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Disparities in mortality for chronic liver disease among Asian subpopulations in the United States from 2007 to 2016

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Summary

The Asian American population is characterized by remarkable diversity. Studying Asians as an aggregate group may obscure clinically meaningful heterogeneity. We performed a population-based study using data from the US National Vital Statistics System. We determined the trends in age-standardized mortality rates for chronic liver disease stratified by aetiology among the most populous US-based Asian subgroups (Asian Indians, Chinese, Filipino, Japanese, Korean and Vietnamese) and compared it to non-Hispanic whites. Annual percentage change was calculated to determine temporal mortality patterns using joinpoint analysis. Hepatitis C virus-related mortality rates were higher in non-Hispanic whites compared to individual Asian subgroups, but a sharp decline in mortality rates was noted in 2014 among non-Hispanic whites and all Asian subgroups. Age-standardized hepatitis B virus-related mortality rates were higher in all Asian subgroups as compared to non-Hispanic whites in 2016, with the highest mortality among Vietnamese followed by Chinese. Mortality rates for alcoholic liver disease have been steadily trending upwards in all Asian subgroups, with the highest mortality in Japanese. Overall, age-standardized cirrhosis-related mortality rates were highest in non-Hispanic whites, followed by Japanese, and more distantly by Vietnamese and other subgroups. However, hepatocellular carcinoma-related mortality rates were higher in most Asian subgroups led by Vietnamese, Japanese and Koreans compared to non-Hispanic whites. In this population-based study utilizing a nationally representative database, we demonstrated a marked heterogeneity in the mortality rates of aetiology-specific chronic liver disease among Asian subgroups in the United States.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Keywords

Asian; end-stage liver disease; National Vital Statistic System

1 | INTRODUCTION

The Asian population has been the fastest growing racial group since 2000 in the United States with a population totaling 21 million in 2015.^{1,2} Asians' share of the total US population in 2014 was 5.4% and will account for 9.3% of the total US population in 2060.¹ Understanding the health and mortality of this growing population and related disparities within the Asian sub-ethnicities or subgroups has emerged as an area of focus for future research. The largest Asian subgroups in the United States are Asian Indians, Chinese, Filipinos, Japanese, Koreans, and Vietnamese; these six subgroups make up 85% of the Asian population in the United States based on the 2016 American Community Survey.³ As a single group, Asian Americans showed remarkable heterogeneity, reflective of different countries of origin, cultural diversity, educational attainment, socio-economic status, immigration status, lifestyle patterns, insurance coverage, and accessibility of health services.^{4,5} Therefore, aggregating Asian Americans into a single group can mask important differences in disease burden and mortality rates. A few studies have described national trends in the health and mortality rates of Asians,^{6–8} but overall mortality is lower in Asian Americans compared to non-Hispanic whites.⁶ While these data are scant, a small number of studies have examined the trends in the mortality rates among Asian sub-groups with results demonstrating a remarkable heterogeneity in the leading causes of death (e.g., cancer, cardiovascular disease, and stroke) between Asian American subgroups.^{5,6} However, aetiology-specific mortality rates in the setting of chronic liver disease among Asian subgroups in the United States on a national level have not been established and have been a limiting factor in improving access to care and addressing health disparities. Several regional studies on state and city levels have attempted to describe the prevalence and patterns of aetiology-based chronic liver disease in Asian subgroups in the United States. These data showed marked differences in the prevalence of chronic liver diseases among Asian subgroups. In terms of chronic hepatitis B virus (HBV) infection, contrary to a lower prevalence rate of 0.5% in the general US population, the prevalence among Asian subgroups and communities ranges widely from 9% to 25%.^{9–12} Regarding chronic hepatitis C virus (HCV) infection, estimates of national prevalence range from 1.6% to 2%,¹³ but the prevalence of HCV in Asian subgroups ranges from 2.9% to 5.2% in local community-based screening studies.^{14–16} These data emphasize the importance of improving the understanding of aetiology-based prevalence, trends, and outcomes of cirrhosis, hepatocellular carcinoma (HCC) and chronic liver disease among Asian subgroups. We hypothesized that there are disproportionate differences in chronic liver disease-related mortality across Asian subgroups in the United States, which potentially resulted in obscure heterogeneity that is not characterized and masked by aggregating Asians into a single group. We examined temporal trends in aetiology-based chronic liver disease-related mortality rates utilizing the US National Vital Statistics System (NVSS) database. We focused on HCV, alcoholic liver disease (ALD), HBV, cirrhosis, and HCC among the six

