ISSN 1007-9327 (print)
ISSN 2219-2840 (online)

World Journal of *Gastroenterology*

World J Gastroenterol 2018 October 7; 24(37): 4217-4296

Published by Baishideng Publishing Group Inc

World Journal of Gastroenterology

Contents

Weekly Volume 24 Number 37 October 7, 2018

EDITORIAL

4217 Focus on the gut-brain axis: Multiple sclerosis, the intestinal barrier and the microbiome

Camara-Lemarroy CR, Metz LM, Yong VW

4224 Hepatocellular carcinoma in Latin America: Diagnosis and treatment challenges

Piñero F, Poniachik J, Ridruejo E, Silva M

REVIEW

4230 New prognostic biomarkers of mortality in patients undergoing liver transplantation for hepatocellular carcinoma

Lorente L

MINIREVIEWS

4243 Colonoscopy attachments for the detection of precancerous lesions during colonoscopy: A review of the literature

Gkolfakis P, Tziatzios G, Spartalis E, Papanikolaou IS, Triantafyllou K

ORIGINAL ARTICLE

Basic Study

4254 VSL#3 can prevent ulcerative colitis-associated carcinogenesis in mice

Wang C, Li WB, Wang HY, Ma YM, Zhao XH, Yang H, Qian JM, Li JN

4263 Potential involvement of heat shock proteins in pancreatic-duodenal homeobox-1-mediated effects on the genesis of gastric cancer: A 2D gel-based proteomic study

Ma J, Wang BB, Ma XY, Deng WP, Xu LS, Sha WH

Case Control Study

4272 Evaluation of elastography combined with serological indexes for hepatic fibrosis in patients with chronic hepatitis B

Xu B, Zhou NM, Cao WT, Li XJ

Observational Study

4281 Risk factors for liver disease among adults of Mexican descent in the United States and Mexico

Flores YN, Zhang ZF, Bastani R, Leng M, Crespi CM, Ramírez-Palacios P, Stevens H, Salmerón J

CASE REPORT

4291 Cerebral lipiodol embolism related to a vascular lake during chemoembolization in hepatocellular carcinoma: A case report and review of the literature

Ishimaru H, Morikawa M, Sakugawa T, Sakamoto I, Motoyoshi Y, Ikebe Y, Uetani M

ABOUT COVER

Editorial board member of *World Journal of Gastroenterology*, Cesare Tosetti, MD, Doctor, Professor, Department of Primary Care, Health Care Agency of Bologna, Porretta Terme 40046, Bologna, Italy

AIMS AND SCOPE

World Journal of Gastroenterology (*World J Gastroenterol*, *WJG*, print ISSN 1007-9327, online ISSN 2219-2840, DOI: 10.3748) is a peer-reviewed open access journal. *WJG* was established on October 1, 1995. It is published weekly on the 7th, 14th, 21st, and 28th each month. The *WJG* Editorial Board consists of 642 experts in gastroenterology and hepatology from 59 countries.

The primary task of *WJG* is to rapidly publish high-quality original articles, reviews, and commentaries in the fields of gastroenterology, hepatology, gastrointestinal endoscopy, gastrointestinal surgery, hepatobiliary surgery, gastrointestinal oncology, gastrointestinal radiation oncology, gastrointestinal imaging, gastrointestinal interventional therapy, gastrointestinal infectious diseases, gastrointestinal pharmacology, gastrointestinal pathophysiology, gastrointestinal pathology, evidence-based medicine in gastroenterology, pancreatology, gastrointestinal laboratory medicine, gastrointestinal molecular biology, gastrointestinal immunology, gastrointestinal microbiology, gastrointestinal genetics, gastrointestinal translational medicine, gastrointestinal diagnostics, and gastrointestinal therapeutics. *WJG* is dedicated to become an influential and prestigious journal in gastroenterology and hepatology, to promote the development of above disciplines, and to improve the diagnostic and therapeutic skill and expertise of clinicians.

