Incidence, inhospital mortality, and readmission among patients with alcoholic hepatitis in Korea: A nationwide study

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Running head: Epidemiology of alcoholic hepatitis in Korea

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This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/jgh.14513

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List of Abbreviations: AH, alcoholic hepatitis; AUD, alcohol use disorder; ALD, alcoholic liver disease; OR, odds ratio; CI, confidence interval; NHI, National Health Insurance; HIRA, Health Insurance Review and Assessment; KNSO, Korea National Statistics Office

Electronic word count: 2824
Number of figures and tables: 7
Abstract word count: 250

Declaration of conflict of interest: The authors declare no conflicts of interest that pertain to this work.
Financial support: No financial support was received to produce this manuscript.
Authors contributions: W. K., K. L. L, J. Y. L., and Y. C. contributed resources and designed the research; J. Y. L. and J. K. performed the experiments; D. H. L., Y. J. J., B. G. K., K. L. L., and W. K. contriubuted for acquisition of data; J. Y. L., Y. C., M. H. H., W. K. and K. L. L. analyzed and interpreted the data; J. Y. L., Y. C., and W. K. wrote the manuscript. All authors were involved in critical revision of the manuscript for important intellectual content.

Abstract

Background and Aim: Alcoholic hepatitis (AH) ranks among the most costly diseases in South Korea. However, accurate hospitalization incidence rates, mortality rates, and contributing factors have not been investigated in South Korea. This study aimed to provide the nationwide incidence of hospitalization, inhospital mortality, and readmission rates for South Korean patients with AH.

Methods: Using the Korean Health Insurance Review and Assessment service database, a total of 39,800 inpatient cases from 2008 to 2012 were identified based on the *International Classification of Diseases, 10th Revision* diagnosis code for AH (K70.1). Standardized hospitalization incidence and mortality rates were calculated, and logistic regression analysis was performed to identify risk factors for inhospital mortality and readmission. Follow-up data for those admitted in 2008 were collected to assess readmissions.

Results: The standardized incidence rate for AH hospitalization per 10^5 person/year decreased from 19 in 2008 to 14 in 2012 (P=0.001). The annual inhospital mortality rate ranged from 0.2% to 0.5%. Inhospital mortality was significantly higher in older patients (odds ratio [OR], 1.36) and those with cirrhosis (OR, 4.40). The readmission rate for patients admitted in 2008 was 34.0%. Male sex (OR, 1.21) and low economic status (OR, 2.35) were significantly associated with readmission, whereas older age (OR, 0.96), cirrhosis (OR, 0.77), and urban residency (OR, 0.68) were inversely associated with readmission.

Conclusions: This study captured a 5-year epidemiologic period in South Korea of patients with AH to reflect the real burden of AH and to provide valuable information to policymakers assessing public health priorities.

Key words: alcoholic hepatitis, hospitalization, incidence, mortality, readmission

Introduction

Alcohol consumption contributes markedly to the global burden of death and disability and alcoholic liver diseases (ALD) constitutes the major portion of alcohol-related mortality and morbidity.[1-3] ALD includes steatosis, steatohepatitis, fibrosis, cirrhosis, and hepatocellular carcinoma. Alcoholic hepatitis (AH) is a clinical syndrome characterized by acute hepatic decompensation and portal hypertension resulting from chronic and heavy alcohol abuse.[4, 5] AH is usually considered a treatable form of ALD, although it may progress to acute on chronic liver failure occasionally, requiring specific pharmacotherapy such as corticosteroids treatment.[6] However, accurate hospitalization incidence, mortality, and readmission rates, and contributing factors in AH have rarely been investigated.

South Korea has a unique health care security system that is a nationwide compulsory social insurance system managed and supervised by the government. The two main components are the Korean National Health Insurance (KNHI) program, which covers nearly the entire South Korean population, and the Medical Aid program, which covers the low-income population (approximately 3% of the total population). The Health Insurance Review and Assessment (HIRA) service reviews the cost of health care benefits and evaluates the reasonableness of the health care services provided by medical institutions based on NHI and Medical Aid programs. A primary focus of HIRA is on the development of criteria for review and evaluation, as well as on other matters related to the review of medical costs.[7] The HIRA database includes the entire South Korean population and contains information on the diagnostic codes for claims made, medications, and medical services.[8] Thus, the HIRA database provides a useful and reliable source of epidemiologic data, enabling nationwide studies.[9] All medical costs associated with AH treatment, including laboratory examinations, medications, surgeries, and hospitalization, are reimbursed by the health security system, and all related records are stored in HIRA databases.[10]

In the present study, we used HIRA databases to investigate the nationwide incidence of hospitalization, inhospital mortality, and readmission rates in patients with AH in South Korea and to identify the risk factors for these events.

