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Alcohol-Related and Viral Hepatitis C-Related Cirrhosis Mortality among Hispanic Subgroups in the United States, 2000–2004

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Abstract

Background—Hispanics have much higher cirrhosis mortality rates than non-Hispanic Blacks and Whites. Although heavy alcohol use and hepatitis C virus (HCV) infection are two major risk factors for cirrhosis, no studies have systematically assessed the contribution of alcohol- and HCV-related cirrhosis deaths to the total cirrhosis mortality for Hispanics as a whole and its variations across Hispanic subgroups. To fill this gap, the current study presents the latest data on total cirrhosis mortality as well as its component alcohol- and HCV-related cirrhosis mortality for all Hispanics and for Hispanic subgroups.

Methods—The multiple-cause approach was used to analyze data from the U.S. Multiple Cause of Death Data Files for 28,432 Hispanics and 168,856 non-Hispanic Whites (as a comparison group) who died with cirrhosis as the underlying or a contributing cause during 2000–2004. Four major Hispanic subgroups were defined by national origin or ancestry, including Mexicans, Puerto Ricans, Cubans, and Other Hispanics. The cirrhosis deaths were divided into four distinctive cause-of-death categories: alcohol-related, HCV-related, both alcohol- and HCV-related, and neither alcohol- nor HCV-related. Age-adjusted total cirrhosis death rates and percentage shares of the cause-specific categories were compared across Hispanic subgroups and non-Hispanic Whites.

Results—Compared with non-Hispanic Whites, all Hispanic subgroups except Cubans had much higher cirrhosis mortality. The age-adjusted total cirrhosis death rates were twice as high for Puerto Ricans and Mexicans as for non-Hispanic Whites. Alcohol-related and HCV-related cirrhosis death rates also were higher for most Hispanic subgroups than for non-Hispanic Whites.

Conclusions—Heavy alcohol use and hepatitis C viral infection are two important factors contributing to the high cirrhosis mortality among Hispanics. However, their relative contributions to total cirrhosis mortality varied by gender and Hispanic subgroup. This information is useful for targeted prevention and intervention efforts to address the excessive cirrhosis mortality in the Hispanic population.

Keywords

Ethnic Groups; Female; Health Status Disparities; Male; Risk Factors

INTRODUCTION

As the fastest growing ethnic group in the United States, the Hispanic population is an increasingly visible and important demographic group. In 2004, the number of Hispanics in the United States was approximately 41.3 million (14.1 percent of US population) (Miniño et al., 2007); by 2050, this number is expected to increase to 132.8 million (30 percent of US population) (Bureau of the Census, 2008).

While Hispanics have a mortality advantage compared with non-Hispanics with respect to all-cause death and some major causes of death, such as coronary heart diseases and certain cancers, they have a disadvantage with respect to several specific causes of death, including liver cirrhosis, diabetes, human immunodeficiency virus (HIV) disease, and homicide (Centers for Disease Control and Prevention, 2004).

Liver cirrhosis is an especially serious public health problem for the Hispanic population in the United States. In 2004, cirrhosis was the 6th leading cause of death for Hispanics, but only the 12th leading cause of death for the total population in the United States (Heron, 2007). Compared with non-Hispanic Whites and Blacks, Hispanics have consistently shown the highest cirrhosis death rates for both males and females since the early 1990s, when comprehensive information on Hispanic origin first became available on death records (Stinson et al., 2001; Yoon and Yi, 2007) (See Figure 1).

Today, alcohol abuse and hepatitis C virus (HCV) infection are known as two major causes of chronic liver disease in the United States. Since the seminal work of Pearl, *Alcohol and Longevity* published in 1926, extensive scientific research has firmly established the association between alcohol consumption and cirrhosis risk. This connection is so robust that in the 1950s researchers began using cirrhosis mortality as an indicator of alcohol problems in populations. Cirrhosis mortality rates also have been used as a benchmark for evaluating the preventive impact of policies aimed at reducing alcohol consumption (Bruun et al., 1975; Edwards et al., 1994).

While the overall cirrhosis mortality rate has been declining during the last three decades (Yoon and Yi, 2007), HCV mortality rates, highly associated with cirrhosis, have been increasing since the 1990s (Kim, 2002; Vong and Bell, 2004; Wise et al., 2008). Up to 20 percent of individuals infected with HCV develop cirrhosis over a 20–30 year period (Seeff, 2002; Tong et al., 1995). Heavy alcohol use is among the most important factors influencing disease outcome in chronic HCV, exacerbating fibrosis progression in the liver, which is a precursor to cirrhosis (Poynard et al., 1997; Tong et al., 1995), and causing premature hospitalization and death (Chen et al., 2007; Jamal and Morgan, 2003).

The HCV literature indicates that Hispanics have a higher prevalence of anti-HCV antibodies than non-Hispanic Whites (Alter et al., 1999; Armstrong et al., 2006; Yen et al., 2003). Moreover, Hispanic patients with HCV infection have a faster fibrosis progression rate than non-Hispanic patients (Bonacini et al., 2001; Verma et al., 2006). Consequently, Hispanics are at higher risk for HCV-related cirrhosis death than non-Hispanic Whites and Blacks (Vong and Bell, 2004; Wise et al., 2008).

