Cheng *et al.*, 2001). Two psychiatric research nurses with 2 and 13 years of psychiatric ward experience and 4 years of psychiatric research experience were trained in the administration of SCAN for 6 months. At the end of that period, there was good inter-rater reliability between a research psychiatrist and the research nurses (generalized kappa of 0.88 for lifetime diagnosis of alcohol abuse or dependence according to DSM-IV standards). Throughout the study period, the research nurses were monitored weekly, with review of the interview processes, feedback on diagnoses and detailed discussion of patients’ responses.

Study procedures

This study consisted of a two-stage interview. Immediately after the patient agreed to participate and signed informed consent, a trained research assistant carried out the first stage interview. This consisted of helping the participants complete a self-report questionnaire, which included demographic and clinical information and a series of questions on health-related behaviors, including smoking, betel nut chewing and drinking. For the latter, the Chinese versions of the 10-item AUDIT, CAGE, SMAST and TWEAK questionnaires were used. The responses from the full AUDIT were then also used to generate AUDIT-C, AUDIT-4 and AUDIT-3 scores. Later, one of the research nurses, who was blinded to the results of the initial questionnaire, interviewed each participant using SCAN and determined if there was hazardous drinking, alcohol abuse or alcohol dependence.

Data analysis

Receiver-operating characteristic (ROC) curves were generated to compare the ability of the various screening instruments to detect hazardous drinking based on the SCAN reference standard. The curves were generated from sensitivity and 1-specificity pairs associated with various cutoff points and plotted by using a Statistical Package for the Social Sciences (SPSS), Version 12.0 (SPSS Inc., Chicago, IL, USA). Areas under the curves, standard errors and 95% confidence intervals (CI) were also calculated. To compare simultaneously whether the areas under the curve for each of the seven screening instruments were significantly different from each other, we used the method of Hanley and McNeill (Hanley and McNeil, 1983) of adjusting the correlation between two areas under the curve derived from the same population (Murphy *et al.*, 1987). Sensitivity, specificity, and positive and negative predictive values were calculated by using 2×2 tables. The optimal cutoff point

Table 1. Sociodemographic and current alcohol-use patterns among all subjects ($N = 404$) based on the SCAN interview

	Total	Non-drinkers	Safe-drinkers	Hazardous drinking	DSM-IV alcohol abuse	DSM-IV alcohol dependence	AUD
Number of subjects	404 (100)	195 (100)	109 (100)	100 (100)	11 (100)	77 (100)	88 (100)
Gender							
Men	242 (59.9)	84 (43.1)	69 (63.3)	89 (89)	11 (100)	71 (92.2)	82 (93.2)
Women	162 (40.1)	111 (56.9)	40 (36.7)	11 (11)	0 (0)	6 (7.8)	6 (6.8)
Age	42.9 (± 13.6)	43.4 (± 14.1)	43.4 (± 14.9)	41.3 (± 10.6)	36.0 (± 16.2)	43.0 (± 9.1)	42.1 (± 10.4)
Marital status							
Married	251 (62.1)	120 (61.5)	71 (65.1)	60 (60.0)	5 (45.5)	49 (63.6)	54 (61.4)
Single	100 (24.8)	50 (25.6)	29 (26.6)	21 (21.0)	5 (45.5)	11 (14.3)	16 (18.2)
Divorced	32 (7.9)	13 (6.7)	3 (2.8)	16 (16.0)	1 (9.1)	13 (16.9)	14 (15.9)
Widowed	21 (5.2)	12 (6.2)	6 (5.5)	3 (3.0)	0 (0)	4 (5.2)	4 (4.5)
Education (years)	9.6 (± 4.7)	9.4 (± 5.1)	10.0 (± 4.9)	9.5 (± 3.7)	9.6 (± 3.4)	9.0 (± 3.2)	9.0 (± 3.2)

Data are reported as n (%) or mean (\pm SD).