largest Asian subgroups (Asian Indians, Chinese, Filipinos, Japanese, Koreans and Vietnamese) from 2007 to 2016.

2 | MATERIALS AND METHODS

2.1 | Study data

We utilized deidentified US national mortality data from the NVSS and analysed it to determine trends in chronic liver disease-related mortality rates. The NVSS database stores death certificate records of >99% of deaths in the 50 states and the District of Columbia. Data for the population under 20 years of age were excluded as they were unreliable due to a small number of events. Cause of death was coded using the International Classification of Diseases, Tenth Revision (ICD-10), with each observation corresponding to one death and the demographics associated with that person. Cause of death was incorporated into three fields: underlying cause of death, the entity axis and the record axis.¹⁷ The underlying cause of death field lists the one condition which leads to death; the entity axis includes all causes of death on the death certificate; and the record axis provides a modified version of the entity axis in which related conditions are combined, and overlapping conditions are eliminated.¹⁷ Additionally, within the record axis, causes violating logical checks are deleted in an effort to promote specificity and resolve contradictions.¹⁷ As the record axis provides the higher specificity, this was utilized for determining the contributing cause of death.¹⁷

2.2 | Definitions of aetiologies of chronic liver disease

ICD-10 codes were used to determine the contribution of the aetiology of chronic liver disease to mortality based on both the multiple causes of death (combined underlying cause of death and contributing causes through the record axis) and the underlying cause of death. Chronic HCV infection was based on ICD-10 codes B17.1, B18.2 and B19.2; chronic HBV infection was identified with codes B16, B17.0, B18.0, B18.1 and B19.1; ALD was identified with codes K70.0, K70.1, K70.2, K70.3, K70.4 and K70.9. Cirrhosis-related mortality was determined by utilizing the following diagnosis codes: cirrhosis (K70.3, K74.0, K74.1, K74.3, K74.4, K74.5 and K74.6); or portal hypertension (K76.6); and/or diagnosis code for hepatic decompensation in the setting of cirrhosis such as variceal bleeding (I85.0 and I85.1), spontaneous bacterial peritonitis (K65.2). HCC was identified with code C22.0. For sensitivity analyses using underlying cause of death, viral hepatitis was defined as chronic HCV infection and/or chronic HBV infection. Chronic liver disease and cirrhosis were defined as viral hepatitis, ALD and/or cirrhosis. HCC was identified with code C22.0. Demographic information on age, sex, race/ethnicity, education status was also analysed. Race/ethnicity was categorized into mutually exclusive groups or subgroups of non-Hispanic whites and all non-Hispanic Asians. All Asians were further categorized into subgroups of the six largest or most populous Asian ethnicities (referred to as subgroups) in the United States: Asian Indians, Chinese, Filipinos, Japanese, Koreans and Vietnamese.

