Effectiveness of the AUDIT-C as a Screening Test for Alcohol Misuse in Three Race/Ethnic Groups

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BACKGROUND: The Alcohol Use Disorders Identification Test—Consumption (AUDIT-C) is a brief validated screen for risky drinking and alcohol abuse and dependence (alcohol misuse). However, the AUDIT-C was validated in predominantly White populations, and its performance in different racial/ethnic groups is unclear.

OBJECTIVE: To evaluate the validity of the AUDIT-C among primary care patients from the predominant racial/ethnic subgroups within the United States: White, African American, and Hispanic.

DESIGN: Cross-sectional interview validation study.

PARTICIPANTS: 1,292 outpatients from an academic family practice clinic in Texas (90% of randomly sampled eligible).

MEASUREMENTS AND MAIN RESULTS: Race/ethnicity was self-reported. Areas under the receiver operating curve (AuROCs) evaluated overall AUDIT-C performance in the 3 racial/ethnic groups compared to diagnostic interviews for alcohol misuse. AUDIT-C sensitivities and specificities at recommended screening thresholds were compared across racial/ethnic groups. AuROCs were greater than 0.85 in all 3 groups, with no significant differences across racial/ethnic groups in men (P=.43) or women (P=.12). At previously recommended cut points, there were statistically significant differences by race in AUDIT-C sensitivities but not specificities. In women, the sensitivity was higher in Hispanic (85%) than in African-American (67%; P=.03) or White (70%; P=.04) women. In men, the sensitivity was higher in White (95%) than in African-American men (76%; P=.01), with no significant difference from Hispanic men (85%; P=.11).

CONCLUSIONS: The overall performance of the AUDIT-C was excellent in all 3 racial/ethnic groups as reflected by high AuROCs. At recommended cut points, there were significant differences in the AUDIT-C's sensitivity but not in specificity across the 3 racial/ethnic groups.

KEY WORDS: alcohol; alcohol misuse; race; ethnicity; screening; diagnostic test.
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INTRODUCTION

Alcohol misuse is the third leading cause of preventable death in the United States[1] and is common among primary care patients.[2] Randomized controlled trials have demonstrated that brief counseling interventions in primary care settings can decrease alcohol misuse.[3–6] Alcohol screening is therefore recommended to identify patients who benefit from such interventions.[7] Although older screening questionnaires such as the CAGE were developed to identify only alcohol use disorders (definitions, Fig. 1),[8] newer screening questionnaires also identify patients with risky drinking who also benefit from brief interventions.[6,9]

Research on the validity of alcohol-screening questionnaires in different racial/ethnic groups has had inconsistent findings. Some studies have found a significant difference in the performance of alcohol-screening questions across racial/ethnic groups, whereas others have not.[10–14]

The Alcohol Use Disorders Identification Test (AUDIT) is a 10-item alcohol-screening questionnaire that was specifically designed to avoid cultural bias but is not often used, likely because of its length.[15,16] The AUDIT—Consumption (AUDIT-C), the first 3 questions of the AUDIT pertaining to alcohol consumption, is a 3-item screening test for alcohol use disorders or risky drinking (Table 1). The AUDIT-C was first validated in a predominantly White VA patient population.[17,18] The purpose of this study was to evaluate the validity of the AUDIT-C among male and female primary care patients from the predominant racial/ethnic subgroups within the United States (White, African American, and Hispanic). In addition, we sought to compare the performance of the AUDIT-C with the performance of the CAGE questionnaire in the 3 racial/ethnic groups.

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Figure 1. Definitions and terminology.

