Original Article

# Cut-off points for screening at-risk drinking by AUDIT-C Korean version at emergency department

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ABSTRACT

Purpose: To reduce problems caused by alcohol drinking, it is necessary to identify those with 'at-risk drinking' behavior to maximize therapeutic access or intervention. To this end, we sought to determine the cut-off point for screening of at-risk drinking by the Korean version of the AUDIT-C (Alcohol Use Disorder Identification Test-Consumption).
Materials and methods: We obtained data from the scientific research project of "the supervision of the Korea Center for Disease Control and Prevention (KCDCP)" in 2010. Injured patients over an 18-year-of age who visited an emergency department of an academic tertiary hospital from May to September 2010 were recruited to perform the AUDIT. The total number of patients who underwent the screening test was 640, 12.7% of the entire patients studied. Among them, 375 patients (58.4%) were men, and 265 patients (41.4%) were women. At-risk drinking was diagnosed based on the AUDIT total score and the cut-off points of the AUDIT-C were determined.
Results: Cut-off points were 5 for men [Area Under the Receiver Operation Characteristic (AUROC) 0.956], 4 for women (AUROC 0.966), and 4 in elders >65-year-of age (AUROC 0.972).
Conclusion: This study is the first research about the cut-off points of Korean version of AUDIT-C for patients including women and elders to screen for at-risk drinking in South Korea. AUDIT-C is a useful and accurate tool to screen patients for at-risk drinking.

## 1. Introduction

Socio-economic costs including medical expenses, premature death, property damage and reduced productivity average about US11.4 billion dollars annually in South Korea, with costs derived from alcohol-related diseases comprising US2.25 billion dollars.[1] Alcohol consumption causes the death of approximately 22,000 Koreans annually, representing 8.7% of the total annual deaths.[2] In addition, drunken driving fatalities are on the rise in South Korea.[3] Thus, alcohol drinking has passed from an individual preference to become a public and national interest.

Various terms or definitions are used to determine the pattern of alcohol consumption. "Problem drinking" is a term commonly termed at-risk drinking and alcohol use disorder (AUD). At-risk drinking means a pattern of alcohol consumption that increases the risk of harmful consequences for the user or others, and is defined by the amount of alcohol consumption.[4] To reduce alcohol-related problems, previous studies emphasized the efficacy of therapeutic access and intervention for patients who are at increased risk for alcohol-related problems based on the pattern of alcohol consumption. Accordingly, studies concerned with screening and brief intervention of at-risk drinking have been undertaken.[5–7] The emergency department is an important clinical environments for screening at-risk drinking and conducting brief interventions, and many studies have shown that brief interventions in the emergency department focused on alcohol consumption are effective.[8–11]

A representative and widely-used method for screening at-risk drinking is the Alcohol Use Disorder Identification Test (AUDIT).[12]

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Despite AUDIT is widely-used at presentation as a screening tool for at-risk drinking, it is not easy to perform the 10 items of AUDIT in the crowded and hectic environment of an out-patient clinic or emergency department (ED). These limitations have prompted several on-going studies of simple screening tools that include AUDIT-C, AUDIT-3 and AUDIT-4 which derived from AUDIT.[13–16] AUDIT-C (Alcohol Use Disorder Identification Test − Consumption) consists of the first three items of the first to third steps the 10 items of AUDIT. The accuracy of AUDIT-C has been shown in a comparison with full AUDIT.[17–19]

The Korean domestic study about AUDIT-C in 2009 was limited to males.[20] To address this short-coming, we determined the adequate cut-off points of the AUDIT-C compared with AUDIT in men, women and elder groups to determine at-risk drinking.

## 2. Materials and methods

### 2.1. Study population

We obtained data from a single-centered observational prospective study, "The Development of Brief Motivational Intervention Program for the risk drinkers among injured patients in emergency department". This program was performed as the scientific research project of "the supervision of the Korea Center for Disease Control and Prevention (KCDCP)" in 2010. Injured patients over the age of 18 who visited the ED of an academic tertiary hospital for 17 weeks from May to September 2010 and agreed to participate completed the 10 items of AUDIT questionnaire. Patients under the age of 18, with unstable mental or hemodynamic status, and refused to participate were excluded.

