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Original Article

Screening Test for At-Risk Drinking in the Elderly: Abbreviated Version of the Alcohol Use Disorders Identification Test for the Elderly Population

Jae Hee Lee [a], Yoon Hee Choi [a,b] *

[a] *Department of Emergency Medicine, Ewha Womans University Mokdong Hospital, Seoul, Republic of Korea,* [b] *Department of Emergency Medicine, Ewha Womans University, Seoul, Republic of Korea*

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SUMMARY

Background: In this study, we developed the Screening Test for At-risk Drinking in the Elderly (STAD-E), a new abbreviated version of the Alcohol Use Disorders Identification Test (AUDIT) intended for use in the elderly populations. This test comprises three questions that reflect the structure of the AUDIT 10 questionnaire and the characteristics of the Korean population and was developed using nationally representative data from the Korea National Health and Nutrition Examination Survey (KNHANES).
*Methods:*We performed exploratory factor analysis for each question from the AUDIT questionnaire that was responded by elderly (≥ 65 years) participants of KNHANES IV-V to derive our abbreviated test based on the structure of each AUDIT item. For validation, we analyzed the sensitivity, specificity, and area under the receiver operating characteristic curve (AUROC) of the new abbreviated test using KNHANES VI datasets (excepting KNHANES VI-2).
Results: We selected question (Q) 1, Q3, and Q7 on the three-factor structure for the elderly population. The cut-off values of STAD-E were 4 for elderly males and 3 for elderly females. During the validation test, STAD-E yielded significantly greater AUROC values than AUDIT-QF and similar values to AUDIT-C.
Conclusions: Unlike previous abbreviated tests, STAD-E reflects the item structure of AUDIT and the alcohol consumption patterns in an elderly population. Therefore, it can be used as a simple and reliable screening test for at-risk drinking in clinical settings.

1. Introduction

Each year, alcohol consumption is responsible for approximately 22,000 deaths in Korea (8.7% of the total annual deaths).[1] It is being increasingly recognized as a major health problem in the elderly population, resulting in a significant burden on the health status of this group.[2] In 2017, residents aged 65 years and older accounted for 13.8% of the total population of the Republic of Korea, and this proportion is expected to increase to 20.0% by 2026.[3] Therefore, the issue of alcohol consumption by elderly people is not merely a matter of personal preference, but rather comprises a nationwide public health issue.

At-risk drinking refers to 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 consumed.[4] The National Institute on Alcohol Abuse and Alcoholism (NIAAA) proposed several clinical situations as key opportunities for the screening of at-risk drinking, including emergency departments or urgent care centers.[5] However, it is not practically feasible to administer the full 10-question Alcohol Use Disorders Identification Test (AUDIT) in outpatient clinics or crowded emergency departments. Therefore, studies have aimed to develop and test simplified and abbreviated versions of AUDIT that could be administered quickly.[6–13]

The abovementioned abbreviated tests do not properly reflect the AUDIT survey structure and are thus have a limited scope. Therefore, we developed the Screening Test for At-risk Drinking (STAD) to reflect the factor structure of AUDIT.[14] Since drinking behaviors vary with age and screening tests should consider the characteristics specific to the elderly populations, we aimed to develop the Screening Tool for At-risk Drinking in the elderly (STAD-E), which comprises three questions to reflect the structure of AUDIT questionnaire and the drinking habits of elderly people. For this research, we used data from the Korea National Health and Nutrition Examination Survey (KNHANES), which are representative of the population of the Republic of Korea.

2. Materials and methods

2.1. Study design and setting

The new abbreviated test was developed using data from the fourth and fifth KNHANES (KNHANES IV-V). Data on drinking behaviors of all 65 years and older participants were analyzed and those with a total AUDIT score of ≥ 7 were classified into the at-risk drinking group. The health questionnaire comprised 12 alcohol-related questions, including 10 questions based on AUDIT 10 and

* Corresponding author. Ewha Womans University Mokdong Hospital, 1071 Anyangcheon-ro, Yangcheon-gu, Seoul, 07985, Republic of Korea.
E-mail address: like-lemontea@hanmail.net (Y. H. Choi)

two questions about drinking experiences. We performed exploratory factor analysis (EFA) to identify the factor structure of AUDIT. To investigate the differences according to gender, EFA was performed separately for both elderly male and elderly female groups. Items with high factor loading were then included in our abbreviated version of AUDIT.