Methods

Data Source and Patient Selection

The annual admission cases associated with AH from 2008 to 2012 were extracted from the HIRA database by searching for the *International Classification of Diseases-10th Revision (ICD-10)* primary diagnosis code K70.1 in South Korea, which had a population of 48.9 million during the study period. Sex, type of insurance, residential area, and co-morbidity were also collected as candidate covariates that could affect the admission associated with AH. For this study, two co-morbid conditions were defined: liver cirrhosis (*ICD-10* codes: K70.2, K70.3, K70.4, and K74.6) and alcohol use disorder (AUD; *ICD-10* codes: F10.2, F10.7, F10.8, F10.9, and T51.x) (Table S1).[11]

Incidence of Hospitalization

The annual incidence is the number of new cases of AH within a specified period of time, which in the present study was 1 year. In cases of repeated admission within a specific year, only the earliest (oldest) claims data were retained. Rather than using the mid-year population to calibrate annual incidence rates, the residential population from the Korea National Statistics Office (KNSO) for producing annual crude incidence rates was used. All incidence rates were standardized by sex and age using the 2012 South Korean population data from the KNSO and were finally computed as the annual number per 10^5 persons.

Inhospital Mortality

The annual inhospital mortality rates were calculated as the number of mortality case in a given year divided by the total number of admission incidence in that year. Mortality was defined as death associated with hospital admission and discharge. Therefore, in the current study, mortality refers only to inhospital mortality. The annual mortality rates associated with AH are presented stratified by age, sex and co-morbidities including cirrhosis and AUD.

Readmission

To calculate the readmission rate, a retrospective cohort based on 5-year claims data was used that included patients who were hospitalized for AH in 2008 but did not die at the first admission. All admission histories were collected for the 5-year periods and each person's

admission history was reviewed. With regard to the presence and number of readmissions, the interval was restricted to be longer than 30 days between both starting dates of hospitalizations recorded on the claims data (Figure S1). If the start date of second hospital admission was less than 30 days from that of the first admission, it was counted as one admission event. The baseline socio-demographic characteristics were investigated based on 2008 records. The readmission rate was calculated as the number of patients who had experienced readmission from 2009 to 2012 divided by the number of patients who were hospitalized for AH in 2008.

Statistical Analyses

Frequency analyses were conducted for the incidence of admission, inhospital mortality, and readmission rates associated with AH from 2008 to 2012, categorized by sex, age group, type of health insurance, residential area, and co-morbid conditions. For statistical analyses, the actual age (a continuous variable) was transformed into age groups (each decade categorized from 0 to 9), and other variables were used as binary variables. Multivariable logistic regression was then performed to identify the risk factors contributing to inhospital mortality and readmission, after adjusting for the aforementioned independent variables. All the analyses were conducted using SAS, version 9.2 (SAS Institute, Inc., Cary, NC) and figures were generated using R 2.14.2 (The Comprehensive R Archive Network). All statistical tests were two-sided, and *P*-values < 0.05 were considered statistically significant.

Ethical Statement

The current study was conducted according to the principles expressed in the Declaration of Helsinki. The institutional review board of the Seoul Metropolitan Government Seoul National University Boramae Medical Center approved this study.

Results

Baseline Demographics

During the 5-year study period from 2008 to 2012, 39,800 cases were collected (8676, 8338, 7799, 7667, and 7320, each year respectively). As of 2012, 7,320 inpatients with the mean age of 51.1 years (male, 51.7 years vs. female, 46.5 years) were hospitalized for AH in South Korea. Among the 7,320 patients, 87.8% were male. 25.9% of the patients were the beneficiaries of the Medical Aid program, and 16.5% were rural residents. Regarding co-morbid conditions, 5.1% of the patients had cirrhosis, and 16.9% had AUD.

The distribution ranges of variables from 2008 to 2012 were as follows: annual number of admissions, 7320–8676; male sex, 87.8%–90.4%; age, 49.7–51.1 years; rural area, 14.0%–16.9%; Medical Aid beneficiary, 25.9%–33.2%; comorbid cirrhosis, 4.5%–5.3%; and comorbid AUD, 16.9%–18.5%. Table 1 presents detailed patient demographic and clinical characteristics for the annual admissions from 2008 to 2012.