Although Hispanics are often considered a single ethnic group, they are in fact heterogeneous in terms of socioeconomic status (Ramirez and Cruz, 2002), health risk behaviors (Marks et al., 1990), drinking patterns (Black and Markides, 1993; Caetano, 1988; Canino, 1994; Gilbert and Cervantes, 1986; Johnson et al., 1998; Rogers, 1991), and alcohol abuse and dependence (Caetano et al., 2008), all of which vary by country of origin. The three largest Hispanic subgroups are Mexicans, Puerto Ricans, and Cubans (65.9, 9.2, and 3.9 percent of all Hispanics, respectively), with the remaining 21 percent of Hispanics in the

United States coming from all other Latin American and Caribbean countries (Miniño et al., 2007).

The heterogeneity among Hispanic subgroups generally has been ignored in mortality studies as data normally have been aggregated. Only a few studies have examined cirrhosis mortality by disaggregating Hispanic subgroups. Based on mortality data from 15 states for 1979 to 1981, Rosenwaik (1987) reported that the age-adjusted cirrhosis death rate varied across foreign-born Hispanic subgroups. Using more complete national mortality data for 2000–2004, Yoon and Yi (2007) confirmed the diverse cirrhosis mortality rates among Hispanic subgroups.

To date, there have been no national data that systematically assess the role of alcohol use and HCV infection in the excessive cirrhosis mortality of the Hispanic population and its subpopulations. Therefore, the objective of our study was to present the latest data for Hispanics on total cirrhosis mortality as well as its component alcohol- and HCV-related cirrhosis mortality and to disaggregate these data for Hispanic subgroups. To this end, we analyzed national mortality data for 2000–2004 using a multiple-cause approach. This approach included deaths for which cirrhosis was recorded as either the underlying cause or a contributing cause of death, allowing us to capture the full scope of cirrhosis mortality and its relatedness to alcohol use and HCV infection. All data are presented with non-Hispanic Whites as a comparison group.

MATERIALS AND METHODS

Data

Mortality data were taken from the Multiple Cause of Death public-use data file for 2000 to 2004 provided by the National Center for Health Statistics. The Multiple Cause of Death data include information from all resident death certificates filed each year in the 50 states and the District of Columbia. To increase the reliability of the analysis results, data for the 5-year period were pooled to calculate annual averages.

In the Multiple Cause of Death data, causes of death were classified according to the International Classification of Diseases, Tenth Revision (ICD-10). Each death record includes codes for one underlying cause and up to 20 contributing causes of death. For the current study, we included deaths for which cirrhosis was listed either as the underlying cause or as one of the contributing causes. The ICD-10 codes used in the current study are listed in Table 1. Following the National Institute on Alcohol Abuse and Alcoholism's surveillance report on liver cirrhosis mortality (Yoon and Yi, 2007), the ICD-10 codes used to identify all liver cirrhosis deaths are K70, K73, K74, K76.0 and K76.6. Among these codes, K70 indicates alcoholic liver cirrhosis. ICD-10 codes for HCV are B17.1 and B18.2. Based on the cirrhosis codes, a total of 28,432 Hispanics who resided in the United States at the time of their death during 2000–2004 were identified and included in the analysis. According to the U.S. Standard Certificate of Death, decedent's Hispanic origin is filled by funeral directors based on information given by the informant, and the definition of origin includes “ancestry, nationality, and lineage” (National Center for Health Statistics, 2003). The Hispanic decedents were divided into four major subgroups for the analysis: Mexicans (n=18,151; 63.8 percent), Puerto Ricans (n=3,863; 13.6 percent), Cubans (n=1,214; 4.3 percent), and Other Hispanics (n=5,204; 18.3 percent). The Other Hispanics category included “Central and South Americans” (n=1,683) and “Other and Unknown Hispanics” (n=3,521). These two groups can be identified separately in the mortality data. However, Dominicans were moved from the “Central and South Americans” to “Other Hispanics” in the population data from the Current Population Survey (CPS) since 2003. This change in categorization of the denominator data made it necessary to collapse the two groups in our

study. Hispanics were not further broken down by race in our analysis, since over 98.6 percent of all Hispanics were identified as Whites in the death certificates. As a comparison group, 168,856 non-Hispanic White cirrhosis deaths during the same period were also included in the analysis.

The population data used as the denominators to calculate death rates were taken from estimates based on the CPS prepared by the U.S. Census Bureau for National Center for Health Statistics (Arias et al., 2003; Hoyert et al., 2006; Kochanek et al., 2004; Miniño et al., 2002; Miniño et al., 2007). This is the only source that includes Hispanic subgroup population data. Information on Hispanic origin on the CPS was determined on the basis of a question that asked for self-identification of the person's origin or descent. The definition of Hispanic origin was similar to that in the mortality data as described above (Bureau of Labor Statistics, 1997). The CPS population estimates were adjusted to resident Hispanic population control totals (i.e., the year 2000-based population estimates for the respective subpopulations in the United States for July 1 of each year).