To validate STAD-E, we used the alcohol-related components of the sixth KNHANES (KNHANES VI, 2013-2015). As these components were identical in all years except the second year of KNHANES VI (KNHANES VI-2, 2014), data from KNHANES VI-2 were excluded.

For this study, we requested raw data through the National Health and Nutrition Survey homepage of the Korea Centers for Disease Control and Prevention.[15] Informed consent was obtained from the all participants in KNHANES. The protocol of the KNHANES was approved by the institutional review board of the Korea Centers for Disease Control and Prevention.

2.2. Data collection and statistical analysis

We applied the cut-off value of 7, as proposed by the World Health Organization (WHO) for at-risk drinking to KNHANES IV-V participants older than 65 years, dividing the cohort into normal and at-risk drinking groups.[16] We performed EFA on AUDIT 10 questions in KNHANES IV-V to derive an abbreviated test based on the factor structure of the AUDIT. To address gender differences, we performed EFA on elderly male and elderly female groups. The fit of factor structure was assessed using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy, p-value of Bartlett's Test of Sphericity with respective cut-off values of > 0.5, and $p < 0.05$. Based on the EFA results for AUDIT 10 questions, we selected one question from each factor. All statistical analyses were performed using PASW 18 (IBM Corp., Armonk, NY, USA).

The sensitivity, specificity, and AUROC of the new abbreviated test were validated using KNHANES VI (except for KNHANES VI-2) data. PASW 18 and MedCalc Statistical Software version 17.2 (MedCalc Software bvba, Ostend, Belgium) were used for these analyses.

3. Results

3.1. Factor loadings for exploratory factor analysis of AUDIT in elderly participants

KNHANES IV-V was conducted from 2007 to 2012 and included 8,814 people aged 65 years and older, 3,677 of which were men (41.7%) and 5,137 were women (58.3%), with an average age of 72.8 years. The results of the EFA on AUDIT in this population supported the 3-factor structure. Based on factor loading > 0.4, question (Q) 4, Q5, Q7, Q8, and Q9 of the 10-question AUDIT were grouped as the first factor, Q2 and Q3 were classified as the second factor, and Q1 and Q6 were included as the third factor. The highest factor loading in each factor was Q7, Q3, and Q1 (Table 1).

3.2. Gender differences of factor structure of AUDIT in elderly group

To determine any gender difference in factor structure, elderly participants were divided into male and female groups, and EFA was calculated again. The first factor in the elderly male group included Q4, Q5, Q7, Q8, and Q9, the second factor included Q2 and Q3, and the third factor included only Q1. In the elderly female group Q4, Q5, Q7 and Q8 made the first factor, Q1, Q6, and Q10 the second factor, and Q2 and Q3 the third factor. Common items in both groups were Q4, Q5, Q7, Q8 for the first factor, Q2, Q3 for the second, and Q1 for the third factors. This tendency was the same as the overall factor structure in this cohort (Table 2).

Table 1
The exploratory factor analysis of AUDIT in elderly participants (≥ 65 yrs).

Item	Communalities	3-factor solution		
		Factor 1	Factor 2	Factor 3
Q1	0.810	-0.105	0.102	**0.888**
Q2	0.730	0.114	**0.833**	-0.149
Q3	0.789	0.091	**0.839**	0.276
Q4	0.507	**0.661**	0.218	0.151
Q5	0.469	**0.676**	0.079	0.079
Q6	0.297	0.282	0.078	**0.460**
Q7	0.535	**0.725**	0.065	0.076
Q8	0.528	**0.708**	0.157	0.047
Q9	0.190	**0.412**	-0.122	0.076
Q10	0.252	0.289	-0.179	0.369
KMO measure of sampling adequacy			0.690	
Bartlett's Test of Sphericity	Approx. Chi-Square		1883.697	
	df		45	
	Sig.		0.000	

Data in bold represents the factor loading based upon the chosen statistical analysis.
AUDIT = Alcohol Use Disorders Identification Test; KMO = Kaiser-Meyer-Olkin.

Table 2
Gender specific exploratory factor analysis of AUDIT in elderly cohort.

