Gender-specific relationship between alcohol consumption and injury in the South Korean adults

A nationwide cross-sectional study

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Abstract
Alcohol-related injuries have been concerned worldwide. However, there have been no large cross-sectional epidemiologic studies. The aim of this study was to investigate the association between alcohol and the prevalence of injury according to gender in a representative sample of the South Korean population. This cross-sectional study was based on data obtained in the Korea National Health and Nutrition Examination Survey from 2010 to 2012. In total, 15,249 Korean adults (7128 men and 8121 women) aged 19 years or older were enrolled. Injury was defined as the incidence of an injury or intoxication within the year before completing the survey questionnaire. Univariate and multiple logistic regression analyses were conducted to analyze the relationship between alcohol consumption and the prevalence of injury. Heavy alcohol consumption and high-risk drinking were associated with a higher prevalence of injury in women (adjusted odds ratio [aOR] and corresponding 95% confidence interval [CI]: 2.48 [1.321, 4.656], 1.816 [1.136, 2.929], respectively), and Alcohol Use Disorders Identification Test (AUDIT) scores ≥20 were associated with a higher prevalence of injury in both men and women (aOR and 95% CI: 1.425 [1.004, 2.024] and 3.71 [2.067, 6.66], respectively). According to the AUDIT scores results, women who were injured reported significantly more high-risk drinking behaviors per month compared with those who were not injured. Gender disparities in the relationship between alcohol and the prevalence of injury were found. Indeed, future research using a prospective design should examine the causal relationship between alcohol consumption and the prevalence injury according to gender to confirm that alcohol is a risk factor for injury and to identify the possible mechanisms underlying this phenomenon.

Abbreviations: AUDIT = Alcohol Use Disorders Identification Test, BMI = body mass index, CI = confidence interval, GBD = Global Burden of Disease, KNHANES = Korea National Health and Nutrition Examination Survey, OR = odds ratio, WC = waist circumference.

Keywords: alcohol, gender, injury

1. Introduction
A large proportion of adults in many countries consume alcohol. However, the prevalence of drinkers and the amount of alcohol consumption per capita in the Republic of Korea are among the highest worldwide, and the prevalence of alcohol consumption has been increasing. Alcohol is one of the leading causes of the Global Burden of Disease (GBD), as it accounts for 3.9% of the GBD. Injury is a major contributor to morbidity, disability, and even early mortality. Injuries are categorized as intentional and unintentional. Intentional injuries include road traffic injuries, drowning, burns, poisoning, and falls. Unintentional injuries result from deliberate acts of violence against oneself or others. Injuries constitute a major part of alcohol-attributable disability-adjusted life years (33.2%) and alcohol-attributable mortality (24.4%). Of the total number of alcohol-attributable deaths, unintentional injuries constitute 32.0% and intentional injuries constitute 13.7%. Alcohol affects psychomotor skills, including reaction time, as well as cognitive skills, such as judgment. Consequently, individuals under the influence of alcohol tend to be exposed to situations that present a high risk for injury.

In this study, we aimed to investigate the relationship between alcohol consumption and the prevalence of injury according to gender in the South Korean population based on data from the 2010 to 2012 Korea National Health and Nutrition Examination Survey (KNHANES).
2. Materials and methods

2.1. Study participants

This study was based on data acquired from the 2010 to 2012 KNHANES V, which was conducted by the Korea Centers for Disease Control and Prevention. The KNHANES is an ongoing, population-based, cross-sectional nationwide study of noninstitutionalized South Korean civilians. A complex, stratified, multistage, cluster sampling design with proportional allocation based on the National Census Registry was used for the selection of household units.

Trained interviewers conducted face-to-face interviews, health examinations, and nutrition surveys at participants’ homes using structured questionnaires. In total, 25,534 participants completed these surveys. Individuals younger than 19 years of age (n=5935) were excluded, and an additional 4359 participants were excluded due to missing values for variables, yielding a final study population of 15,240 participants (7128 men and 8112 women). The Institutional Review Board of The Catholic University of Korea approved this study (SC15EISI0140).