2.3 | Statistical analysis

Age-standardized mortality rates were determined by dividing the number of deaths from a given chronic liver disease by the total US census population among Asian subgroups and non-Hispanic whites for each year. Age-standardized mortality rates per 100 000 persons by

race/ethnicity and by age groups (20–29, 30–39, 40–49, 50–59, 60–69, 70–79, and 80 years) were calculated. The population for each Asian subgroup was calculated using previously described methods^{6,18} of linear interpolation for 2007–2009, the US Census data for 2010, and extrapolation for 2011–2016 using full population data count stratified by Asian subgroups that were available during the study period from the 2000–2010 US Census reports. Using the direct method, age-specific mortality rates were standardized to the age distribution of the US standard population in 2000. Temporal changes in patterns and trends over time were determined using the National Cancer Institute's joinpoint regression software (version 4.5.0.1). Joinpoint attempts to fit a series of combined linear lines to temporal data, which in this case determines whether the mortality data are best fit by single or multiple trend segments. An annual percentage change (APC) is calculated for each trend segment, and the average APC is a summary measure of the overall trend accounting for transitions within each trend segment. These year-to-year percentage changes in annual age-standardized mortality rate are expressed with a 95% confidence interval (CI) over each trend segment.

3 | RESULTS

From 2007 to 2016, a total of 25 379 768 deaths occurred among US adults aged ≥20 years. Our study population was comprised of 548 505 deaths for all Asian subgroups and 20 144 802 for non-Hispanic whites (Table 1). Compared to non-Hispanic whites, all Asian subgroups except for Japanese tended to be younger at time of death, with 14.2%–24.8% of Asian Indians, Chinese, Filipinos, Koreans and Vietnamese being younger than 60 years old in comparison to 7.5% of Japanese and 15.7% of non-Hispanic whites. Levels of education varied widely in Asian subgroups as Asian Indians, Filipinos and Koreans were more likely to have education beyond high school compared with other Asian subgroups. Vietnamese had the lowest levels of education, followed by Chinese. Socio-economic demographics of the broader population of these Asian subgroups surveyed based on US Census data are summarized in Table S1. Most Asian subgroups are largely composed of new immigrants with exception to Japanese.

3.1 | Age-standardized mortality for chronic liver disease among Asian subgroups

Trends in age-standardized HCV-related mortality rates are shown in Figure 1A and Table 2. There was a steady increase in age-standardized HCV-related mortality in non-Hispanic whites from 2007 to 2014, after which it began to decline at a rate of –5.6% per year (95% CI –8.8 to –2.2). Age-standardized HCV-related mortality was lower in all Asians throughout the study period. The mortality rate for all Asians decreased at an annual rate of 2.8% (95% CI –4.0 to –1.6) from 2007 to 2013 and then markedly declined from 2013 to 2016 at a rate of 11.5% per year (95% CI –14.7 to –8.2). Among Asian subgroups, large differences were observed in HCV-related mortality rates. For example, age-standardized HCV-related mortality was higher in Japanese and Vietnamese than non-Hispanic whites in 2007. Additionally, age-standardized HCV-related mortality rates per 100 000 persons in 2016 were highest in Vietnamese at 5.14 and Japanese at 3.68. Filipinos and Koreans demonstrated a steady decline in age-standardized HCV-related mortality with statistical significance, while other Asians subgroups did not demonstrate a significant change in trend