Legend-Figure 1
***Risky Drinking*:**
Women: greater than 7 drinks a week or 4 or more drinks on any single occasion;
Men: greater than 14 drinks a week or 5 or more drinks on any single occasion.
***Alcohol Abuse*:**
A maladaptive pattern of alcohol use leading to clinically significant impairment or distress, as manifested by one (or more) of the following occurring within a 12-month period: failure to fulfill major role obligations at work, school, or home; use in hazardous situations; recurrent use despite alcohol-related legal problems or interpersonal problems caused by the effects of alcohol.[42]
***Alcohol Dependence*:**
Clinically significant impairment or distress resulting from chronic alcohol use in the presence of 3 or more of the following occurring at any time in a 12-month period: tolerance, withdrawal, ingestion of larger amounts or over longer periods than intended, persistent desire or unsuccessful efforts to cut down or control alcohol use, great deal of time spent in activities to obtain, use, or recover from alcohol, important social, occupational, or recreational activities are given up or reduced because of alcohol, continued use despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to be caused or exacerbated by continued drinking.[42]
Note: Each section of the figure is a separate subgroup of patients who drink.

MATERIALS AND METHODS

Study Sample and Procedures

This study used secondary data from a cross-sectional validation study of the 10-item AUDIT conducted in an academic family practice clinic in Galveston, TX (1993–1994). Patients were eligible for the study if they had a scheduled appointment, were more than 18, and self-identified as: White, African American, or Hispanic. Adult family medicine patients were randomly sampled for recruitment into the study with oversampling of minority and female patients.[19] Participants completed written questionnaires providing sociodemographic information before their clinic appointments and completed the comparison standard interviews and screening questionnaires after their appointments. Thirty patients elected to be interviewed in Spanish, and all patients were reimbursed $10 for their time.

The same nonclinician interviewer administered the standardized, comprehensive assessment of alcohol use disorders and questions regarding alcohol consumption that were used for the comparison standard, followed by screening questionnaires. Interviewers were blinded to whether or not patients met diagnostic criteria for alcohol use disorders and to the scoring and positive cut points of the screening instruments.

The present study was approved by the Human Studies Committees of the University of Washington, Seattle, WA, and Baylor College, Houston, TX, and all subjects provided informed consent.

MEASURES

Interview Comparison Standards

The main comparison standard for this study was alcohol misuse, defined as meeting criteria for either (1) a Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) alcohol use disorder or (2) risky drinking defined as drinking above recommended limits according to the National Institute on Alcohol Abuse and Alcoholism (NIAAA) definition.[16] The alcohol problems module of the Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS) was used to identify DSM-IV alcohol use disorders. The AUDADIS is an in-depth interview designed to be administered by lay interviewers and has demonstrated reliability and validity. The AUDADIS has been used widely in validation studies of alcohol-screening tests in diverse populations[20–23] and was administered to all participants except those who reported drinking fewer than 12 drinks ever in their lives. Risky drinking (Fig. 1, legend) was assessed based on 4 interview questions[19]:

1. Think back over the past 30 days, on how many of those days did you drink any alcoholic beverage?
2. On the days that you drink, about how many drinks do you typically have?
3. Now think back over the past 30 days and remember the time when you had the most to drink. About how many drinks did you have at that time?
4. During the past 30 days, on about how many different days, if any, did you have 5 or more drinks in 1 day?

Screening Tests

Alcohol Use Disorders Identification Test—Consumption Questionnaire. The AUDIT-C questions are shown in Table 1. The response options for each item are scored 0–4 points, and

Table 1. AUDIT-C Questions

AUDIT-C screening questionnaire
1. How often do you have a drink containing alcohol?
Never (0 points), Monthly or less (1 point), Two to four times a month (2 points)
Two to three times a week (3 points), Four or more times a week (4 points)
2. How many drinks containing alcohol do you have on a typical day when you are drinking?
1 or 2 (0 points), 3 or 4 (1 point), 5 or 6 (2 points), 7 to 9 (3 points), 10 or more (4 points)
3. How often do you have six or more drinks on one occasion?
Never (0 points), Less than monthly (1 point), Monthly (2 points), Weekly (3 points), Daily or almost daily (4 points)
Scoring: Sum of 3 questions results in possible AUDIT-C scores of 0–12 points
Recommended screening thresholds: ≥4 points for men; ≥3 points for women

