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Risk Factors for Chronic Liver Disease in Blacks, Mexican Americans, and Whites in the United States: Results From NHANES IV, 1999–2004

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Abstract

OBJECTIVES—Morbidity and mortality due to liver disease and cirrhosis vary significantly by race/ethnicity in the United States. We examined the prevalence of liver disease risk factors among blacks, Mexican Americans, and whites, including elevated aspartate aminotransferase and alanine aminotransferase activity, infection with viral hepatitis B or hepatitis C, alcohol intake, obesity, diabetes, and metabolic syndrome.

METHODS—Data were obtained from the Fourth National Health and Nutrition Examination Survey (NHANES IV). A logistic regression was used to examine the association of race/ethnicity to liver disease risk factors, controlling for the demographic and socioeconomic variables.

RESULTS—Mexican-American men and women are the most likely to have elevated aminotransferase activity. Among men, Mexican Americans are more likely than whites to be heavy/binge drinkers, and blacks are more likely to have hepatitis B or hepatitis C. Among

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Human subjects protection: NHANES IV (1999–2004) is a secondary data set without individual subject identifiers and is available to the general public.

CONFLICT OF INTEREST

Potential competing interests: None.

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Specific author contributions: Yvonne N. Flores and Leo S. Morales originated the study and lead the analyses, interpretation of the findings, and writing of the article; Hal F. Yee and José Escarce assisted with the study design; Mei Leng conducted all the data management and statistical analyses; and Roshan Bastani and Jorge Salmerón contributed to the critical revisions of the article. Each of the seven authors played a critical role in this study and made significant contributions to this manuscript. All authors have approved the final draft of this manuscript.

women, Mexican Americans are more likely than whites to be obese and diabetic, and less likely to be heavy/binge drinkers; blacks are more likely than whites to have hepatitis B or hepatitis C, be obese or diabetic, and less likely to be heavy/binge drinkers.

CONCLUSIONS—In this national sample, the prevalence of risk factors for liver disease varies by race/ethnicity. Mexican Americans and blacks have a greater risk of developing liver disease than their white counterparts. These findings are consistent with the observed racial/ethnic disparities in morbidity and mortality due to chronic liver disease and contribute to the efforts to identify the causes of these disparities. This information can be used by health professionals to tailor screening and intervention programs.

BACKGROUND

In 2004, cirrhosis and chronic liver disease was the 12th leading cause of death in the United States and the sixth among Hispanics (1, 2). Cirrhosis rates are higher for blacks than for whites, and the highest cirrhosis mortality rates are observed among Hispanics (3, 4). Chronic liver disease is the seventh leading cause of death among Hispanics aged 25–44 yr, and is the third leading cause of death among Hispanics aged 45–64 yr. The frequency of steatohepatitis and cirrhosis varies significantly by ethnicity: 45% among Hispanics, 33% among whites, and 24% among blacks (5). From 1997 to 2001, Hispanics in the United States had the highest incidence of and mortality from liver cancer after Asians and Pacific Islanders (6).

Some of the principal known risk factors for cirrhosis and chronic liver disease include high alcohol consumption (7–9), hepatitis B virus (10–12) or hepatitis C virus (13, 14) infection, obesity (15, 16), diabetes (17–19), and certain features of the metabolic syndrome, including insulin resistance, high triglycerides, and low high-density lipoprotein (HDL) cholesterol (20, 21). Aminotransferase levels are considered the clinical indicators of liver health. Chronic liver disease is often diagnosed by detecting asymptomatic elevations in serum aminotransferases, which include alanine aminotransferase (ALT) and aspartate aminotransferase (AST). Not all persons with elevated aminotransferase activity have liver disease. However, some studies indicate that more advanced liver disease, including cirrhosis, may be detected from seemingly slight aminotransferase elevations (22, 23).

Although morbidity and mortality due to chronic liver disease vary significantly by race and ethnicity, there is little information about the prevalence of specific risk factors for liver disease by race/ethnicity in a representative sample of the U.S. population. This lack of comprehensive information about the risk factors for liver disease among different racial/ethnic groups in the United States limits our understanding of the natural history of this disease, and how it disproportionately affects specific populations. This absence of data also restricts our ability to develop effective and appropriate primary prevention programs and services for groups who have a greater risk of developing liver disease.