SCAN: Schedule for Clinical Assessments in Neuropsychiatry; Hazardous drinking: defined by the quantity of consumption and includes both alcohol abuse and dependence; AUD: alcohol-use disorders, comprising both alcohol abuse and alcohol dependence by the DSM-IV criteria.

for each instrument was determined by finding the highest chi-square value, which gives equal weight to sensitivity and specificity. All tests were two-tailed, and the level of significance was set at a P of <0.05 .

RESULTS

Socio-demographic and alcohol data

Of 449 admissions during the study period, 404 patients (90.0%) completed both the self-administered questionnaire and the SCAN interview. Of the 45 who were excluded from analysis, 23 were discharged and 2 were transferred before the SCAN interview, 4 were too ill, 1 had the SCAN interview but had not completed the self-report questionnaire and 15 refused to participate. There were no significant differences in demographic data or average scores on the screening instruments among the 45 subjects who did not complete the SCAN interview and the 404 who did.

Of the 404 study subjects, 236 (58.4%) were skilled workers, 88 (21.8%) were unemployed, 40 (9.9%) were women with domestic duties, 27 (6.7%) were students and 13 (3.2%) were retired. About half ($n = 204$) had <9 years of schooling, while 52 (12.9%) had completed higher education. The majority ($n = 249$, 61.6%) were hospitalized on the internal medicine service, with the remainder ($n = 155$, 38.4%) on the surgical service. Of the 404 respondents, about half were non-drinkers ($n = 195$, 48.3%, Table 1), which is a substantially higher proportion than in most Western countries

(MacKenzie *et al.*, 1996; Saunders *et al.*, 1993; Volk *et al.*, 1997). Out of 404 respondents, 100 (24.8%) were identified by SCAN as hazardous drinkers, 88 of whom (21.8%) had an alcohol-use disorder. The prevalence of hazardous drinking among women was quite low, 11 of 162 (6.8%), among whom 6 were alcohol-dependent. Alcohol-use disorders were significantly associated with male gender, middle age and being married.

Comparisons of screening instruments among all subjects and male patients

All seven screening instruments had areas under the ROC curve significantly >0.5 (Table 2), indicating fairly good performance in identifying hazardous drinking as compared with the reference standard. This was true for the study population as a whole and for the subset of men. Among all patients, the areas under the curve for AUDIT, AUDIT-4 and AUDIT-C were significantly larger than those for AUDIT-3, TWEAK, SMAST and CAGE. AUDIT, AUDIT-4 and AUDIT-C performed equally well, with no significant differences among their areas under the curve. SMAST, TWEAK and CAGE did not differ significantly among themselves, but all forms of AUDIT were significantly better than CAGE, SMAST and TWEAK. The findings were similar for the use of the instruments in men alone, with AUDIT, AUDIT-C and AUDIT-4 all performing significantly better than the rest. The area under the curve for AUDIT-3 among men was significantly better than CAGE but not for SMAST or TWEAK.

Table 2. Areas under the receiver-operating characteristic curves of screening instruments of all subjects ($n = 404$) and male only ($n = 242$)

	Hazardous drinkers ($n = 100$)			Hazardous male drinkers ($n = 89$)		
	AUC	SE	95% CI*	AUC	SE	95% CI
AUDIT	0.967	0.01	0.950–0.984	0.949	0.01	0.921–0.977
AUDIT-C	0.964	0.01	0.944–0.985	0.953	0.01	0.926–0.981
AUDIT-4	0.965	0.01	0.944–0.985	0.950	0.02	0.920–0.979
AUDIT-3	0.911	0.02	0.871–0.952	0.901	0.02	0.856–0.947
TWEAK	0.878	0.02	0.839–0.917	0.819	0.03	0.765–0.873
SMAST	0.867	0.02	0.825–0.909	0.807	0.03	0.751–0.863
CAGE	0.851	0.02	0.806–0.896	0.781	0.03	0.721–0.840

*95% CI : 95% confidence interval.

Hazardous drinking: defined by the quantity of consumption and includes both alcohol abuse and dependence.

AUC: area under the receiver-operating characteristic curve.

