

Association between Excessive Alcohol Use and Alcohol-Related Injuries in College Students: A Multi-Center Cross-Sectional Study in Japan

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Alcohol-related injuries in college students are a major public health problem worldwide. We clarified the association between excessive drinking and alcohol-related injuries in Japanese college students. This was a cross-sectional study with a self-administered questionnaire. From January to March 2013, we sampled all college students and graduate students aged 20 years or older during annual health examinations at three colleges in Mie Prefecture in Japan. The questionnaire assessed the frequency of alcohol drinking, amount of alcohol consumed per day, binge drinking during the past year, alcohol-related injuries during the past year, and demographic data. Logistic regression analysis was conducted on the association between excessive alcohol use and alcohol-related injuries. A total of 2,842 students underwent health examinations, of whom 2,177 (76.6%) completed the questionnaire. Subjects included 1,219 men (56.0%) and 958 women (44.0%). Eighty-eight men (7.2%) and 93 women (9.7%) were classified as excessive weekly drinkers, while 693 men (56.8%) and 458 women (47.8%) were determined to be binge drinkers. Eighty-one men (6.6%) and 26 women (2.7%) had experienced alcohol-related injuries during the past year. In the logistic regression analysis, binge drinkers (odds ratio 25.6 [8.05-81.4]) and excessive weekly drinkers (odds ratio 3.83 [2.41-6.09]) had a history of significantly more alcohol-related injuries, even after adjusting for age and sex. In conclusion, alcohol-related injuries in college students in Japan were strongly associated with excessive drinking. As a strategy for preventing such injuries in this population, an interventional study is required to identify effective methods for reducing excessive alcohol use.

Keywords: alcohol-related injuries; Asian country; binge drinking; college student; heavy drinking
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Introduction

According to Mokdad and colleagues, alcohol consumption is now the third leading cause of death (first is tobacco, second is unhealthy lifestyle) (Mokdad et al. 2004). In 2004, the World Health Organization (WHO) announced the finding that “2.5 million people die from alcohol-related problems worldwide, including 320,000 young people aged 15-29” (World Health Organization

2009). Globally, excessive alcohol use is the primary risk factor for premature death and disability among people between the ages of 15 and 49 (Lim et al. 2012).

Excessive drinking in young people is a major public health problem worldwide. It is known that excessive drinking not only causes acute alcohol poisoning, but also contributes to dangerous behaviors while in the drunken state, such as those leading to injuries, rape, suicide, etc. (Eaton et al. 2010; World Health Organization 2014). There

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are several types of excessive alcohol use, including binge drinking, heavy drinking, and any drinking by pregnant women or people under the legal drinking age (White and Hingson 2014). In light of the fact that people who drink heavily have an increased risk of developing alcohol problems, the US Dietary Guidelines define moderate drinking as up to 1 drink per day for women and up to 2 drinks per day for men (US Department of Health and Human Services and US Department of Agriculture 2015). Binge drinking (National Institute of Alcohol Abuse and Alcoholism 2004) is a drinking pattern that involves consuming large quantities of alcohol in a single session.

Excessive drinking in young people causes many alcohol-related problems. In particular, alcohol-related injuries that require emergency medical care are especially frequent in young people (Kowalenko et al. 2013). Alcohol-related injuries include both unintentional injuries, including road traffic injuries, drowning, burns, poisoning and falls; and intentional injuries, which result from deliberate acts of violence against oneself or others. These injuries incurred by an individual while under the influence of alcohol, and about half of alcohol-related deaths are the result of injuries caused by excessive alcohol use (World Health Organization 2007). Injuries to young people are more likely to be fatal when they are alcohol-related than when they are not (Aziz et al. 2015). College students are known to consume more alcohol than non-college students (Hingson et al. 2002), and have a higher risk of developing alcohol-related problems (Wechsler et al. 1994). The increased frequency and quantity of alcohol intake in this group are related to a higher incidence of alcohol-related injuries (Mundt et al. 2009), and it is possible to prevent these injuries by controlling alcohol consumption.

The frequency of injuries due to alcohol intake in college students in Asian countries may differ from that in Western countries because of different drinking habits (Obot and Room 2005), physical characteristics, and alcohol metabolism (Luczak et al. 2001) in young people in the two regions. However, to the best of our knowledge, no study has examined alcohol-related injuries in college students in Asian countries.