Thus, we aimed to determine the prevalence of specific known risk factors for liver disease by race/ethnicity, gender, and other sociodemographic characteristics. We examined the data from a nationally representative sample of black, Mexican-American, and white men and women taken from the Fourth National Health and Nutrition Examination Survey, which

was conducted between 1999 and 2004 (henceforth referred to as NHANES IV). We hypothesized that Mexican Americans would have a higher prevalence of elevated aminotransferase activity and metabolic risk factors for liver disease than blacks or whites. We tested this hypothesis by analyzing the independent association between race/ethnicity, gender, education, income, and the following risk factors for liver disease: elevated serum aminotransferase activity, infection with the hepatitis B virus (HBV) or hepatitis C virus (HCV), heavy or binge drinking, obesity, diabetes, and metabolic syndrome, controlling for potential confounders.

METHODS

Study Design and Population

Data for this study were obtained from the NHANES IV, a cross-sectional examination survey that provides a national estimate for the U.S. population at the time of the survey (1999–2004). Health status data were collected via standardized questionnaires that were administered at the participants' homes and by physical examinations and laboratory tests that were conducted at mobile examination centers. The surveys were conducted in English and Spanish. The NHANES IV began in April 1999 and will be conducting surveys in 15 U.S. locations each year. Each year, approximately 5,000 people will be surveyed. The NHANES IV study design is based on a complex multistage probability sample design, and the study sample represents the total civilian noninstitutionalized population in the United States. The design of NHANES IV is described in detail elsewhere (24).

We restricted our analysis to study participants with health examination data who were 20 yr of age and older ($N = 14,213$) because of the lower rates of diabetes in younger individuals. We also excluded other non-Hispanics (*e.g.*, Asians; $N = 417$), non-Mexican-American Hispanics ($N = 641$), and women who were pregnant or breast-feeding ($N = 795$) from the study. Our final sample of 12,360 consisted of 2,670 blacks, 2,961 Mexican Americans, and 6,729 whites.

Definition of Dependent Variables/Liver Disease Risk Factors

ELEVATED LIVER ENZYME TESTS—We used the following definition of elevated aminotransferase activity: an AST >43 IU/L or ALT >40 IU/L for men and women (22, 25). We compared individuals with elevated ALT or AST activity with those with normal activity.

HEPATITIS B OR HEPATITIS C VIRAL INFECTION—HBV infection was identified by having a positive hepatitis B core antibody serology and a positive hepatitis B surface antigen serology. We identified an HCV infection by a positive antibody titer (26). We combined individuals infected with hepatitis B and hepatitis C into one category due to the very small numbers of individuals with only one or the other infection.

ALCOHOL CONSUMPTION—The survey participants were categorized as: (1) nondrinker/moderate drinker or (2) heavy/binge drinker. We compared nondrinkers and moderate drinkers, which were defined as no more than one drink per day for women and no

more than two drinks per day for men (27) and represent a lower level of alcohol consumption, with heavy (2–4 drinks per day for women, and 3–4 drinks per day for men) or binge drinkers (five or more drinks at one time for both men and women), which represent a higher level of alcohol consumption (28).

BODYMASSINDEX(BMI)—The subjects were categorized according to BMI (kg/m^2) following the recommendations of the National Heart, Lung and Blood Institute: underweight ($< 18.5 \text{ kg}/\text{m}^2$), normal ($18.5\text{--}24.9 \text{ kg}/\text{m}^2$), overweight ($25.0\text{--}29.9 \text{ kg}/\text{m}^2$), and obese ($\geq 30.0 \text{ kg}/\text{m}^2$) (29). We compared subjects with an obese BMI with those with a normal or overweight BMI.

DIABETES—Type 2 diabetes was defined as having one of the following: (a) a medical history of diabetes (other than during pregnancy), (b) currently taking medication for diabetes, (c) a plasma glucose level $>125 \text{ mg}/\text{dL}$ after a more than 8-h fast, or (d) a random glucose test $>200 \text{ mg}/\text{dL}$ (30).

METABOLIC SYNDROME—We used the definition of metabolic syndrome that was developed by the Third Report of the National Cholesterol Education Program's Adult Treatment Panel III (ATP III), which is having three or more of the following criteria: (a) abdominal obesity, given as a waist circumference greater than 102 cm for men and greater than 88 cm for women; (b) triglycerides greater than or equal to $150 \text{ mg}/\text{dL}$; (c) HDL cholesterol less than $40 \text{ mg}/\text{dL}$ for men and less than $50 \text{ mg}/\text{dL}$ for women; (d) a blood pressure greater than or equal to 130/85 mmHg, or currently taking blood pressure medication; and (e) a fasting glucose greater than or equal to $110 \text{ mg}/\text{dL}$ (31).