Table 3. Cutoff points and performance of screening instruments for determining hazardous drinking

	All hazardous drinkers (<i>n</i> = 100 of 404)					Male hazardous drinkers (<i>n</i> = 89 of 242)				
	Cutoff	Se (%)	Sp (%)	PPV (%)	NPV (%)	Cutoff	Se (%)	Sp (%)	PPV (%)	NPV (%)
AUDIT	≥6	91.0	88.2	71.7	96.8	≥6	92.1	79.7	72.6	94.6
	≥7	90.0	93.4	81.8	96.6	≥7	91.0	88.9	82.7	94.4
AUDIT-C	≥8	84.0	95.1	84.8	94.8	≥8	86.5	90.8	84.6	92.1
	≥3	95.0	86.5	69.9	98.1	≥4	92.1	86.3	79.6	95.0
	≥4	90.0	92.1	78.9	96.6	≥5	88.8	90.8	84.9	93.3
AUDIT-4	≥5	84.0	94.7	84.0	94.7	≥6	78.7	95.4	90.9	88.5
	≥5	92.0	88.2	71.9	97.1	≥6	91.0	84.3	77.1	94.2
	≥6	90.0	90.8	76.3	96.5	≥7	86.5	88.9	81.9	91.9
	≥7	86.0	93.4	81.1	95.3	≥8	83.1	94.1	89.2	90.6
AUDIT-3	≥1	88.0	86.8	68.8	95.7	≥1	88.8	79.1	71.2	92.4
	≥2	68.0	97.4	89.5	90.2	≥2	71.9	95.4	90.1	85.4
TWEAK	≥1	93.0	73.0	53.1	96.9	≥2	88.8	65.4	56.4	94.6
	≥2	87.0	78.9	57.6	94.9	≥3	82.0	68.6	59.8	90.9
SMAST	≥3	80.0	82.6	60.2	92.6	≥4	92.1	56.9	64.9	92.6
	≥1	91.0	72.4	52.0	96.1	≥2	85.4	64.1	58.0	88.3
	≥2	85.0	79.3	57.4	94.1	≥3	76.4	73.9	63.0	84.3
CAGE	≥3	75.0	85.5	63.0	91.2	≥4	69.7	79.7	66.7	81.9
	≥1	89.0	72.4	51.4	95.2	≥1	89.9	56.2	54.4	90.5
	≥2	75.0	83.2	59.5	91.0	≥2	75.3	68.6	58.3	82.7
					≥3	57.7	86.0	63.1	83.1	

Bold font indicates the optimal cutoff points for each instrument.

Se: sensitivity, Sp: specificity, PPV: positive predictive value, NPV: negative predictive value.

Operating characteristics of screening instruments among all subjects and men

Table 3 shows the operating characteristics of the seven screening instruments for detecting hazardous drinking. Because of the small number of females in the study, we will recommend the cutoff points for all subjects and male patients only. Based on previous studies and the results for the entire sample that likely the cutoff points for women would be lower than for men. Sensitivity and specificity at each cutoff point were closer and higher for AUDIT and its shorter forms compared with the other instruments.

DISCUSSION

Our study among hospitalized Chinese patients in Taiwan demonstrated that AUDIT is superior to CAGE, SMAST or TWEAK for identifying hazardous drinking. Both the full AUDIT and its shorter forms, perhaps with the exception of AUDIT-3, performed better than the other instruments. These findings are in agreement with the general conclusion that AUDIT performs well in a range of ethnic groups (Reinert and Allen, 2007).

Strengths of the study

The response rate was quite satisfactory, with participants representative of all non-psychiatric inpatients in a general hospital during the study period. Interviewer bias was avoided by using a validated reference standard administered by trained researchers blinded to the results of the test instruments.