2.2. Definition of injury

This study identified the incidence of injury or intoxication among participants within the year before completion of the KNHANES questionnaire. Individuals who reported sustaining an injury within the past year were categorized according to whether they were hospitalized.

2.3. Demographic variables

Data on the demographic and socioeconomic characteristics and medical history of participants were collected by trained interviewers. Self-report questionnaires were used to determine participants’ age, sex, alcohol consumption, smoking status, waist circumference (WC), body mass index (BMI), physical activity, residential area, marital status, occupation, and socioeconomic status.

The amount of pure alcohol consumed (g/d) was calculated using the average number of alcoholic beverages consumed and the frequency of alcohol consumption. Participants were categorized into the following 3 groups according to their daily alcohol consumption: nondrinker, light-to-moderate drinker (1–30 g/d), and heavy drinker (>30 g/d).[7]

Binge drinking was defined as consuming ≥7 drinks/drinking day for men and ≥5 drinks/drinking day for women at a sitting more than twice per week.[8,9]

The Alcohol Use Disorders Identification Test (AUDIT) was used to assess patterns of alcohol use and to divide the participants into 4 levels. The AUDIT score is calculated by summing the scores of 10 questions concerning alcohol consumption, including those about the frequency of consumption and the amount of alcohol consumed per occasion (AUDIT score tier levels: 0–7, 8–14, 15–19, and ≥20).[10–12] Three domains, including hazardous alcohol use, dependence symptoms, and harmful alcohol use, are included in the AUDIT, which consists of 10 questions about recent alcohol use, alcohol dependence symptoms, and alcohol-related problems.[12]

Subjects who were currently smoking and had smoked >100 cigarettes in their lifetime were defined as current smokers.

Height, weight, and WC were measured using standard procedures. Height was measured with an accuracy of 0.1 cm, and weight was measured to the nearest 0.1 kg. WC was measured at the midpoint of the lower margin of the 12th rib and the iliac crest in the mid-axillary line at the end of expiration. BMI was calculated as weight in kilograms divided by height in meters squared. Total caloric intake and the proportions of energy obtained from carbohydrates, protein, and fat were also estimated. Physical activity was categorized as regular exercise and nonregular exercise. Regular exercise was defined as exercising more than 3 times per week for more than 20 minutes at a time. Place of residence was categorized either as rural or urban, and marital status was categorized as either married or single.

Hypertension was defined by systolic blood pressure ≥140 mm Hg, diastolic blood pressure ≥90 mm Hg, or current use of antihypertensive medicines. Diabetes was defined by fasting plasma glucose levels ≥126 mg/dL with diabetes treatment or diagnosis by a physician. Metabolic syndrome was defined according to the American Heart Association/National Heart, Lung, and Blood Institute scientific statement criteria for Asians.[13] Participants with household incomes in the lowest quartile were defined as the low-income group, and those who did not attend school beyond middle school (higher than ninth grade) were defined as the low-education group.

2.4. Statistical analyses

All analyses were performed using SAS software version 9.3 (SAS Institute Inc., Cary, NC). All data are presented as means± standard errors of the mean for continuous variables and as percentages and standard errors for categorical variables. The SAS survey procedure reflected the complex sampling design and the sampling weights of the KNHANES and provided nationally representative prevalence estimates. The Student t test or the Rao–Scott chi-square test was used for comparisons among groups. Univariate and multiple logistic regression analyses were used to estimate the association of injury with level of alcohol consumption and its individual components. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated after adjusting for potential confounders. In multiple logistic regression analyses, adjustments were made first for age (Model 1) and subsequently for the same variables in Model 1 plus BMI, exercise, smoking, education, and income (Model 2). A P value of <0.05 was considered statistically significant.

3. Results

Table 1 shows the general characteristics of participants according to gender and the presence of injury. The mean age of men and women who sustained an injury was 41.4±0.8 and 45.6±0.9 years, respectively. Males who had an injury had a higher WC and BMI and were more likely to smoke and live in rural area. Females who had an injury were more likely to smoke, be heavy drinkers, and have hypertension. Moreover, household income was significantly lower in women who have an injury than in women without an injury (P<0.05). Both males and females with injuries were more frequently hospitalized due to an injury than a due to situation not associated with an injury (noninjury).