Definition of Independent Variables

The main independent variable in this study is race/ethnicity. The subjects were assigned to one of the three racial/ethnic categories based on self-report, including non-Hispanic black/African American (henceforth, black), Mexican American, and non-Hispanic white (henceforth, white).

Other independent variables include age (20–44 yr, 45–60 yr, and 61 yr or more), sex (male vs female), education (less than high school, completed high school, and more than high school), and income based on poverty-to-income ratio (0–1.0, greater than 1.0, and 3.0 or greater). The Poverty Income Ratio (PIR) is the ratio of family income to the poverty level taking family size into account (32). PIR values less than 1.0 are below the federal poverty threshold. PIR values of 1.0 or greater indicate an income above the federal poverty threshold.

Approximately 9% of subjects were missing family income data, while less than 1% of subjects were missing data of other independent variables. The missing income data were imputed using a three-step procedure: first, an ordinal logistic regression model (*i.e.*, PIR regressed on sex, age, education, and race/ethnicity) was estimated with individuals with complete income data; second, probability thresholds for each subject missing family income data were generated using the regression coefficients from the estimated model; and third, a random number between naught and unity drawn from a uniform distribution was

used to assign each subject missing income data to one of the three income categories. The missing values for all other independent variables were imputed using a modal value substitution.

Analysis

The prevalence rates were calculated for each of the liver disease risk factors stratified by sex, race/ethnicity, education, and income. Separate multivariate logistic regression models were estimated for men and women to evaluate the independent associations of each liver disease risk factor to race/ethnicity, education, and income. All analyses were conducted using the survey suite commands in STATA (33). We followed all the recommendations of the National Center for Health Statistics for the analysis of NHANES IV data (24). We combined the weights of the three NHANES IV cycles together and followed the guidelines, using the examined weight (Mobile Examination Center weight) for all of the analyses.

RESULTS

Subject Characteristics

Nearly 60% of the black and 74% of the Mexican-American study subjects are between the ages of 20 and 44 yr, while approximately 50% of the white subjects are in this age category. Almost 90% of the white and 66% of the black subjects completed high school and/or some college or more, whereas 56% of the Mexican Americans did not complete high school. Whites have the highest average income, followed by blacks and Mexican Americans (Table 1).

Prevalence of Liver Disease Risk Factors

Mexican-American men have a higher prevalence of elevated aminotransferase activity (28%) than their black (14%) and white (15%) counterparts. Black men are more likely to be infected with HBV and/or HCV (6%) than Mexican-American (3%) and white (2%) men. Mexican-American men are more likely to be heavy or binge drinkers (63%) than black (33%) and white (37%) men. The prevalence of obesity and diabetes is similar among black, white, and Mexican-American men. The rate of metabolic syndrome is lower among black and Mexican-American men (22% and 25%, respectively) than among white men (33%). Men with less education have a higher prevalence of elevated aminotransferase activity, HBV or HCV infection, heavy or binge drinking, and metabolic syndrome. The prevalence of elevated aminotransferase activity, HBV or HCV infection, and heavy or binge drinking is greatest among men in the lowest income category (Table 2).

The prevalence of elevated aminotransferase activity is more than twice as high among Mexican-American women (11%) as among black (4%) and white (5%) women. Black (4%) women are more likely to be infected with HBV or HCV than white or Mexican-American women (both 1%). The prevalence of heavy or binge drinking is greater among white women (38%) than among Mexican-American (33%) and black (30%) women. The rates of obesity are highest among black women (50%), followed by Mexican-American (38%) and white (31%) women. The presence of diabetes is greater among Mexican-American and black women (both 9%) than among white (4%) women. The rate of

metabolic syndrome is higher among Mexican-American women (36%) than among black (34%) and white (33%) women. The prevalence of HBV or HCV infection, obesity, diabetes, and metabolic syndrome are higher among women who are in the lowest education and income categories, except for heavy binge drinking, which is lower in these groups. Among women, the prevalence of elevated aminotransferase activity did not vary significantly by education and income (Table 2).