Emergency medicine trainees explained to potential participants about the screening test for at-risk drinking during the waiting period for some tests or procedures. After obtaining their consent, the standardized AUDIT questionnaire[21] was distributed to patients for completion. Other patient information including age and gender was collected. The trainees calculated the AUDIT score and immediately told the patients.

### 2.2. Study protocol

In this study, at-risk drinking was diagnosed by AUDIT which was developed by WHO in 1989 and propagated to screen the at-risk drinking in the early stage. AUDIT is composed of 10 items. The Korean version of AUDIT was introduced in 1998.[21] We determined 8 points or more of AUDIT scores as the cut-off point for at-risk drinking. Furthermore, we also analyzed the results after determining 7 points as cut-off point in women and in elders ≥65-year-of age.[22]

AUDIT-C (Table 1) - most widely used abbreviated version of AUDIT - consists of the first three items of the first to third steps the 10 items of AUDIT. We analyzed cut-off values and AUROC of AUDIT-C in men, women and elders.

### 2.3. Statistical analysis

Collected data was analyzed by SPSS version 12.0 (SPSS, Chicago, IL, USA) and MedCalc Statistical software version 18 (MedCalc Software bvba, Ostend, Belguim; http://www.medcalc.rog;2018) to determine the adequate cut-off points of AUDIT-C based on the results of AUDIT. We drew a Receiver Operation Characteristic (ROC) curve and estimated an Area Under the ROC Curve (AUROC) using sensitivity and specificity of each interval in males, females, and males ≥65-year-of age.

**Table 1**
Alcohol use disorder identification test consumption (AUDIT-C) questionnaire.

| | |
|---|---|
| 1. How often do you have a drink containing alcohol? | (0) Never<br>(1) Monthly or less<br>(2) 2 to 4 times a month<br>(3) 2 to 3 times a week<br>(4) 4 or more times a week |
| 2. How many drinks containing alcohol do you have on a typical day when you are drinking? | (0) 1 or 2<br>(1) 3 or 4<br>(2) 5 or 6<br>(3) 7, 8, or 9<br>(4) 10 or more |
| 3. How often do you have six or more drinks on one occasion? | (0) Never<br>(1) Less than monthly<br>(2) Monthly<br>(3) Weekly<br>(4) Daily or almost daily |

AUDIT-C: alcohol use disorder identification test-consumption.

## 3. Results

During the period of this research, 6014 injured patients over an 18-year-of age visited the ED of Ewha Womans University Mokdong Hospital. Hospitalization, transfer, death or drunkenness were excluded, therefore 5030 injured patients were studied. The total number of patients who underwent the screening test was 640, 12.7% of the entire patients studied. Among them, 375 patients (58.4%) were men, and 265 patients (41.4%) were women. Mean age of the patients was 39.4 years, and the number of elders aged over 65 years was 38 (7.5%). Slip down is the most common mechanism of injury (32%). Injured patients who drank within 6 h of injury totaled 113 (17.7%). Five hundred twenty-seven patients (82.3%) did not drink before injury. Most common diagnosis is laceration (39.1%). Mean AUDIT score of all patients was 4.7. Low-risk drinking group less than 7 points of AUDIT score consisted of 495 patients (77.3%). At-risk drinking group between 8 and 15 points was 103 patients (16.1%), and AUD more than 16 points was 42 patients (6.6%) (Table 2).

In Fig. 1, AUROC of AUDIT-C was 0.956 (0.937−0.975), 0.966 (0.941−0.991) and 0.972 (0−1), respectively in men, women and elders. The sensitivity/specificity was 95.8%/80.4%, 96.0%/86.7% and 100.0%/91.7%, respectively in Table 3. Appropriate cut-off values of at-risk drinking using AUDIT-C were 5 points for men, 4 points for women and 4 points in elders. We analyzed again regarding more than 7 points of AUDIT in female and male elders as at-risk drinking. However, cut-off points of AUDIT-C were identical.