across the study period with the notable exception for Japanese. From 2007 to 2012, HCV-related mortality remained stable in Japanese (APC 3.1%, CI −6.6 to 13.7), followed by a marked decline in mortality rate from 2012 to 2016 (APC −16.3%, CI −27.2 to −3.9). HBV-related mortality in Asians was markedly higher than in non-Hispanic whites from 2007 to 2016. (Figure 1B, Table 2). The burden of HBV-related mortality among Asian sub-groups varied widely, with the highest age-standardized HBV-related mortality in 2016 in Vietnamese at 4.66 per 100 000 persons, followed by Chinese, and Koreans; Asian Indians had a rate of 0.44, comparable to non-Hispanic whites. Across all subgroups, these rates remained stable with a decreasing tendency over the study period. When we analysed our data using the underlying cause of death for sensitivity analysis (Table S2 and Figure S1), age-standardized viral hepatitis-related mortality rates in Asians declined more markedly over 10 years (APC −6.9%, CI −8.9 to −4.8) compared to all-cause mortality (combined underlying cause of death and contributing causes through the record axis). The decline in the burden of viral hepatitis among certain Asian subgroups including Filipinos, Japanese and Vietnamese demonstrated a statistically significant downtrend. ALD had a substantially higher mortality in non-Hispanic whites as compared to all Asians over the study period (Figure 1C, Table 2). Mortality in non-Hispanic whites steadily increased with a statistically significant average APC of 3.7% (95% CI 3.0 to 4.3) and all Asians with annual 2.2% increase (95% CI 0.5 to 4.0). All Asian subgroups had a higher rate of age-standardized ALD-related mortality in 2016 than in 2007 led by Japanese at 5.48 per 100 000 persons, followed by Asian Indians, Vietnamese, Filipinos, Koreans and Chinese. A statistically significant average APC increase in ALD-related mortality was only noted in Chinese (APC 5.6%, 95% CI 0.4 to 11.1) compared with other Asian subgroups with increasing tendency of a wide range of CI, partly as a result of the small number of outcomes.

3.2 | Age-standardized mortality for cirrhosis and HCC among Asian subgroups

Mortality related to cirrhosis was almost approximately threefold higher among non-Hispanic whites than all Asians through the study period (Figure S2A, Table 3). We observed a statistically significant average APC increase of 3.0% (95% CI 2.6 to 3.4) in non-Hispanic whites, while all Asians remained stable during study periods. Non-Hispanic whites were followed by Japanese among Asian subgroups and then more distantly by Vietnamese and Filipinos. Japanese were the only Asian subgroup to have an appreciably lower mortality rate in 2016 compared to 2007, though Vietnamese had a small decrease from observed as well.

As shown in Figure S2B, all Asians had a higher age-standardized mortality rate than non-Hispanic whites for HCC-related mortality. There was a statistically significant trend segment decrease in HCC-related mortality among all Asians overall (APC −2.0%, 95% CI −3.6 to −0.5) with a more abrupt decline of −3.5% (95% CI −4.6 to −2.4) from 2009 to 2016. The highest rates of HCC-related mortality were seen in Vietnamese, trailed by Japanese, and Koreans as compared to non-Hispanic whites. In particular, a statistically significant annual increase of 1.8% (95% CI 0.4 to 3.2) was observed in Vietnamese. However, a steady linear decrease in HCC-related mortality was observed in the Chinese subgroup over the 10-year period (APC −2.5%, 95% CI −4.7 to −0.3). In the sensitivity analysis using underlying cause of death (Table S2 and Figure S1), age-standardized chronic

liver disease and cirrhosis-related mortality rates in Asians declined steadily over 10 years (APC -2.2% , CI -2.8 to -1.5), which may reflect the decline in mortality from viral hepatitis. Across all subgroups, Japanese and Filipinos declined with statistical significance. In the subgroup with HCC, the decline in overall mortality among all Asians (APC -2.5% , 95% CI -4.1 to -0.8) demonstrated a more abrupt decline of -4.0% (95% CI -5.7 to -2.1) from 2010 to 2016, comparable with all-cause mortality.

4 | DISCUSSION

This population-based study of nationally representative mortality data revealed remarkable heterogeneity across Asian American sub-groups in trends of mortality from chronic liver disease in the United States. Previously, population-based studies aggregated Asians as a single ethnicity/race which may obfuscate some meaningful differences between Asian subgroups. By examining disaggregated Asian subgroups, we found that the highest rates of cirrhosis-related mortality were observed in Japanese and Vietnamese. Consistent with a prior study,⁶ HCC-related mortality was higher in most Asian subgroups than in non-Hispanic whites with highest mortality rates observed in the Vietnamese and Japanese. Interestingly, while observed mortality rates are different between non-Hispanic whites and all Asians, the overall trends over time are consistent with a decline in HBV and HCV-related mortality accompanied by an increase in ALD-related mortality with wide variation among different Asian subgroups. These differences highlight area of possible future investigation in ethnicity/race-based epidemiological studies and more importantly can help to guide efforts to reach disproportionately affected Asian subgroups—targeted linkage to care, prompt diagnosis and access to treatment.

