

## **Optimal Cutoff Values of the Alcohol Use Disorders Identification Test and its Short Version for Detecting Excessive Alcohol Use in Japanese College Students**

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Alcohol use disorder is a serious health problem in college students. Alcohol Use Disorders Identification Test (AUDIT) is a 10-item screening tool to assess alcohol consumption, drinking behaviors, and alcoholrelated problems. AUDIT-C is a short version of AUDIT, consisting of consumption items 1-3. However, the optimal cutoff values of AUDIT and AUDIT-C for detecting excessive drinking are not available for Japanese college students. The aim of this study was to evaluate the validity of cutoff points of AUDIT and AUDIT-C for detecting moderate drinking, heavy drinking and binge drinking among Japanese college students. The cross-sectional study was based on an anonymous, self-administered questionnaire. In January 2017, we sampled college students and graduate students aged 20 years or older during annual health examinations at Mie University in Japan. Two thousand students underwent health examinations, and the eligible subjects were 1,600, including 152 (9.5%) moderate drinkers, 58 (3.6%) heavy drinkers and 666 (41.6%) binge drinkers. ROC (receiver operating characteristic) curve analysis showed that the optimal cutoff values for moderate drinking, heavy drinking and binge drinking were 5, 8 and 5 for men and 4, 7 and 4 for women in AUDIT; and 4, 7 and 4 for men and 4, 7 and 4 for women in AUDIT-C, respectively. Moderate drinking is considered unsafe drinking. Therefore, the optimal cutoff values for moderate drinking (5 for men and 4 for women in AUDIT and 4 for both sexes in AUDIT-C) are important parameters for prevention of alcohol use disorder in Japanese college students.

**Keywords:** Alcohol Use Disorders Identification Test (AUDIT); Alcohol Use Disorders Identification Test-Consumption (AUDIT-C); college students; cutoff; excessive drinking Tohoku J. Exp. Med., 2021 January, **253** (1), 3-10.

#### Introduction

Alcohol use disorder (AUD) is a chronic relapsing brain disorder characterized by an impaired ability to stop or control alcohol use despite adverse social, occupational, or health consequences (National Institute on Alcohol Abuse and Alcoholism (NIAAA) 2004). Accordingly, it is considered a public health problem. In 2018, WHO, the World Health Organization announced that the harmful use of alcohol resulted in an estimated 3 million deaths (5.3% of all deaths) globally in 2016 (WHO 2018).

The most recent statistics indicate that drinking by college students aged 18 to 24 contributes to an estimated 1,519 deaths per 100,000 population each year (Hingson et al. 2017). In addition, 54% of full-time college students aged 18 to 22 drank alcohol in the past month, 36.9% engaged in binge drinking (5 or more drinks on a single occasion for men or 4 or more drinks on an occasion for women) in the past month, and 9.6% engaged in heavy alcohol use (binge drinking on 5 or more days) in the past

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month (Substance Abuse and Mental Health Services Administration 2018). These rates are higher for college students than for their non-college-attending peers (Substance Abuse and Mental Health Services Administration 2013). In Japan, 7.2% of men and 9.7% of women were classified as moderate drinkers, and 56.8% of men and 47.8% of women engaged in binge drinking in the past year; 6.5% of men and 8.5% of women qualified as both binge drinkers and moderate drinkers (Yoshimoto et al. 2017). Another study reported that 74.9% of men and 59.6% of women had engaged in binge drinking during the past year (Kawaida et al. 2018). These data indicate that college students are a risk group for excessive drinking.