## 4. Discussion

Various definitions and terms have been applied to estimate the pattern of alcohol consumption. Among them, the definitions by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) and WHO are widely-accepted (Fig. 2). WHO uses the terms hazardous drinking, harmful use and alcohol dependence. However, each term is often replaced by other words with similar meaning according to the research or reference. Hazardous drinking means a pattern of alcohol consumption that can lead to increase in the risk of harmful consequence due to alcohol drinking, and it is defined by the amount of alcohol consumption. Similar terms include risky drinking, risk drinking, at-risk drinking, problem drinking, and risk drinker. NIAAA defines at-risk drinking as men who drink more than four standard drinks in a day (or ≥14/week) and women who drink more than three in a day (or ≥7/week).[4]

Pattern of alcohol consumption has been defined variously, and is complicated to apply clinically. As a result, AUDIT was developed as a screening test including amount of alcohol consumption,

**Table 2**
Demographic characteristics of study population.

| | |
|---|---|
| Age (years, mean ± SD) | 39.4 ± 14.5 |
| Gender | |
|   Male (%) | 375 (58.6) |
|   Female (%) | 265 (41.4) |
| Elderly (over 65 years, %) | 38 (5.9) |
| Mechanisms of injury (%) | |
|   Slip down | 205 (32.0) |
|   Blunt trauma | 133 (20.8) |
|   Stabbing/cutting | 83 (13.0) |
|   Traffic accident | 91 (14.2) |
|   Assault | 42 (6.6) |
|   Self-harm | 4 (0.6) |
|   Fall down | 9 (1.4) |
|   Etc. | 73 (11.5) |
| Drunken within 6 h (%) | |
|   Yes | 113 (17.7) |
|   No | 527 (82.3) |
| Diagnosis (%) | |
|   Laceration | 250 (39.1) |
|   Contusion | 130 (20.3) |
|   Sprain | 78 (12.2) |
|   Fracture | 74 (11.6) |
|   Concussion | 38 (5.9) |
|   Foreign body | 21 (3.3) |
|   Abrasion | 13 (2.0) |
|   Burn | 9 (1.4) |
|   Dislocation | 7 (1.1) |
|   Etc. | 20 (3.1) |
| Risk drinking (AUDIT ≥ 8, %) | |
|   Yes | 495 (77.3) |
|   No | 145 (22.7) |

alcohol-related problems and alcohol dependence symptoms. AUDIT consists of 10 items. Among these items, the first to third reflect hazardous alcohol use, that is, the amount and frequency of alcohol intake. Items 4 to 6 reveal dependence symptoms, and items 7 to 10 consist of questions about harmful alcohol use (*ie*, alcohol-related problems). WHO suggests cut-off AUDIT scores of 8–15 points as hazardous drinking (at-risk drinking), 16–19 points as alcohol abuse and 20 or more points as alcohol dependence. Additionally, according to WHO, lowering the cut-off point to 7 could lead to increased sensitivity in women and elders.[22]

In previous studies about AUDIT-C, at-risk drinking has been diversely defined as [1] whole AUDIT score,[20,23] [2] four standard drinks/day or 14 standard drinks/week for men and three standard drinks/day or seven standard drinks/week for women and elders,[16–18] [3] amount of alcohol intake per week over 280 g for men and over 168 g for women,[14] and [4] amount of alcohol intake per day; 40 g for men and 20 g for women.[15] In this study, we diagnosed at-risk drinking using AUDIT, because we thought that the definition of heavy drinking and AUDIT by NIAAA was sufficient, and because the reliability of AUDIT had been amply-validated as a tool of alcohol screening test. An AUDIT score of 8 points was used as cut-off of at-risk drinking in this study. Of course, unconditional acceptance of the criteria recommended in the United States is a problem. However, it is impossible to accept the same value from previous Korea studies about cut-off point of AUDIT, given the use of different definitions like physical problem drinking and hazardous drinking, rather than at-risk drinking. As a result, we decided to use the internationally accepted WHO criteria in this study, and additionally analyzed using 7 points as cut-off point for women and elders.[22]