Risk Differences by Race/Ethnicity

After controlling for age, education, and income, Mexican-American men are more likely to have elevated aminotransferase activity and be heavy or binge alcohol drinkers than white men. Black men are more likely to have HBV or HCV infection and are less likely to have elevated aminotransferase activity, be heavy or binge drinkers, and have metabolic syndrome than white men. Men in the lower education categories are more likely to have elevated aminotransferase activity, be infected with HBV or HCV, be heavy or binge drinkers, and have metabolic syndrome than those in the highest education group. Men in the lower income categories were more likely to be infected with HBV or HCV, be obese, and have diabetes than men in the highest income category (Table 3).

After controlling for the aforementioned covariates, Mexican-American women are more than twice as likely to have elevated aminotransferase activity, be obese, and have diabetes than white women, and they are less likely to be heavy or binge drinkers than white women. Black women are more likely to be infected with HBV or HCV, are more than twice as likely to be obese or have diabetes than white women, and they are less likely to be heavy or binge drinkers than white women. The risk of being infected with HBV or HCV, being obese, as well as having diabetes and metabolic syndrome is greater among women in the lower education categories as compared with those in the highest education category. A higher risk of infection with HBV or HCV, obesity, and metabolic syndrome is observed among women in the lower income categories as compared with women in the highest income group. The risk of elevated aminotransferase activity did not vary significantly by education and income (Table 3).

In secondary analyses, we found that Mexican-American men are significantly more likely to be overweight or obese than white or black men (OR 1.6, 95% CI 1.29–1.98). We also examined the association between elevated aminotransferase activity and overweight and obesity. Our results indicate that there is a significantly higher risk of having elevated aminotransferase activity among Mexican Americans who are overweight (OR 2.53, 95% CI 1.81–3.52) and among those who are obese (OR 6.07, 95% CI 4.47–8.23) (data not shown).

DISCUSSION

Our findings indicate that the prevalence of certain liver disease risk factors varies by race/ethnicity, gender, and income level. These results are consistent with the observed racial and ethnic disparities in morbidity and mortality due to liver disease and contribute to the efforts to identify the underlying causes for these disparities. Other studies have examined the prevalence and predictors of elevated aminotransferase activity as a surrogate of the burden of liver disease (22, 25). However, this is the first study that examines the prevalence of

specific risk factors for liver disease by race/ethnicity, gender, and other sociodemographic characteristics in a representative sample of the U.S. population.

In this national sample, Mexican Americans and blacks are significantly more likely to have the risk factors for liver disease than whites. Elevated aminotransferase activity and heavy/binge drinking are more common among Mexican-American men than among white or black men. Black men are twice as likely to be infected with HBV or HCV than Mexican-American or white men. Mexican-American and black women are more likely to be obese and diabetic and less likely to be heavy or binge drinkers than white women. Black women have a nearly two-fold greater risk of infection with HBV or HCV than white women. Our results also show that elevated aminotransferase activity is more common among Mexican Americans and less common among blacks than whites. To the extent that elevated aminotransferase levels reflect subclinical liver inflammation (22, 25, 34), our results suggest that Mexican Americans have a greater risk of developing chronic liver disease.

Although there is no clear or proven explanation for why Mexican Americans may be at greater risk of developing chronic liver disease, there is evidence that this population has a higher rate of cirrhosis mortality in both the United States (3, 4) and Mexico, where chronic liver disease was the third leading cause of death in 2005 (35). Some possible explanations for this increased risk of liver disease among Mexican Americans may include predisposing genetic factors or gene–environment interactions. Studies have also shown that having a combination of risk factors for liver disease, for example, obesity and drinking, or HCV and diabetes, increases the risk of abnormal aminotransferase activity and liver cancer (36, 37). Future studies are needed to examine if an accumulation of individual risk factors may contribute to an increased risk of liver disease among Mexican Americans.

Hispanics are the largest, youngest, and fastest growing group in the United States, accounting for approximately 14% of the population (38, 39). Finding ways to prevent chronic liver disease among this rapidly growing population is very important because as the number of Hispanics in the United States increases, the challenge to address the high rates of liver disease, obesity, and related metabolic disorders among this group will also increase. The fact that diabetes disproportionately affects Hispanics in the United States is also relevant because a recent study reported that diabetes is associated with a 2- to 3-fold increase in the risk of liver cancer, regardless of the presence of other major risk factors (40).