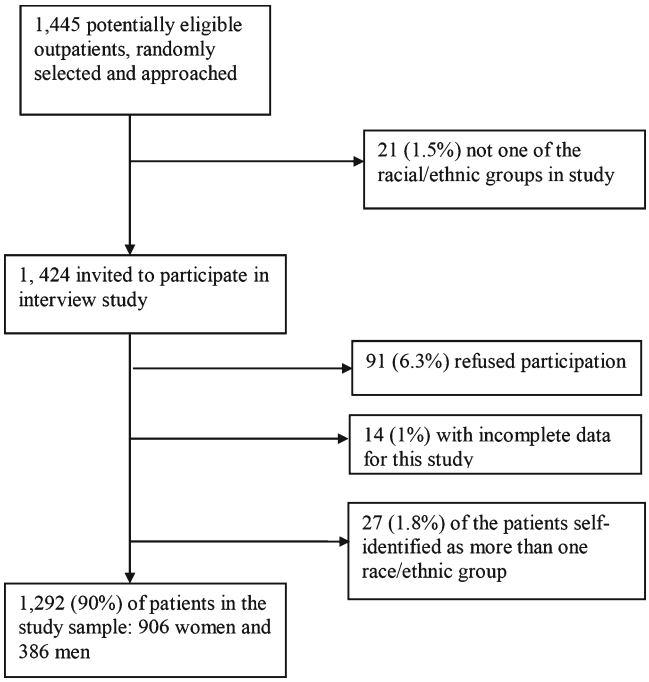

Figure 2. Flow diagram of study sample.

possible AUDIT-C scores range 0–12 points. AUDIT-C scores greater than or equal to 4 in men and greater than or equal to 3 in women are recommended based on previous validation studies.[9,17,18] The lower recommended cut point in women based on validation studies reflects the lower threshold for risky drinking in women and the fact that women often underreport alcohol consumption more than men, potentially because of greater stigma.[9]

CAGE Questionnaire

The CAGE questionnaire was developed to identify alcohol use disorders[8] and includes 4 questions: Have you ever felt you should *C*ut down on your drinking? Have people *A*nnoyed you by criticizing your drinking? Have you ever felt bad or *G*uilty about your drinking? Have you ever had a drink first thing in the morning (*E*ye-opener) to steady your nerves or to get rid of a hangover? Each question is scored 0–1, and possible CAGE scores range from 0 to 4. The standard CAGE cut point for alcohol abuse or dependence is greater than or equal to 2 points.[24]

Analyses

The AUDIT-C was compared to a comparison standard of alcohol misuse (alcohol use disorders or risky drinking) as well as a comparison standard of alcohol use disorders alone, in analyses stratified by race/ethnicity and gender. The CAGE was compared only to the comparison standard of alcohol use disorders because it was not designed to identify risky drinking.

Sensitivity and specificity at recommended screening thresholds for men and women[9] were calculated. Sensitivity refers to the proportion of people with the condition who have a positive test result ("true positive rate"). Specificity refers to the proportion of people without the condition who have a negative test result ("true negative rate"). For this study, we evaluated recommended AUDIT-C cut points for screening for alcohol misuse in men and women in previous studies.[9] Sensitivities and specificities were compared in the 3 racial/ethnic groups for men and women separately using two-sample tests of proportions (P=.05), resulting in 12 comparisons across the 6 gender-stratified racial/ethnic groups (for 2 comparison standards). We chose not to adjust for multiple statistical comparisons and instead discuss the possible interpretations of the results as is often recommended.[25–27]

Positive and negative likelihood ratios were also calculated. The likelihood ratio incorporates both the sensitivity and specificity of a test at a specific cut point and provides a direct estimate of how much a screening result will change the odds of having alcohol misuse or an alcohol use disorders (positive likelihood ratio=sensitivity/1−specificity; negative likelihood ratio=[1−sensitivity)/specificity).