In terms of aetiologies of chronic liver disease, HBV-related mortality rates in Asians were markedly higher than in non-Hispanic whites, consistent with the higher prevalence of chronic HBV in Asians.^{9–11,15} Likewise, trends in mortality rates also reflected the higher prevalence noted in Vietnamese and Chinese amongst the Asian subgroups.^{14,15} These data, as well as experience from prior and existing programs, clearly support the targeted interventions in Asian subgroups.^{19,20} The ALD-related mortality rates in Asian Americans were markedly lower than in non-Hispanic whites but did increase over the study period with an annual 2.2% increase (CI 0.5 to 4.0). The highest rates of ALD-related mortality were noted in Japanese, followed by Asian Indians, and Vietnamese, though all subgroups trended to a higher rate of mortality over the 10-year period examined. Asian Indians had relatively higher ALD-related mortality rates versus HBV and HCV infections. Potent and well-tolerated direct-acting antiviral (DAA) agents introduced in 2013 have led to the effective cure of chronic HCV infection,²¹ with an observed decline in HCV-related mortality rates, though this was not likely entirely attributable only to DAA agents as declines were noted as early as 2013 in Asians and even in 2012 among Japanese. A significant decline in HCV-related mortality among non-Hispanic whites was noted after 2013, and there were also interesting temporal trends across the Asian subgroups. Among the Japanese sub-group, from 2007 to 2016, the rate of HCV-related mortality was reduced by approximately 50%, with the remarkable decline noticed after the introduction of DAA agents after 2012, overlapping with the DAA era. However, the HCV-related mortality rates in other sub-groups and the Vietnamese subgroup have lagged. The Vietnamese subgroup

demonstrated the highest HCV-related mortality rate amongst the Asian subgroups, and more importantly, there was no evidence of a clear downward trend in 2016. Thus, our data suggest that there is a gap in the medical management of HCV-infected Vietnamese population in the United States and a clear need for HCV screening, treatment access and HCC screening followed by surveillance. There may be a delay in the availability of DAA agents in the Vietnamese Asian subgroup as demonstrated by no appreciable decline in HCV-related mortality in this Asian subgroup.

Among Asian Americans, age-standardized cirrhosis-related mortality rates remained stable during the study period. The continuing increase in cirrhosis-related mortality rates was noted in the Asian Indian subgroup (APC 3.3%, 95% CI 1.2 to 5.5) and Filipino subgroup (APC 2.2%, 95% CI 0.3 to 4.2), while Japanese experienced a nonsignificant decline of mortality rates related to cirrhosis compared with other Asian subgroups who instead demonstrated a nonsignificant increase in mortality rates over the study period. The highest age-adjusted HCC incidence rates (>20/100 000) are found in Eastern Asia (China, Korea and Vietnam) and sub-Saharan Africa.²² In 2012, Eastern Asia was noted to have the highest HCC-related incidence and mortality in both genders in the World.²³ According to Asian-Pacific clinical practice guideline, there was a clear difference of incidence and mortality in this region.²² For example, the cause of HCC in Japan (mainly HCV) differs greatly from other countries (mainly HBC) in the region. Nationwide programs for HCC surveillance or HBV vaccination were introduced variably in each country.²² With exception of Japanese, all other Asian Americans were 70% foreign-born immigrants. Therefore, advanced liver disease such as cirrhosis and HCC among Asian Americans indicate that the liver disease was acquired most likely in the country of origin.