	Male				Female			
	Comm	Factor structure			Comm	Factor structure		
		1	2	3		1	2	3
Q1	.869	-.008	.029	**.932**	.564	.017	**.748**	-.063
Q2	.762	.088	**.857**	-.140	.666	-.032	-.236	**.781**
Q3	.797	.095	**.812**	.358	.570	.239	.002	**.716**
Q4	.505	**.657**	.240	.124	.517	**.715**	.053	.048
Q5	.471	**.673**	.120	.053	.548	**.688**	-.151	-.227
Q6	.275	.360	.065	.376	.335	.037	**.578**	.007
Q7	.551	**.736**	.095	.011	.377	**.553**	.187	.191
Q8	.526	**.701**	.181	-.045	.602	**.729**	.136	.228
Q9	.201	**.422**	-.128	.076	.366	.356	-.371	-.319
Q10	.206	.386	-.197	.133	.368	.119	**.579**	-.136
KMO measure of sampling adequacy		0.696				0.557		
Bartlett's Test of Sphericity		Approx. Chi-Square	1771.145			164.742		
		df	45			45		
		Sig.	0.000			0.000		

Data in bold represents the factor loading based upon the chosen statistical analysis.
AUDIT = Alcohol Use Disorders Identification Test; Comm = Communalities; KMO = Kaiser-Meyer-Olkin.

3.3. Development and validation of STAD-E

It was confirmed that the factor structure among the elderly participants, have the same tendency, irrespective of gender. Hence, we concluded that the to select items for the new abbreviated test for the elderly, we should use the overall EFA analysis scores. Finally, Q1, Q3, and Q7, were included in STAD-E.

STAD-E was applied to KNHANES VI dataset (except for KNHANES VI-2), which included 2,923 elderly participants (men, 1,261 [43.1%] and women, 1,662 [56.9%]) with a mean age of 72.9 years. The minimum total AUDIT score among at-risk elderly drinkers was 7. Validation was performed on each elderly male and elderly female group. The cut-off values derived in the development of STAD-E were 4 for elderly males and 3 for elderly females. As a result, the sensitivity/specificity were 89.13/89.36 and 93.62/94.53, respectively for male and female (Table 3).

3.4. Comparison of the AUROCs between STAD-E and the abbreviated version of AUDIT

We compared the utility of the existing abbreviated tests, AUDIT-QF and AUDIT-C, with that of the new abbreviated test, STAD-E by using the KNHANES VI dataset (except for KNHANES VI-2). The AUROC of STAD-E was significantly greater than that of the AUDIT-QF and did not differ significantly from that of the AUDIT-C in both elderly male and elderly female group (Table 4).

4. Discussion

AUDIT was initially developed by the WHO in 1987 for early detection and intervention of at-risk drinking. During the development process of AUDIT, 150 questions related to alcohol consumption were conceptually grouped into several domains, from which four domains were selected through intra-scale reliability, correlation, and factor analyses. Subsequently, the 10-item AUDIT was developed by selecting two or three questions per domain based on the weighted item-to-total correlation coefficient.[17,18]

In this study, we aimed to construct a new, abbreviated version of AUDIT by selecting one question from each of the factors determined by EFA. Most of the items in the elderly male and elderly female groups matched. The items that differed between the genders were in Q6, Q9 and Q10, which had the lowest communalities values overall and in both gender groups. The composition of the remaining items showed the same tendency and no gender differences. Since screening should take into account not only the reliability of the test but also ease of use, and considering that the factor structures were similar between elderly male and female factors, we selected the overall common items and developed an abbreviation test. We did not choose the items with the highest factor loading in each factor between the elderly male and elderly female groups, as this meant that separate tests should be applied for elderly men or women, which would defy the ease of use concept of a screening test.

