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 secondary 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) 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; Reintert 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 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 $2 \times 2$ tables. The optimal cutoff point...
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 1. Sociodemographic and current alcohol-use patterns among all subjects ($N = 404$) based on the SCAN interview

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

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

<table>
<thead>
<tr>
<th>Interpretation</th>
<th>AUC</th>
<th>SE</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AUDIT</strong></td>
<td>0.967</td>
<td>0.01</td>
<td>0.950–0.984</td>
</tr>
<tr>
<td><strong>AUDIT-C</strong></td>
<td>0.964</td>
<td>0.01</td>
<td>0.944–0.985</td>
</tr>
<tr>
<td><strong>AUDIT-4</strong></td>
<td>0.965</td>
<td>0.01</td>
<td>0.944–0.985</td>
</tr>
<tr>
<td><strong>AUDIT-3</strong></td>
<td>0.911</td>
<td>0.02</td>
<td>0.871–0.952</td>
</tr>
<tr>
<td><strong>TWEAK</strong></td>
<td>0.878</td>
<td>0.02</td>
<td>0.839–0.917</td>
</tr>
<tr>
<td><strong>SMAST</strong></td>
<td>0.867</td>
<td>0.02</td>
<td>0.825–0.909</td>
</tr>
<tr>
<td><strong>CAGE</strong></td>
<td>0.851</td>
<td>0.02</td>
<td>0.806–0.896</td>
</tr>
</tbody>
</table>

**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.
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., 1999).
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 (≥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, Daepen et al. found that embedding AUDIT into general health measures did not compromise its validity (Daepen 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.

**References**