The strength of this study includes the capture of national trends in chronic liver disease mortality, allowing for insight into disparities among Asian subgroups. Additionally, portal hypertension-related complications, such as spontaneous bacterial peritonitis or variceal bleeding, which are the most likely cause of mortality, were captured in the cirrhosis category. These are likely more reliable estimates than those provided in the National Vital Statistics Report which is based on diagnosis codes of “chronic liver disease and cirrhosis,” which may fail to capture mortality attributed to complications of portal hypertension and HCC.²⁴ This study has several limitations in its design and analysis of mortality data. As it relies on the cause of death based on death certificates, it can be affected by underestimation and mis-classification. However, the coding methodology has been constant over the study period and thus the trends described above for chronic liver disease-related mortality are likely not explained by this. Likewise, if ethnicity/race data are misreported, mortality rates can be affected. A recent study found that the ethnicity of Asians or Pacific Islanders on death certificates in 2009–2011 was misreported by approximately 3%,²⁵ though this likely varies across subgroups. The degree of significant changes reported in this study exceeds this estimate and suggests, perhaps, that they are slightly underestimated. Age-standardized mortality rates may not represent actual mortality rates, but these rates do account for changes in population distributions over time and allow for comparison between groups. Finally, we cannot estimate age-standardized NAFLD-mortality rates, because data for NAFLD-related mortality were unreliable due to the small number of events among Asian subgroups.

Our population-based study identified marked heterogeneity in chronic liver disease and end-stage liver disease-related mortality on a national level among the six most populous Asian subgroups in the United States and outlined differences in trends from non-Hispanic whites. Aggregation of Asian Americans as a single ethnicity/race may fail to elucidate important differences in the burden of chronic liver disease. We recommend that health policy guidelines to screen for chronic liver diseases may be based on a deeper understanding of population-based data. Despite a clear improvement in the treatment of HCV infection, there may inequity in access to treatment. We recommend continued efforts to target Asian subgroups based on disease prevalence and improvement in medical services for timely screening, diagnosis, linkage to care, treatment authorization, compliance with therapy and proper follow-up care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Abbreviations:

ALD	alcoholic liver disease
APC	annual percentage change
CI	confidence interval
DAA	direct-acting antiviral
HBV	hepatitis B virus
HCC	hepatocellular carcinoma
HCV	hepatitis C virus
ICD-10	International Classification of Diseases Tenth Revision
NAFLD	nonalcoholic fatty liver disease
NVSS	National Vital Statistic System

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FIGURE 1. Annual age-standardized mortality rate for chronic liver disease by Asian subgroup in the United States between 2007 and 2016. A, Hepatitis C virus infection. B, Hepatitis B virus infection. C, Alcoholic liver disease

TABLE 1

Characteristics of study populations, 2007–2016

	All Asians	Asian Indians	Chinese	Filipinos	Japanese	Koreans	Vietnamese	Non-Hispanic whites
Total	548 505	56 412	120 907	101 297	74 365	41 830	39 674	20 144 802
Age								
20–39 y	24 907 (4.5)	3 608 (6.4)	3210 (2.7)	3587(3.5)	731 (1)	1985 (4.8)	2051 (5.2)	574 670 (2.9)
40–59 y	83 021(15.1)	9503 (16.9)	13 988 (11.6)	15 166(15.0)	4838 (6.5)	6241 (14.9)	7784 (19.6)	2 587 062 (12.8)
60 y	440 577 (80.3)	43 301 (76.8)	10 709 (85.8)	82 544 (81.5)	68 796(92.5)	33 604 (80.3)	29 839(75.2)	16 983 070 (84.3)
Sex								
Men	282 228 (51.5)	33 169 (58.8)	63 244 (52.3)	50 156 (49.5)	31 805 (42.8)	19 382 (46.3)	22 518 (56.8)	9 978 037 (49.5)
Women	266 277(48.5)	23 243 (41.2)	57 663 (47.7)	51 141 (50.5)	42 560 (57.2)	22 448 (53.7)	17 156(43.2)	10 166 765 (50.5)
Education								
Less than high school	121227(25.7)	14 860 (28.1)	37 800(35.1)	15 753 (18.1)	7057 (13.5)	10 062 (26.1)	12 786 (34.0)	2 982 194 (19.6)
Completed high school	134 926 (47.1)	13 127 (24.8)	29 125 (27.0)	19 608 (22.5)	23 173 (44.4)	12 040(31.2)	14 032 (37.3)	6 821 958 (44.9)
Some college	43 968 (14.1)	2828 (5.3)	7233 (6.7)	12 647 (14.5)	7361 (14.1)	2966 (7.7)	3252 (8.7)	1 965 458 (12.9)
Completed college or beyond	146 166 (13.1)	22 149 (41.8)	33 676 (31.2)	39 061 (44.8)	14 477 (27.7)	13 477 (34.9)	7516 (20.0)	3 438 285 (21.6)