Comparisons of screening instruments

The finding that AUDIT-C and AUDIT-4 are as effective as the full AUDIT in discriminating patients hazardous drinking, with or without other alcohol-related problems, is similar to those of studies in the West (Bradley *et al.*, 2007; Gual

et al., 2002). If brevity is the main concern in the busy clinical setting, the use of such a screening instrument has definite advantages, particularly if it is self-administered. This allows the clinician to assess the results and quickly address any issues indicated by the score. CAGE, SMAST and TWEAK were developed and tested in psychiatric hospitals or among subjects who were already recognized as having an alcohol-use disorder (Mayfield *et al.*, 1974). They immediately focus on the adverse consequences of alcohol use without first inquiring about the quantity and frequency of alcohol consumption (Reid *et al.*, 1999). They may therefore fail to identify hazardous drinking alone that is not yet associated with abuse or dependence. A further difficulty may be that, without first determining alcohol drinking patterns, such questions may evoke defensiveness, resulting in patients denying problems when they actually have them (Barry and Fleming, 1993; Rumpf *et al.*, 1997). This could be a particular problem in the more conservative Chinese culture. Beginning with relatively neutral questions about the quantity and frequency of alcohol use, as the AUDIT does, may help allay this problem. Particularly among men in our study, even the AUDIT-3 was as good or better than SMAST, TWEAK or CAGE. This suggests that asking hospitalized Chinese men if they have ≥6 drinks on occasion is also a reasonable option for identifying hazardous drinking. Once it is established that a patient is a hazardous drinker, one must go on to determine if abuse or dependence is present. Although we did not do a statistical comparison of the various instruments for identifying an alcohol-use disorder, it is simple and time saving to proceed with the full AUDIT if a hazardous drinking pattern is ascertained to give an indication of the likelihood of abuse or dependence.

Choosing cutoff points for the screening instruments

It is difficult to compare exact cutoff points between studies in part because of varying definitions for hazardous drinking (Bohn *et al.*, 1995; Bradley *et al.*, 1998a, 1998b; Bush

et al., 1998; Dybek *et al.*, 2006; Piccinelli, 1997; Rumpf *et al.*, 1998; Volk *et al.*, 1997). In our study, all instruments showed good sensitivity (85.0–93.0%) and specificity (72.4–93.4%) for diagnosing hazardous drinking in Chinese inpatients, results better than or at least as good as those of other investigators (Adewuya, 2005; Bohn *et al.*, 1995; Bush *et al.*, 1998; Conigrave *et al.*, 1995a; Fiellin *et al.*, 2000; Knight *et al.*, 2003; Volk *et al.*, 1997). Although CAGE, TWEAK and SMAST are not designed for identifying hazardous drinking *per se* but rather overt alcohol-use disorders, we found that the area under the curve, sensitivity and specificity for these instruments were adequate, though not as good as that for AUDIT.

In addition to using different definitions of hazardous drinking, other studies have tested the instruments in different settings, which may also affect the sensitivity and specificity and hence the cutoff point. For AUDIT, the reported cutoff has ranged from ≥ 4 in a family practice center (Volk *et al.*, 1997) to ≥ 10 in hospital inpatients and outpatients who volunteered for the study (Bohn *et al.*, 1995), with other values in between these extremes (Gache *et al.*, 2005) (Conigrave *et al.*, 1995a, 1995b; Gomez *et al.*, 2005; Adewuya, 2005). Our value of ≥ 7 in the entire sample and also in men falls in the middle of this range. The values we determined for AUDIT-C of ≥ 4 (≥ 5 in men) and for AUDIT-4 of ≥ 6 (or ≥ 7 in men) are the same or close to what others have reported (Bradley *et al.*, 2003; Bush *et al.*, 1998; Dawson *et al.*, 2005; Gual *et al.*, 2002). Any positive response on AUDIT-3 is usually considered significant and was in our study as well as in other investigations (Bush *et al.*, 1998; Gomez *et al.*, 2005). In addition to the population screened, gender composition and varying definitions of hazardous drinking, cultural differences may also account for the discrepancies in the cutoff points among various studies. We believe it is important to validate such instruments in the population we deal with to make sure that they perform adequately. Based on our results, for Chinese patients hospitalized in Taiwan, we recommend using AUDIT-C or AUDIT-4 for initial screening. A score of ≥ 4 (≥ 5 in men) on AUDIT-C or a score of ≥ 6 (≥ 7 in men) on AUDIT-4 indicates hazardous drinking and should prompt the use of the full AUDIT to further screen for an alcohol-use disorder (Bradley *et al.*, 2007). Even if abuse or dependence is not apparent, individuals with hazardous drinking should be counseled regarding the associated risks or harms, or referred to a specialist for further intervention.