Analysis

The analysis is primarily descriptive. Mortality rates were calculated as the number of deaths per 100,000 population. In order to compare mortality across subpopulation groups in a manner uninfluenced by differences in the subpopulation age structures, these rates were adjusted (or standardized) by age using the direct standardization method. The age-adjustment involved two steps. First, age-specific death rates for a subpopulation group were calculated for 8 age categories: 0–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75–84, and 85+ years. Second, the age-specific rates were weighted by the Year 2000 U.S. population distribution (as the age standard) and summed up as the age-adjusted rate for the respective subpopulation group. All age-adjusted death rates were calculated by sex and five racial/ethnic groups: Mexican, Puerto Rican, Cuban, Other Hispanics, and non-Hispanic White (as the comparison group). In most cases, the 5-year annual average of each descriptive statistic was used to ensure the reliability of the results by minimizing random fluctuations over time. However, since population estimates for Hispanic subgroups are derived from the CPS, the death rates calculated are subject to survey sampling variability in the denominator as well as random variability in the numerator. Therefore, 95 percent confidence intervals were calculated using standard errors for age-specific and age-adjusted rates derived from formula recommended by the National Center for Health Statistics (Miniño et al., 2007). In accordance with the National Center for Health Statistics formula (1, p.115), standard errors of age-adjusted death rates (R') were calculated as follows:

$$SE(R') = \sqrt{\sum_i \left\{ \left(\frac{P_{si}}{P_s} \right)^2 R_i^2 \left[\frac{1}{D_i} + 0.67 \left(a + \frac{b}{P_i} \right) \right] \right\}}$$

where

P_{si} = age-specific standard population for the i th age group from the U.S. standard population age distribution

P_s = total U.S. standard population (all age combined)

R_i = age-specific rate for the i th age group

D_i = number of deaths for the i th age group

a = parameter derived from the CPS data for each year and varying depending on the subgroup of interest

b = parameter derived from the CPS data for each year and varying depending on the subgroup of interest

P_i = number of population for the i th age group

Furthermore, calculated age-adjusted rates were deemed unreliable if their relative standard error (i.e., standard error divided by its respective age-adjusted rate and multiplied by 100) was 23 percent or more (Miniño et al., 2007, p.115).

Taking a multiple-cause approach, cirrhosis death rates were calculated based on the underlying cause as well as contributing causes. To assess the relatedness of cirrhosis deaths to alcohol use, the age-adjusted alcohol-related cirrhosis death rate as well as its percentage share in the total age-adjusted cirrhosis death rate were calculated. Similarly, the relatedness of cirrhosis deaths to HCV was determined by the age-adjusted rate and percentage share of deaths with a co-occurring HCV infection in the total age-adjusted cirrhosis death rate. Percentage shares of alcohol-related and HCV-related liver cirrhosis death rates were derived by dividing the age-adjusted death rates for each type of cirrhosis by the age-adjusted death rate for all liver cirrhosis. The 95 percent confidence intervals for the percentage shares were calculated according to the formula recommended by Kegler (2007).

It should be noted that, when making comparisons, the ranking of a cause-specific cirrhosis death rate for a subpopulation group is not necessarily consistent with the ranking of its percentage share. This is because the death rates are absolute values, whereas percentage shares are relative within each subpopulation group. Consequently, one cause-specific cirrhosis category can have a low rate but a high percentage share, depending on its denominator—the all-cirrhosis death rate of the respective subpopulation group.

RESULTS

Liver cirrhosis mortality among Hispanic subgroups

As shown in Table 2, during 2000–2004, the annual average number of deaths from all types of liver cirrhosis (as either the underlying cause or a contributing cause) was 5,686 for Hispanics, corresponding to a rate of 25.70/100,000, and 33,771 for non-Hispanic Whites, corresponding to a rate of 14.98/100,000. Thus, the annual average age-adjusted death rate from all liver cirrhosis was higher for Hispanics as a whole than for non-Hispanic Whites. The same was true when males and females were analyzed separately.

Among Hispanics, the rate of deaths from all cirrhosis varied greatly across subgroups. Compared with non-Hispanic Whites (20.91/100,000 and 9.67/100,000 for males and females, respectively), the rate was substantially higher for Puerto Ricans (49.31/100,000 and 16.83/100,000, respectively), Mexicans (40.41/100,000 and 17.52/100,000, respectively) and Other Hispanics (31.50/100,000 and 13.34/100,000, respectively), and lower for Cubans (16.41/100,000 and 7.86/100,000, respectively). The rate for males was consistently more than twice the rate for females for all Hispanic subgroups as well as for non-Hispanic Whites. Furthermore, the median age at death was younger for Puerto Ricans (54 and 60 years for males and females, respectively), Mexicans (53 and 64, respectively) and Other Hispanics (52 and 65, respectively) and much older for Cubans (66 and 74, respectively) compared with non-Hispanic Whites (58 and 66, respectively).

Alcohol-related and HCV-related liver cirrhosis mortality among Hispanic subgroups

Table 2 also shows age-adjusted death rates from alcohol-related and HCV-related cirrhosis. Table 3 shows the relatedness of cirrhosis mortality to alcohol use and HCV as indicated by percentage shares of alcohol- and HCV-related cirrhosis death rates in the total cirrhosis death rates. These data indicate that, in general, the prevalence and share of alcohol-related

cirrhosis are higher than that for HCV-related cirrhosis. For both sexes combined, the share of alcohol-related cirrhosis death rates was about three times the share of HCV-related cirrhosis death rates for Hispanics (37.0 vs. 12.8 percent), and this difference was even greater among non-Hispanic Whites (36.5 vs. 9.7 percent). However, considerable variation existed in the alcohol-relatedness and HCV-relatedness across gender and Hispanic subgroups.