Admission Incidence Associated with Alcoholic Hepatitis

The standardized annual incidence rate for admission associated with AH in 2012 was 14 people per 10^5 persons (male, 25 per 10^5 persons vs. female, 4 per 10^5 persons). The annual incidence rate decreased from 19 to 14 per 10^5 persons during the 5-year study period (P = 0.001). The admission incidence rate for men dropped from 35 to 25 per 10^5 persons (P = 0.001), whereas women showed a steady admission incidence rate of 3 or 4 per 10^5 persons (P = 0.638) (Figure 1). Age was assessed by decade as nine categories, starting with 0 to 9 years old and ending at the 9th category that included ages from 80 to 100 years. The standardized annual incidence rates for each category are presented in Figure 1. The admission incidence rate for patients < 60 years was higher than that for patients ≥ 60 years (P < 0.0001; Table 4).

Inhospital Mortality and Risk Factors

The annual inhospital mortality rate doubled from 0.23% to 0.46% during the 5-year study period. The annual number of admissions decreased from 8,676 to 7,320, whereas the number of deaths increased from 20 to 34 (Table 2). The inhospital mortality rate for women in 2012 (0.67%) was three times as high as that in 2009 (0.23%), which was not statistically

significant (P = 0.289). In 2012, the inhospital mortality rate in women (0.67%) was 1.52 times as high as that in men (0.44%), which was not statistically significant (P = 0.296) (Figure 2A).

Logistic regression was performed to identify the risk factors for inhospital mortality, after adjusting for the effects of explanatory variables (Table 3). Being in the older age group or having concomitant cirrhosis were statistically significant variables associated with inhospital mortality. For each increased decade of age, the risk of mortality increased by 36.3% (odds ratio [OR], 1.36; 95% CI, 1.18–1.58; $P < 0.0001$). In particular, if a patient with AH was also diagnosed with liver cirrhosis, the mortality risk increased by 4.4 times (OR, 4.4; 95% CI, 2.79–6.94; $P < 0.0001$) (Figure 2B). There was no significant difference for inhospital mortality among patients with or without AUD (OR, 0.64; 95% CI, 0.37–1.09; P = 0.101) (Figure 2C). Patients ≥ 60 years experienced significantly higher risk of inhospital mortality as compared to patients < 60 years (OR, 1.43; 95% CI, 1.18–1.74; $P < 0.0001$) (Figure 2D).

Readmission and Risk Factors

We further analyzed the 5-year HIRA data of 8,656 patients (20 patients were excluded because these patients died during the first hospitalization) admitted in 2008 to assess how many patients were readmitted through 2012 and to identify the risk factors for readmission. Among them, 2,944 (34.0%) patients experienced at least one readmission associated with AH (Table 4).

Logistic regression analysis was performed to identify the risk factors associated with readmission. The results indicated that all variables (sex, age group, comorbid cirrhosis, type of health insurance, and residential area) were significantly associated with readmission. Compared with women, men had a 21% higher probability of readmission (OR, 1.21; 95% CI, 1.12–1.32; $P < 0.0001$). For each increased decade of age, the risk of readmission decreased by 4.4% (OR, 0.96; 95% CI, 0.92–0.99; P = 0.036). Young age group was a risk factor contributing to increase readmission due to AH. In the presence of comorbid cirrhosis, the risk of readmission was reduced by 23% (OR, 0.77; 95% CI, 0.60–0.99; P = 0.038). Medical Aid beneficiaries had a 2.35 times higher risk of readmission than patients covered by NHI (OR, 2.35; 95% CI, 2.14–2.58; $P < 0.0001$). Patients living in urban areas had a 32% lower risk of readmission than those living in rural areas (OR, 0.68; 95% CI, 0.60–0.77; P <

0.0001). Comorbid AUD showed a trend toward increased risk of readmission by 13% (OR, 1.13; 95% CI, 1.00–1.28; $P = 0.052$) (Table 5).

Discussion

In this population-based cohort study of all patients with a hospital discharge diagnosis of AH in South Korea from 2008 to 2012, the overall hospitalization incidence rate for AH was 14 to 19 per 10^5 persons/year. The hospitalization incidence rate was higher in men than in women, and the annual incidence rate of AH hospitalization gradually decreased from 19 to 14 per 10^5 persons/year between 2008 and 2012. Although the incidence rate decreased markedly for men, it remained steady for women during the study period. Older age and comorbid cirrhosis were significant determinants of inhospital mortality. Cirrhosis and AUD were significant risk factors for readmission of patients with AH in South Korea.