INDEXING/ABSTRACTING

World Journal of Gastroenterology (*WJG*) is now indexed in Current Contents®/Clinical Medicine, Science Citation Index Expanded (also known as SciSearch®), Journal Citation Reports®, Index Medicus, MEDLINE, PubMed, PubMed Central and Directory of Open Access Journals. The 2018 edition of Journal Citation Reports® cites the 2017 impact factor for *WJG* as 3.300 (5-year impact factor: 3.387), ranking *WJG* as 35th among 80 journals in gastroenterology and hepatology (quartile in category Q2).

NAME OF JOURNAL
World Journal of Gastroenterology

ISSN
ISSN 1007-9327 (print)
ISSN 2219-2840 (online)

LAUNCH DATE
October 1, 1995

FREQUENCY
Weekly

EDITORIAL OFFICE
Ze-Mao Gong, Director
World Journal of Gastroenterology
Baishideng Publishing Group Inc
7901 Stoneridge Drive, Suite 501,
Pleasanton, CA 94588, USA
Telephone: +1-925-2238242
Fax: +1-925-2238243
E-mail: editorialoffice@wjgnet.com
Help Desk: http://www.f6publishing.com/helpdesk
http://www.wjgnet.com

PUBLISHER
Baishideng Publishing Group Inc
7901 Stoneridge Drive, Suite 501,
Pleasanton, CA 94588, USA
Telephone: +1-925-2238242
Fax: +1-925-2238243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.f6publishing.com/helpdesk
http://www.wjgnet.com

PUBLICATION DATE
October 7, 2018

INSTRUCTIONS TO AUTHORS
Full instructions are available online at http://www.wjgnet.com/bpg/gerinfo/204

ONLINE SUBMISSION
http://www.f6publishing.com

World Journal of Gastroenterology

Submit a Manuscript: http://www.f6publishing.com

World J Gastroenterol 2018 October 7; 24(37): 4281-4290

DOI: 10.3748/wjg.v24.i37.4281

ISSN 1007-9327 (print) ISSN 2219-2840 (online)

ORIGINAL ARTICLE

Observational Study

Risk factors for liver disease among adults of Mexican descent in the United States and Mexico

Yvonne N Flores, Zuo-Feng Zhang, Roshan Bastani, Mei Leng, Catherine M Crespi, Paula Ramírez-Palacios, Heather Stevens, Jorge Salmerón

Yvonne N Flores, Paula Ramírez-Palacios, Jorge Salmerón, Unidad de Investigación Epidemiológica y en Servicios de Salud, Delegación Morelos, Instituto Mexicano del Seguro Social, Cuernavaca, Morelos 62000, México

Yvonne N Flores, Roshan Bastani, UCLA Department of Health Policy and Management and Kaiser Permanente Center for Health Equity, Fielding School of Public Health, Los Angeles, CA 90095, United States

Yvonne N Flores, Roshan Bastani, Catherine M Crespi, UCLA Cancer Prevention and Control Research Center, Fielding School of Public Health and Jonsson Comprehensive Cancer Center, Los Angeles, CA 90095, United States

Zuo-Feng Zhang, UCLA Department of Epidemiology, Fielding School of Public Health, Los Angeles, CA 90095, United States

Mei Leng, UCLA Division of General Internal Medicine and Health Services Research, Los Angeles, CA 90095, United States

Catherine M Crespi, UCLA Department of Biostatistics, Fielding School of Public Health, Los Angeles, CA 90095, United States

Heather Stevens, University of Washington, School of Medicine, Seattle, WA 98195, United States

Jorge Salmerón, Universidad Nacional Autónoma de México, Academic Epidemiology Research Unit, Avenida Universidad 3000, Ciudad Universitaria, Coyoacán, Mexico City 04510, México

Jorge Salmerón, Centro de Investigación en Salud Poblacional, Instituto Nacional de Salud Pública, Cuernavaca, Morelos 62100, México

ORCID number: Yvonne N Flores (0000-0002-0601-357X); Zuo-Feng Zhang (0000-0002-4669-3995); Roshan Bastani (0000-0001-6594-9231); Mei Leng (0000-0002-2758-7599); Catherine M Crespi (0000-0002-6150-2181); Paula Ramírez-Palacios (0000-0002-2586-4396); Heather Stevens (0000-0002-8261-2005); Jorge Salmerón (0000-0001-8654-2393).