To lay a foundation for effective interventions for reducing the incidence of such injuries, the purpose of this research was to clarify the association between excessive drinking and alcohol-related injuries in Japanese college students.

Materials and Methods

Study design and participants

This was a cross-sectional study via an anonymous, self-administered questionnaire. From January to March 2013, we sampled all college students and graduate students aged 20 years or older during annual health examinations at three colleges in Mie Prefecture in Japan. Mie Prefecture is located in central Japan on the Pacific coast. People under 20 years of age are legally prohibited from drinking in Japan, and since they are likely to be untruthful in their responses

regarding alcohol, they were excluded from analysis. Students who did not provide consent were also excluded.

Data collection

The questionnaire covered five topics: 1) frequency of alcohol drinking; 2) amount of alcohol consumed per day; 3) whether or not the participant engaged in binge drinking during the past year, as evaluated by the following question: "During the last 12 months, how often did you have five or more (males) or four or more (females) drinks containing any kind of alcohol within a 2-hour period?" (Yes: one or more; or No); 4) whether or not alcohol-related injuries were sustained during the past year, as evaluated by the following question: "In the past 12 months, how often have you been in situations where you could have caused an accident or gotten hurt due to being under the influence of alcohol;" and 5) demographic data (gender and age). To maximize the accuracy of the number of drinks reported, students were required to list all drinks consumed as well as their numbers. To facilitate this process, the questionnaire provided a list of standard types of alcohol, specifically, *sake*, beer, *shochu* (Japanese distilled beverage), *chuhai* (spirit-based cocktail), cocktails, plum wine, whiskey, and wine. Students specified alcohol consumption by selecting one of several answers that ranged from every day to less than once per year. The amount of weekly consumption was calculated by multiplying the alcohol consumption frequency by the amount consumed per drinking session. In this study, we defined "excessive weekly drinking" as a weekly pure alcohol intake of 140 g or more for men and 70 g or more for women. We also defined binge drinking as 50 g or more for men and 40 g or more for women in a 2-hour period (National Institute of Alcohol Abuse and Alcoholism 2004). Excessive alcohol use was defined as excessive weekly drinking, binge drinking, or both.

Statistical analyses

The t-test was used to compare the age, frequency of drinking, and amount of alcohol consumed per day among men and women. The chi-squared test was used to examine the differences of excessive alcohol use and alcohol-related injuries. The chi-squared test was also conducted separately for each gender to evaluate the difference between excessive alcohol use and the presence/absence of alcohol-related injuries. We determined the overlap between excessive weekly drinkers and binge drinkers who experienced alcohol-related injuries. Multivariate logistic regression analysis was used to examine whether age, sex, and excessive alcohol use were associated with alcohol-related injuries. If there was multi-collinearity between variables using the variance inflation factor, then one variable was removed. $p < 0.05$ was considered statistically significant. All statistical analyses were performed using Stata 13.1 for Windows (Stata Corp., College Station, Texas, USA).

Ethical considerations

To obtain the consent of participants, we distributed questionnaires and explained their content and purpose in writing and verbally. This research was approved by the medical ethics committee of both Mie University and the University of Tsukuba.

Results

During the study period, 2,842 students underwent health examinations, of which 2,177 (76.6%) were analyzed after exclusions. A flow chart is shown in Fig. 1.

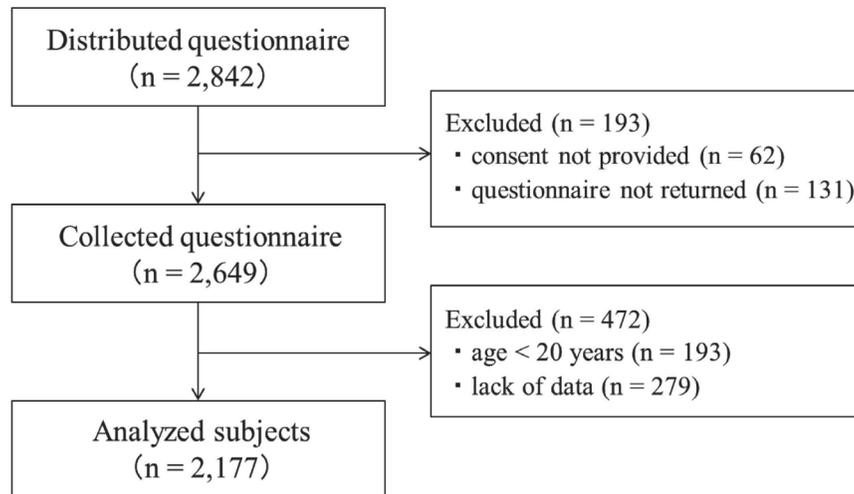


Fig. 1. Study flow chart.