The strength of the current study is that we were able to examine data from all hospitals and medical facilities in South Korea during a 5-year period because they are under a compulsory medical insurance system (KNHI) administered by the South Korean government. These government-monitored databases (HIRA) provide information on the whole population of South Korea and include complete follow-up data. To the best of our knowledge, this is the largest population-based study investigating the incidence of admission, inhospital mortality, and readmission in patients with AH.

Accurate incidence and prevalence rates of AH are unknown because AH usually presents without any specific symptom and often remains undiagnosed. One previous US study showed an average of 4.5 hospitalizations/year per 10^5 persons from 1998 to 2004.[12] In a Danish population study, the average annual hospitalization incidence rate per 10^5 persons was 3.7 to 4.6 in men and 2.4 to 3.4 in women.[13] The annual incidence rate of admission for AH detected in the present study was higher in South Korea than in Western countries, although previous Western epidemiologic studies reviewed old data and excluded psychiatric admissions.[12, 13] There are at least two plausible explanations for the higher incidence of admission rate we found in South Korea. First, high alcohol consumption per capita, high prevalence of risky drinking patterns, and high consumption rate in the form of spirits rather than beer or wine all might have contributed to a larger number of AH hospitalizations in South Korea.[14] Second, given the lower inhospital mortality in South Korea (0.2%–0.5%)

compared with that in Western countries (20.2%, 15%, and 6.8% in previous large studies),[12, 13, 15] a significant portion of admitted patients might have had a milder form of AH in South Korea than in Western countries.

The decrease we found for overall hospitalizations was attributed to the decrease in male patient hospitalizations (Figure 1), which differed from the trend previously observed.[12, 13] However, the standardized hospitalization incidence rate per 10^5 persons for women did not decrease during the study period. These findings suggest that alcohol consumption was decreasing in men during the 5-year study period but not in women.

Consistent with the results of previous studies, the presence of cirrhosis and older age were statistically significant risk factors for inhospital mortality.[13, 15, 16] However, the overall effect of sex on inhospital mortality was not statistically significant (Table 3), although inhospital mortality in women slightly increased from 0% to 0.67% during the study period. Notably, in 2012, the morality rate in women (0.67%) was almost twice that in men (0.44%). There is no concrete evidence to suggest that the prognosis of AH in women is worse than that in men. However, given that overall alcohol consumption is generally lower in women, alcohol may affect women more severely than men, accounting for higher susceptibility to ALD in women than in men.[17]

We found that the hospital readmission rate for patients with AH in South Korea (2008–2012) was 34%. The risk factors that were associated with readmission included male, young age, the absence of cirrhosis, low economic status, and rural area residency. Given the drinking pattern shown in previous studies,[18, 19] it can be postulated that young and non-cirrhotic patients have a greater chance to survive the event and that patients with low income, rural residency, and AUD are likely exposed to alcohol more frequently after discharge.

Compared with patients without AUD, those with AUD had a higher risk of readmission without an increased risk of inhospital mortality. Patients with AH who experience irreversible immune paralysis at the first admission usually do not recover from a severely de-conditioned state, and eventually die from multiple organ failure.[20, 21] By contrast, patients with AH and AUD who survive the first admission usually recover from deconditioning and eventually have a greater chance of alcohol recidivism, leading to repeated hospitalization. Those patients might not experience immune paralysis but recover from the repeated events of AH, leading to a higher incidence rate of readmission.

Compared with patients without liver cirrhosis, those with liver cirrhosis had lower risk of

readmission and higher risk of inhospital mortality. Patients with alcoholic cirrhosis have a high prevalence of complications such as variceal bleeding and hepatic encephalopathy at the time of cirrhosis diagnosis. For the patients with alcoholic cirrhosis who experience hepatic encephalopathy, the 1-year mortality is up to 85%.[11] Due to high mortality of patients with alcoholic cirrhosis, the risk of readmission for patients with cirrhosis might be lower than that of patients without cirrhosis,

There are a few potential limitations of the present study. First, case selection was solely based on a search of medical record for a diagnostic code input by physicians who manage AH. Most of the diagnoses were not based on liver biopsy; thus, information (misclassification) bias in coding could exist, depending on the physician. Second, because a diagnosis of cirrhosis was also made based on diagnostic coding, there were potential risks for overdiagnosis and underdiagnosis. Third, the ICD-10 code for AH captures only a small subset of AH, which may be subject to underestimation. Fourth, mortality refers only to inhospital mortality. Therefore, inhospital mortality might be underestimated. Finally, because the HIRA database does not provide laboratory, radiologic, or medical data, we were unable to identify critical information, such as the presence of viral hepatitis or other concomitant chronic liver disease.[12]

In conclusion, we examined the epidemiological data over a 5-year period to assess hospitalization, inhospital mortality, and readmission rates for patients with AH in South Korea. The overall hospitalization incidence rates for AH decreased from 2008 to 2012, especially in men. Older age and the presence of cirrhosis were significantly associated with inhospital mortality due to AH, whereas male sex, younger age, the absence of cirrhosis, the presence of AUD, rural residency, and low economic status were associated with readmission. These results provide valuable information for deciding public health policy priorities regarding ALD burden.