Author contributions: Flores YN, Zhang ZF, Bastani R, Leng M, Crespi CM, Ramírez-Palacios P, Stevens H, Salmerón J contributed to the study design; statistical analysis; interpretation of the findings; writing the article and approval of the final draft.

Supported by the Programa de Investigación en Migracion y Salud (PIMSA), No. 2015-2106; the Instituto Mexicano del Seguro Social (IMSS), No. 2005/1/ I /093; and the Consejo Nacional de Ciencia y Tecnología (CONACYT), No. 26267M and No. SALUD-2011-01-161930; the NIH, No. UL1TR000124 to Crespi CM, and NIH/NCI No. K07CA197179 to Flores YN.

Institutional review board statement: Approval for both the Health Worker Cohort Study and this bi-national investigation was obtained from the Internal Review Boards of IMSS and UCLA.

Conflict-of-interest statement: All authors declare no potential conflicts of interest relevant to this article.

Data sharing statement: No additional data are available.

STROBE statement: The guidelines of the STROBE Statement have been adopted.

Manuscript source: Unsolicited manuscript

Correspondence to: Yvonne N Flores, PhD, Unidad de Investigación Epidemiológica y en Servicios de Salud, Delegación Morelos, Instituto Mexicano del Seguro Social, Blvd. Juárez #31, Colonia Centro, Cuernavaca, Morelos 62000, México. ynflores@ucla.edu
Telephone: +52-777-1001364

Received: June 20, 2018
Peer-review started: June 20, 2018
First decision: July 4, 2018
Revised: August 1, 2018
Accepted: August 24, 2018
Article in press: August 24, 2018
Published online: October 7, 2018

Abstract

AIM

To compare the prevalence of chronic liver disease (CLD) risk factors in a representative sample of Mexican-Americans born in the United States (US) or Mexico, to a sample of adults in Mexico.

METHODS

Data for Mexican-Americans in the US were obtained from the 1999-2014 National Health and Nutrition Examination Survey (NHANES), which includes persons of Mexican origin living in the US (n = 4274). The NHANES sample was restricted to Mexican-American participants who were 20 years and older, born in the US or Mexico, not pregnant or breastfeeding, and with medical insurance. The data in Mexico were obtained from the 2004-2013 Health Worker Cohort Study in Cuernavaca, Mexico (n = 9485). The following known risk factors for liver disease/cancer were evaluated: elevated aminotransferase levels (elevated alanine aminotransferase was defined as > 40 IU/L for males and females; elevated aspartate aminotransferase was defined as > 40 IU/L for males and females), infection with hepatitis B or hepatitis C, metabolic syndrome, high total cholesterol, diabetes, obesity, abdominal obesity, and heavy alcohol use. The main independent variables for this study classified individuals by country of residence (*i.e.*, Mexico *vs* the US) and place of birth (*i.e.*, US-born *vs* Mexico-born). Regression analyses were used to investigate CLD risk factors.

RESULTS

After adjusting for socio-demographic characteristics, Mexican-American males were more likely to be obese, diabetic, heavy/binge drinkers or have abdominal obesity than males in Mexico. The adjusted multivariate results for females also indicate that Mexican-American females were significantly more likely to be obese, diabetic, be heavy/binge drinkers or have abdominal obesity than Mexican females. The prevalence ratios and prevalence differences mirror the multivariate analysis findings for the aforementioned risk factors, showing a greater risk among US-born as compared to Mexico-born Mexican-Americans.

CONCLUSION

In this study, Mexican-Americans in the US had more risk factors for CLD than their counterparts in Mexico. These findings can be used to design and implement more effective health promotion policies and programs to address the specific factors that put Mexicans at higher risk of developing CLD in both countries.

