Alcohol Screening Scores and the Risk of New-Onset Gastrointestinal Illness or Related Hospitalization

Anna Lembke, MD[1], Katharine A. Bradley, MD, MPH[2], Patricia Henderson, MS[3], Rudolf Moos, PhD[3], and Alex H. S. Harris, PhD[3]

[1]Department of Psychiatry, Stanford University School of Medicine, Palo Alto, CA, USA; [2]Group Health Research Institute, Health Services Research & Development (HSR&D) Northwest Center of Excellence, Veterans Affairs (VA) Puget Sound Health Care System, Seattle, WA; Departments of Medicine, Health Services, Group Health Cooperative; VA Puget Sound and University of WA, Seattle, WA, USA; [3]Center for Health Care Evaluation, VA Palo Alto Health Care System and Stanford University School of Medicine, Palo Alto, CA, USA.

BACKGROUND: Excessive alcohol use is associated with a variety of negative health outcomes, including liver disease, upper gastrointestinal bleeding, and pancreatitis.

OBJECTIVE: To determine the 2-year risk of gastrointestinal-related hospitalization and new-onset gastrointestinal illness based on alcohol screening scores.

DESIGN: Retrospective cohort study.

PARTICIPANTS: Male (N=215, 924) and female (N= 9,168) outpatients who returned mailed questionnaires and were followed for 24 months.

MEASUREMENTS: Alcohol Use Disorder Identification Test—Consumption Questionnaire (AUDIT-C), a validated three-item alcohol screening questionnaire (0–12 points).

RESULTS: Two-year risk of hospitalization with a gastrointestinal disorder was increased in men with AUDIT-C scores of 5–8 and 9–12 (OR 1.54, 95% CI= 1.27–1.86; and OR 3.27; 95% CI=2.62–4.09 respectively), and women with AUDIT-C scores of 9–12 (OR 6.84, 95% CI=1.85 – 25.37). Men with AUDIT-C scores of 5–8 and 9–12 had increased risk of new-onset liver disease (OR 1.49, 95% CI=1.30–1.71; and OR 2.82, 95% CI=2.38–3.34 respectively), and new-onset of upper gastrointestinal bleeding (OR 1.28, 95% CI= 1.05–1.57; and OR 2.14, 95% CI=1.54-2.97 respectively). Two-year risk of new-onset pancreatitis in men with AUDIT -C scores 9–12 was also increased (OR 2.14; 95% CI=1.54–2.97).

CONCLUSIONS: Excessive alcohol use as determined by AUDIT-C is associated with 2-year increased risk of gastrointestinal-related hospitalization in men and women and new-onset liver disease, upper gastrointestinal bleeding, and pancreatitis in men. These results provide risk information that clinicians can use in evidence-based conversations with patients about their alcohol consumption.

KEY WORDS: alcohol; AUDIT; gastrointestinal; hospitalization; new-onset; women.
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BACKGROUND

Excessive alcohol consumption has been linked to the development of a variety of gastrointestinal illnesses, including hepatitis, cirrhosis, pancreatitis, ulcers, and gastrointestinal neoplasms.[1] As the average daily volume of alcohol consumption goes up in men, so does the risk for liver cancer and cirrhosis.[2] Risk for other gastrointestinal disorders is likely dose-dependent as well,[3] but evidence is more limited. Data are particularly sparse for women. Ideally, a clinically feasible alcohol screening instrument would provide evidence-based risk assessment for future alcohol-related gastrointestinal illness.

The Alcohol Use Disorders Identification Test–Consumption (AUDIT-C) is a screen of alcohol misuse which evaluates quantity and frequency of alcohol consumption, and has been validated in medical settings.[4–8] AUDIT-C scores of 5 or greater ('hazardous drinking': e.g., 3 or more drinks per occasion, on four or more days per week) have been associated with increased risk for subsequent medical problems, including medication non-adherence,[9] fractures,[10] hospitalization for gastrointestinal illnesses,[11] and all-cause mortality.[12] Giving patients specific feedback about alcohol consumption, for example linking their drinking to health risks, can reduce hazardous alcohol use.[13,14] However, few providers give explicit alcohol-related advice to patients with known hazardous drinking.[15]

The purpose of this study was to extend prior research on AUDIT-C scores and risk of gastrointestinal illness. In particular we sought to examine the associations between AUDIT-C scores and risk for new-onset liver disease, pancreatitis, and gastrointestinal bleeding, as well as gastrointestinal-related hospitalization; and to study these associations in women as well as men. To that end, we examined the association between AUDIT-C scores and risk for 2-year new-onset gastrointestinal disorder or

gastrointestinal-related hospitalization in a national sample of male and female patients.