Data are presented as number (percent).

Age-standardized chronic liver disease-related mortality rates and annual percentage change (APC) among adults 20 years in the United States according to ethnicity status, 2007–2016

TABLE 2

	Age-standardized mortality rate		Average APC (95% CI)		Trend segment 1		Trend segment 2	
	2007	2016	2007–2016		Year	APC (95% CI)	Year	APC (95% CI)
Hepatitis C								
Non-Hispanic whites	5.81	5.93	0.4 (−0.3, 1.0)		2007–2014	2.1 (1.7, 2.6)	2014–2016	−5.6 (−8.8, −2.2)
All Asians	3.27	1.94	−5.8 (−6.8, −4.7)		2007–2013	−2.8 (−4.0, −1.6)	2013–2016	−11.5 (−14.7, −8.2)
Asian Indians	1.24	0.84	−4.6 (−10.6, 1.9)		2007–2016	−4.6 (−10.6, 1.9)		
Chinese	1.36	1.34	−2.1 (−7.2, 3.2)		2007–2016	−2.1 (−7.2, 3.2)		
Filipinos	2.0	1.33	−4.8 (−9.3, −0.1)		2007–2016	−4.8 (−9.3, −0.1)		
Japanese	7.23	3.68	−6.0 (−11.8, 0.0)		2007–2012	3.1 (−6.6, 13.7)	2012–2016	−16.3 (−27.2, −3.9)
Koreans	2.22	1.25	−7.0 (−9.6, −4.4)		2007–2016	−7.0 (−9.6, −4.4)		
Vietnamese	6.5	5.14	−1.3 (−3.7, 1.1)		2007–2016	−1.3 (−3.7, 1.1)		
Hepatitis B								
Non-Hispanic whites	0.57	0.42	−3.0 (−4.0, −2.0)		2007–2016	−3.0 (−4.0, −2.0)		
All Asians	3.03	2.45	−2.2 (−4.8, 0.6)		2007–2016	−2.2 (−4.8, 0.6)		
Asian Indians	0.26	0.44	−0.7 (−9.4, 8.8)		2007–2016	−0.7 (−9.4, 8.8)		
Chinese	4.19	4.07	0.0 (−1.8, 1.8)		2007–2016	0.0 (−1.8, 1.8)		
Filipinos	1.74	1.11	−2.9 (−6.5, 0.7)		2007–2016	−2.9 (−6.5, 0.7)		
Japanese	1.27	0.8	−0.7 (−8.3, 7.5)		2007–2016	−0.7 (−8.3, 7.5)		
Koreans	2.56	2.78	0.2 (−5.5, 6.3)		2007–2016	0.2 (−5.5, 6.3)		
Vietnamese	5.14	4.66	1.1 (−1.3, 3.4)		2007–2016	1.1 (−1.3, 3.4)		
Alcoholic liver disease								
Non-Hispanic whites	8.43	11.52	3.7 (3.0, 4.3)		2007–2013	2.9 (2.2, 3.6)	2013–2016	5.1 (3.0, 7.3)
All Asians	1.83	2.35	2.2 (0.5, 4.0)		2007–2016	2.2 (0.5, 4.0)		
Asian Indians	2.51	2.86	0.9 (−2.8, 4.7)		2007–2016	0.9 (−2.8, 4.7)		
Chinese	0.57	0.93	5.6 (0.4, 11.1)		2007–2016	5.6 (0.4, 11.1)		
Filipinos	1.4	1.78	2.4 (−0.3, 5.1)		2007–2016	2.4 (−0.3, 5.1)		
Japanese	2.98	5.48	4.2 (−1.7, 10.3)		2007–2016	4.2 (−1.7, 10.3)		
Koreans	0.74	1.49	4.8 (−1.8, 11.9)		2007–2016	4.8 (−1.8, 11.9)		