Key words: Liver disease; Risk factors; Health disparities; Mexico; Mexican Americans; Latinos

Core tip: United States (US) Latinos have greater morbidity and mortality from liver disease than non-Hispanic whites, and liver disease is the fifth leading cause of death in Mexico. Known risk factors for chronic liver disease include hepatitis B or C infection, heavy/binge drinking, obesity, diabetes, and metabolic syndrome. We found that Mexican-Americans in the US have a greater risk of obesity, diabetes and heavy/binge drinking than their counterparts in Mexico. The prevalence of heavy/binge drinking was alarmingly high among Mexican-Americans, with over 70% among males and over 50% among US-born females. Our results identify a high prevalence of specific risk factors that should be targeted to reduce the high rates of liver disease-related mortality in this population.

Flores YN, Zhang ZF, Bastani R, Leng M, Crespi CM, Ramírez-Palacios P, Stevens H, Salmerón J. Risk factors for liver disease among adults of Mexican descent in the United States and Mexico. *World J Gastroenterol* 2018; 24(37): 4281-4290 Available from: URL: http://www.wjgnet.com/1007-9327/full/v24/i37/4281.htm DOI: http://dx.doi.org/10.3748/wjg.v24.i37.4281

INTRODUCTION

Over 30 million people, or one in ten, are likely to have some form of chronic liver disease (CLD) in the United States (US). This number includes the approximately 850000 to 2.2 million cases of chronic hepatitis B (HBV), 3.5 million cases of chronic hepatitis C (HCV)[1], the estimated 30% of Americans who have non-alcoholic fatty liver disease (NAFLD), and the 10% with advanced fibrosis[2,3]. Also included are the nearly 20000 individuals who die from alcoholic liver disease in the US each year[4]. In 2017, there were an estimated 40000 incident cases of liver cancer and 30000 deaths from liver cancer[5]. New cases of liver cancer have more than tripled since 1980 and liver cancer mortality has increased by nearly 3% each year since 2000[5]. CLD is the 12th leading cause of general mortality in the US[4], the fifth among individuals between 45-54 years, and the sixth among 25-44 year olds and those aged 55-64 years[6].

Latinos in the US have disproportionately higher rates of CLD. Since 2002, CLD has consistently been the sixth leading cause of mortality for Latinos[7], and the third cause of death among Latino males ages 55-64[8]. They are twice as likely to have CLD and 1.7 times more likely to die from liver cancer than non-Hispanic

whites (whites)[9]. The prevalence of earlier stage liver disease, such as steatohepatitis, is also higher among Latinos (45%) than whites (33%) or blacks (24%)[10]. In Mexico, cirrhosis and other forms of CLD were the fourth leading cause of general mortality in 2016, and the third among males aged 35-65 years[11]. An estimated 3 million individuals are infected with HBV and 400000 to 1400000 people are infected with HCV[12]. In 2016, there were 38755 deaths due to CLD in Mexico and 14029 (36%) were attributed to alcoholic liver disease[11]. By 2050, an estimated 90% of cases of CLD in Mexico will be attributable to obesity and excessive alcohol consumption, as compared to other populations with high rates of CLD due to infection with HBV or HCV[13].

Although infection with HBV or HCV and heavy alcohol use are well known risk factors for CLD and liver cancer, a significant proportion of cases (15% to 50%) do not present with these risk factors[14]. Other risk factors for CLD include obesity and diabetes, and the proposed mechanism is through the development of NAFLD and non-alcoholic steatohepatitis (NASH)[15-18]. NAFLD is found in up to 80-90% of obese adults, in 30-50% of patients with diabetes, and in up to 90% of patients with hyperlipidemia[19]. In the US, the prevalence of NAFLD and NASH is highest among Latinos, followed by whites and blacks[10,15,20]. Rates of obesity, diabetes, and hyperlipidemia are also higher among Latinos than whites in the US[21-23]. In Mexico, over 70% of the population is overweight or obese, and this figure is predicted to rise to 90% by 2050[24]. Additionally, the prevalence of metabolic syndrome is estimated to be 40%[25], and in 2015, diabetes was the second cause of general mortality in Mexico, which has one of the highest incidence rates of diabetes in the world[11,26].

Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels are common clinical measures used to assess liver health. Elevated aminotransferase levels can indicate sudden or acute liver injury, or they can be persistently elevated, suggesting ongoing liver disease. The leading cause of mild aminotransferase levels is NAFLD, but other common causes include excessive alcohol consumption, medication-associated liver injury, infection with HVB or HCV, and hemochromatosis[27]. While not all individuals with elevated aminotransferase levels have liver damage or disease, these measures can be used to detect asymptomatic disease[27]. Several US studies report a higher prevalence of elevated ALT among Mexican-Americans (17.4%) than among whites (8.2%)[28-30].

The aim of this study was to compare the prevalence of known risk factors for CLD in a representative sample of Mexican-Americans, who were born in the US or Mexico, to a sample of adults in Mexico. We examined data from the 1999-2014 National Health and Nutrition Examination Survey (NHANES), which includes persons of Mexican origin living in the US, and data from the 2004-2013 Health Worker Cohort Study (HWCS) in Cuernavaca, Mexico. We hypothesized that Mexican-Americans in the US would have a higher prevalence of CLD risk factors than their counterparts in Mexico. This hypothesis is based on studies suggesting that immigrant Mexican-Americans have better health outcomes than more acculturated, US-born Mexican-Americans[31-33]. We tested this hypothesis by analyzing the independent association between country of residence (*i.e.*, Mexico *vs* the US) and place of birth, sex, and the following risk factors for CLD: Elevated ALT or AST levels, infection with HBV or HCV, metabolic syndrome, high cholesterol, diabetes, obesity, abdominal obesity, and heavy or binge drinking, while also controlling for potential confounders.

MATERIALS AND METHODS

Ethical considerations

Ethical approval for the HWCS and this bi-national study was granted from the Internal Review Boards of the Mexican Social Security Institute (IMSS) and the University of California, Los Angeles (UCLA). Informed consent was obtained from all the HWCS subjects prior to their participation in any study activities.

Data sources

This observational study used existing data from Mexican-Americans who participated in NHANES, a cross-sectional, representative, examination survey of the total civilian non-institutionalized population residing in the continental US and Hawaii. This continuous survey is conducted by the National Center for Health Statistics to assess and track the health and nutritional status of Americans over time. The survey collects health data through standardized questionnaires, physical examinations and a series of laboratory tests. The design of NHANES over-samples Mexican-Americans to allow for analyses of this subgroup. The 1999-2014 NHANES data includes a total of 3929 male and 4182 female Mexican-Americans, for a total sample size of 8111[34].

The data in Mexico came from the HWCS, a longitudinal study of workers and their immediate family members from two large health care institutions in Cuernavaca, Mexico: the IMSS and the National Institute of Public Health. Briefly, the HWCS collects information using physical examinations, self-reported questionnaires, and laboratory tests in order to prospectively evaluate risk factors and the incidence of chronic diseases, including heart disease, diabetes, and liver disease (CLD). From 2004 to 2006 (Wave 1), approximately 9000 health workers enrolled in the HWCS. During 2011 to 2013 (Wave 2), a total of 1855 participants were followed-up. Details about the design and methods of the HWCS are described elsewhere[35]. The clinical and anthropometric procedures that were used for the HWCS are comparable to those used for the NHANES surveys[36].

Study samples in the United States and Mexico

The 1999-2014 NHANES sample was restricted to Mexican-American participants who were 20 years and older, born in the US or Mexico, and had medical insurance. Females who were pregnant at the time of

data collection were excluded. The final NHANES sample consisted of 2097 males and 2177 females 20 years and older with completed questionnaire data. Of these individuals, 4075 also underwent physical examinations including laboratory studies, and of the individuals with laboratory studies, 1775 provided fasting blood samples.