METHODS

Data Sources

AUDIT-C data were collected by the VA Office of Quality and Performance as part of the Veteran Health Administration's (VHA's) population-based Survey of Healthcare Experiences of Patients (SHEP), which also collected data on patients' depression symptoms and smoking status. The sampling strategy and logistics of the SHEP are described elsewhere.[16] All patients who received ambulatory care in 2004 and 2005, and who had not been surveyed by SHEP in the past 12 months, were eligible and surveyed in the month after an outpatient visit. Data on patients' age, comorbidities, pre-existing conditions, and 2-year outcomes were obtained from the VHA National Patient Care Databases (NPCD). Internal Review Board (IRB) approval was obtained through VHA and Stanford University for our use of the pre-existing survey data. All statistical analyses were completed with SAS version 9.2.[17]

The AUDIT-C consists of three questions and takes less than three minutes to administer (Online Appendix A). Each AUDIT-C response is scored 0 to 4, with total AUDIT-C scores ranging from 0 to 12.[5] Patients with AUDIT-C scores of 0 are non-drinkers during the past year. Patients with AUDIT-C scores 1–4 are low level drinkers. Patients with AUDIT-C scores 5–8 screen positive for alcohol misuse. Patients with AUDIT-C scores of 9 or greater screen positive for severe alcohol misuse (e.g., drinking six or more drinks most days). A standard drink is 12 ounces of beer, five ounces of wine, or one ounce of hard liquor.[18]

Samples

All survey respondents were outpatients at the time of the AUDIT-C administration and were included in the analysis of gastrointestinal-related hospitalization. The analysis of new-onset gastrointestinal disorders included only respondents with a 2-year history-free period of the gastrointestinal disorder outcome diagnosis of interest (Online Appendix B). For example, in identifying new-onset liver disease, we only included respondents who had no diagnosis of liver disease in the two years prior to completing the AUDIT-C. We called this pattern "onset" of gastrointestinal disease while recognizing that it may signify an exacerbation of a pre-existing condition not recorded during the 2-year history-free period.

Outcome Measures

Outcomes included hospital admission with a gastrointestinal diagnosis (primary and non-primary) in the two years after completing the AUDIT-C, and new-onset gastrointestinal illnesses (i.e., liver disease, pancreatitis, and upper gastrointestinal bleed). We also examined the combined new-onset of any of the three categories of gastrointestinal illness; i.e., liver disease, pancreatitis, upper-gastrointestinal bleed, together. We chose to include gastrointestinal disorders most commonly associated with the toxic effects of excessive alcohol consumption. See Online Appendix B for a list of International Statistical Classification of Diseases and Related Health Problems (ICD9) diagnoses used to define these disorders.

Covariates

The SHEP included questions about race, education (less than high school, high school graduate, college graduate), married status (no/yes), past year depression ("In the past year, have you had 2 weeks or more when you felt sad, blue or depressed or when you lost interest or pleasure in things that you usually cared about or enjoyed?" yes/no), and cigarette smoking status (current, past year, 1–5 years ago, over 5 years ago, or never). Age was obtained from the NPCD. The Deyo Comorbidity Index, adapted from the Charleston Index for use with ICD-9 administrative data, was constructed from the NPCD based on patients' past-year inpatient and outpatient ICD-9 diagnostic codes, less the Deyo items related to the GI outcomes (e.g., items on liver disease and ulcers).[19]