Males—Among males, the age-adjusted death rate of alcohol-related cirrhosis for Hispanics as a whole (16.95/100,000) was about twice the rate for non-Hispanic Whites (8.34/100,000) (Table 2). Furthermore, except for Cuban males (4.95/100,000), the age-adjusted death rate of alcohol-related cirrhosis was higher for the Hispanic subgroups (19.47/100,000, 17.97/100,000, and 14.76/100,000 for Mexicans, Puerto Ricans, and Other Hispanics, respectively) than for non-Hispanic White males. The percentage share of alcohol-related cirrhosis death rate also was higher for Hispanic males as a whole (45.8 percent) than for non-Hispanic White males (39.9 percent). Among the Hispanic subgroups, however, the share of alcohol-related cirrhosis death rate was only higher for Mexican males (48.2 percent) and Other Hispanic males (46.9 percent) than for non-Hispanic White males (Table 3).

For HCV-related cirrhosis, the death rate among Hispanic males as a whole was more than twice as high (4.61/100,000) as that for non-Hispanic White males (2.13/100,000) (Table 2). As with the alcohol-related cirrhosis death rate, the HCV-related cirrhosis death rate varied greatly among Hispanic subgroups. It was highest for Puerto Rican males (9.16/100,000), which was more than four times the rate for non-Hispanic White males (2.13/100,000), more than three times that for Cuban males (2.49/100,000), and more than two times of that for Mexican (4.28/100,000) and Other Hispanic males (3.94/100,000). Consequently, Puerto Rican males had the highest share of HCV-related cirrhosis (18.6 percent) among all male subgroups (Table 3).

The cirrhosis death rate related to both alcohol and HCV was relatively low at 1.70/100,000 for Hispanic males as a whole. Nevertheless, this was two times the rate for non-Hispanic White males (0.78/100,000). There seemed to be a fair amount of variation in this rate across the Hispanic subgroup, but comparisons could not be made with certainty due to the unreliability of the estimated rate for some subgroups.

Females—In contrast to males, females had a much lower age-adjusted death rate of alcohol-related cirrhosis, which was about the same for Hispanic and non-Hispanic White females (2.83/100,000 and 2.84/100,000, respectively). Among the Hispanic subgroups, however, the rate varied in a similar pattern to that in the male subgroups, with the highest rate found among Mexican females (3.22/100,000), followed by Puerto Ricans (3.07/100,000), Other Hispanics (2.65/100,000), and Cubans (0.53/100,000). Also, in contrast to males, the share of alcohol-related cirrhosis death rate was lower for Hispanic females (18.5 percent) than for Non-Hispanic White females (29.4 percent). There was little variation among the subgroups of Hispanic females, except that Cuban females had a considerably smaller share of any alcohol-related cirrhosis deaths (6.7 percent) than other Hispanic female subgroups (ranging from 18.2 to 19.9 percent).

The age-adjusted death rate of HCV-related cirrhosis for Hispanic females as a whole (2.02/100,000) was about 2.4 times that for non-Hispanic Whites (0.83/100,000), with relatively small variations within Hispanic subgroups. The percentage share of HCV-related cirrhosis death rate was higher for Hispanic females (13.2 percent) than for non-Hispanic White females (8.6 percent). Among the subgroups, Cuban females displayed the highest

(24.0 percent) and Mexican females the lowest share (11.4 percent) of HCV-related cirrhosis deaths.

The cirrhosis death rate related to both alcohol and HCV was low for Hispanic and non-Hispanic females (0.29/100,000 and 0.21/100,000, respectively). Moreover, its percentage share also was low and similar for Hispanic and non-Hispanic females. Again, comparisons across Hispanic subgroups could not be made with certainty due to unreliability of some estimates.

It should be noted from Table 3 that, although alcohol and HCV are two well-known etiological factors for cirrhosis deaths, a substantial proportion of the total cirrhosis death rates were due to neither alcohol- nor HCV-related cirrhosis (i.e., unknown etiological factors). The percentage share of this “residual” category was 3 percentage points lower for Hispanics than for non-Hispanic Whites. Further breaking down by gender and Hispanic subgroup revealed a greater variability of this category. For instance, the percentage share of this “residual” category was 7.4 percentage points lower for Hispanic males than for non-Hispanic White males. The percentage share of this category varied even more across Hispanic subgroups, ranging from 44.9 to 57.3 percent in males and from 64.1 to 72.0 percent in females.

DISCUSSION

From 2000 through 2004, cirrhosis was the underlying or a contributing cause of death for 28,432 (or 5,686 per year) Hispanics in the United States. Compared with non-Hispanic Whites, all Hispanic subgroups, except Cubans, were at much higher risk for cirrhosis mortality. In particular, Puerto Ricans and Mexicans were about twice as likely to die from cirrhosis as non-Hispanic Whites. These results confirm findings of mortality differentials among Hispanic subgroups in an earlier study by Rosenwaike (1987).