The HWCS sample was limited to participants 20 years and older who reside and were born in Mexico, and had medical insurance. Of the 10035 participants in the HWCS sample with questionnaire and laboratory data, 193 females were excluded because they were pregnant or breastfeeding at the time of the survey. An additional 48 individuals were excluded because they were not born in Mexico, and 309 were excluded because they did not report a place of birth. The final HWCS sample consisted of 3010 males and 6475 females 20 years and older who reside and were born in Mexico, with completed questionnaire and laboratory data. The total study sample of 13798 individuals consisted of 9485 Mexican subjects who currently reside in Mexico, 2324 US-born Mexican-Americans who live in the US, and 1989 Mexican-Americans who were born in Mexico and now live in the US.

Definition of chronic liver disease risk factors

Elevated aminotransferase levels: Elevated ALT was defined as > 40 IU/L for males and females; elevated AST was defined as > 40 IU/L for males and females[29,30].

Hepatitis B or hepatitis C 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[36]. Individuals infected with HBV and HCV were combined into one category due to their small sample sizes.

Metabolic syndrome: We used the definition of metabolic syndrome from the Third Report of the National Cholesterol Education Program's Adult Treatment Panel Ⅲ (NCEP/ATPⅢ) criteria[37].

High Total Cholesterol: Following NCEP/ATPⅢ recommendations, high total cholesterol was defined as > 200 mg/dL for males and females[37].

Diabetes: Type 2 diabetes in males and females was defined as having one of the following: a plasma glucose level > 125 mg/dL after > 8 h of fasting, a medical history of diabetes (other than during pregnancy), currently taking medication for diabetes, or a random glucose test > 200 mg/dL[38].

Obesity: Subjects were categorized according to body mass index (BMI) following the recommendations of the National Heart, Lung and Blood Institute: Normal (BMI 18.5-24.9 kg/m^2), overweight (BMI 25.0-29.9 kg/m^2), and obese (BMI $\geqslant$ 30.0 kg/m^2)[39].

Abdominal obesity: Abdominal obesity was defined as a waist circumference > 102 cm for males and a waist circumference > 88 cm for females[40].

Alcohol consumption: Heavy drinking was defined as two to four drinks per day for females and three to four drinks per day for males, and binge drinking was defined as having five or more drinks at one time for both males and females[41].

Definition of independent variables

The main independent variables for this study classified individuals by country of residence (*i.e.*, Mexico *vs* the US) and place of birth (*i.e.*, US-born *vs* Mexico-born). The HWCS participants represent Mexicans who were born and currently live in Mexico. Individuals from the NHANES sample were further classified by birthplace (US-born *vs* Mexico-born). The following three groups were compared: (1) HWCS (Mexico resident, Mexico-born), (2) NHANES (US resident, Mexico-born), and (3) NHANES (US resident, US-born). Other independent variables included age, sex, marital status, and education level. Approximately 18% of the subjects in the HWCS sample had missing education data, which was imputed using a three-step procedure. There were no missing data for the other independent variables.

Statistical analysis

Descriptive analyses were performed to characterize the study population and examine the study variables. Chi-square tests were used to compare the socio-demographic characteristics of the study sample by country of birth/residence, which were stratified by sex. Age-adjusted means and prevalence rates were calculated for each CLD risk factor, which were stratified by sex and country of birth/residence. Separate multiple logistic regression models were estimated for males and females to evaluate the independent associations of each liver disease risk factor to country of birth/residence. Adjusted odds ratios with 95% confidence intervals (95%CI) are reported. Marginal standardization was used to calculate the predicted probability as well as the prevalence ratios and prevalence differences with their corresponding 95%CIs. This allowed us to compare the prevalence of CLD risk factors between the three groups. For all analyses, a two-sided *P*-value < 0.05 was considered statistically significant. The data analyses were conducted using SAS software, version 9.4 for Windows, and STATA 14.