Limitations

There were some limitations in this study. First, we focus on the discussion of recent alcohol use though CAGE, TWEAK and SMAST assess lifetime alcohol issues, and AUDIT focuses on both previous and recent years. SCAN assesses recent use patterns but may also be used to identify an alcohol-use disorder at any time in the individual's life. The reason is that our primary purpose is to identify current hazardous drinkers who are in need of intervention in the immediate medical setting rather than those with a previous alcohol-use disorder who are currently abstaining but who have persistent disease caused by previous alcohol use. Second, the low prevalence of hazardous drinking and alcohol-use disorders among women in our study may have influenced the cutoff points. That is why we also calculated areas under the curve and cutoff points for men alone. Oversampling of women in future studies is needed

to obtain more precise gender-specific cutoff points. Third, our study population consisted of general hospital inpatients in Taiwan, so the results may differ somewhat in other clinical settings. However, the fact that AUDIT has been found useful in a wide variety of settings worldwide suggests that its good performance in our study is not unusual. It would be well to test it more widely in Taiwan, but it would be surprising if the performance differed drastically from our findings and those of others. Finally, we incorporated these alcohol screening instruments in general health survey questionnaires, which might have affected their performance. However, Daepfen *et al.* found that embedding AUDIT into general health measures did not compromise its validity (Daepfen *et al.*, 2000).

In this study, we have demonstrated the validity of the Mandarin Chinese version of different screening instruments for detecting hazardous drinking in hospitalized patients in Taiwan. We recommend the use of shorter forms of AUDIT as screening tools in general medical or surgical wards to identify patients with hazardous drinking patterns who may benefit from a brief intervention in this setting. For this purpose, AUDIT-C, AUDIT-4 or even AUDIT-3 may be adequate. However, if hazardous drinking is detected on these shorter forms, the entire AUDIT should be administered and appropriate intervention be undertaken if the results suggest the presence of an alcohol-use disorder.

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REFERENCES

- Adams WL, Barry KL, Fleming MF. (1996) Screening for problem drinking in older primary care patients. *JAMA* **276**:1964–7.
- Adewuya AO. (2005) Validation of the alcohol use disorders identification test (audit) as a screening tool for alcohol-related problems among Nigerian university students. *Alcohol Alcohol* **40**:575–7.
- American Psychiatric Association. (1994) Diagnostic criteria from Diagnostic and Statistical Manual of Mental Disorders, 4th edn. *American Psychiatric Association*, Washington, D.C.
- Barry KL, Fleming MF. (1993) The alcohol use disorders identification test (AUDIT) and the SMAST-13: predictive validity in a rural primary care sample. *Alcohol Alcohol* **28**:33–42.
- Bohn MJ, Babor TF, Kranzler HR. (1995) The alcohol use disorders identification test (AUDIT): validation of a screening instrument for use in medical settings. *J Stud Alcohol* **56**:423–32.
- Bradley KA, Bush KR, Epler AJ *et al.* (2003) Two brief alcohol-screening tests from the alcohol use disorders identification test (AUDIT): validation in a female veterans affairs patient population. *Arch Intern Med* **163**:821–9.
- Bradley KA, Bush KR, McDonell MB *et al.* (1998a) Screening for problem drinking: comparison of CAGE and AUDIT. Ambulatory care quality improvement project (ACQUIP). Alcohol use disorders identification test. *J Gen Intern Med* **13**:379–88.
- Bradley KA, DeBenedetti AF, Volk RJ *et al.* (2007) AUDIT-C as a brief screen for alcohol misuse in primary care. *Alcohol Clin Exp Res* **31**:1208–17.
- Bradley KA, McDonell MB, Bush K *et al.* (1998b) The AUDIT alcohol consumption questions: reliability, validity, and responsiveness to change in older male primary care patients. *Alcohol Clin Exp Res* **22**:1842–9.
- Bush K, Kivlahan DR, McDonell MB *et al.* (1998) The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory care quality improvement project (ACQUIP). Alcohol use disorders identification test. *Arch Intern Med* **158**:1789–95.