This study has some limitations. This analysis is limited to Mexican Americans and does not include other Hispanic groups in the United States. Given what is known about the heterogeneity of health status among Hispanic groups, it is likely that these results do not generalize to other Hispanics. Furthermore, NHANES IV may not be representative of Mexican Americans in the United States. Although Mexican Americans comprise 22% of the total NHANES IV population of approximately 38,000 individuals, the sample of Mexican Americans represents only a small fraction of the total Mexican-American population in the United States. Finally, this study examines some of the most common risk factors for liver disease, but it does not include all risk factors because we are limited to the data collected for NHANES IV. Despite these limitations, however, NHANES IV is one of

the only sources of available data for this type of analysis. We plan to conduct additional analyses that will identify the changing trends in liver disease risk factors using the data from NHANES III (1988–1994) and NHANES IV (1999–2004).

Several lifestyle changes have been identified as important for the prevention and treatment of liver disease, including avoiding infection with HBV and HCV through vaccination and behavioral risk reduction, abstinence or reduced alcohol consumption, diet and exercise for weight loss/maintenance, and management of diabetes. Identifying the specific risk factors and circumstances that affect different populations permits an effective targeting of the prevention efforts. The findings of this study could be used to help develop more appropriate prevention programs that address the specific needs of the racial/ethnic and sociodemographic groups that have a greater risk of developing liver disease.

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STUDY HIGHLIGHTS

What Is Current Knowledge

- Liver disease mortality varies by race/ethnicity.
- The risk factors include high alcohol intake, hepatitis B and hepatitis C, obesity, diabetes, and metabolic syndrome.
- Aminotransferase levels are an indicator of liver health.

What Is New Here

- The risk factors for liver disease were found to vary by race/ethnicity, gender, and income in this nationally representative sample.
- Elevated aminotransferase levels were most common among Mexican Americans.
- Mexican Americans and blacks had more liver disease risk factors than whites.

Table 1

Sociodemographic Characteristics of the Study Sample by Race/Ethnicity, Age, Education, Income, and Gender (N [weighted %])

Sociodemographic Characteristics	Men			Women		
	White (N = 3,433)	Black (N = 1,309)	Mexican American (N = 1,520)	White (N = 3,296)	Black (N = 1,361)	Mexican American (N = 1,441)
Age						
20–44	1,255 (48)	619 (58)	742 (74)	1,136 (43)	610 (54)	633 (66)
45–60	749 (28)	298 (26)	270 (18)	734 (28)	320 (27)	280 (21)
61+	1,429 (23)	392 (16)	508 (9)	1,426 (29)	431 (20)	528 (13)
Education						
Less than high school	627 (14)	498 (34)	973 (56)	582 (15)	492 (33)	885 (53)
High-school diploma	937 (28)	304 (25)	249 (21)	977 (29)	320 (24)	228 (20)
More than high school	1,869 (59)	507 (41)	298 (23)	1,737 (57)	549 (43)	328 (28)
Income (PIR) [*]						
0–1.0	342 (8)	280 (22)	419 (25)	389 (11)	374 (28)	445 (31)
>1.0–3.0	1,278 (32)	573 (43)	773 (53)	1,335 (36)	618 (44)	683 (46)
>3.0	1,813 (60)	456 (36)	328 (22)	1,572 (53)	369 (28)	313 (23)

* The Poverty Income Ratio (PIR) is the ratio of income to the family's appropriate poverty level (U.S. Census Bureau, 2003a). PIR values less than 1.0 are below the official poverty threshold. PIR values of 1.0 or greater indicate an income above the poverty threshold.

Prevalence of Liver Disease Risk Factors by Race/Ethnicity, Education, Income, and Gender (Percentages [95% Confidence Intervals])