Receiver operating characteristic (ROC) curves were used to assess each screening test's overall performance. ROC curves plot the true positive rate of a test (sensitivity) against the false positive rate (1−specificity) across the range of possible cut points. An area under the ROC curve (AuROC) of 1.0 indicates

Table 2. Characteristics of Study Sample and Prevalence of Alcohol Misuse* and Alcohol Use Disorders*

	Women, *N* (%)			Men, *N* (%)		
	African American	Hispanic	White	African American	Hispanic	White
	N=332	*N*=235	*N*=339	*N*=125	*N*=98	*N*=163
Age						
18–29	88 (26)	78 (33)	65 (19)	23 (18)	21 (21)	25 (15)
30–44	129 (39)	78 (33)	105 (31)	41 (33)	30 (31)	48 (29)
45–64	89 (27)	62 (27)	127 (38)	39 (31)	31 (32)	56 (34)
65+	26 (8)	17 (7)	42 (12)	22 (18)	16 (16)	34 (21)
Education						
≤High school	138 (42)	139 (59)	106 (31)	67 (54)	56 (57)	51 (32)
Some college	165 (50)	81 (35)	161 (48)	47 (38)	31 (32)	52 (32)
College graduate	29 (9)	15 (6)	72 (21)	10 (8)	11 (11)	59 (36)
Income						
<$20,000	233 (71)	147 (63)	136 (40)	76 (62)	51 (53)	46 (28)
Alcohol misuse*	52 (16)	55 (23)	66 (19)	29 (23)	40 (41)	56 (34)
AUD*,†	26 (8)	22 (9)	31 (9)	17 (14)	22 (22)	25 (15)

**Based on comparison standards (see text)*
†*Alcohol use disorders*

Table 3. Performance of AUDIT-C at Recommended Cut-points* for Detecting Alcohol Misuse†

	Sn	Sp	LR+	95% CI	LR–	95% CI	AuROC	95% CI
Women								
AA	0.67	0.92	8.57	5.50, 13.35	0.35	0.25, 0.56	0.90	0.85, 0.95
W	0.70	0.91	7.93	5.24, 11.99	0.33	0.23, 0.51	0.86	0.81, 0.92
H	0.85	0.88	7.32	4.83, 11.11	0.16	0.10, 0.32	0.93	0.89, 0.97
Men								
AA	0.76	0.93	10.40	4.95, 21.86	0.26	0.13, 0.53	0.95	0.92, 0.99
W	0.95	0.89	8.44	4.93, 14.43	0.06	0.03, 0.18	0.95	0.92, 0.98
H	0.85	0.84	5.48	2.96, 10.13	0.18	0.09, 0.37	0.91	0.85, 0.97

Sn Sensitivity, Sp specificity, LR likelihood ratio, LR+ positive likelihood ratio, LR– negative likelihood ratio, CIs confidence intervals, AuROC areas under the receiving operating characteristic curves, AA African American, W White, H Hispanic
**AUDIT-C cut points greater than or equal to 4 points for men; greater than or equal to 3 points for women*
†*Based on comparison standard (see text)*

the best possible performance for a screening questionnaire, whereas an AuROC of 0.5 indicates that a screening test predicts outcomes no better than chance alone. To test the hypothesis that the AuROC for the AUDIT-C and the CAGE differed significantly, we used a nonparametric approach taking into account the correlation between tests performed on the same individuals.[28] All analyses were conducted using STATA V9.2 (StataCorp, College Station, TX, USA).

RESULTS

Of 1,445 eligible outpatients, 48 (3%) were ineligible because they did not self-identify as 1 of the 3 major racial/ethnic groups studied or they self-identified as more than 1 race/ethnicity, and 1,292 (90% of eligible patients) agreed to participate (Fig. 2). Because of oversampling, participating patients were approximately evenly distributed among the 3 racial/ethnic groups, and 70% of participants were women. The mean age of those interviewed was 43 years. Level of education and annual family income differed among racial/ethnic groups (Table 2), with Whites reporting more education and higher incomes ($P<.001$). The prevalence of alcohol misuse in the study sample was 32% for men and 19% for women, whereas the prevalence of alcohol use disorders was 17% and 9% in men and women, respectively.