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Tables

Table 1. Demographic and clinical characteristics of inpatients with alcoholic hepatitis nationwide in South Korea, 2008-2012

Variables	Category	Year				
		2008	2009	2010	2011	2012
Total, n (%)		8,676 (100)	8,338 (100)	7,799 (100)	7,667 (100)	7,320 (100)
Sex, n (%)	Male	7,839 (90.4)	7,484 (89.8)	6,983 (89.5)	6,817 (88.9)	6,429 (87.8)
	Female	837 (9.6)	854 (10.2)	816 (10.5)	850 (11.1)	891 (12.2)
Age†	Total	49.7 (11.0)	49.8 (11.1)	50.5 (10.9)	51.2 (11.1)	51.1 (11.1)
	Male	50.1 (10.6)	50.3 (10.6)	51.0 (10.6)	51.7 (10.7)	51.7 (10.6)
	Female	46.2 (13.0)	46.2 (13.6)	46.0 (12.5)	47.1 (13.2)	46.5 (13.4)
Age, n (%)	0–59 years	7,182 (82.8)	6,905 (82.8)	6,356 (81.5)	6,140 (80.1)	5,892 (80.5)
	≥60 years	1,494 (17.2)	1,433 (17.2)	1,443 (18.5)	1,527 (19.9)	1,428 (19.5)
Residential area, n (%)	Urban	7,459 (86.0)	6,981 (83.7)	6,482 (83.1)	6,404 (83.5)	6,115 (83.5)
	Rural	1,217 (14.0)	1,357 (16.3)	1,317 (16.9)	1,263 (16.5)	1,206 (16.5)
Type of public medical insurance, n (%)	Medical Aid	2,884 (33.2)	2,666 (32.0)	2,306 (29.6)	2,035 (26.5)	1,898 (25.9)
	Non-Medical Aid	5,792 (66.8)	5,672 (68.0)	5,493 (70.4)	5,632 (73.5)	5,422 (74.1)
Cirrhosis, n (%)	Yes	389 (4.5)	416 (5.0)	414 (5.3)	381 (5.0)	371 (5.1)
	No	8,287 (95.5)	7,922 (95.0)	7,385 (94.7)	7,286 (95.0)	6,949 (94.9)
Alcohol use disorder, n (%)	Yes	1,606 (18.5)	1,461 (17.5)	1,321 (16.9)	1,370 (17.9)	1,234 (16.9)
	No	7,070 (81.5)	6,877 (82.5)	6,478 (83.1)	6,297 (82.1)	6,086 (83.1)

†Age is expressed as mean (standard deviation).

Table 2. Demographic and clinical characteristics of patients with alcoholic hepatitis nationwide based on inhospital mortality data in South Korea, 2008–2012

Variable	Year	Category	Total No.	Dead		Alive		By year†	Pooled‡
				n	% or Mean (SD)	n	% or Mean (SD)	*P*-value	*P*-value
Total	2008		8,676	20	0.2%	8,656	99.8%		
	2009		8,338	20	0.2%	8,318	99.8%		
	2010		7,799	26	0.3%	7,773	99.7%		
	2011		7,667	25	0.3%	7,642	99.7%		
	2012		7,320	34	0.5%	7,286	99.5%		
Age§	2008	Total	8,676	20	56.6 (12.7)	8,656	49.7 (11.0)	0.005	0.001
	2009		8,338	20	51.1 (11.2)	8,318	49.8 (11.1)	0.625	
	2010		7,799	26	56.3 (14.3)	7,773	50.4 (10.9)	0.045	
	2011		7,667	25	52.9 (13.7)	7,642	51.2 (11.1)	0.428	
	2012		7,320	34	55.6 (13.7)	7,286	51.0 (11.1)	0.018	
	2008	Male	7,839	20	56.6 (12.7)	7,819	50.1 (10.6)	0.006	0.001
	2009		7,484	18	51.9 (11.4)	7,466	50.3 (10.6)	0.516	
	2010		6,983	24	55.1 (13.1)	6,959	51.0 (10.6)	0.057	
	2011		6,817	20	55.8 (13.0)	6,797	51.7 (10.7)	0.087	
	2012		6,429	28	55.6 (12.0)	6,401	51.7 (10.6)	0.049	
	2008	Female	837	0	-	837	46.2 (13.0)	-	0.333
	2009		854	2	43.5 (4.9)	852	46.2 (13.7)	0.781	
	2010		816	2	71.5 (26.2)	814	46.0 (12.4)	0.004	
	2011		850	5	41.6 (11.3)	845	47.2 (13.2)	0.348	
	2012		891	6	55.2 (21.2)	885	46.4 (13.3)	0.110	