Table 1. Participant characteristics.

Variable	Total (n = 2,177)	Men (n = 1,219)	Women (n = 958)	p
Age (years), mean \pm SD	21.6 \pm 2.5	22.0 \pm 2.7	21.2 \pm 2.2	< 0.001 ^c
Frequency of drinking (days/week), mean \pm SD	0.8 \pm 1.2	0.9 \pm 1.3	0.6 \pm 0.9	< 0.001 ^c
Amount of drinking (g/day), mean \pm SD	38.0 \pm 32.5	40.1 \pm 33.8	35.2 \pm 30.7	< 0.001 ^c
Excessive weekly drinking ^a , n (%)				
yes	181 (8.3)	88 (7.2)	93 (9.7)	0.037 ^d
no	1,996 (91.7)	1,131 (92.8)	865 (90.3)	
Binge drinking, n (%)				
yes	1,151 (52.9)	693 (56.8)	458 (47.8)	< 0.001 ^d
no	1,026 (47.1)	526 (43.2)	500 (52.2)	
Alcohol-related injuries ^b , n (%)				
one or more	107 (4.9)	81 (6.6)	26 (2.7)	< 0.001 ^d
no	2,070 (95.1)	1,138 (93.4)	932 (97.3)	

^aweekly pure alcohol intake of over 140 g for men and over 70 g for women. ^bnumber of injuries in the past 12 months. ^ct-test. ^dchi-squared test.

The baseline characteristics of the study participants are illustrated in Table 1. Eighty-eight (7.2%) men and 93 (9.7%) women were classified as excessive weekly drinkers, while 693 (56.8%) men and 458 (47.8%) women were determined to be binge drinkers. Seventy-nine (6.5%) men and 81 (8.5%) women qualified as both binge drinkers and excessive weekly drinkers. Eighty-one (6.6%) men and 26 (2.7%) women had experienced alcohol-related injuries during the past year. Men and women differed significantly in age ($p < 0.001$), frequency of alcohol drinking ($p < 0.001$), amount of alcohol consumed per day ($p < 0.001$), excessive weekly drinking ($p = 0.037$), binge drinking ($p < 0.001$), and alcohol-related injuries ($p < 0.001$).

Characteristics of students who experienced alcohol-related injuries are shown in Table 2. Among students with

alcohol-related injuries, 78 (96.3%) men and 26 (100%) women participated in binge drinking more than once a year. On the other hand, 20 men (24.7%) and 13 women (50.0%) with alcohol-related injuries were excessive weekly drinkers. Regardless of gender, excessive weekly drinkers ($p < 0.001$) and binge drinkers ($p < 0.001$) had significantly more alcohol-related injuries.

The percentages of participants with alcohol-related injuries who engaged in excessive weekly drinking or binge drinking are shown in Fig. 2. Of the excessive weekly drinkers who experienced alcohol-related injuries, 20 were men and 13 were women, and all were binge drinkers.

In multivariate analysis (Table 3), alcohol-related injuries were significantly associated with binge drinking (odds ratio [OR], 25.6; 95% confidence interval [CI], 8.05-81.4)

Table 2. Characteristics of students with alcohol-related injuries.

Variable	men			women		
	Alcohol-related injuries		P	Alcohol-related injuries		P
	yes ^b (n = 81)	no (n = 1,138)		yes ^b (n = 26)	no (n = 932)	
Age (years), mean \pm SD	21.6 \pm 1.3	22.0 \pm 2.8	0.181 ^c	21.3 \pm 1.2	21.2 \pm 2.2	0.756 ^c
Excessive weekly drinking ^a , n (%)						
yes	20 (24.7)	68 (6.0)	< 0.001 ^d	13 (50.0)	80 (8.6)	< 0.001 ^d
no	61 (75.3)	1,070 (94.0)		13 (50.0)	852 (91.4)	
Binge drinking, n (%)						
yes	78 (96.3)	615 (54.0)	< 0.001 ^d	26 (100.0)	432 (46.4)	< 0.001 ^d
no	3 (3.7)	523 (46.0)		0 (0.0)	500 (53.6)	

^aweekly pure alcohol intake of over 140 g for men and over 70 g for women. ^bone or more injuries in the past 12 months. ^ct-test. ^dchi-squared test.