Table 2 shows the distribution of injury according to drinking pattern and AUDIT score among men and women. Individuals who experienced an injury tended to be binge drinkers and to have high AUDIT scores than individuals who had no injuries, and this was the case for both men and women.
Table 3 shows the distribution of the causes for hospitalizations and outpatient visits due to injury and noninjury according to drinking pattern and AUDIT score among men and women. Males and females who were hospitalized for an injury tended to be heavy drinkers compared with those hospitalized for a noninjury. Females who were hospitalized for an injury also had higher AUDIT scores compared with those hospitalized for a noninjury.

Table 4 shows the adjusted ORs (aORs) and 95% CIs for the prevalence of injuries according to drinking pattern and AUDIT level among men and women. In men and women, the aORs (95% CI) of injury for binge drinking were 1.401 (1.054, 1.863), 2.004 (1.288, 3.118), respectively in Model 1. In Model 2, the aORs (95% CI) in women for heavy alcohol consumption and binge drinking were 2.48 (1.321, 4.656) and 1.816 (1.136, 2.929), respectively. In men and women, the aORs (95% CI) for AUDIT scores ≥20 were 1.667 (1.183, 2.34) and 4.238 (2.409, 7.455), respectively, in Model 1 and 1.425 (1.004, 2.024) and 3.71 (2.067, 6.66), respectively in Model 2. This reflected a trend toward an association between increased alcohol consumption and binge drinking and a higher prevalence of injury in women and between high AUDIT scores and injury in both men and women.

Table 1
General characteristics of participants who experienced injury by gender.

| Experience of injury | Men (n = 7128) | Women (n = 8112) |
|----------------------|---------------|------------------|
|                      | No (n = 6612) | Yes (n = 516) | P    | No (n = 7593) | Yes (n = 519) | P    |
| Age, y               | 44.1 ± 0.3    | 41.4 ± 0.8    | <0.001 | 43.3 ± 0.3    | 45.6 ± 0.9    | 0.013 |
| Smoking status       |               |                |        |               |                |      |
| Current smokers (%)  | 42.8 (0.8)    | 54.6 (2.6)    | <0.001 | 6.1 (0.4)     | 9.9 (1.8)     | 0.01  |
| Alcohol consumption  |               |                |        |               |                |      |
| Heavy drinkers (%)   | 18.8 (0.6)    | 22.8 (2.4)    | 0.084  | 2.6 (0.3)     | 6.5 (1.7)     | <0.001 |
| Physical activity    |               |                |        |               |                |      |
| Regular exerciser (%)| 23.0 (0.7)    | 21.9 (2.1)    | 0.636  | 16.8 (0.5)    | 17.1 (2.3)    | 0.909 |
| WC, cm               | 84 ± 0.2      | 85.9 ± 0.6    | 0.002  | 77.4 ± 0.2    | 78.6 ± 0.6    | 0.052 |
| Hypertension (%)     | 30.4 (0.7)    | 28.2 (2.5)    | 0.413  | 19.7 (0.6)    | 24.2 (2.3)    | 0.037 |
| Diabetes mellitus (%)| 9.4 (0.4)     | 10.1 (1.5)    | 0.638  | 5.6 (0.3)     | 7 (1.3)       | 0.267 |
| Metabolic syndrome (%)| 26 (0.7)   | 28.2 (2.4)    | 0.371  | 21.6 (0.6)    | 26.3 (2.6)    | 0.061 |
| Occupation (%)       | 78.3 (0.7)    | 81.3 (1.9)    | 0.154  | 53.3 (0.8)    | 52.1 (2.8)    | 0.683 |
| Low education level  | 78.4 (0.7)    | 78.5 (2.2)    | 0.967  | 71.2 (0.8)    | 66.3 (2.6)    | 0.056 |
| Low household income | 13.6 (0.6)    | 13.1 (1.7)    | 0.772  | 14.8 (0.6)    | 18.7 (2.1)    | 0.035 |
| Marital status       |               |                |        |               |                |      |
| Married (%)          | 84.3 (0.9)    | 81.7 (2.7)    | 0.322  | 77.9 (0.8)    | 52.1 (2.8)    | 0.683 |
| Place of residence   |               |                |        |               |                |      |
| Urban                | 80.8 (1.7)    | 74.8 (3.3)    | 0.013  | 82.1 (1.6)    | 82.7 (2.7)    | 0.824 |
| Hospitalization      |               |                |        |               |                |      |
| No                   | 93.2 (0.4)    | 48.2 (2.6)    | 0.091  | 57.2 (2.8)    | 90.1 (0.4)    | 57 (2.8) |
| Yes: noninjury       | 6.7 (0.4)     | 51.8 (2.6)    | 0.091  | 42.8 (2.6)    | 49.9 (2.8)    | 90.1 (0.4) |
| Injury               | 43.4 (2.7)    | 43.4 (2.7)    | 0.366  | 33.6 (2.5)    | 33.6 (2.5)    | 0.366 |
| Outpatient visit     |               |                |        |               |                |      |
| No                   | 75 (0.7)      | 62.3 (2.7)    | 0.672  | 52.1 (2.8)    | 62.3 (2.7)    | 0.672 |
| Yes: noninjury       | 25 (0.7)      | 26.7 (2.4)    | 0.328  | 35.8 (2.6)    | 35.8 (2.6)    | 0.328 |
| Injury               | 11 (16)       | 11 (16)       |        | 11.5 (1.8)    | 11.5 (1.8)    | 11.5 (1.8) |