Analysis Strategy

Based on the recent work of Bradley and colleagues,[9] and on the fact that low-level drinkers have lower risk of death and other medical problems than non-drinkers,[5,6,8] we categorized AUDIT-C scores into four groups (0, 1–4, 5–8, and 9–12) with 1–4 as the reference group. Initial analyses described the sample, evaluated associations between each covariate and AUDIT-C group with chi-square tests, and calculated the unadjusted prevalence of the outcomes in each AUDIT-C group. Then, covariate-adjusted logistic regression models were used to assess the risk of each outcome based on AUDIT-C risk group. A priori AUDIT-C group by age interaction effects were evaluated. The interaction of age and AUDIT-C group was not significant and was dropped from subsequent analyses (although age was retained as a control variable).

Given the lack of data evaluating the association between alcohol screening scores and gastrointestinal outcomes in women, we gender-stratified all analyses. Because the recommended limits for women are lower, we also examined different AUDIT-C groupings (1–2 reference group, with 0, 3–4, 5–8 and 9–12 as comparators) for women in sensitivity analyses.

RESULTS

Sample Characteristics and Distribution of AUDIT-C Scores

Overall, 391,111 unique outpatients were selected for the survey and 270,710 responded (69%). From the sample of responders, 225,092 provided usable AUDIT-C data, of which 215,924 were men and 9,168 were women. Response rates were somewhat higher for males and patients over 50 years old.[16] The mean (SD) age of the sample was 67.7 (11.9) years.

Table 1. Characteristics of Male and Female Outpatients in Study Sample (N=225,092) by AUDIT-C Scores

		AUDIT-C 0 (101,109)	AUDIT-C 1–4 (95,001)	AUDIT-C 5–8 (22,973)	AUDIT-C 9–12 (6,009)	P value
		N (%)	N (%)	N (%)	N (%)	
Gender						
	Female	4393 (4.3)	4268(4.5)	409 (1.8)	98 (1.6)	<0.001
Age	< 30	239 (0.2)	651 (0.7)	218 (0.9)	54 (0.2)	
	30–39	923 (0.9)	1610 1.7)	452 (2.0)	122 (2.0)	
	40–49	4518 (4.5)	4887 (5.1)	1671 (7.2)	605 (10.1)	
	50–59	19,880 (19.7)	17,760 (18.7)	6993 (30.4)	2608 (43.4)	
	60–69	22,880 (22.6)	22,020 (23.2)	6553 (28.5)	1575 (26.2)	
	70–79	33,930 (33.6)	32,280 (34.0)	5685 (24.7)	876 (14.6)	
	> 80	18,700 (18.5)	15,750 (16.6)	1394 (6.1)	165 (2.7)	<0.001
Race/ Ethnicity						
	White	83,390 (84.7)	82,130 (88.0)	18,800 (83.0)	4687 (79.2)	<0.001
	African American	6966 (7.0)	4952 (5.3)	1744 (7.7)	506 (8.6)	
	Hispanic	4404 (4.4)	3639 (3.9)	1372 (6.1)	490 (8.3)	
Education						
	Less than 12th	24,050 (24.3)	12,140 (13.0)	3109 (13.7)	928 (15.7)	
	HS graduate	61,710 (62.4)	59,330 (63.5)	15,520(68.4)	4263 (72.1)	
	College graduate	13,120 (13.3)	22,010 (23.5)	4047 (17.8)	723 (12.2)	<0.001
Married		67,540 (66.8)	65,520 (69.0)	13,070(56.9)	2716 (45.2)	<0.001
Cigarette smoking						
	Last regular smoking					
	Never	29,450 (29.1)	25,700 (27.0)	4876 (21.2)	1245 (20.7)	
	Past year	4671 (4.6)	4416 (4.6)	1805 (7.9)	558 (9.3)	
	1–5 years ago	5021 (5.0)	4163 (4.4)	1235 (5.4)	326 (5.4)	
	>5 years ago	50,790 (50.2)	50,830 (53.5)	10,260 (44.7)	1892 (31.5)	
	Current	11,170 (11.0)	9894 (10.4)	4794 (20.9)	1988 (33.1)	<0.001
Past Year Depression Screen		36,140 (35.7)	26,470 (27.9)	8267 (36.0)	3164 (52.7)	<0.001
Deyo Comorbidity Score Mean (SD)		1.20 (1.44)	0.89 (1.25)	0.73 (1.12)	0.72 (1.11)	<0.001