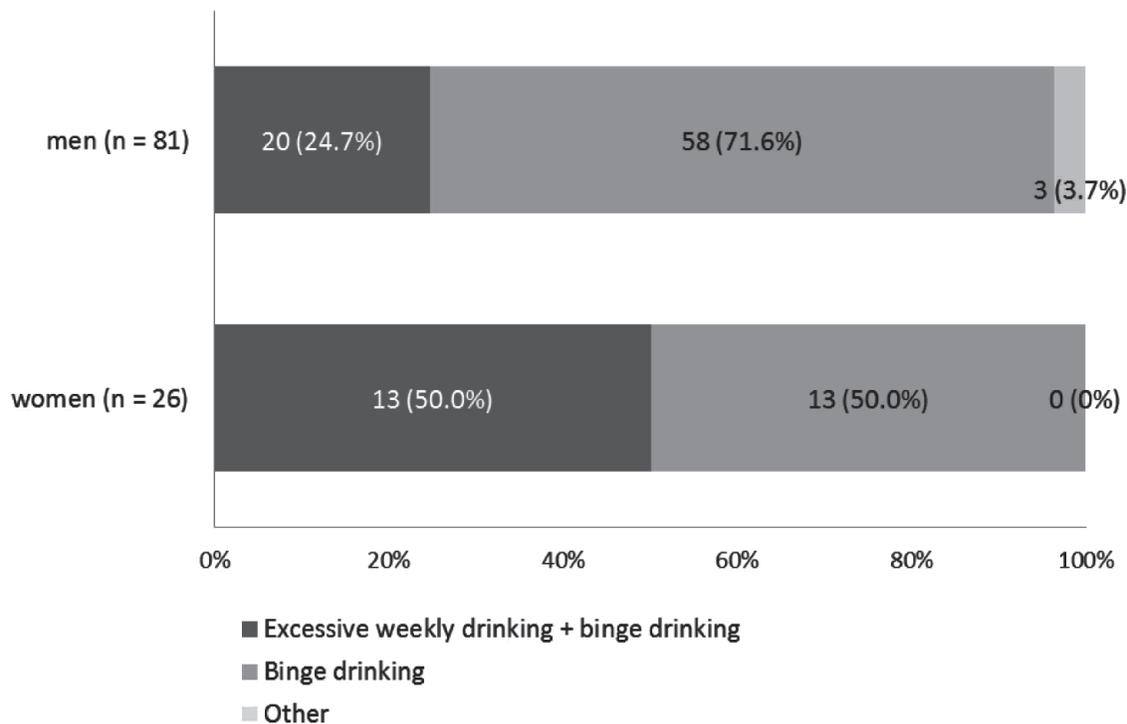


Fig. 2. Percentages of participants with alcohol-related injuries who engaged in excessive weekly drinking, binge drinking, or both.

and excessive weekly drinking (OR 3.83; 95% CI 2.41-6.09) after adjusting for gender and age. There was no multi-collinearity of independent variables.

Discussion

This survey showed that excessive drinking was strongly associated with alcohol-related injuries. In particular, binge drinking episodes were reported in almost all students who experienced alcohol-related injuries. In multivariate analyses, alcohol-related injuries were significantly associated with binge drinking (OR 25.6) and excessive weekly drinking (OR 3.83).

Binge drinking rapidly elevates the blood alcohol concentration and causes alcohol-related injuries due to impairment of reaction time, attention, and visual function (Higuchi 2011). The elevation of the blood alcohol concentration is also related to factors including gender, metabolic rate, type of build, and amount of body fat (Kypri et al. 2005). In a cross-sectional study of predominantly white college students sampled from 14 campuses, O'Brien et al. (2006) reported that 91% of binge drinkers experienced traumatic injuries in the previous 12 months. Though their study contained higher proportions of Caucasians and women than this survey, our results demonstrated similarly

Table 3. Factors independently related to alcohol-related injuries.