- Chan AW, Pristach EA, Welte JW *et al.* (1993) Use of the TWEAK test in screening for alcoholism/heavy drinking in three populations. *Alcohol Clin Exp Res* **17**:1188–92.
- Cheng AT, Tien AY, Chang CJ *et al.* (2001) Cross-cultural implementation of a Chinese version of the schedules for clinical assessment in neuropsychiatry (SCAN) in Taiwan. *Br J Psychiatry* **178**:567–72.
- Cherpitel CJ. (1995) Screening for alcohol problems in the emergency room: a rapid alcohol problems screen. *Drug Alcohol Depend* **40**:133–7.
- Conigrave KM, Hall WD, Saunders JB. (1995a) The AUDIT questionnaire: choosing a cut-off score. Alcohol use disorder identification test. *Addiction* **90**:1349–56.
- Conigrave KM, Saunders JB, Reznik RB. (1995b) Predictive capacity of the AUDIT questionnaire for alcohol-related harm. *Addiction* **90**:1479–85.
- Daepfen JB, Yersin B, Landry U *et al.* (2000) Reliability and validity of the alcohol use disorders identification test (AUDIT) imbedded within a general health risk screening questionnaire: results of a survey in 332 primary care patients. *Alcohol Clin Exp Res* **24**:659–65.
- Dawson DA, Archer LD. (1993) Relative frequency of heavy drinking and the risk of alcohol dependence. *Addiction* **88**:1509–18.
- Dawson DA, Grant BF, Stinson FS *et al.* (2005) Effectiveness of the derived alcohol use disorders identification test (AUDIT-C) in screening for alcohol use disorders and risk drinking in the US general population. *Alcohol Clin Exp Res* **29**:844–54.
- Dybek I, Bischof G, Grothues J *et al.* (2006) The reliability and validity of the alcohol use disorders identification test (AUDIT) in a German general practice population sample. *J Stud Alcohol* **67**:473–81.
- Ewing JA. (1984) Detecting alcoholism. The CAGE questionnaire. *JAMA* **252**:1905–7.
- Fiellin DA, Reid MC, O'Connor PG. (2000) Screening for alcohol problems in primary care: a systematic review. *Arch Intern Med* **160**:1977–89.
- Gache P, Michaud P, Landry U *et al.* (2005) The alcohol use disorders identification test (AUDIT) as a screening tool for excessive drinking in primary care: reliability and validity of a French version. *Alcohol Clin Exp Res* **29**:2001–7.
- Gomez A, Conde A, Santana JM *et al.* (2005) Diagnostic usefulness of brief versions of alcohol use disorders identification test (AUDIT) for detecting hazardous drinkers in primary care settings. *J Stud Alcohol* **66**:305–8.
- Gual A, Segura L, Contel M *et al.* (2002) Audit-3 and audit-4: effectiveness of two short forms of the alcohol use disorders identification test. *Alcohol Alcohol* **37**:591–6.
- Hanley JA, McNeil BJ (1983) A method of comparing the areas under receiver operating characteristic curves derived from the same cases. *Radiology* **148**:839–43.
- King M. (1986) At risk drinking among general practice attenders: validation of the CAGE questionnaire. *Psychol Med* **16**:213–7.
- Knight JR, Sherritt L, Harris SK *et al.* (2003) Validity of brief alcohol screening tests among adolescents: a comparison of the AUDIT, POSIT, CAGE, and CRAFFT. *Alcohol Clin Exp Res* **27**:67–73.
- Kuo C-J, Chen W-J, Cheng ATA. (1999) Validity of the CAGE questionnaire in a primary care setting in Taiwan: a cross-cultural examination. *Chin J Public Health* **18**:87–94.
- Liu SI, Cheng AT. (1998) Alcohol use disorders among the Yami aborigines in Taiwan. An inter-ethnic comparison. *Br J Psychiatry* **172**:168–74.