More detailed analyses found that among males, the high rate of alcohol-related cirrhosis deaths among Hispanics accounted for a large part of the cirrhosis mortality disparities. Except for Cuban males, Hispanic males had alcohol-related cirrhosis mortality rates that were twice as high as the rate among non-Hispanic White males. In contrast, there were no substantial differences in alcohol-related cirrhosis mortality rates between most Hispanic and non-Hispanic White females (again, Cuban females were an exception with a much lower rate). These mortality patterns are consistent with previous findings on the total alcohol intake and drinking patterns of Hispanics and non-Hispanics. Stinson and colleagues (Stinson et al., 1998) reported that there were no differences in average daily ethanol consumption between Hispanic and non-Hispanic males. However, Hispanic males were more likely to be engaged in weekend binge drinking. From a life course perspective, Jackson and colleagues (Jackson et al., 1998) showed that Hispanic males developed heavy drinking patterns later in life but sustained these patterns for longer periods of time than did White males. Among the Hispanic subgroups, Mexican males exhibited a higher prevalence of heavy alcohol use and alcohol dependence than non-Hispanic White males, whereas Cuban males showed a lower prevalence (Caetano et al., 2008; Johnson et al., 1998).

In the Hispanic community, heavy drinking and drunkenness is primarily a male activity, whereas abstention and infrequent light drinking is the common pattern for women (Caetano, 1988; Canino, 1994; Gilbert and Cervantes, 1986). Nevertheless, differences in consumption patterns exist among Hispanic female subgroups, with Mexican and Puerto Rican women more likely than Cuban women to consume larger amounts of alcohol (Black and Markides, 1993; Rogers, 1991).

Our results also indicate that HCV infection also contributes to the high Hispanic cirrhosis mortality. The proportion of HCV infection in liver cirrhosis deaths was higher for all of the four Hispanic subgroups than for non-Hispanic Whites. Among Hispanic subgroups, Puerto Ricans had the highest co-occurring HCV infection among cirrhosis deaths in both males and females. This may be associated with the high rates of HIV infection and illicit drug use among Puerto Ricans. According to a National Research Council's report on emerging issues in Hispanic health (National Research Council, 2002), HIV infection is the third leading cause of death for Puerto Ricans. Puerto Ricans also have a higher prevalence of illicit drug use than other Hispanic subgroups (Johnson et al., 1998). Previous research indicates that many people are infected with both HCV and HIV due to injection drug use (Wise et al., 2008), and coinfection with HIV is an important prognostic factor exacerbating the course of HCV infection (Graham et al., 2001).

Despite the growing concern about the HCV epidemic (Armstrong et al., 2000), our data suggest that alcohol played a more important role than HCV infection in the development of liver cirrhosis among Hispanics. For instance, the percentage share of alcohol-related cirrhosis among cirrhosis deaths was substantially greater than that of HCV-related cirrhosis for all demographic subgroups, except Cuban females. The contribution of alcohol involvement relative to HCV infection in all cirrhosis deaths generally was greater among males than females, especially among Mexican, Other Hispanic and non-Hispanic White males.

While the differences between Hispanic subgroups in the percentage shares of co-occurring alcohol- and HCV-related cirrhosis death rate were not particularly striking, they should be noted because individuals with this comorbidity are at increased risk of early death. Previous research has found that in the presence of heavy alcohol use, HCV accelerates premature deaths from cirrhosis (Chen et al., 2007).

Our results on the percentage share of the “residual” category (i.e., neither alcohol- nor HCV-related cirrhosis) indicated that alcohol and HCV played more important roles in cirrhosis mortality among males than among females, among Hispanic males than among non-Hispanic White males, and among Mexican males than among Cuban males. However, overall, only about half of cirrhosis deaths were related to alcohol or HCV in this study. As an effort to explore etiological factors other than alcohol and HCV, we examined non-alcoholic fatty liver disease (NAFLD), which is regarded as hepatic manifestation of metabolic syndrome. Histologically, NAFLD is a spectrum ranging from benign hepatic steatosis to steatohepatitis, fibrosis, and cirrhosis (Alazmi et al., 2006). With the dramatic increase in the prevalence of obesity, NAFLD has become one of the most common chronic liver diseases (Lazo and Clark, 2008). Previous studies also indicated that Hispanics (especially Mexican Americans) have a higher prevalence of NAFLD than non-Hispanic Whites (Browning et al., 2004; Clark, 2006; Weston et al., 2005). According to the recently released ICD-10-CM (NCHS, 2010, p.634), we used two ICD-10 codes—K76.0 (Change of fatty liver, not elsewhere classified) and K75.8 (Other specified inflammatory liver diseases, a category for nonalcoholic steatohepatitis [NASH]), as a direct measure for NAFLD. We identified 6,226 deaths (or 1,245 per year) from NAFLD-related cirrhosis (not related to either alcohol or HCV). Contrary to what was expected, the prevalence of NAFLD-related cirrhosis was substantially lower than that of alcohol- and HCV-related cirrhosis across the board. Overall, age-adjusted death rates from NAFLD were 0.52 and 0.51 per 100,000 population for Hispanics and non-Hispanic Whites, respectively. Among Hispanics, Mexicans showed higher age-adjusted death rates from NAFLD cirrhosis than non-Hispanic Whites (0.63 versus 0.51). While the relative contribution of NAFLD cirrhosis to the total cirrhosis death rate was generally low, it was greater for non-Hispanic Whites (3.4 percent) than for all Hispanic subgroups (ranging from 1.1 to 2.2 percent). The low prevalence of

NAFLD-related cirrhosis deaths could be partly due to the under-reporting on the death certificate because NAFLD is difficult to determine since steatosis may disappear as cirrhosis develops (McCullough, 2002). Future research is needed to identify etiological factors that account for the cirrhosis mortality that is neither alcohol- nor HCV-related.