Screening for Risky Drinking and Alcohol Use Disorders (Alcohol Misuse)

The sensitivity of the AUDIT-C at recommended cut points for detecting alcohol misuse (greater than or equal to 3 points for women and greater than or equal to 4 points for men) differed significantly in the 3 racial/ethnic groups (Table 3).[9,17,18] However, differences in sensitivities across racial/ethnic groups were not consistent in women and men, except that the AUDIT-C tended to have the lowest sensitivity and highest specificity in African-American patients. Among women, the AUDIT-C's sensitivity was significantly higher in Hispanic (85%) than in African-American (67%; $P=.03$) or White (70%; $P=.04$) women. Among men, the AUDIT-C's sensitivity was significantly higher in White (95%) than in African-American (76%; $P=.01$) men but not significantly higher than in Hispanic men (85%; $P=.11$). There were no significant differences in the specificities between the 3 racial/ethnic groups in men or women. Negative likelihood ratios were lowest in Hispanic women and White men, reflecting the AUDIT-C's higher sensitivities in these groups. In contrast, positive likelihood ratios were highest in African-American women and men, reflecting the tendency for the AUDIT-C to have the highest specificity among African-American patients.

Despite differences in sensitivity across racial/ethnic groups, the overall performance of the AUDIT-C as a screen for alcohol misuse did not differ across racial/ethnic groups based on AuROCs (Table 3). In each of the 3 racial/ethnic groups, the AuROCs for alcohol misuse were greater than 90% in men and greater than 85% in women (Figs. 3 and 4).

Screening for Alcohol Use Disorders

The AUDIT-C was also an effective screening test for alcohol use disorders in all racial/ethnic groups (Table 4), although its sensitivity again varied across the groups. However, the pattern of variation across the racial/ethnic groups in the AUDIT-Cs sensitivity for identifying alcohol use disorders was not consistent in women and men and did not follow the same pattern across the racial/ethic groups as the AUDIT-C's sensitivity for alcohol misuse. The sensitivity of the AUDIT-C for alcohol use disorders was lower in African-American men than in White ($P=.008$) or Hispanic ($P=.003$) men but did not differ significantly across the groups of women ($P>.70$ for all comparisons). As a screen for alcohol use disorders, the AUDIT-C's specificity also varied across racial/ethic groups, but the pattern of variation differed for men and women. Its specificity was higher in African-American men compared to White men ($P=.02$) but not compared to Hispanic men ($P=.07$). In contrast, among women, the AUDIT-

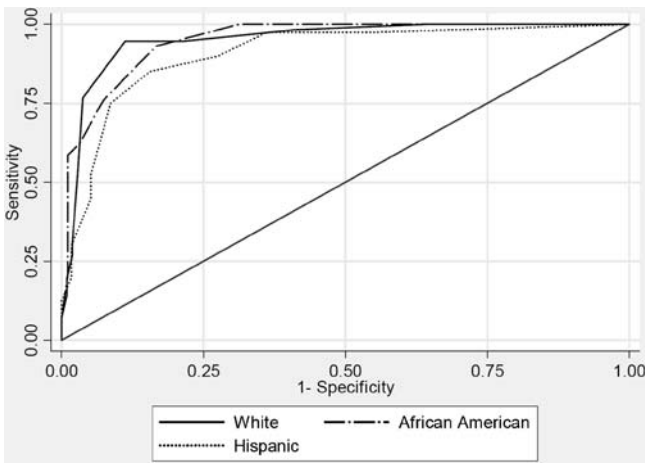

Figure 3. AUDIT-C ROC curves for alcohol misuse in men.