Sex	2008	Male	7,839	20	0.3%	7,819	99.7%	0.252*	0.630
		Female	837	0	0%	837	100%		
	2009	Male	7,484	18	0.2%	7,466	99.8%	1.0*	
		Female	854	2	0.2%	852	99.8%		
	2010	Male	6,983	24	0.3%	6,959	99.7%	1.0*	
		Female	816	2	0.2%	814	99.8%		
	2011	Male	6,817	20	0.3%	6,797	99.7%	0.189*	
		Female	850	5	0.6%	845	99.4%		
	2012	Male	6,429	28	0.4%	6,401	99.6%	0.296*	
		Female	891	6	0.7%	885	99.3%		
Residential area	2008	Rural	1,217	1	0.1%	1,216	99.9%	0.345*	0.331
		Urban	7,459	19	0.3%	7,440	99.7%		
	2009	Rural	1,357	3	0.2%	1,354	99.8%	1.0*	
		Urban	6,981	17	0.2%	6,964	99.8%		
	2010	Rural	1,317	1	0.1%	1,316	99.9%	0.11*	
		Urban	6,482	25	0.4%	6,457	99.6%		
	2011	Rural	1,263	5	0.4%	1,258	99.6%	0.591*	
		Urban	6,404	20	0.3%	6,384	99.7%		
	2012	Rural	1,205	6	0.5%	1,199	99.5%	0.852	
		Urban	6,114	28	0.5%	6,086	99.5%		
Type of public medical insurance	2008	Medical Aid	2,884	4	0.1%	2,880	99.9%	0.208	0.237
		Non-Medical Aid	5,792	16	0.3%	5,776	99.7%		
	2009	Medical Aid	2,666	7	0.3%	2,659	99.7%	0.771	
		Non-Medical Aid	5,672	13	0.2%	5,659	99.8%		
	2010	Medical Aid	2,306	8	0.3%	2,298	99.7%	0.893	

		Non-Medical Aid	5,493	18	0.3%	5,475	99.7%		
	2011	Medical Aid	2,035	4	0.2%	2,031	99.8%	0.232	
		Non-Medical Aid	5,632	21	0.4%	5,611	99.6%		
	2012	Medical Aid	1,898	8	0.4%	1,890	99.6%	0.749	
		Non-Medical Aid	5,422	26	0.5%	5,396	99.5%		
Cirrhosis	2008	Yes	389	3	0.8%	386	99.2%	0.058*	< 0.0001
		No	8,287	17	0.2%	8,270	99.8%		
	2009	Yes	416	6	1.4%	410	98.6%	0.0003*	
		No	7,922	14	0.2%	7,908	99.8%		
	2010	Yes	414	2	0.5%	412	99.5%	0.647*	
		No	7,385	24	0.3%	7,361	99.7%		
	2011	Yes	381	6	1.6%	375	98.4%	0.001*	
		No	7,286	19	0.3%	7,267	99.7%		
	2012	Yes	371	6	1.6%	365	98.4%	0.007*	
		No	6,949	28	0.4%	6,921	99.6%		
Alcohol use disorder	2008	Yes	1,606	4	0.2%	1,602	99.8%	0.777*	0.101
		No	7,070	16	0.2%	7,054	99.8%		
	2009	Yes	1,461	0	0%	1,461	100%	0.036*	
		No	6,877	20	0.3%	6,857	99.7%		
	2010	Yes	1,321	4	0.3%	1,317	99.7%	1.0*	
		No	6,478	22	0.3%	6,456	99.7%		
	2011	Yes	1,370	4	0.3%	1,366	99.7%	1.0*	
		No	6,297	21	0.3%	6,276	99.7%		
	2012	Yes	1,234	3	0.2%	1,231	99.8%	0.21	
		No	6,086	31	0.5%	6,055	99.5%		

*Because the frequency was lower than expected, the *P*-value is from Fisher's exact test.