For prevention and intervention, early detection of excessive alcohol use using appropriate high-quality screening is very important. The Alcohol Use Disorders Identification Test (AUDIT) was developed by WHO as a screening tool for AUD in various populations (Saunders et al. 1993). AUDIT is a 10-item screening tool to assess alcohol consumption, drinking behaviors, and alcoholrelated problems. Total AUDIT scores range from 0 to 40, with higher scores indicating greater likelihood of hazardous and harmful drinking. The original WHO algorithms suggested that an AUDIT score of 8 for men and 7 for women to identify problem drinkers in primary care settings (WHO 2001). AUDIT-Consumption (AUDIT-C), a short version consisting of consumption items 1-3 alone, is used to screen for AUD. Landmark clinical studies by Bradley and colleagues identified 4 for men and 3 for women as ideal AUDIT-C cutoff points to detect alcohol misuse in primary care. (Bradley et al. 2007). In previous studies in Japan, the appropriate AUDIT cutoff point was 8 (Fujii et al. 2016), and the cutoffs for AUDIT-C were 5 for men and 4 for women (Osaki et al. 2014). The subjects of these studies were employees working at medical facilities and individuals who visited outpatient clinics. These results of previous studies indicate that the cutoff points of AUDIT and AUDIT-C for detecting excessive alcohol use varies by characteristics of subjects such as drinking behavior, culture, metabolism and sex.

In Japan, optimal cutoff points of AUDIT and AUDIT-C for college students have not been validated as screening methods for excessive alcohol use. Outside Japan, optimal cutoff scores of AUDIT and AUDIT-C for screening at-risk drinking among college students have been explored and confirmed in studies not solely targeting students (García Carretero et al. 2016), but also students utilizing a primary care setting or who are current drinkers (Demartini and Carey 2012; Kwon et al. 2013; Campbell and Maisto 2018). Results in foreign countries could differ due to differences in social and cultural context, such as the minimum age for alcohol sales and the standard serving size of alcoholic beverages (Dawson 2011; Room and Rehm 2012; Kalinowski and Humphreys 2016).

Periodic health examinations provide important opportunities to screen college students for physical and mental problems. In Japan, the Guidelines for standardization of health examination and health related information in college (Japanese National University Council of Health Administration Facilities 2019) were recently announced, and alcohol-related problems are also mentioned in those guidelines. Accurate detection is essential in order to refer individuals to the appropriate intervention. Clarifying the optimal cutoff points for AUDIT and AUDIT-C that effectively identify students engaging in excessive drinking would make it possible to ensure that those students receive appropriate interventions. The aim of this study was to evaluate the validity of cutoff points of AUDIT and its short version, AUDIT-C for detecting moderate drinking, heavy drinking and binge drinking among Japanese college students.

#### **Materials and Methods**

#### Study design and participants

This was a cross-sectional study based on an anonymous, self-administered questionnaire. On January 2017, we sampled college students and graduate students aged 20 years or older during annual health examinations at Mie University in Japan.

#### Data collection

We sampled all college students and graduate students aged 20 years or older during annual health examinations at Mie University. Our questionnaire included questions about: 1) frequency of alcohol consumption, 2) amount of alcohol consumed per day, 3) binge drinking during the past month, 4) demographic data (sex and age), and 5) AUDIT.

As mentioned above, AUDIT was developed by WHO as a screening tool for AUD in various populations; it consists of a self-administered questionnaire with a scoring range of 0-40 points. The test consists of ten questions: the first three refer to high-risk consumption, the next three explore potential dependence symptoms, and the final four focus on hazardous consumption. The first eight questions are scored from 0 to 4, and questions nine and ten are scored as 0, 2, or 4 points. Depending on the cutoff, the total score enables the identification of risky consumption patterns and possible alcohol dependence (Saunders et al. 1993).

To improve the accuracy of the number of drinks reported, subjects were required to list everything they drank and describe the number of drinks. Types of alcohol listed in the questionnaire included *sake*, beer, *shochu* (Japanese distilled alcoholic beverage), *chuhai* (spirit-based cocktail), cocktail, plum wine, whiskey, and wine. To report the frequency of drinking, each subject was asked to choose one of the following answers: "every day," "six times a week," "five times a week," "four times a week," "three times a week," "twice a week," "once a week," "three times a month," "twice a month," "once a month," "3 to 11 times a year," "once or twice a year," or "less than once a year."