HS=High school
Past Year Depression Screen=single item survey question ("In the past year, have you had 2 weeks or more when you felt sad, blue or depressed or when you lost interest or pleasure in things that you usually cared about or enjoyed?" yes/no)
Deyo Comorbidity Score: Adapted from the Charleston Index for use with ICD-9 administrative data, and constructed from the NPCD based on patients' past-year inpatient and outpatient ICD-9 diagnostic codes, less the Deyo items related to the GI outcomes in this study (e.g., items on liver disease and ulcers)

The majority was Caucasian (86%), finished high school but not college (64%), and was married (66%). Table 1 presents the characteristics of the entire sample of men and women who completed the AUDIT-C. Of the 225,092 patients in the sample, 44.9% had an AUDIT-C score of 0, 42.2% had an AUDIT-C score of 1–4, 10.2% had an AUDIT-C score of 5–8, and 2.7% had an AUDIT-C score of 9–12. A greater proportion of men, unmarried patients, patients aged 30–60, and African American or Hispanic patients was represented in the AUDIT-C 5–8 and 9–12 groups, as were respondents who were positive on a single item depression screen, and current smokers.

AUDIT-C Risk Group and Gastrointestinal Outcomes in Men

Table 2 presents cross-tabulation of outcomes and rates of prior diagnoses separately for men and women. Table 3

Table 2. Frequency of Outcomes and Rates of Prior Diagnoses in Men and Women

	# Hospitalized with G.I. dx/ total # surveyed (% hospitalized)	# Liver dx/ total # no 2-year prior hx liver dx (% new onset)	# UGIB dx/ total # no 2-year prior hx UGIB dx (% new onset)	# Pancr dx/ total # no 2-year prior hx pancr dx (% new onset)	# Any G.I. dx/ total # no 2-year prior hx any G.I. dx (% new onset)
Men	1,217/ 215,924 (0.56%)	2080/ 208,177 (1.0%)	1,158/ 210,116 (0.55%)	627/ 210,506 (0.30%)	2,530/ 205,410 (1.23%)
Women	40/ 9168 (0.44%)	97/ 8,862 (1.09%)	44/ 8,970 (0.49%)	35/ 8,986 (0.39%)	126/ 8,768 (1.44%)

G.I. dx=gastrointestinal diagnosis, liver dx=liver diagnosis, UGIB dx=upper gastrointestinal bleed diagnosis, pancr dx=pancreatic diagnosis, any G.I. dx=any gastrointestinal diagnosis, hx=history of

Table 3. AUDIT-C Risk Group and Gastrointestinal (GI) Outcomes in Men Over 2 Years

	AUDIT-C 0	AUDIT-C 1–4	AUDIT-C 5–8	AUDIT-C 9–12
	OR (95% CI)	2-Year Incidence Rate	OR (95% CI)	OR (95% CI)
Hospitalization with GI Diagnosis	1.42 (1.24, 1.64)[a]	0.36%	1.54 (1.27, 1.86)[a]	3.27 (2.62, 4.09)[a]
Hospitalization with Primary GI Diagnosis	1.48 (1.22, 1.79)[a]	0.19%	1.59 (1.21, 2.08)[a]	3.88 (2.89, 5.21)[a]
Onset of Liver Disease	1.09 (.98, 1.21)	0.79%	1.49 (1.30, 1.71)[a]	2.82 (2.38, 3.34)[a]
Onset of Upper GI Bleed	1.28 (1.12, 1.46)[a]	0.43%	1.28 (1.05, 1.57)[a]	1.81 (1.35, 2.42)[a]
Onset of Pancreatitis	.98 (.82, 1.18)	0.25%	1.22 (.95, 1.58)	2.14 (1.54, 2.97)[a]
Onset of Any GI Condition	1.08 (.98, 1.18)	0.99%	1.43 (1.26, 1.62)[a]	2.64 (2.25, 3.09)[a]