RESULTS

Sample characteristics

The socio-demographic characteristics of the bi-national study sample are presented in Table 1. One third of the HWCS participants in Mexico are male, as compared to the US NHANES sample, which is 49% male. There are no differences between the US and Mexico samples in

Table 1 Socio-demographic characteristics of the study sample *n* (%)

	Male			*P* value[1]		Female			*P* value[1]	
	Mexico cohort (REF)	NHANES Mexico born	NHANES US born	Mexico born	US born	Mexico cohort (REF)	NHANES Mexico born	NHANES US born	Mexico born	US born
Total sample sizes	3010 (58.9)	1021 (20.0)	1076 (21.1)	0.925	0.897	6475 (68.3)	944 (10.9)	1233 (14.3)	0.923	0.845
Age (yr)										
20-44	1680 (55.8)	380 (58.6)	377 (59.8)			3357 (51.8)	356 (55.5)	460 (56.9)		
45-59	951 (31.6)	239 (25.6)	222 (22.7)			2031 (31.4)	196 (24.3)	256 (23.4)		
60+	379 (12.6)	402 (15.9)	477 (17.5)			1087 (16.8)	392 (20.2)	517 (19.8)		
Marital status				0.074	0.804				0.088	0.423
Never married/single	458 (15.2)	73 (9.8)	162 (22.4)			1489 (23.0)	81 (10.0)	169 (19.5)		
Married/living together	2390 (79.4)	843 (83.)	746 (65.2)			3701 (57.2)	580 (67.8)	697 (57.3)		
Divorced/separated/widowed	162 (5.4)	105 (6.6)	167 (12.4)			1285 (19.8)	283 (22.2)	367 (23.2)		
Education										
Less than high school	706 (23.5)	724 (61.7)	381 (24.8)	0.000	0.463	2073 (32.0)	660 (61.3)	436 (24.8)	0.002	0.705
High school graduate	574 (19.1)	136 (17.6)	246 (26.2)			1121 (17.3)	108 (14.6)	279 (23.6)		
More than high school	1730 (57.5)	160 (20.7)	447 (48.9)			3281 (50.7)	173 (24.1)	513 (51.5)		

[1]The Chi square test was used to determine differences between groups.

terms of age or marital status. Approximately half the total sample is between 20 to 44 years, nearly 30% is 45 to 59 years, and roughly 20% is 60 years or older. Most of the study subjects are married/living together (65%), almost 20% are never married/single, and the rest are divorced/separated/widowed. There are no differences in the levels of education observed between the HWCS participants in Mexico and the Mexican-Americans who were born in the US. Approximately half of the participants in both groups have an education beyond high school and less than a third did not finish high school. The only significant difference observed between the two samples is that over 60% of the Mexico-born NHANES participants did not graduate from high school, compared to 29% of the participants in Mexico.

Chronic liver disease risk factors

Table 2 reports the age-adjusted means and prevalence of CLD risk factors for males and females by country of birth/residence. Elevated ALT levels are more common among males (22%-27%) than females (8%-10%), with a mean ALT ranging from 35-36 IU/L among males and 23-25 IU/L among females. There are no differences in mean AST levels among males (range 28-30 IU/L), but a significantly higher mean AST is observed among the Mexico-born (23.6 IU/L) and US-born (25.9 IU/L) females, as compared to the mean AST of 22.2 IU/L found among females in Mexico. The prevalence of diabetes, obesity, abdominal obesity, and heavy/binge drinking is higher among the NHANES participants than among the HWCS subjects. Conversely, more HWCS participants are current smokers and have lower levels of HDL cholesterol and elevated triglycerides compared with their NHANES counterparts.

Mexican-American males born in Mexico have a lower rate of HBV or HCV infection (0.4%) than either US-born Mexican-Americans (3.0%) or the HWCS participants (2.6%). A greater proportion of Mexico-born Mexican-American males have high cholesterol (49%) compared with males in Mexico (40%) and US-born Mexican-Americans (39%). Males in Mexico are more likely to have elevated triglycerides (57.5%) compared with Mexico-born (35.4%) and US-born Mexican-Americans (41%). The prevalence of diabetes is significantly lower among males in Mexico (6%) when compared with the 11% and 16% rates among the Mexico- and US-born NHANES participants, respectively. The proportion of obese males in Mexico is 17%, compared to 30% and 45% among Mexico- and US-born males in the US, respectively. Males in Mexico have a lower prevalence of abdominal obesity (16%) than Mexico- and US-born Mexican-American males (36% and 49%, respectively), with mean waist circumferences of 91.4 cm, 98.7 cm and 103.1 cm, respectively. Heavy or binge drinking is more common among the Mexico- and US-born Mexican-American males (75% and 71%, respectively) compared with their counterparts in Mexico (38%).