As mentioned above, the definition of one standard unit or drink differs among countries (Dawson 2011; Room and Rehm 2012; Kalinowski and Humphreys 2016). In the United States, 14 g of pure alcohol is considered to be a standard drink, whereas in Japan it is 10 g. In this study, we used the Japanese definition of a standard drink. We defined "heavy drinking" as a weekly pure alcohol intake of 280 g or more for men and 140 g or more for women, and "moderate drinking" as a weekly pure alcohol intake of 140 g or more for men and 70 g or more for women (Ministry of Health, Labour and Welfare 2012). Weekly consumption was calculated by multiplying alcohol consumption frequency by the amount consumed per drinking session. The definition of binge drinking varies across studies, but commonly entails consumption of five or more drinks (for men) or four or more drinks (for women) over a period of about 2 hours (NIAAA 2004). Given that we defined a standard drink as 10 g of pure alcohol in Japan, we considered binge drinking as consumption of 50 g or more of alcohol for men and 40 g or more for women in a 2-hour period on one occasion within the past month.

#### Statistical analysis

Regarding the status of excessive drinking and AUDIT, a descriptive analysis was conducted separately for each gender. The *t*-test was used to compare age, frequency of drinking, amount of alcohol consumed per day, AUDIT, and AUDIT-C among men and women. The chi-squared test was used to examine differences in heavy drinking, moderate drinking, and binge drinking between men and women.

Excessive alcohol use was defined as heavy drinking, moderate drinking and binge drinking. The abilities of AUDIT and AUDIT-C to detect excessive alcohol consumption were determined based on areas under the curve (AUCs), which were determined by receiver operating characteristic (ROC) (Hanley and McNeil 1982). AUCs higher than 0.80 are generally considered sufficient. The AUC was measured for the total study sample and for male and female students separately. Positive likelihood ratio (LR+) was calculated as 'sensitivity/(1 – specificity).' Negative likelihood ratio (LR-) was calculated as '(1 – sensitivity)/specificity.' The Youden index was calculated as 'sensitivity + specificity – 1.' The optimal cutoff values were determined at the point where the Youden index was maximum. All statistical analyses were performed using Stata 13.1 for Windows (Stata Corp., College Station, Texas, USA); p < 0.05 was considered statistically significant.

#### Ethical considerations

To obtain informed consent from participants, we enclosed a document that explained the purpose, methods, and ethical considerations of the research. The questionnaire was anonymous. Returning the questionnaire was deemed to be providing informed consent for participation in our study. This research was approved by the medical ethics committees of both Mie University and University of Tsukuba.

#### Results

Two thousand students underwent health examinations, 1,700 (88.6%) students responded and 1,600 (80.0%) were analyzed subjects (Fig.1).

#### Participant characteristics

The baseline characteristics of the studied participants are illustrated in Table 1. Thirty-six (3.6%) men and 22 (3.7%) women were classified as heavy drinkers, 92 (9.2%) men and 60 (10.0%) women were classified as moderate drinkers, and 436 (43.6%) men and 230 (38.3%) women were classified as binge drinkers. Men and women differed significantly in age (p < 0.001), frequency of alcohol drink-



Fig. 1. Flow chart of this study.

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Table 1. Participant characteristics.