The elderly population exhibits characteristic drinking behavior patterns that were not considered by previous abbreviated versions of AUDIT. Therefore, to derive an abbreviated version of AUDIT reflective of the characteristics of drinking in elderly people, we analyzed the EFA for each question of AUDIT 10 among our elderly cohort, and further subclassified the data for male and female groups. STAD, an abbreviated version of AUDIT to screen at-risk drinking of young and middle-aged adults, includes Q3 and Q7[14] of AUDIT 10 questionnaire. For STAD-E, Q1 (How often do you have a drink containing alcohol?) was added to STAD questions, as we found that this is important in screening at-risk drinking behavior among the elderly. Alcohol drinking pattern differs by age and gender. For example, men younger than 65 years drank alcohol frequently and consumed large amounts of alcohol at once, whereas elderly at-risk drinkers consumed alcohol frequently but rarely drank a large amount at one time. These alcohol consumption behaviors are not limited to at-risk drinking groups. According to the 2009 National Health Statistics of the Centers for Disease Control and Prevention (CDC),[19] the annual drinking frequencies of lifelong drinkers aged 19 years and older in Korea differed by sex and age. Specifically, 33.8% of men younger than 65 years drank 2–4 times per month and 25.4% drank 2–3 times per week. In contrast, 26.3% of the elderly did not drink at all, whereas 26.0% drank more than 4 times per week. Therefore, we decided that Q1, which inquired about drinking frequency, should be included in an abbreviated test for subjects aged 65 years and older.

Our validation of the newly developed tests on KNHANES VI (except for the KNHANES VI-2) datasets revealed that STAD-E had higher AUROC than AUDIT-QF and no statistically significant differences with AUDIT-C. AUDIT-QF, and AUDIT-C, items were selected based on past researches.[12,20] AUDIT-QF includes Q1 and Q2 which are questions about 'Quantity' and 'Frequency' of alcohol drinking, while AUDIT-C, the most popular abbreviated version of AUDIT, includes 3 questions (Q1, Q2 and Q3) on alcohol 'Consumption' from

Table 4
Comparison of AUROCs between STAD-E and the abbreviated version of AUDIT used in the KNHANES VI.

	Question combination	AUROC	Test name	AUROC	p-value
Male	STAD-E (Q1+Q3+Q7)	0.966	AUDIT-QF	0.949	< 0.0001*
			AUDIT-C	0.965	0.5350
Female	STAD-E (Q1+Q3+Q7)	0.988	AUDIT-QF	0.970	0.0307*
			AUDIT-C	0.984	0.4986

STAD-E = Screening test for At-risk Drinking-Elderly; AUDIT = Alcohol Use Disorders Identification Test.
* Significantly highest value relative to other groups.

Table 3
Cut-off values, sensitivities, and specificities of STAD-E.

	Sensitivity (95% CI)	Specificity (95% CI)	+' LR (95% CI)	–' LR (95% CI)
Male				
≥ 3	96.47 (94.0–98.1)	80.52 (77.9–83.5)	5.04 (4.0–4.6)	0.04 (0.03–0.07)
≥ 4*	89.13 (85.5–92.1)	89.36 (87.0–91.4)	8.38 (16.5–23.8)	0.12 (0.09–0.2)
≥ 5	75.00 (70.2–79.3)	96.50 (95.0–97.7)	21.40 (79.5–258.8)	0.26 (0.2–0.3)
Female				
≥ 2	97.87 (88.7–99.9)	87.28 (85.5–88.9)	7.69 (6.7–8.8)	0.024 (0.004–0.2)
≥ 3*	93.62 (82.5–98.7)	94.53 (93.3–95.6)	17.11 (13.7–21.4)	0.068 (0.02–0.2)
≥ 4	89.36 (76.9–96.5)	97.50 (96.6–98.2)	35.67 (25.7–49.6)	0.11 (0.05–0.2)

STAD-E = Screening Test for At-risk Drinking-Elderly; LR = likelihood ratio; CI = confidence interval.
* Means recommended cut-off values of STAD-E.

AUDIT. Abbreviated tests are limited in reflecting the structure of the complete AUDIT 10 questionnaire. In other words, STAD-E is equally useful as the currently widely used AUDIT-QF and AUDIT-C, without the limitations of either of these tests.

This study is limited by the fact that the alcohol-related questionnaire in KNHANES did not record the exact amount of alcohol consumption or frequency of intake. If the criteria recommended by NIAAA were used to diagnose at-risk drinking, the KNHANES data would be more reliable and more easily compared with other studies.

This study developed new, accurate, and efficient abbreviated tests to screen for at-risk alcohol behaviors using national data. Specifically, we developed STAD-E, which comprises Q1, Q3, and Q7 of AUDIT 10 questionnaire, and we believe it is a useful screening test, which reflects both the structure of AUDIT and the characteristic drinking patterns of the elderly population. We expect that this test will replace previous abbreviated tests and facilitate screenings for at-risk drinking.

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Conflict of interest

The authors declare that they have no competing interests.

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