†Statistical test was conducted for each year, and all variables except age were analyzed using chi-square tests. Age was compared using *t*-tests.
‡Statistical analysis was conducted for 5-year pooled data sets, and statistical methods are the same as those used for the single-year tests.
§Age is expressed as mean (standard deviation).

Table 3. Odds ratios for logistic regression analysis of the inhospital mortality among patients with alcoholic hepatitis

Variable	OR	95% CI	*P*-value
Male	0.79	0.46–1.37	0.402
Age*	1.36	1.18–1.58	< 0.0001
Medical aid	0.87	0.58–1.31	0.512
Cirrhosis	4.40	2.79–6.94	< 0.0001
Alcohol use disorder	0.64	0.37–1.09	0.101
Urban resident	1.33	0.78–2.25	0.298

Abbreviations: OR, odds ratio; CI, confidence interval

*Age assessed by decade using nine categories, starting with 0 to 9 years old and ending at the 9th category that included ages from 80 to 100 years.

Table 4. Demographic and clinical characteristics of nonreadmitted vs. readmitted patients' demographic characteristics in the alcoholic hepatitis cohort, South Korea (2008–2012)*

Variable	Category	No.	Nonadmitted		Readmitted		*P*-value
			n	%	n	%	
Total		8,656	5,712	66.0	2,944	34.0	
Type of public medical insurance	Non-Medical Aid	5,675	4,145	73.0	1,530	27.0	< 0.0001
	Medical Aid	2,981	1,567	52.6	1,414	47.4	
Residential area	Urban	7,440	5,031	67.6	2,409	32.4	< 0.0001
	Rural	1,216	681	56.0	535	44.0	
Sex	Male	7,819	5,093	65.1	2,726	34.9	< 0.0001
	Female	837	619	74.0	218	26.0	
Age	0–59 years	7,169	4,623	64.5	2,546	35.5	< 0.0001
	≥60 years	1,487	1,089	73.2	398	26.8	
Cirrhosis	Yes	338	243	71.9	95	28.1	0.019
	No	8,318	5,469	65.7	2,849	34.3	
Alcohol use disorder	Yes	1,392	891	64.0	501	36.0	0.089
	No	7,264	4,821	66.4	2,443	33.6	

*Chi-square test was conducted for all variables ex.cept for age, which was compared using *t*-tests.

Table 5. Odds ratios from logistic regression analyses of readmissions for patients with alcoholic hepatitis

Variable	OR	95% CI	*P*-value
Male	1.21	1.12–1.32	< 0.0001
Age*	0.96	0.92–0.99	0.036
Cirrhosis	0.77	0.60–0.99	0.038
Alcohol use disorder	1.13	1.0–1.28	0.052
Medical Aid	2.35	2.14–2.58	< 0.0001
Urban residency	0.68	0.60–0.77	< 0.0001

Abbreviations: OR, odds ratio; CI, confidence interval

*Age assessed by decade as nine categories, starting with 0 to 9 years old and ending at the 9th category that included ages from 80 to 100 years.