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Variable	Total (n = 1,600)	Men (n = 1,000)	Women (n = 600)	р
Age (years), mean ± SD	$21.9\pm2.4$	$22.1\pm2.5$	$21.6\pm2.3$	$< 0.001^{a}$
Frequency of drinking (days/week)				
mean $\pm$ SD	$0.9\pm1.1$	$1.0\pm1.2$	$0.7\pm1.0$	$< 0.001^{b}$
Amount of drinking (g/day)				
mean $\pm$ SD	$39.3\pm 29.9$	$42.1\pm31.9$	$34.5\pm25.6$	$< 0.001^{a}$
Moderate drinking <sup>d</sup> , n (%)				
Yes	152 (9.5)	92 (9.2)	60 (10.0)	0.597°
No	1,448 (90.5)	908 (90.8)	540 (90.0)	
Heavy drinking <sup>e</sup> , n (%)				
Yes	58 (3.6)	36 (3.6)	22 (3.7)	0.945°
No	1,542 (96.4)	964 (96.4)	578 (96.3)	
Binge drinking <sup>f</sup> , n (%)				
Yes	666 (41.6)	436 (43.6)	230 (38.3)	0.039 <sup>c</sup>
No	934 (58.4)	564 (56.4)	370 (61.7)	
AUDIT (points)				
mean $\pm$ SD	$4.9\pm4.1$	$5.4\pm4.3$	$4.1\pm3.6$	$< 0.001^{a}$
AUDIT-C (points)				
$mean \pm SD$	$3.7\pm2.5$	$3.9\pm 2.5$	$3.2\pm 2.1$	$< 0.001^{a}$

AUDIT, Alcohol Use Disorders Identification Test; AUDIT-C, AUDIT-Consumption; SD, standard deviation.

<sup>a</sup>*t*-test (men vs. women).

<sup>b</sup>Mann-Whitney U-test (men vs. women).

°Chi-squared test (men vs. women).

<sup>d</sup>Weekly pure alcohol intake of 140 g or more for men and 70 g or more for women.

eWeekly pure alcohol intake of 280 g or more for men and 140 g or more for women.

<sup>f</sup>Consumption of 50 g or more of alcohol for men and 40 g or more for women in a 2-hour period.

ing (p < 0.001), amount of alcohol consumed per day (p < 0.001), binge drinking (p = 0.039), AUDIT (p < 0.001), and AUDIT-C (p < 0.001).

# *Cutoff points of AUDIT and AUDIT-C for detecting each type of excessive alcohol use*

*Moderate drinking*: The AUC values for AUDIT were 0.887 for men and 0.872 for women, and the AUC values for AUDIT-C were 0.905 for both men and women. The optimal cutoff values for AUDIT were 5 for men (sensitivity 0.83, specificity 0.78, LR+ 3.72, LF- 0.22) and 4 for women (sensitivity 0.81, specificity 0.79, LR+ 3.81, LR- 0.24). The optimal cutoff values for AUDIT-C were 4 for men (sensitivity 0.91, specificity 0.75, LR+ 3.64, LR- 0.12) and 4 for women (sensitivity 0.77, specificity 0.84, LR+ 4.83, LR- 0.27) (Table 2).

*Heavy drinking*: The AUC values for AUDIT were 0.928 for men and 0.936 for women, and the AUC values for AUDIT-C were 0.959 for men and 0.961 for women. The optimal values for AUDIT were 8 for men (sensitivity 0.94, specificity 0.78, LR+ 4.21, LR- 0.07) and 7 for women (sensitivity 0.95, specificity 0.84, LR+ 5.81, LR- 0.05). The optimal cutoff values for AUDIT-C were 7 for men (sensitivity 0.94, specificity 0.86, LR+ 6.84, LR- 0.06)

and 7 for women (sensitivity 0.91, specificity 0.95, LR+ 18.11, LR- 0.09) (Table 3).

*Binge drinking*: The AUC values for AUDIT were 0.882 for men and 0.872 for women and the AUC values for AUDIT-C were 0.90 for men and 0.884 for women. The optimal cutoff values for AUDIT were 5 for men (sensitivity 0.83, specificity 0.77, LR+ 3.55, LR- 0.22) and 4 for women (sensitivity 0.81, specificity 0.78, LR+ 3.62, LR- 0.24). The optimal cutoff values for AUDIT-C were 4 for men (sensitivity 0.91, specificity 0.74, LR+ 3.49, LR- 0.13) and 4 for women (sensitivity 0.77, transmittive) 0.77, specificity 0.83, LR+ 4.47, LR- 0.27) (Table 4).