The 'C' of AUDIT-C stands for consumption. AUDIT-C is a screening tool composed of the first three items (frequency of drinking, amount on one occasion, frequency of binge drinking) among the 10 items of AUDIT 10 concerning hazardous alcohol use, namely the amount of alcohol consumption. AUDIT-C is easy to perform and has a similar screening reliability compared to the existing AUDIT.[14–16] Bradley et al. (2003) compared the results from full 10-item AUDIT, AUDIT-C and AUDIT question 3 alone. They insisted that AUDIT-C is a useful screening tool to diagnose hazardous drinking, because AUROC of full 10-item AUDIT, AUDIT-C and AUDIT were 0.91, 0.71 and 0.87, respectively. To use the AUDIT-C practically, various appropriate cut-off points according to country and research study were presented. The study about performance of AUDIT-C in Korea recommended 8 points as cut-off point of AUDIT-C for problem drinking based on AUDIT.[20] In contrast, a study conducted by Gual et al., in 2002 in Spain recommended 5 points for men and 4 points for women as the cut-off point based on 280 g weekly alcohol consumption in men, 168 g in women or WHO criteria of hazardous or harmful drinking. In Taiwan,[15] study concluded that 5 points for men and 4 points for all population as an AUDIT-C cut-off point of a hazardous drinker (men drinking >40 g daily or women >20 g daily or at least weekly consumption of more than six drinks on a single occasion). Also, some studies conducted in the U.S. revealed diverse results as 4–5 points for men and 2–3 points for women to screen for risky drinking.[13,16,17]

## 5. Limitations

There were several limitations in this study. First, we applied the criteria of AUDIT when defining at-risk drinking. If we define at-risk drinking on the basis of criteria after an additional survey about amount of alcohol consumption, reliability and accuracy would
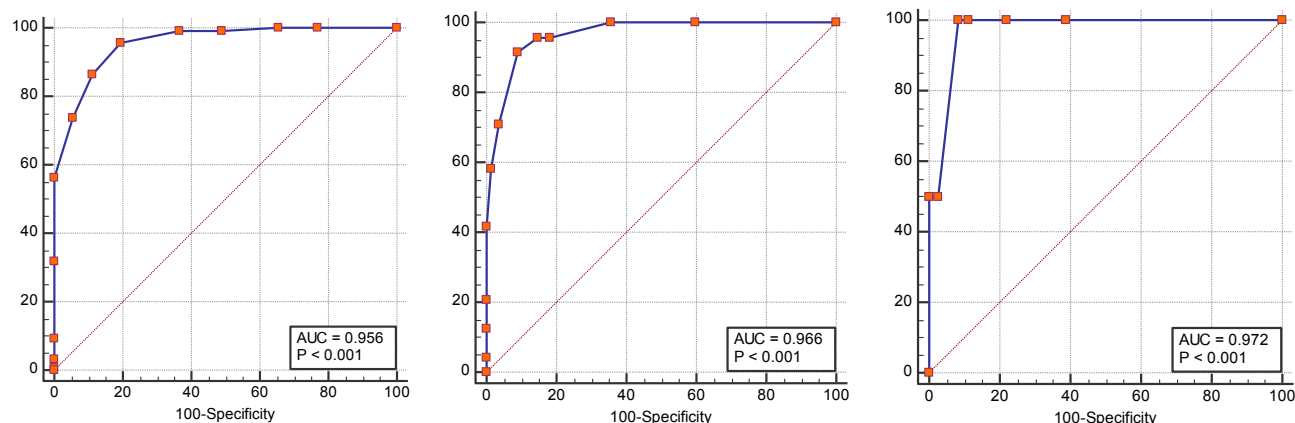