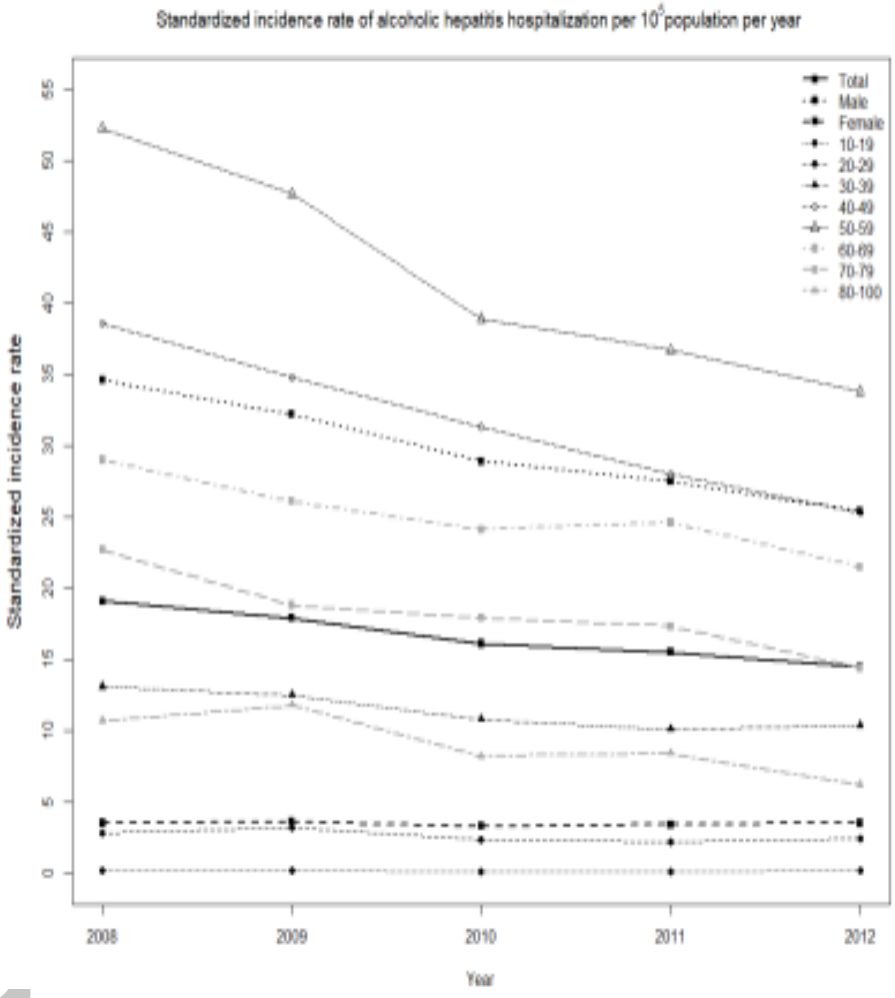

Figure 1. Standardized annual incidence rates of alcoholic hepatitis hospitalization per 10^5 persons in South Korea

The standardized population size is based on that in 2012, and the annual nationwide population information is from the National Statistical Office in South Korea and the incidence of alcoholic hospitalization in age group 0–9 was not presented in the figure due to null incidence.

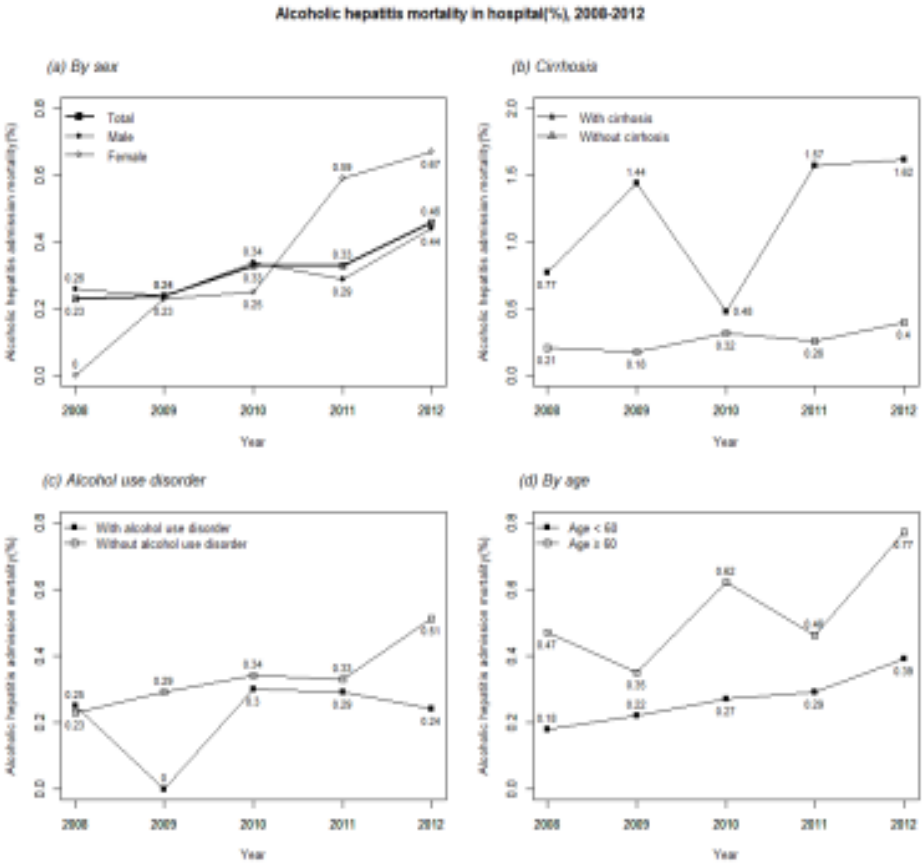

Figure 2. Inhospital mortality rates of patients with alcoholic hepatitis in South Korea, 2008–2012

(A) Inhospital mortality rates of male vs. female patients (B) Inhospital mortality rates of patients with vs. without cirrhosis (C) Inhospital mortality rates of patients with vs. without alcohol use disorder (D) Inhospital mortality rates of patients < 60 years vs. patients ≥ 60 years