#### Discussion

Key results

This research was designed to evaluate how effectively AUDIT and AUDIT-C can detect excessive alcohol use in Japanese college students. The results confirm that the optimal cutoff values of AUDIT for moderate drinking were 5 for men and 4 for women; and the optimal cutoff values of AUDIT-C were 4 for men and 4 for women; for heavy drinking, 8 for men and 7 for women in AUDIT and 7 for both sexes in AUDIT-C; and for binge drinking, 5 for men and 4 for women in AUDIT and 4 for women

		AUC	Cutoff point	Sensitivity	Specificity	Youden Index	LR+	LR–
Men –		0.887	4	0.93	0.67	0.60	2.81	0.10
	AUDIT		5	0.83	0.78	0.61	3.72	0.22
			6	0.72	0.85	0.58	4.86	0.32
	AUDIT-C	0.905	3	0.98	0.58	055	2.31	0.04
			4	0.91	0.75	0.66	3.64	0.12
			5	0.72	0.89	0.60	6.25	0.32
Women —		0.872	3	0.92	0.62	0.53	2.39	0.14
	AUDIT		4	0.81	0.79	0.60	3.81	0.24
			5	0.68	0.87	0.55	5.13	0.37
	AUDIT-C	0.905	3	0.92	0.65	0.57	2.61	0.13
			4	0.77	0.84	0.61	4.83	0.27
			5	0.57	0.94	0.51	9.78	0.46

Table 2. Cutoff points of AUDIT and AUDIT-C for detecting moderate drinking in college students.

Values in boldface indicate optimal cutoff point (i.e., the score at or above which the individual is considered to have AUD), sensitivity, specificity, Youden Index, LR+, and LR-.

AUC, area under the curve; AUDIT, Alcohol Use Disorders Identification Test; AUDIT-C, AUDIT-Consumption; LR+, positive likelihood ratio; LR-, negative likelihood ratio.

		AUC	Cutoff point	Sensitivity	Specificity	Youden Index	LR+	LR-
Men	AUDIT	0.928	7	0.97	0.71	0.68	3.37	0.03
			8	0.944	0.775	0.719	4.21	0.07
			9	0.889	0.828	0.717	5.19	0.13
	AUDIT-C	0.959	6	1.00	0.75	0.75	4.00	0.00
			7	0.94	0.86	0.80	6.84	0.06
			8	0.81	0.93	0.74	11.8	0.21
Women -		0.936	6	1.00	0.76	0.76	4.19	0.00
	AUDIT		7	0.95	0.84	0.79	5.81	0.05
			8	0.77	0.88	0.65	6.57	0.25
	AUDIT-C	0.961	6	0.95	0.87	0.82	7.25	0.05
			7	0.91	0.95	0.86	18.11	0.09
			8	0.36	0.97	0.33	13.13	0.65

Table 3. Cutoff points of AUDIT and AUDIT-C for detecting heavy drinking in college students.

Values in boldface indicate optimal cutoff point (i.e., the score at or above which the individual is considered to have AUD), sensitivity, specificity, Youden Index, LR+, and LR–.

AUC, area under the curve; AUDIT, Alcohol Use Disorders Identification Test; AUDIT-C, AUDIT-

Consumption; LR+, positive likelihood ratio; LR-, negative likelihood ratio.

in AUDIT-C. The area under the ROC curve (AUC) values for each drinking pattern ranged from 0.87 to 0.96.