Our findings revealed that Cubans had remarkably lower cirrhosis mortality rates than the rest of the Hispanic subgroups as well as non-Hispanic Whites. This may be due to their distinctive features documented in the literature. A large majority of Cubans are foreign-born (Hajat et al., 2000). The early emigrants are mostly political refugees from upper and middle classes and had experienced high-quality health care even before their arrival to the United States (Diaz-Briquets, 1991). Compared with other Hispanics, Cubans are more likely to have private health insurance (Escarce and Kapur, 2006). They are less likely to have obesity (Diaz-Briquets, 1991; Escarce et al., 2006; Morales et al., 2002) and more likely to drink alcohol in moderation (Black and Markides, 1993; Caetano et al., 2008; Diaz-Briquets, 1991; Johnson et al., 1998; Marks et al., 1990; Rogers, 1991). However, we were unable to examine these factors due to the lack of information on such factors in death certificates.

To our knowledge, the current study is the only one in recent years that presents cirrhosis mortality data for Hispanic population subgroups in the United States. Our study also is unique in that it examined the contributions of both heavy alcohol use and HCV infection to the high cirrhosis mortality among Hispanics. This is much-needed information for addressing disparity issues in Hispanic health. The findings presented here extend our understanding of cirrhosis mortality differentials among Hispanic subgroups. Previous research has shown excess cirrhosis mortality for Hispanics as a whole. Our study unmasked the wide subgroup variations in the rates and relative contributions of major etiological factors (i.e., alcohol and HCV) for cirrhosis mortality among the Hispanic population. The results provide basic epidemiologic data to develop public health strategies targeting risk factors unique to each Hispanic subgroup, such as heavy alcohol use among Mexican and Puerto Rican males to reduce their high alcoholic cirrhosis mortality and HCV infection among Puerto Ricans to reduce their high HCV-related cirrhosis mortality.

There are several limitations to this study. First, identification of Hispanic ethnicity in mortality data has some sources of error. Differences exist in reporting Hispanic origin on death certificates and on censuses and the Current Population Surveys (Miniño et al., 2007), which were used as the denominator in computing age-adjusted death rates in the current study. The ratio of death estimates from Current Population Surveys to death certificates for Hispanics was found to be 1.05, indicating a 5-percent net underreport of Hispanic origin on death certificates (Miniño et al., 2007, p.107). Second, alcohol-related and HCV-related cirrhosis deaths could be underestimated because of underreporting of alcohol-relatedness and inadequate identification of HCV infection on death certificates. This may in part explain the relatively large residual proportion of liver cirrhosis deaths that are yet to be accounted for. Previous research has indicated that a large portion of the unspecified cirrhosis deaths were in fact alcohol-related (Parrish et al., 1993). Moreover, the detection of HCV has not been comprehensive for various reasons (Manos et al., 2008; Wu et al., 2005). Third, data from death certificates lack information on etiological factors other than alcohol and HCV. Although we attempted to examine the etiological role of NAFLD, the low prevalence of it did not add much to the explanation of the Hispanic cirrhosis mortality. As mentioned earlier, underreporting in the death certificates also may be responsible for the low NAFLD-related cirrhosis death rates. Finally, genetic and environmental risk factors play important roles in ethnic differences in alcohol metabolism and subsequent liver injury (Day, 2006; Kemmer and Neff, 2008; Reuben, 2008; Zakhari and Li, 2007). Future studies

analyzing the excessive cirrhosis mortality among Hispanics, especially Hispanic males, should take these factors into consideration.

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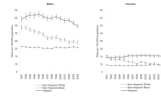


Figure 1.

Age-adjusted death rates from all liver cirrhosis based on multiple-cause for “Non-Hispanic White,” “Non-Hispanic Black,” and “Hispanic” by sex: United States, 1991–2004. Vertical bars represent 95 percent confidence intervals.

Data Source: Multiple Cause of Death data files, 1991–2004 (National Center for Health Statistics).