Table 2

	Elevated ALT or AST ² (N = 5,879)	Hepatitis B or C (N = 5,906)	Heavy or Binge Drinker ³ (N = 4,983)	Obesity ⁴ (N = 6,047)	Diabetes (N = 2,669)	Metabolic Syndrome ⁵ (N = 2,524)
<i>Men</i>						
Race/Ethnicity						
Black	14 (12–16)	6 (5–8) [/]	33 (29–38)	29 (26–32)	7 (5–10)	22 (18–26) [/]
Mexican American	28 (25–32) [/]	3 (2–4)	63 (59–66) [/]	28 (25–32)	7 (5–10)	25 (20–30) [/]
White [*]	15 (13–17)	2 (2–3)	37 (34–40)	29 (27–31)	9 (7–11)	33 (30–36)
Education						
Less than high school	19 (16–22) [/]	4 (3–6) [/]	47 (43–51) [/]	28 (25–31)	8 (6–11)	33 (28–39)
High-school diploma	16 (14–19)	4 (3–6) [/]	45 (40–50) [/]	31 (28–34)	8 (5–11)	35 (30–42) [/]
More than high school [*]	15 (13–16)	2 (1–3)	34 (31–37)	29 (27–31)	9 (7–11)	27 (24–31)
Income (PIR) ⁶						
0–1.0	21 (17–25) [/]	8 (6–10) [/]	46 (41–51) [/]	26 (22–29)	10 (6–15)	22 (17–27) [/]
>1.0–3.0	16 (14–18)	3 (2–4)	43 (39–46) [/]	30 (28–32)	10 (8–14)	31 (28–35)
>3.0 [*]	15 (13–17)	2 (1–3)	35 (32–38)	29 (27–31)	7 (5–10)	32 (28–36)
<i>Women</i>						
Race/Ethnicity						
Black	4 (3–5) [/]	4 (3–5) [/]	30 (26–34) [/]	50 (47–54) [/]	9 (7–12) [/]	34 (29–40)
Mexican American	11 (9–14) [/]	1 (0–2)	33 (30–37) [/]	38 (34–43) [/]	9 (6–15) [/]	36 (31–42)
White [*]	5 (5–6)	1 (1–2)	38 (35–40)	31 (29–33)	4 (3–5)	33 (30–36)
Education						
Less than high school	6 (4–8)	2 (1–3) [/]	28 (26–30) [/]	41 (38–44) [/]	11 (9–14) [/]	43 (38–49) [/]
High-school diploma	5 (4–7)	3 (2–4) [/]	36 (32–40)	36 (33–39) [/]	5 (3–7)	40 (35–45) [/]

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More than high school [*]	6 (5–7)	1 (1–2)	40 (37–43) ^{<i>I</i>}	31 (28–33)	3 (2–4)	27 (24–31)
Income (PIR) ^{<i>g</i>}						
0–1.0	5 (4–7)	3 (2–4) ^{<i>I</i>}	35 (30–39)	40 (37–43) ^{<i>I</i>}	7 (5–10)	36 (29–44) ^{<i>I</i>}
1.0–3.0	6 (5–7)	2 (2–3) ^{<i>I</i>}	35 (32–38) ^{<i>I</i>}	37 (34–39) ^{<i>I</i>}	7 (5–9)	39 (35–43) ^{<i>I</i>}
3.0 + [*]	6 (5–7)	1 (0–1)	38 (36–41)	30 (27–33)	3 (2–5)	29 (25–33)

^{*} Reference category.

^{*I*} P< 0.05 for test of null hypothesis that rate is equal to rate in reference category.

² Elevated ALT and AST were defined as: AST >43 IU/L or ALT >40 IU/L for men and women.

³ Heavy drinking was defined as 2–4 drinks per day for women and 3–4 drinks per day for men. Binge drinking was defined as having five or more drinks at one time for both men and women.

⁴ Obesity was defined as having a body mass index (BMI) of ≥30.0 kg/m².

⁵ We used the definition of metabolic syndrome that was developed by the Third Report of the National Cholesterol Education Program's Adult Treatment Panel III.

⁶ The Poverty Income Ratio (PIR) is the ratio of income to the family's appropriate poverty level (U.S. Census Bureau, 2003a). PIR values less than 1.0 are below the official poverty threshold. PIR values of 1.0 or greater indicate an income above the poverty threshold.