Values are presented as the mean (SEM) or percentage (SE). BMI = body mass index, WC = waist circumference.

Table 2
Prevalence of injuries according to drinking pattern and AUDIT score.

| Experience of injury or intoxication | Men | Women |
|-------------------------------------|-----|-------|
|                                     | No (n = 6612) | Yes (n = 516) | P    | No (n = 7593) | Yes (n = 519) | P    |
| Alcohol consumption                 |     |       | 0.084 |     |       | <0.001 |
| None                                | 9.4 (0.6) | 6.9 (1.2) | 19.3 (0.6) | 20.2 (2.1) | 20.2 (2.1) | 20.2 (2.1) |
| Light-to-moderate                   | 71.8 (0.7) | 70.3 (2.6) | 78.2 (0.6) | 73.3 (2.6) | 73.3 (2.6) | 73.3 (2.6) |
| Heavy                               | 18.8 (0.6) | 22.8 (2.4) | 2.6 (0.3) | 6.5 (1.7) | 6.5 (1.7) | 6.5 (1.7) |
| Binge drinker                       | 25.3 (0.8) | 32.4 (23.1) | 0.019 | 7 (0.5) | 12.5 (2.4) | 0.004 |
| AUDIT score                         |     |       | 0.029 |     |       | <0.001 |
| 0–7                                 | 44.7 (0.8) | 38.3 (2.7) | 83 (0.6) | 77.7 (2.4) | 77.7 (2.4) | 77.7 (2.4) |
| 8–14                                | 29.7 (0.7) | 30.2 (2.5) | 12.2 (0.5) | 12.1 (1.8) | 12.1 (1.8) | 12.1 (1.8) |
| 15–19                               | 14.6 (0.5) | 15.9 (2.1) | 2.9 (0.3) | 3.9 (1.2) | 3.9 (1.2) | 3.9 (1.2) |
| ≥20                                 | 11 (0.5) | 15.7 (2) | 1.9 (0.2) | 6.4 (1.6) | 6.4 (1.6) | 6.4 (1.6) |

Values are presented as percentages (SE). AUDIT = Alcohol Use Disorders Identification Test.
### Table 3
Distribution of the causes for hospitalization and outpatient visits according to drinking pattern and AUDIT scores.