Table 1**ICD-10 Codes for HCV and Liver Cirrhosis**

Hepatitis C Infection	
B17.1	Acute hepatitis C
B18.2	Chronic viral hepatitis C
Liver Cirrhosis	
Alcohol-related cirrhosis	
K70.0	Alcoholic fatty liver
K70.1	Alcoholic hepatitis
K70.2	Alcoholic fibrosis and sclerosis of liver
K70.3	Alcoholic cirrhosis of liver
K70.9	Alcoholic liver disease, unspecified
K70.4	Alcoholic hepatic failure
Specified liver cirrhosis without mention of alcohol	
K73.0	Chronic persistent hepatitis, not elsewhere classified (n.e.c.)
K73.1	Chronic lobular hepatitis, n.e.c.
K73.2	Chronic active hepatitis, n.e.c.
K73.8	Other chronic hepatitis, n.e.c.
K73.9	Chronic hepatitis, unspecified
K74.3	Primary biliary cirrhosis
K74.4	Secondary biliary cirrhosis
K74.5	Biliary cirrhosis, unspecified
K76.0	Fatty (change of) liver, n.e.c. ^a
K76.6	Portal hypertension ^a
Unspecified liver cirrhosis without mention of alcohol	
K74.0	Hepatic fibrosis
K74.2	Hepatic fibrosis with hepatic sclerosis
K74.6	Other and unspecified cirrhosis of liver
K74.1	Hepatic sclerosis

Source: *International Classification of Diseases and Related Health Problems, Tenth Revision*. Geneva, Switzerland: World Health Organization, 1992.

^aCategorization by the National Institute on Alcohol Abuse and Alcoholism (Yoon and Yi, 2007). K76.0 is not defined as liver cirrhosis by the National Center for Health Statistics.

Table 2

Five-Year Annual Average Number of Deaths, Median Age at Death, and Annual Average of Age-Adjusted Death Rates from All Liver Cirrhosis, Alcohol- and HCV-Related Cirrhosis Among Hispanic Subgroups and Non-Hispanic Whites by Sex, United States, 2000–2004

	5-year Annual Average Number of Deaths	Median Age at Death (Years)	Age-Adjusted Death Rates (Number of Deaths per 100,000 Population) and 95% Confidence Intervals (CI)						
			All Cirrhosis	Alcohol-Related Cirrhosis	HCV-Related Cirrhosis	Both Alcohol- and HCV-Related Cirrhosis ^a	Neither Alcohol- Nor HCV-Related Cirrhosis		
			(1)	(2)	(3)	(4)	(5)		
			Rate (95% CI)	Rate (95% CI)	Rate (95% CI)	Rate (95% CI)	Rate (95% CI)	Rate (95% CI)	
Both Sexes									
Hispanic	5,686	56	25.70 (25.41, 25.99)	9.50 (9.33, 9.68)	3.30 (3.20, 3.41)	0.97 (0.92, 1.03)	13.86 (13.63, 14.09)		
Mexican	3,630	55	28.79 (28.36, 29.21)	11.11 (10.86, 11.37)	3.16 (3.02, 3.30)	1.07 (1.00, 1.15)	15.59 (15.25, 15.92)		
Puerto Rican	772	55	31.66 (30.62, 32.70)	9.78 (9.22, 10.34)	5.77 (5.36, 6.19)	1.37 (1.17, 1.57)	17.49 (16.68, 18.29)		
Cuban	243	69	12.01 (11.31, 12.70)	2.69 (2.34, 3.04)	2.20 (1.90, 2.50)	0.25 ^b (0.14, 0.37)	7.37 (6.85, 7.88)		
Other Hispanic	1,041	55	21.34 (20.71, 21.97)	7.92 (7.58, 8.27)	2.76 (2.54, 2.98)	0.74 (0.64, 0.84)	11.40 (10.91, 11.88)		
Non-Hispanic White	33,771	60	14.98 (14.91, 15.05)	5.47 (5.42, 5.51)	1.46 (1.44, 1.49)	0.49 (0.48, 0.50)	8.54 (8.49, 8.59)		
Male									
Hispanic	4,027	54	37.03 (36.53, 37.52)	16.95 (16.61, 17.29)	4.61 (4.43, 4.79)	1.70 (1.59, 1.80)	17.16 (16.79, 17.54)		
Mexican	2,601	53	40.41 (39.68, 41.13)	19.47 (18.97, 19.96)	4.28 (4.05, 4.50)	1.83 (1.69, 1.98)	18.50 (17.99, 19.00)		
Puerto Rican	563	54	49.31 (47.39, 51.23)	17.97 (16.82, 19.12)	9.16 (8.39, 9.92)	2.46 ^b (2.07, 2.85)	24.65 (23.29, 26.00)		
Cuban	149	66	16.41 (15.20, 17.62)	4.95 (4.28, 5.63)	2.49 (2.02, 2.97)	0.44 ^b (0.23, 0.66)	9.41 (8.56, 10.26)		
Other Hispanic	714	52	31.50 (30.33, 32.66)	14.76 (14.01, 15.51)	3.94 (3.56, 4.33)	1.35 (1.15, 1.54)	14.14 (13.56, 14.72)		
Non-Hispanic White	21,887	58	20.91 (20.80, 21.03)	8.34 (8.27, 8.42)	2.13 (2.09, 2.17)	0.78 (0.76, 0.81)	11.22 (11.15, 11.30)		
Female									
Hispanic	1,659	65	15.31 (14.99, 15.63)	2.83 (2.70, 2.97)	2.02 (1.90, 2.14)	0.29 (0.24, 0.33)	10.74 (10.46, 11.02)		
Mexican	1,029	64	17.52 (17.03, 18.00)	3.22 (3.03, 3.42)	1.99 (1.82, 2.15)	0.31 (0.25, 0.36)	12.61 (12.21, 13.02)		
Puerto Rican	209	60	16.83 (15.77, 17.89)	3.07 (2.64, 3.49)	2.80 (2.39, 3.20)	0.44 ^b (0.29, 0.59)	11.41 (10.78, 12.03)		
Cuban	94	74	7.86 (7.12, 8.61)	0.53 (0.32, 0.75)	1.89 (1.52, 2.26)	0.05 ^b (0.00, 0.13)	5.49 (5.17, 5.82)		
Other Hispanic	327	65	13.34 (12.66, 14.02)	2.65 (2.38, 2.91)	1.74 (1.49, 1.98)	0.23 ^b (0.17, 0.30)	9.19 (8.82, 9.56)		
Non-Hispanic White	11,884	66	9.67 (9.59, 9.74)	2.84 (2.79, 2.88)	0.83 (0.81, 0.85)	0.21 (0.19, 0.22)	6.20 (6.15, 6.25)		