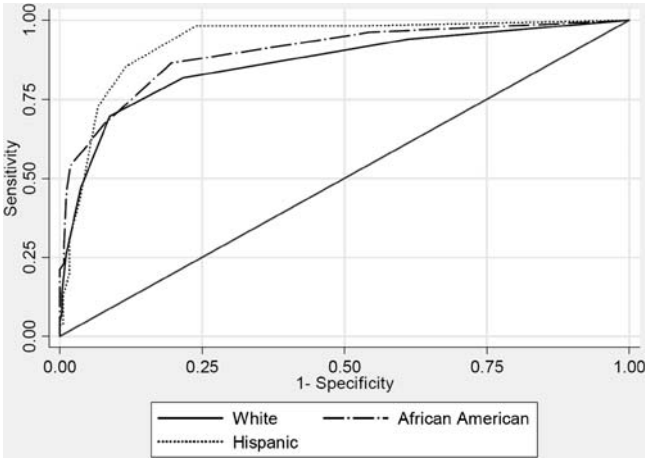

Figure 4. AUDIT-C ROC curves for alcohol misuse in women.

C's specificity was significantly higher in African-American women compared to Hispanic women (P=.001) but not compared to White patients (P=.27). There were no significant differences in the AUDIT-C's AuROCs for detecting alcohol use disorders across racial/ethnic groups in men (P=.43) or women (P=.12).

In each racial/ethnic group, the AUDIT-C had a higher AuROC curve than the CAGE for detecting alcohol use disorders (P<.05 for each comparison except for Hispanic women (P=.07). As described previously,[13] the CAGE had a relatively low sensitivity for alcohol use disorders (0.23–0.72; Table 4).

DISCUSSION

The AUDIT-C was an effective alcohol-screening test in male and female primary care patients in each of 3 racial/ethnic groups (African American, Hispanic, and White) in this study. Moreover, the AUDIT-C was an effective screening test for the full spectrum of alcohol misuse (including alcohol use disorders and risky drinking), as well as for alcohol use disorders alone. Whereas the AUDIT-C's sensitivity for alcohol misuse varied across racial/ethnic groups, there was no consistent pattern of variation across the racial/ethnic groups for men and women or across the 2 comparison standards. The AUDIT-C's screening performance was equal or superior to that of the CAGE questionnaire for detection of alcohol use disorders in each of the 3 racial/ethnic groups.

This study has several important limitations. First, unlike previous validation studies, the AUDIT-C used in this study did not specify a time frame (past year) or standard drink sizes. Second, the order in which the instruments were completed may have led to underreporting on screening questionnaires, which followed in-depth interviews, and particularly on the AUDIT-C because it followed the CAGE. When alcohol-related questions are asked in sequence, patients tend to underreport their drinking and problems on questions asked later in the interviews.[29] Third, although the AUDADIS is a validated measure, the comparison standard for risky drinking has not been validated, and the questions were similar to the AUDIT-C questions, which might overestimate the ability of the AUDIT-C to detect alcohol misuse. Fourth, this study included a single primary care clinic in South Texas, potentially limiting generalizability. Finally, this study used secondary data collected 14 years ago, and the validity of the AUDIT-C could have changed over time. However, we are unaware of any evidence that the performance of screening questions has changed over time, and U.S. drinking practices have been generally stable.[30]

However, this study has important strengths, including its oversampling of both women and racial/ethnic minorities and its high recruitment rate. Furthermore, the AUDIT-C has not been validated previously as a screening test for alcohol misuse in male and female patients from the major racial/ethnic groups in the United States: White, African-American, and Hispanic patients.

The AUDIT-C had the greatest sensitivity for detecting alcohol misuse in Hispanic women and White men and the lowest sensitivity in African-American men and women. Several factors could account for differences in the AUDIT-C's sensitivity across racial/ethnic groups in this study. First, variation across racial groups may reflect variation of reporting of alcohol use on the AUDIT-C because of differences in drinking patterns in the racial/ethnic groups studied or differences in stigma or cultural norms across the groups. Second, the observed variation might reflect differences in the validity of the comparison standards across racial/ethnic groups.[11] Finally, racial/ethnic variation in the sensitivity of the AUDIT-C could reflect confounding (e.g., by education or income) or an artifact because of multiple statistical comparisons.[12,25–27]

Table 4. Performance of AUDIT-C and CAGE at Recommended Cutpoints*, ‡ for Detecting Alcohol Abuse or Dependence† in the Past Year

