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High-risk drinking is associated with a higher risk of diabetes mellitus in Korean men, based on the 2010–2012 KNHANES

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ABSTRACT

We examined the association between alcohol-drinking pattern and diabetes mellitus (DM) in Korean adults. This cross-sectional study included 12,486 participants (5551 men and 6935 women) who participated in the 2010–2012 Korean National Health and Nutrition Examination Survey. We categorized alcohol-drinking pattern into three groups based on the alcohol-use disorders identification test (AUDIT): low-risk (score: 0–7), intermediate-risk (score: 8–14), and high-risk (score: ≥15). DM was defined as having fasting plasma glucose ≥126 mg/dL or taking glucose-lowering medication, including insulin therapy. In the study population, 25.2% of men and 4.7% of women were high-risk drinkers. DM prevalence was 9.2% in men and 5.4% in women. DM prevalence was 9.0% and 5.7% in the low-risk drinking group, 7.6% and 4.1% in the intermediate-risk drinking group, and 11.2% and 3.5% in the high-risk drinking group in men and women, respectively. Compared to the low-risk drinking group, odds ratios (95% confidence intervals) of men and women in the intermediate-risk drinking group for DM were 1.043 (0.779–1.396) and 1.139 (0.712–1.824), respectively, and 1.480 (1.133–1.933) and 0.827 (0.296–2.311) in the high-risk drinking group, after adjusting for age and other confounding factors. In conclusion, high-risk drinking appears to be associated with a higher risk of DM in men, but not in women.

Introduction

The net effect of alcohol consumption on public health and economic cost is detrimental, though some beneficial effects have been documented. Alcohol contributes to 3.8% of all mortality and 4.6% of the burden of disease and injury worldwide (Rehm et al., 2009). Alcohol drinking is a very common component of social culture for Korean adults. Among Korean adults, 81.6% of men and 52.4% of women in Korea drink alcohol. The mean amount of per capita alcohol consumption is 30.1 g/day for men and 6.6 g/day for women, according to Korean statistical data (Korea Centers for Disease Control and Prevention, 2010). A high prevalence of alcohol drinking could affect public health in Korea. For instance, alcohol consumption has been shown to substantially influence diabetes mellitus (DM) risk (Baliunas et al., 2009; Roh, Shin, Choi, Lee, & Kim, 2009). Heavy alcohol consumption is associated with a higher risk of DM and metabolic dysfunction, whereas light to moderate alcohol consumption is associated with a lower risk of DM. These mixed findings suggest that the relationship between alcohol consumption and DM risk is U- or J-shaped; however, no consensus has been reached on this matter (Baliunas et al., 2009).

To identify hazardous drinkers (problem drinkers), we used the alcohol-use disorders identification test (AUDIT) questionnaire, which was developed to screen for excessive alcohol drinking and to help health care providers identify people who could benefit from reducing or eliminating alcohol consumption (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). AUDIT includes three domains: hazardous alcohol use (frequency of drinking, typical quantity, and frequency of binge drinking), dependence symptoms (impaired control over drinking, increased salience of drinking, and morning drinking), and harmful alcohol use (guilt after drinking, blackouts, alcohol-related injuries, and others concerned about drinking) (Babor et al., 2001; Skipsey, Burleson, & Kranzler, 1997). AUDIT is a reliable test to assess hazardous and harmful drinking

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and is the best-suited screening tool for our study purposes (Babor et al., 2001; Conigrave, Hall, & Saunders, 1995; Skipsey et al., 1997).

The high-risk drinking group, as screened by the AUDIT tool, includes various ranges of alcohol-drinking patterns in addition to quantity and frequency. Accordingly, AUDIT is used for screening alcohol-use disorders by using a comprehensive concept of disease, including biological and sociological aspects. Participants with high AUDIT scores tend to have impulsive personality traits when intoxicated and when sober. Furthermore, persons with these personalities experience frequent injuries that sometimes result in physical immobility. Decreased physical activity and exercise resulting from injury can lead to weight gain and raise the risk of DM. Thus, classification of alcohol-drinking pattern based on the AUDIT tool might be more effective for early identification of hazardous or harmful drinking than a simple classification based on quantity or frequency.

There are few studies that examine the relationship between alcohol-drinking pattern and DM risk, though one previous study did find a relationship between heavy alcohol consumption and DM risk (Roh et al., 2009). We examined the association between prevalence risk of DM and alcohol-drinking pattern according to AUDIT score in a weighted, representative sample of Korean adults.