#### Comparison with previous studies

The original WHO algorithms suggested the use of an AUDIT score of 8 for men and 7 for women to identify unhealthy alcohol use (WHO 2001). For AUDIT-C,

		AUC	Cutoff point	Sensitivity	Specificity	Youden Index	LR+	LR–
Men -		0.882	4	0.93	0.66	0.59	2.72	0.10
	AUDIT		5	0.83	0.77	0.60	3.55	0.22
			6	0.72	0.84	0.56	4.67	0.33
	AUDIT-C	0.900	3	0.97	0.57	0.54	2.27	0.04
			4	0.91	0.74	0.65	3.49	0.13
			5	0.72	0.88	0.60	5.76	0.32
Women –		0.872	3	0.92	0.61	0.53	2.32	0.14
	AUDIT		4	0.81	0.78	0.59	3.62	0.24
			5	0.69	0.86	0.55	5.01	0.36
	AUDIT-C	0.884	3	0.92	0.64	0.56	2.53	0.13
			4	0.77	0.83	0.60	4.47	0.27
			5	0.57	0.94	0.51	8.85	0.46

Table 4. Cutoff points of AUDIT and AUDIT-C for detecting binge drinking in college students.

Values in boldface indicate optimal cutoff point (i.e., the score at or above which the individual is considered to have AUD), sensitivity, specificity, Youden Index, LR+, and LR-.

AUC, area under the curve; AUDIT, Alcohol Use Disorders Identification Test; AUDIT-C, AUDIT-

Consumption; LR+, positive likelihood ratio; LR-, negative likelihood ratio.

Bradley and colleagues (2007) identified ideal cutoff points of 4 for men and 3 for women. These results have been validated using a large sample of adults presenting to primary care. In a previous Japanese study among adults, the appropriate AUDIT cutoff point was 8 (Fujii et al. 2016), and the cutoff for AUDIT-C was 5 for men and 4 for women (Osaki et al. 2014), mostly consistent with our study. In a US study among 18-25-year-old college students, AUDIT performed best, with cutoff scores of 8 for both men and women, with sensitivity and specificity of 72-89%; in the same population, the cutoff for AUDIT-C to predict at-risk drinking was 7 for men and 5 for women (Demartini and Carey 2012). Also, a Korean study reported that the optimal screening scores for at-risk drinking were 10 for men and 8 for women (AUDIT) or 6 in men and 4 in women (AUDIT-C) among college students who identified themselves as alcohol drinkers (Kwon et al. 2013). In another US study among students who utilized on-campus primary care, optimal AUDIT-C cutoff scores for at-risk drinking were 7 for men and 5 for women, with sensitivity and specificity of 77-96% (Campbell and Maisto 2018). These three studies used the same definitions of a standard drink (equivalent to 14 g of pure alcohol) and at-risk drinking (males who drink at least 14 drinks [196 g of pure alcohol] and females who drink at least 7 drinks [98 g of pure alcohol] recommended by NIAAA). On the other hand, our study used the Japanese criteria for a standard drink (10 g of pure alcohol) and defined "heavy drinking" as a weekly pure alcohol intake of 280 g or more for men and 140 g or more for women, and "moderate drinking" as a weekly pure alcohol intake of 140 g or more for men and 70 g or more for women (Ministry of Health, Labour and Welfare 2012). These differences are likely to influence the recommended cutoff scores used with AUDIT and AUDIT-C. An additional explanation lies in the specific composition of our participants. The subjects of this study were students who underwent health examinations, including non-drinkers. By contrast, the US and Korean studies included only drinkers (Demartini and Carey 2012; Kwon et al. 2013) or students who had recently used university primary care (Campbell and Maisto 2018). Hence, in comparison with our participants, a heavier-drinking sample might have resulted in higher AUDIT and AUDIT-C scores when screening at-risk drinkers. A Spanish study that used the same criteria for a standard drink suggested that the best cutoff points for students who engaged in high-risk consumption [28 standard drinks (280 g of pure alcohol) for men and 17 standard drinks (170 g of pure alcohol) for women] were as follows: for AUDIT, 8 for men and 6 for women; and for AUDIT-C, 5 for men and 4 for women (García Carretero et al. 2016). Although the AUDIT cutoff scores in that study were similar to ours, their AUDIT-C scores were lower. We observed no significant difference between the cutoff scores for AUDIT and AUDIT-C, suggesting that most students were hazardous (high-risk) drinkers, but not harmful drinkers or alcohol-dependent.