	Sensitivity		Specificity		AuROC		
	AUDIT-C†	CAGE‡	AUDIT-C	CAGE	AUDIT-C (95%CI)	CAGE (95%CI)	*P* value§
Women							
AA	0.88	0.69	0.89	0.94	0.94 (0.90, 0.99)	0.88 (0.81, 0.95)	.01
H	0.91	0.23	0.77	0.96	0.90 (0.84, 0.95)	0.69 (0.58, 0.80)	.01
W	0.87	0.45	0.86	0.90	0.90 (0.84, 0.96)	0.77 (0.68, 0.85)	.01
Men							
AA	0.65	0.47	0.83	0.74	0.87 (0.81, 0.94)	0.67 (0.52, 0.81)	.02
H	1.00	0.41	0.72	0.88	0.90 (0.84, 0.96)	0.74 (0.63, 0.85)	.07
W	0.96	0.72	0.70	0.77	0.91 (0.86, 0.96)	0.79 (0.71, 0.87)	.01

AA African American, H Hispanic, W White
**AUDIT-C cut points greater than or equal to 3 points for women; greater than or equal to 4 points for men*
†*Based on comparison standard (see text)*
‡*CAGE cut point greater than or equal to 2*
§*P value for comparing AuROC of the AUDIT-C and CAGE*

Despite differences in the AUDIT-C's sensitivity across racial/ethnic groups in this study, we do not recommend using different cut points for African-American, Hispanic, or White patients based on this study. Previous research comparing alcohol-screening tests across racial/ethnic groups in the United States have not found consistent patterns of differences between African American, Hispanic, and White patients (Supplementary Table 5)[12,13,31–38] suggesting that differences in sensitivity might reflect local factors. Moreover, it would be impractical to vary screening cut points based on race/ethnicity as well as gender in many clinical settings. For these reasons, we recommend using the validated AUDIT-C cut points of greater than or equal to 3 in women and greater than or equal to 4 in men for most settings. However, the choice of the cut point for a specific setting can be varied depending on the prevalence of alcohol misuse in that setting and the balance between the benefits of true-positive screens and the costs of false-positive screens.[9]

The validated AUDIT-C cut points of greater than or equal to 3 in women and greater than or equal to 4 in men are often questioned because patients can screen positive with scores of 4 or 5 while reporting drinking within recommended limits. For example, reporting drinking 4 or more days a week (question 1), 1–2 drinks a day (question 2), and never 6 or more drinks on an occasion (question 3) results in an AUDIT-C score of 4. However, although the AUDIT-C score is an effective screening test for alcohol misuse, the responses a patient reports on AUDIT-C questions numbers 1 and 2 often underestimate drinking.[39] When patients undergo detailed standardized interviews, which are the gold standard for validating alcohol-screening questionnaires, the sensitivity of AUDIT-C questions numbers 1–2 for drinking more than 14 drinks a week is only 54%.[39] Additionally, among male outpatients with AUDIT-C scores of 4–5, 25% who reported no prior alcohol treatment or involvement in Alcoholics Anonymous and 46% of those with prior alcohol treatment reported problems because of drinking in the past year on the remainder of the AUDIT.[40] In addition, among male outpatients under 50 years old, those who scored 4–5 on the AUDIT-C were at increased risk for subsequent hospitalization for liver disease, upper gastrointestinal bleeding, or pancreatitis compared with drinkers who screened negative on the AUDIT-C.[41] Therefore, the fact that the AUDIT-C score identifies patients with alcohol misuse who do not report drinking above the daily or weekly limits on the individual AUDIT-C questions is actually one of the AUDIT-C's strengths.

To summarize, this study demonstrates that the brief AUDIT-C is an effective 3-item screening test for detecting the full spectrum of alcohol misuse in African-American, Hispanic, and White patients. Moreover, although the AUDIT-C does not explicitly ask about problems because of drinking, the AUDIT-C was an effective screen across all racial/ethnic groups for identifying men and women who met diagnostic criteria for alcohol abuse or dependence.

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