|                | Hospitalization | | | | | |
|----------------|-----------------|---|---|---|---|---|---|
|                | Male            | Female | Male | Female | Male | Female | Male | Female |
| Alcohol consumption | No | Noninjury | Injury | P | No | Noninjury | Injury | P | No | Noninjury | Injury | P |
| None            | n = 6363 | 8.7 (0.4) | 16.8 (1.9) | 8.1 (1.8) | 7.6 (0.5) | 13.8 (0.9) | 10.8 (4.2) | <0.001 | n = 7187 | 72.4 (0.7) | 65.8 (2.5) | 66.1 (3.9) | 73.5 (4) | 72.8 (0.8) | 67.3 (1.3) | 84.1 (5.2) | <0.001 |
| Light-to-moderate | No | 18.1 (0.6) | 31.2 (2.1) | 16.4 (2.9) | 27.2 (0.9) | 23.0 (3.8) | 20.2 (3.1) | 0.138 | 20.4 (0.7) | 17.8 (1.4) | 18.1 (1.3) | 30.1 (3.7) | 19.0 (3.7) | 17.4 (1.3) | 5.1 (3.2) | 0.029 |
| Heavy           | No | 25.7 (0.8) | 24.5 (2.8) | 33.4 (7.6) | 7.3 (0.5) | 6.2 (1.0) | 14.6 (4.3) | 0.003 | 26.3 (0.9) | 24.5 (1.3) | 25.8 (8.1) | 0.535 | 20.2 (0.8) | 21.2 (0.7) | 11.3 (2) | 0.561 |
| Binge drinker   | No | 0.616 | 0.616 | 0.616 | 0.616 | 0.616 | 0.616 | 0.616 | 0.616 | 0.616 | 0.616 | 0.616 | 0.616 | 0.616 | 0.616 | 0.616 |
| AUDIT score     | 0–7 | 44.3 (0.8) | 44.7 (2.9) | 38.4 (3.9) | 82.5 (0.9) | 86.7 (1.7) | 74.4 (8.4) | 43.1 (0.9) | 47.3 (1.4) | 36.7 (5) | 83.2 (0.7) | 81.8 (1) | 77.4 (7.5) | 11.6 (0.6) | 13.1 (0.9) | 10.6 (4.7) |
|                | 8–14 | 30.5 (0.7) | 26.5 (2.3) | 31.5 (4.3) | 12.5 (0.5) | 9.2 (1.4) | 11.4 (3) | 0.535 | 20.2 (0.8) | 21.2 (0.7) | 11.3 (2) | 0.561 | 20.2 (0.8) | 21.2 (0.7) | 11.3 (2) | 0.561 |
|                | 15–19 | 14.5 (0.5) | 15.9 (2.2) | 17.2 (8.6) | 3.0 (0.3) | 2.6 (0.8) | 2.8 (1.6) | 0.029 | 20.2 (0.8) | 21.2 (0.7) | 11.3 (2) | 0.561 | 20.2 (0.8) | 21.2 (0.7) | 11.3 (2) | 0.561 |
|                | ≥20 | 11.2 (0.5) | 12.9 (1.9) | 13.2 (3.1) | 2.0 (0.2) | 1.6 (0.7) | 11.8 (3.7) | 0.029 | 20.2 (0.8) | 21.2 (0.7) | 11.3 (2) | 0.561 | 20.2 (0.8) | 21.2 (0.7) | 11.3 (2) | 0.561 |

Values are presented as the mean (SEM) or percentage (SE). AUDIT = Alcohol Use Disorder Identification Test.
between alcohol and injury have focused on emergency department patients, this study is based on data from the KNHANES. The Korean drinking culture has been changing, as excessive drinking in women is rising in parallel to women’s increased participation in social activities.

This study has several limitations. First, we were unable to evaluate the causal relationship between alcohol and the prevalence of injury due to the cross-sectional and retrospective design of the study. Second, self-reported alcohol intake and AUDIT scores may not have high validity due to recall and social desirability biases.[26,27] Third, excluding participants with missing values may lead to selection bias. Finally, women have a stronger interest in health issues than men,[28,29] which may contribute the decreased prevalence of injury in women.

Despite these limitations, this is the first epidemiologic study that examines the association between alcohol and injury in the Korean population using nationally representative data.

In conclusion, men with a high AUDIT level were more likely to experience injury, regardless of age, BMI, exercise, smoking, education, and income. In contrast, in women, both the AUDIT level and heavy and binge drinking were positively associated with the prevalence of injury. Given the multidimensionality of alcohol consumption and the multiplicity of variables related to injury, future prospective studies may identify drinking patterns and AUDIT level as predictors of injury among women.

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