The cutoff points for binge drinking in the present study were as follows: for AUDIT, 5 for men and 4 for women; and for AUDIT-C, 4 for both men and women. The Spanish study that used AUDIT and AUDIT-C to screen binge drinking in university students suggested that 4 was an accurate cutoff point for AUDIT and 3 for AUDIT-C, regardless of gender, and that AUDIT-C was confirmed to make better classifications (Cortés Tomás et al. 2017). These cutoff points were lower than those in our study. To interpret this difference, the differences in the characteristics of the participants targeted and the definition of binge drinking should be considered. All participants in the Spanish study were 18 or 19 years old, whereas the average age of participants in our study was  $21.9 \pm 2.4$ . Also, although the standard drink unit (SUD) is the same in both the countries (10 g), the definitions of binge drinking are different. We considered binge drinking to be the consumption of 50 g or more of alcohol for men and 40 g or more for women in a 2-hour period within the past month. By contrast, in the Spanish study, binge drinking was defined as the consumption of 70 g or more of alcohol in a row for men or 60 g or more for women, bringing the BAC to 0.8 g/l, at least once over the past 6 months. These variations are likely to influence the recommended cutoff scores used with the AUDIT-C.

Our results represent the optimal cutoff points for each type of excessive drinking, as indicated by its high AUC value and high levels of sensitivity and specificity. Numerous studies were conducted to explore the optimal cutoff for identification of heavy drinking, binge drinking, or a combination of those. However, this is the first study to identify the validity of cutoff points of AUDIT and AUDIT-C for detecting moderate drinking. In a previous study, we revealed that alcohol-related injuries were significantly associated with moderate drinking (OR 3.83; 95% CI 2.41-6.09), indicating that moderate drinking can be considered unsafe drinking. Also, the population of students judged to be moderate drinkers (9.5%) is larger than that of heavy drinkers (3.6%). Therefore, the optimal cutoff values of AUDIT and AUDIT-C for detecting moderate drinking are the most important parameters for prevention and intervention of AUD in Japanese college students. Thus, this study demonstrates that the optimal cutoff values of AUDIT for detecting excessive alcohol use are 5 for men and 4 for women, and the optimal cutoff values of AUDIT-C are 4 for both sexes in Japanese college students.

In summary, it was confirmed that using these scores makes it possible to minimize false-negative or positive cases and AUDIT and AUDIT-C could be effective tools for detecting excessive alcohol use in Japanese college students.

#### Limitations

The limitations of this study are follows. The first limitation is the presence of geographical bias, as the survey was performed at Mie University in Japan. However, this study targeted all students of that university who belonged to various fields of studies and underwent the health examination. Diversified sample sources with a larger sample size may be needed in future studies. The second limitation is the possible presence of recall bias. Because participants in this study reported past histories of alcohol consumption and frequency using self-administered questionnaires, the actual amount of alcohol consumed may have differed from that reported. Consumption assessments conducted by in-person interviews might make it possible for participants to provide more thorough information.

Considering these limitations, additional research is needed to determine the feasibility of incorporating AUDIT or AUDIT-C into broader practice on college campuses.

#### Implications

Recently, the Japanese National University Council of Health Administration Facilities formulated the "Guidelines for standardization of health examination and health-related information in college," which included alcohol-related matters. These guidelines recommended that AUDIT and AUDIT-C should be used to detect problematic drinkers among college students, taking advantage of opportunities such as health examinations. From that perspective, the results of this study, which was targeted at students who underwent health examinations, indicate that AUDIT and AUDIT-C are not only convenient but also useful tools for screening for risky drinking behavior like excessive drinking among Japanese college students. Based on our findings, both scales should be used to determine the eligibility of students for further alcohol assessments, and if necessary, be used to refer students for targeted interventions.

#### **Conflict of Interest**

The authors declare no conflict of interest.

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