Odds ratios (ORs) and 95% confidence intervals derived from multivariate logistic regression models adjusted for age, race, education, marital status, cigarette smoking status, past year depression single-question screen, and Deyo co-morbidity index scores
[a] = Odds ratio significantly different from 1, p<0.05

presents logistic regression analyses examining the association between AUDIT-C risk group and 2-year gastrointestinal-related outcomes for men, adjusting for covariates. Compared to men with AUDIT-C scores between 1 and 4, men with AUDIT-C scores of 9 or greater (severe, chronic misuse) had an increased risk for every adverse gastrointestinal outcome. Compared to men with AUDIT-C scores between 1 and 4, men with AUDIT-C scores of 5 or greater (misuse) had an increased risk for every adverse gastrointestinal outcome except pancreatitis. Men who did not drink (AUDIT-C 0) were at increased risk for gastrointestinal-related hospitalization and new-onset upper gastrointestinal bleed. Covariates associated with increased risk of GI outcomes in men included having more comorbidities, being single, being non-Caucasian, having less education, and past year depression.

AUDIT-C Risk Group and Gastrointestinal Outcomes in Women

Table 4 presents logistic regression analyses examining the association between AUDIT-C risk group and 2-year gastrointestinal-related outcomes for women, adjusting for covariates. Compared to women with AUDIT-C scores between 1 and 4, women in the AUDIT-C 9–12 group had an increased 2-year risk of hospitalization for a gastrointestinal disorder. Point estimates for gastrointestinal hospitalizations among women with AUDIT-C scores over 5 were similar to men's but confidence limits were wide. Compared to women with AUDIT-C scores between 1 and 4, women in the AUDIT-C 0 group (past-year abstainers) had an increased risk of new-onset liver disease. Covariates associated with increased risk of GI outcomes in women included having more comorbidities, being single, being non-Caucasian, younger age, having less education, past year depression, and being a current or past smoker. The results were unchanged in sensitivity analyses using different AUDIT-C groups for women (1–2 reference group, with 0, 4–5, 6–8, and 9–12 as comparators).

DISCUSSION

Our study is the first to link AUDIT-C scores to risk of new-onset gastrointestinal illness, and the first to examine these associations in women. Men drinking in the hazardous range based on AUDIT-C scores of 5 or greater are at increased risk for hospitalization with a gastrointestinal diagnosis, new-onset liver disease, and/or new onset upper gastrointestinal bleed in the subsequent two years. Men with AUDIT-C scores of 9 or greater are at increased risk for all adverse gastrointestinal outcomes, including new-onset pancreatitis. Women drinking in the hazardous range based on AUDIT-C scores of 9 or greater are at increased risk for hospitalization with a gastrointestinal diagnosis in the subsequent two years.

Our findings support a growing literature that shows drinking alcohol in excess of recommended quantities and frequencies is linked to a variety of poor health outcomes. These data further establish the AUDIT-C as a useful scaled marker for alcohol-related risk. Like Au et al., we demonstrated that men

Table 4. AUDIT-C Risk Group and Gastrointestinal (GI) Outcomes in Women Over 2 Years

	AUDIT-C 0	AUDIT-C 1–4	AUDIT-C 5–8	AUDIT-C 9–12
	OR (95% CI)	2-Year Incidence Rate	OR (95% CI)	OR (95% CI)
Hospitalization with GI Diagnosis	1.17 (.57, 2.42)	0.30%	2.44 (.78, 7.66)	6.84 (1.85, 25.37)[a]
Hospitalization with Primary GI Diagnosis	1.40 (.57, 3.44)	0.19%	1.86 (.39, 8.93)	3.42 (.41, 28.45)
Onset of Liver Disease	1.71 (1.09, 2.70)[a]	0.82%	1.13 (.39, 3.24)	2.30 (.54, 9.93)
Onset of Upper GI Bleed	1.46 (.76, 2.82)	0.36%	.69 (.09, 5.26)	2.97 (.38, 23.42)
Onset of Pancreatitis	.61 (.29, 1.30)	0.41%	1.47 (.42, 5.15)	1.78 (.23, 13.97)
Onset Any GI Condition	1.29 (.87, 1.90)	1.22%	1.28 (.57, 2.88)	1.49 (.35, 6.31)