Variable (n = 2,177)	Odds Ratio	95% Confidence Interval		p
Age	0.94	0.84	1.06	0.294
Sex				
men	2.65	1.65	4.27	< 0.001
women	Reference	—	—	
Excessive weekly drinking amount				
yes	3.83	2.41	6.09	< 0.001
no	Reference	—	—	
Binge drinking				
yes	25.6	8.05	81.4	< 0.001
no	Reference	—	—	

Multivariate logistic regression.

strong correlations between binge drinking and alcohol-related injury (OR 6.96; 95% CI 4.02-12.04). The larger odds ratio in our study may have been due to differences such as physical size, race, and alcohol metabolism (Luczak et al. 2001) of the participants. The above results showed that binge drinking was related to alcohol-related injuries, perhaps more strongly in Japanese people than in Westerners.

Alcohol-related injuries were also associated with excessive weekly drinking (OR 3.83), presumably due to the above-mentioned physiological impairment caused by elevated blood alcohol concentrations. This is consistent with the findings of the study by O'Brien et al. (OR 4.97; 95% CI 3.49-7.09). In this study, binge drinking demonstrated larger odds ratio, whereas excessive weekly drinking showed similar one than O'Brien's study. It suggests that factors related to blood alcohol concentration, such as physical size, race, and alcohol metabolism, may be strongly related to patterns of rapid alcohol consumption such as binge drinking (Moskowitz and Burns 1976).

As has been observed previously, men in this study experienced alcohol-related injuries more frequently than women, possibly due to a greater likelihood of behaviors such as alcohol-related aggression (Scott et al. 1999). In a study examining the association between fatal trauma and alcohol intake, most men and nearly one-third women had alcohol-related injuries (Sjogren et al. 2006). On the other hand, women have a higher risk of injuries than men following lower alcohol intake (Yoonhee et al. 2009). In this study, even though the criteria for women's excessive weekly drinking and binge drinking involved smaller amounts of alcohol than those of men, most students with alcohol-related injuries, both men and women, met the criteria for excessive alcohol use, and it is therefore considered reasonable to set lower alcohol intake criteria for female Japanese college students.

The results of this study provide useful information for developing a strategy to reduce alcohol-related injuries.

Each country should take cultural background into consideration when developing solutions to alcohol-related problems, and, in particular, college students in Japan may benefit from measures against binge drinking as it was involved in almost all alcohol-related injuries in this study.

Our study examined binge drinking in participants during the past year, which is a longer period of time than used by previous studies, most of which focused on binge drinking during the past month (Midanik et al. 2013). This could account for the fact that the incidence of binge drinking in the present study (50%) was higher than that in other reports (Kypri et al. 2009; Penny and Armstrong-Hallam 2010; The Substance Abuse and Mental Health Services Administration 2014). Since it may be more difficult to accurately characterize alcohol consumption in students over shorter time frames such as one month, our results may more clearly reflect the actual alcohol intake of Japanese college students.

There are three limitations to this study. The first is the presence of geographical bias, since the survey was performed at three colleges in Mie Prefecture in Japan. However, this made it possible to target all of the students at the three colleges as they all underwent the health examination that we assessed. The response rate was as high as 76.6% at these colleges, and the subjects of this study had almost the same male-to-female ratio as that in Japanese colleges nationwide (men comprised 56.0% of the sample in this study, compared to 55.9% in Japan in 2015) (Ministry of Education, Culture, Sports, Science and Technology 2015). The proportions of college students reporting alcohol-related injuries during the previous year vary by study, ranging from 3.2% (Moure-Rodriguez et al. 2014) to 18% (O'Brien et al. 2013). Our result (4.9%) falls in this range, suggesting the generalizability of our findings. A second limitation is the possible presence of recall bias. Because participants in this study reported past histories of alcohol consumption and alcohol-related injuries using self-administered questionnaires, the actual amount of alcohol

consumed or frequency of alcohol-related injuries may have differed from that reported. Finally, we cannot determine causal relationship between excessive alcohol use and alcohol-related injuries due to the cross-sectional nature of this study. This limitation warrants further investigation to clarify causation.

This survey of Japanese college students showed that excessive drinking was strongly associated with alcohol-related injuries. In particular, binge drinking episodes were reported in almost all students who experienced alcohol-related injuries. As a strategy for preventing alcohol-related injuries among college students in Japan, an interventional study is required to identify effective methods for reducing excessive alcohol use.

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Conflict of Interest

The authors declare no conflict of interest.

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