	Age-standardized mortality rate		Average APC (95% CI)		Trend segment 1		Trend segment 2	
	2007	2016	2007–2016	2007–2016	Year	APC (95% CI)	Year	APC (95% CI)
	1.09	2.25	5.3 (–0.9, 11.8)	5.3 (–0.9, 11.8)	2007–2016	5.3 (–0.9, 11.8)		
Vietnamese								

APC, annual percentage change; CI, confidence interval.

Age-standardized, cirrhosis and hepatocellular carcinoma-related mortality rates and annual percentage change (APC) among adults 20 years in the United States according to ethnicity status, 2007–2016

TABLE 3

	Age-standardized mortality rate		Average APC (95% CI)		Trend segment 1		Trend segment 2	
	2007	2016	2007–2016		Year	APC (95% CI)	Year	APC (95% CI)
Cirrhosis								
Non-Hispanic whites	18.86	23.93	3.0 (2.6, 3.4)		2007–2016	3.0 (2.6, 3.4)		
All Asians	6.97	6.84	-0.2 (-0.6, 0.3)		2007–2016	-0.2 (-0.6, 0.3)		
Asian Indians	4.11	5.84	3.3 (1.2, 5.5)		2007–2016	3.3 (1.2, 5.5)		
Chinese	3.56	5.14	2.4 (-0.6, 5.4)		2007–2016	2.4 (-0.6, 5.4)		
Filipinos	6.48	6.95	2.2 (0.3, 4.2)		2007–2016	2.2 (0.3, 4.2)		
Japanese	14.96	13.13	-0.8 (-2.5, 0.8)		2007–2016	-0.8 (-2.5, 0.8)		
Koreans	4.13	5.79	2.2 (-1.3, 5.9)		2007–2016	2.2 (-1.3, 5.9)		
Vietnamese	7.78	7.4	1.6 (-1.0, 4.2)		2007–2016	1.6 (-1.0, 4.2)		
Hepatocellular carcinoma								
Non-Hispanic whites	3.01	3.87	2.4 (1.9, 2.8)		2007–2016	2.4 (1.9, 2.8)		
All Asians	4.96	4.31	-2.0 (-3.6, -0.5)		2007–2009	3.3 (-5.0, 12.2)	2009–2016	-3.5 (-4.6, -2.4)
Asian Indians	0.89	0.92	-0.7 (-4.4, 3.2)		2007–2016	-0.7 (-4.4, 3.2)		
Chinese	5.51	4.91	-2.5 (-4.7, -0.3)		2007–2016	-2.5 (-4.7, -0.3)		
Filipinos	4.17	3.96	-0.3 (-1.9, 1.3)		2007–2016	-0.3 (-1.9, 1.3)		
Japanese	5.86	5.87	-2.5 (-5.5, 0.7)		2007–2016	-2.5 (-5.5, 0.7)		
Koreans	4.52	5.38	-0.2 (-3.7, 3.4)		2007–2016	-0.2 (-3.7, 3.4)		
Vietnamese	7.18	7.97	1.8 (0.4, 3.2)		2007–2016	1.8 (0.4, 3.2)		

APC, annual percentage change; CI, confidence interval.