Odds ratios and 95% confidence intervals derived from multivariate logistic regression models adjusted for age, race, education, marital status, cigarette smoking status, past year depression single-question screen, and Deyo co-morbidity index scores [a] = Odds ratio significantly different from 1, p<0.05

with AUDIT-C scores of 5 or greater are at increased risk for hospitalization with a gastrointestinal illness.[11] In addition, our findings show that AUDIT-C scores in men are linked to new-onset gastrointestinal disorders, and that women misusing alcohol are at risk as well. Unlike Au et al., we did not find differences in the associations of AUDIT-C scores and outcomes based on age. Under-ascertainment of gastrointestinal outcomes in younger groups in that study, which included Medicare data, and/or under-ascertainment in patients over 65 years old in the present study, may have biased outcomes.

As with studies linking AUDIT-C scores to risk of mortality,[12] we found that non-drinkers are at increased risk for negative health outcomes compared to people drinking in the healthy range. This result may reflect the fact that patients with more medical co-morbidities are more likely to be non-drinkers. Our data show that patients in the AUDIT-C 0 group had the most comorbid illnesses and patients in the AUDIT-C 9–12 group had the fewest comorbidities. Many people may have stopped drinking due to health problems not related to alcohol, and some current non-drinkers are likely former problem drinkers. The increased risk of gastrointestinal disorders among abstainers might be due in part to alcohol-related harm from former heavy drinking.[20] This may be especially true for women, who are more vulnerable to the toxic effects of alcohol.[21,22] Indeed our data show that women in the AUDIT-C 0 group (abstainers) were at increased risk for new-onset liver disease.

With the exception of abstainers (AUDIT-C 0), women's risk for adverse gastrointestinal outcomes increased only in women in the AUDIT-C 9–12 group. This is unexpected given that men had increased risk at lower scores ($\geq$ 5), and women are more vulnerable than men, especially to the hepatotoxic effects of alcohol.[21,22] Several factors may be biasing the results for women in the AUDIT-C 5–8 group to the null. First, even with a sample of over 9,000 women, we had low power to detect rare events (see Table 2). Also, women typically underreport drinking levels compared to men due to increased stigma for heavy drinking.[21,23] Thus, some women in the low level drinking group (AUDIT-C 1–4), may in fact have been drinking in the hazardous range.

These results need to be understood in light of several additional limitations. Misclassification and under-ascertainment of outcomes threaten the internal validity of this study. Outpatient ICD-9 codes are not as valid as inpatient codes.[24] Many patients in the VHA system use Medicare and do not necessarily get transferred to VA hospitals, which likely decreases detected hospital admissions in the older age group.[24] Incomplete or differential ascertainment of pre-existing gastrointestinal illness could have biased study results. The AUDIT-C assesses drinking in the past year but does not differentiate lifetime abstainers from previous high-risk or problem drinkers. Finally, AUDIT-C data collected in the course of a mailed survey of patient satisfaction may differ in important ways from screening data obtained in the course of clinical care.

The response rate for the SHEP survey was roughly 70% and responders differed from non-responders in age and gender. Although response bias may affect the generalizability of certain data reported here, such as the proportion of patients in various AUDIT-C groups, we have no reason to believe that estimates of the associations between the AUDIT-C and outcomes are affected by non-response.

These data from a large national sample of patients provide important new information about risks of new-onset gastrointestinal illness and related hospitalization associated with AUDIT-C scores. These data furthermore provide a platform for explicit alcohol-related advice, which has been shown to reduce alcohol use among hazardous drinkers.[13,14] This study adds to the growing literature establishing the AUDIT-C as a 'vital sign' that might facilitate improved management of alcohol misuse.[25]

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Corresponding Author: *Anna Lembke; MD, Department of Psychiatry, Stanford University School of Medicine, 401 Quarry Road, Palo Alto, CA 94305, USA (e-mail: alembke@stanford.edu).*

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