Data source: Multiple Cause of Death data files, 2000–2004 (National Center for Health Statistics).

^aThe overlapping portion of (2) and (3).

^bRate unreliable because the relative standard error (i.e., standard error divided by its respective age-adjusted rate and multiplied by 100) is 23 percent or more (Miniño et al., 2007).

Table 3

Percentage Share (%) of Alcohol-Related and HCV-Related Liver Cirrhosis Among All Liver Cirrhosis Deaths by Sex and Hispanic Subgroup, United States, 2000–2004

	Alcohol-Related Cirrhosis	HCV-Related Cirrhosis	Both Alcohol- and HCV-Related Cirrhosis ^a	Neither Alcohol- Nor HCV-Related Cirrhosis
	(1)	(2)	(3)	(4)
	Percent (95% CI)	Percent (95% CI)	Percent (95% CI)	Percent (95% CI)
Both Sexes				
Hispanic	37.0 (36.2, 37.8)	12.8 (12.4, 13.3)	3.8 (3.5, 4.0)	53.9 (52.8, 55.0)
Mexican	38.6 (37.5, 39.7)	11.0 (10.5, 11.5)	3.7 (3.4, 4.0)	54.2 (52.8, 55.6)
Puerto Rican	30.9 (28.9, 33.0)	18.2 (16.8, 19.7)	4.3 (3.7, 5.0)	55.2 (52.2, 58.5)
Cuban	22.4 (19.4, 25.9)	18.3 (15.8, 21.2)	2.1 ^b (1.3, 3.3)	61.4 (56.0, 67.2)
Other Hispanic	37.1 (35.2, 39.1)	12.9 (11.9, 14.1)	3.5 (3.0, 4.0)	53.4 (50.7, 56.3)
Non-Hispanic White	36.5 (36.2, 36.8)	9.7 (9.6, 9.9)	3.3 (3.1, 3.4)	57.0 (56.6, 57.5)
Male				
Hispanic	45.8 (44.7, 46.9)	12.4 (12.0, 13.0)	4.6 (4.3, 4.9)	46.3 (45.2, 47.5)
Mexican	48.2 (46.7, 49.7)	10.6 (10.0, 11.2)	4.5 (4.2, 4.9)	45.8 (44.3, 47.3)
Puerto Rican	36.4 (33.8, 39.3)	18.6 (16.9, 20.4)	5.0 ^b (4.2, 5.9)	50.0 (46.7, 53.5)
Cuban	30.2 (25.8, 35.3)	15.2 (12.4, 18.6)	2.7 ^b (1.6, 4.4)	57.3 (51.1, 64.4)
Other Hispanic	46.9 (44.0, 49.9)	12.5 (11.2, 13.9)	4.3 (3.7, 5.0)	44.9 (42.5, 47.4)
Non-Hispanic White	39.9 (39.5, 40.3)	10.2 (10.0, 10.4)	3.7 (3.6, 3.8)	53.7 (53.2, 54.1)
Female				
Hispanic	18.5 (17.5, 19.5)	13.2 (12.4, 14.0)	1.9 (1.7, 2.2)	70.2 (67.9, 72.5)
Mexican	18.4 (17.2, 19.7)	11.4 (10.4, 12.3)	1.8 (1.5, 2.1)	72.0 (69.0, 75.0)
Puerto Rican	18.2 (15.6, 21.3)	16.6 (14.2, 19.5)	2.6 ^b (1.8, 3.8)	67.8 (62.4, 73.7)
Cuban	6.7 (4.4, 10.2)	24.0 (19.3, 29.9)	0.6 ^b (0.1, 3.1)	69.8 (62.4, 78.2)
Other Hispanic	19.9 (17.7, 22.3)	13.0 (11.3, 15.1)	1.7 ^b (1.3, 2.2)	68.9 (64.5, 73.6)
Non-Hispanic White	29.4 (28.9, 29.8)	8.6 (8.4, 8.8)	2.2 (2.0, 2.4)	64.1 (63.3, 64.9)

Data source: Multiple Cause of Death data files, 2000–2004 (National Center for Health Statistics).

^aThe overlapping portion of (1) and (2).

^bBased on unreliable estimate of rate (see note in Table 2).