Methods

Study population

This cross-sectional study was based on data obtained from the 2010–2012 Korean National Health Examination and Nutrition Survey (KNHANES), which is a nationally representative survey performed by the Korean Ministry of Health and Welfare. The sampling units were households that were selected using a stratified, multistage, probability-sampling design according to geographic area, sex, and age group, based on household registries. Sampling weights assigned to each participant indicate the probability of being sampled; thus, we have confidence that these data appropriately represent the entire Korean population. Participants were asked to complete four parts of a questionnaire that consisted of a health interview survey, a health behavior survey, a health examination survey, and a nutrition survey. At the time of the 2010–2012 KNHANES, citizens had the right to refuse to participate according to the National Health Enhancement Act. All citizens who agreed to participate submitted written informed consent. The Korea Centers for Disease Control and Prevention also received participants' consent to use blood samples for further research. Trained staff carried out standard physical examinations on all participants. Participants answered questionnaires regarding their lifestyle behaviors, including cigarette smoking, alcohol drinking, physical activities, and dietary patterns. We excluded individuals younger than 20 years of age, those without laboratory data ($n = 802$), those missing data regarding alcohol consumption ($n = 2738$), and those who had not fasted overnight prior to blood sampling ($n = 1733$). After these exclusions, 12,486 participants (5551 men and 6935 women) were included in our final analysis. This study was approved by the Institutional Review Board of Yonsei University College of Medicine.

Measurement of anthropometric and laboratory data

Participants' body mass and height were measured to the nearest 0.1 kg and 0.1 cm while wearing light indoor clothing and after removing shoes. Body mass index was defined as the ratio of mass (kg) to squared height (m^2). Medical staff took participants' blood pressure using the right arm with a standard mercury sphygmomanometer (Baumanometer; Baum, Copiague, NY, USA). Blood pressure readings were measured twice at a 5-min interval and then averaged. After overnight fasting, blood samples were obtained from each participant's antecubital vein. Fasting plasma glucose and total cholesterol, triglycerides, and high-density lipoprotein cholesterol (HDL-C) levels were measured using a Hitachi Automatic Analyzer 7600 (Hitachi, Tokyo, Japan).

Definition of diabetes mellitus and lifestyle factors

DM was defined as having fasting plasma glucose levels ≥126 mg/dL or taking glucose-lowering medication, including insulin injections (American Diabetes Association, 2014). We could not include diagnostic criteria for hemoglobin A1C (HbA1C) and the oral glucose tolerance test (OGTT), because HbA1C levels were only assessed for participants with diabetes or hyperglycemia (fasting plasma glucose ≥126 mg/dL) and OGTT was not conducted in the 2010–2012 KNHANES. Therefore, the diagnostic criteria of DM used in this research did not correspond with the current diagnostic criteria proposed by the American Diabetes Association. Additionally, due to a lack of relevant data on insulin and c-peptide levels, we could not distinguish between patients with type 1 and type 2 diabetes.

Lifestyle data were obtained from a questionnaire about recent and current behavior. AUDIT scores were categorized into three groups: low-risk drinkers, 0–7; intermediate-risk drinkers, 8–14, and high-risk drinkers, ≥15 points (Babor et al., 2001). These cut-off points were based on results from previous studies regarding hazardous and harmful drinking (Babor et al., 2001; Conigrave et al., 1995; Skipsey et al., 1997). To assess physical activity levels, the International Physical Activity Questionnaire (IPAQ) short form, which was translated into Korean, was used (Oh, Yang, Kim, & Kang, 2007). According to the questionnaire, a regular exerciser was defined as an individual who incorporated ≥20 min of vigorous-intensity physical activity ≥3 days a week or ≥30 min of light/moderate-intensity physical activity ≥5 days a week. We defined someone as an "ever smoker" if they had smoked ≥100 cigarettes over their lifetime.

Statistical analysis

To ensure we were using a dataset that represented the Korean population without biased estimates, sampling weights were applied to each individual's data. The means of continuous variables, such as age, body mass index, blood pressure, total cholesterol, triglycerides, HDL-C, fasting plasma glucose, calorie intake, and household income were calculated using complex samples plan for descriptive analysis. Complex samples plan for chi-square tests were used to calculate means of categorical variables, including high-risk drinker, regular exerciser, ever smoker, drinking frequency, drinking quantity, frequency of binge drinking, and diabetes. General linear models (GLM) were employed to analyze differences in the variables according to the AUDIT group by gender. All data are presented as mean ± standard error (SE). Multivariate logistic regression analyses were performed to calculate the odds ratios (ORs) for diabetes mellitus according to alcohol-drinking patterns, after adjusting for confounding variables. All analyses were conducted using SAS, version 9.4 (SAS Institute, Cary, NC, USA). All statistical tests were two-sided and statistical significance was set at a p value <0.05.

Results

The characteristics of the study population (unweighted number of participants, 5551 men and 6935 women) are given in Table 1. The mean age and fasting plasma glucose levels were 44.2