Table 3

Odds Ratios and 95% Confidence Intervals for Liver Disease Risk Factors by Race/Ethnicity, Education, Income, and Gender

	Elevated ALT or AST ² (N = 5,879)	Hepatitis B+ or C+ (N = 5,906)	Heavy or Binge Drinker ³ (N = 4,983)	Obesity ⁴ (N = 6,047)	Diabetes (N = 2,669)	Metabolic Syndrome ⁵ (N = 2,669)
<i>Men</i>						
Race/Ethnicity						
Black	0.8 (0.6–0.9) ^I	2.0 (1.2–3.3) ^I	0.6 (0.5–0.8) ^I	1.0 (0.9–1.2)	1.0 (0.6–1.5)	0.6 (0.5–0.9) ^I
Mexican American	1.6 (1.3–2.1) ^I	0.7 (0.3–1.6)	1.8 (1.5–2.2) ^I	1.0 (0.8–1.3)	1.2 (0.7–1.8)	0.8 (0.6–1.2)
White	1.0	1.0	1.0	1.0	1.0	1.0
Education						
Less than high school	1.3 (1.0–1.7) ^I	1.7 (0.9–3.1)	1.7 (1.3–2.2) ^I	1.0 (0.8–1.2)	0.6 (0.4–1.0)	1.5 (1.0–2.1) ^I
High-school diploma	1.1 (0.9–1.3)	1.9 (1.1–3.3) ^I	1.5 (1.2–1.9) ^I	1.1 (0.9–1.3)	0.8 (0.5–1.4)	1.6 (1.2–2.2) ^I
More than high school	1.0	1.0	1.0	1.0	1.0	1.0
Income (PIR) ⁶						
0–1.0	1.2 (0.9–1.6)	4.1 (2.4–6.8) ^I	1.1 (0.9–1.4)	0.9 (0.7–1.1)	2.1 (1.0–4.1) ^I	0.7 (0.5–1.0)
> 1.0–3.0	1.0 (0.8–1.3)	1.7 (1.0–3.0) ^I	1.2 (1.0–1.4)	1.1 (0.9–1.3) ^I	1.8 (1.1–3.1)	0.9 (0.7–1.3)
> 3.0	1.0	1.0	1.0	1.0	1.0	1.0
<i>Women</i>						
Race/Ethnicity						
Black	0.7 (0.5–1.0) ^I	1.8 (1.1–3.0) ^I	0.6 (0.5–0.8) ^I	2.1 (1.8–2.4) ^I	2.7 (1.8–4.0) ^I	1.1 (0.8–1.5)
Mexican American	2.1 (1.6–2.9) ^I	0.4 (0.2–1.2)	0.6 (0.5–0.8) ^I	1.3 (1.0–1.6) ^I	2.6 (1.4–4.8) ^I	1.2 (0.9–1.7)
White	1.0	1.0	1.0	1.0	1.0	1.0
Education						
Less than high school	1.1 (0.7–0.6)	1.5 (0.7–3.3) ^I	0.9 (0.7–1.0)	1.3 (1.0–1.6) ^I	2.3 (1.4–3.6) ^I	1.6 (1.1–2.2) ^I
High-school diploma	1.0 (0.7–1.6)	2.0 (0.9–4.4) ^I	1.0 (0.8–1.3)	1.2 (1.0–1.4) ^I	1.2 (0.7–2.2)	1.5 (1.1–1.9) ^I

More than high school	1.0	1.0	1.0	1.0	1.0	1.0
Income (PIR) ⁶						
0–1.0	0.9 (0.5–1.4)	3.3 (1.6–6.6) ¹	0.9 (0.7–1.1)	1.4 (1.1–1.6) ¹	1.3 (0.7–2.5)	1.4 (0.9–2.0)
> 1.0–3.0	1.1 (0.8–1.6)	3.1 (1.7–5.9) ¹	1.0 (0.9–1.2)	1.3 (1.1–1.5) ¹	1.4 (0.9–2.3)	1.3 (1.0–1.7) ¹
> 3.0	1.0	1.0	1.0	1.0	1.0	1.0

Regressions also include age, education, and income.

¹ $P < 0.05$ for test of null hypothesis that rate is equal to rate in reference category.

² Elevated ALT and AST were defined as: AST > 43 IU/L or ALT > 40 IU/L for men and women.

³ Heavy drinking was defined as 2–4 drinks per day for women and 3–4 drinks per day for men. Binge drinking was defined as having five or more drinks at one time for both men and women.

⁴ Obesity was defined as having a body mass index (BMI) of $\geq 30.0 \text{ kg/m}^2$.

⁵ We used the definition of metabolic syndrome that was developed by the Third Report of the National Cholesterol Education Program's Adult Treatment Panel III.

⁶ The Poverty Income Ratio (PIR) is the ratio of income to the family's appropriate poverty level (U.S. Census Bureau, 2003a). PIR values less than 1.0 are below the official poverty threshold. PIR values of 1.0 or greater indicate an income above the poverty threshold.