- Liu SI, Prince M, Chiu MJ *et al.* (2005) Validity and reliability of a Taiwan Chinese version of the community screening instrument for dementia. *Am J Geriatr Psychiatry* **13**:518–8,473
- MacKenzie D, Langa A, Brown TM. (1996) Identifying hazardous or harmful alcohol use in medical admissions: a comparison of audit, cage and brief mast. *Alcohol Alcohol* **31**:591–9.
- Mayfield D, McLeod G, Hall P. (1974) The CAGE questionnaire: validation of a new alcoholism screening instrument. *Am J Psychiatry* **131**:1121–3.
- Murphy JM, Berwick DM, Weinstein MC *et al.* (1987) Performance of screening and diagnostic tests. Application of receiver operating characteristic analysis. *Arch Gen Psychiatry* **44**:550–5.
- National Institute on Alcohol Abuse and Alcoholism. (1995) *The Physician's Guide to Helping Patients With Alcohol Problems*. Washington, DC: US Department of Health and Human Services, Public Health Service, National Institutes of Health publication, 95–3769.
- Piccinelli M, Tessari E, Bortolomasi M *et al.* (1997) Efficacy of the alcohol use disorders identification test as a screening tool for hazardous alcohol intake and related disorders in primary care: a validity study. *Br Med J* **314**:420–4.
- Reid MC, Fiellin DA, O'Connor PG. (1999) Hazardous and harmful alcohol consumption in primary care. *Arch Intern Med* **159**:1681–9.
- Reinert DF, Allen JP. (2002) The alcohol use disorders identification test (AUDIT): a review of recent research. *Alcohol Clin Exp Res* **26**:272–9.
- Reinert DF, Allen JP. (2007) The alcohol use disorders identification test: an update of research findings. *Alcohol Clin Exp Res* **31**:185–99.
- Rumpf HJ, Hapke U, Erfurth A *et al.* (1998) Screening questionnaires in the detection of hazardous alcohol consumption in the general hospital: direct or disguised assessment? *J Stud Alcohol* **59**:698–703.
- Rumpf HJ, Hapke U, Hill A *et al.* (1997) Development of a screening questionnaire for the general hospital and general practices. *Alcohol Clin Exp Res* **21**:894–8.
- Russell M, Martier SS, Sokol RJ *et al.* (1994) Screening for pregnancy risk-drinking. *Alcohol Clin Exp Res* **18**:1156–61.
- Saunders JB, Aasland OG, Babor TF *et al.* (1993) Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction* **88**:791–804.
- Schneekloth TD, Morse RM, Herrick LM *et al.* (2001) Point prevalence of alcoholism in hospitalized patients: continuing challenges of detection, assessment, and diagnosis. *Mayo Clin Proc* **76**:460–6.
- Tsai MC, Tsai YF, Chen CY *et al.* (2005) Alcohol use disorders identification test (AUDIT): establishment of cut-off scores in a hospitalized Chinese population. *Alcohol Clin Exp Res* **29**:53–7.
- Volk RJ, Steinbauer JR, Cantor SB *et al.* (1997) The alcohol use disorders identification test (AUDIT) as a screen for at-risk drinking in primary care patients of different racial/ethnic backgrounds. *Addiction* **92**:197–206.
- Wechsler H, Davenport A, Dowdall G *et al.* (1994) Health and behavioral consequences of binge drinking in college. A national survey of students at 140 campuses. *J Am Med Assoc* **272**:1672–7.
- World Health Organization (1999) *SCAN 2.1: Schedules for Clinical Assessment in Neuropsychiatry*. Cambridge: Cambridge University Press.
- Wu SI, Liu SI, Fang CK *et al.* (2006) Prevalence and detection of alcohol use disorders among general hospital inpatients in eastern Taiwan. *Gen Hosp Psychiatry* **28**:48–54.