**Fig. 1.** ROC curves of AUDIT-C of men, women and elders groups (≥65 age).

**Table 3**
Cut-off points of AUDIT-C for at-risk drinking.

| Group | AUC | SE | P-point | 95% CI | | Cut-off | Sensitivity | Specificity |
|---|---|---|---|---|---|---|---|---|
| **AUDIT score ≥ 8 for all injured patients** | | | | | | | | |
| Men | 0.956 | 0.01 | 0 | 0.937 | 0.975 | 2 | 1.000 | 0.346 |
| | | | | | | 3 | 0.992 | 0.508 |
| | | | | | | 4 | 0.992 | 0.633 |
| | | | | | | 5 | 0.958 | 0.804 |
| | | | | | | 6 | 0.866 | 0.888 |
| | | | | | | 7 | 0.739 | 0.946 |
| Women | 0.966 | 0.013 | 0 | 0.941 | 0.991 | 2 | 1.000 | 0.671 |
| | | | | | | 3 | 0.960 | 0.833 |
| | | | | | | 4 | 0.960 | 0.867 |
| | | | | | | 5 | 0.880 | 0.917 |
| | | | | | | 6 | 0.680 | 0.967 |
| | | | | | | 7 | 0.560 | 0.987 |
| Elderly | 0.972 | 0.031 | 0.026 | 0 | 1 | 2 | 1.000 | 0.778 |
| | | | | | | 3 | 1.000 | 0.889 |
| | | | | | | 4 | 1.000 | 0.917 |
| | | | | | | 5 | 0.500 | 0.972 |
| **AUDIT score ≥ 7 for women and elders (≥65 age)** | | | | | | | | |
| women | 0.979 | 0.009 | 0 | 0.962 | 0.997 | 2 | 1.000 | 0.691 |
| | | | | | | 3 | 0.969 | 0.858 |
| | | | | | | 4 | 0.969 | 0.893 |
| | | | | | | 5 | 0.906 | 0.944 |
| | | | | | | 6 | 0.688 | 0.987 |
| | | | | | | 7 | 0.531 | 1.000 |
| elderly | 0.972 | 0.031 | 0.026 | 0 | 1 | 2 | 1.000 | 0.778 |
| | | | | | | 3 | 1.000 | 0.889 |
| | | | | | | 4 | 1.000 | 0.917 |
| | | | | | | 5 | 0.500 | 0.972 |

AUDIT-C: alcohol use disorder identification test-consumption; AUC: area under curve; CI: confidential interval.
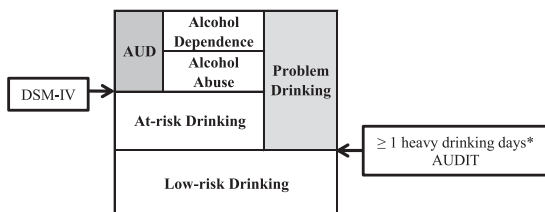


**Fig. 2.** Schema about method and criteria of screening for alcohol drinking, on the basis of algorithm of screening for drinking behaviour recommended by NIAAA.[4] *: five or more drinks (male), four or more drinks (female) per day.

improve. Second, patients were not evenly classified, because injured patients visiting only a single ED were involved in this study. The ratio of women was low, and ratio of elders was very low. Further study with expanded gender and age participation could lead to universal and reasonable result.

## 6. Conclusions

In this study, when screening at-risk drinking using AUDIT 8 points as a cut-off point, optimal cut-off points of AUDIT-C were 5 points for men, 4 points for women and 4 points for men aged over 65 years. Although lowered, the cut-off point of at-risk drinking from 8 points to 7 points of AUDIT score in women and men aged over 65, optimal cut-off points of AUDIT-C were also 4 points. These results revealed a similar level of cut-off points with previous studies from Taiwan, Spain and the U.S. Lowering of criteria for at-risk drinking did not affect the results significantly. A total of 640 patients were involved in this study, including 243 women.

This study is the first research about the cut-off points of AUDIT-C for patients including women and elders to screen for at-risk drinking in South Korea. AUDIT-C is a useful and accurate tool to screen patients for at-risk drinking.

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