Rates of HBV or HCV infection are lower among Mexico-born and US-born Mexican-American females (0.3% and 0.8%, respectively) when compared to females in Mexico (1.7%). A lower percentage of females in Mexico have high cholesterol (36%) compared to the Mexico-born (40.5%) and US-born (40.2%) Mexican-American females. US-born females in the US are less likely to have elevated triglycerides (23.8%) than Mexico-born females (31.9%) and females living in Mexico (34.5%). The prevalence of diabetes among the females in the Mexican sample is 7%, compared to 14% and 11% among Mexico- and US-born Mexican-American females, respectively. Obesity rates are also lower among females in Mexico than among Mexican-American females (19% *vs* 39% and 47%, respectively). Abdominal obesity among females in Mexico is 48%, compared to a prevalence of 68% among their Mexican-American counterparts. Rates of heavy or binge drinking are substantially higher among Mexican-American females born in Mexico or the US (34% and 54%, respectively), as compared to females in Mexico (10%)

Table 2 Age-adjusted means and prevalence of chronic liver disease risk factors

	Male			Female		
	Mexico cohort (REF)	NHANES Ⅶ Mexico-born	NHANES Ⅶ US-born	Mexico cohort (REF)	NHANES Ⅶ Mexico-born	NHANES Ⅶ US-born
Elevated ALT (> 40 IU/L)[1], %	26.7	22.1	25.2	8.7	8.3	10.2
ALT (IU/L), mean	35.9	35.0	36.0	23.0	23.7	25.3[a]
Elevated AST (> 40 IU/L)[2], %	11.2	8.4	12.2	5.2	4.6	5.2
AST (IU/L), mean	27.9	30.1	29.5	22.2	23.6[a]	25.9[b]
Hepatitis B or C, %	2.6	0.4[b]	3.0	1.7	0.3[b]	0.8[a]
Metabolic syndrome[3], %	27.5	23.5	33.4	30.8	28.6	27.6
Elevated total cholesterol (mg/dL)[4], %	39.8	48.8[b]	39.1	36.0	40.5[a]	40.2[a]
Total cholesterol (mg/dL), mean	193.6	199.1[a]	192.7	189.6	193.1[a]	193.6[a]
Low HDL cholesterol (HDL < 40)[5], %	62.9	35.4[b]	27.7[b]	50.1	14.1[b]	12.0[b]
HDL cholesterol (mg/dL), mean	37.6	45.1[b]	46.7[b]	40.7	52.7[b]	55.1[b]
LDL cholesterol (mg/dL), mean	116.5	124.1[b]	117.2	115.2	110.9	11.5[a]
Elevated triglycerides[6] (mg/dL), %	57.5	35.4[b]	41.0[b]	34.5	31.9	23.8[b]
Triglycerides (mg/dL), mean	202.4	150.0[b]	173.9[a]	143.5	132.0[a]	123.8[b]
Diabetic[7], %	6.3	11.0[a]	16.1[b]	6.9	14.4[b]	11.0[a]
Overweight (BMI ⩾ 25)[8], %	48.1	46.3	37.3[b]	37.2	31.1[a]	26.7[b]
Obesity (BMI ⩾ 30)[9], %	17.1	30.0[b]	45.0[b]	19.2	39.2[b]	46.6[b]
BMI (kg/m^2), mean	26.7	28.3[b]	30.1[b]	26.4	29.0[b]	30.2[b]
Abdominal obesity[10], %	15.8	36.0[b]	49.0[b]	48.3	68.3[b]	67.9[b]
Waist circumference (cm), mean	91.4	98.7[a]	103.1[b]	88.5	94.7[b]	97.2[b]
Heavy or binge drinker[11], %	38.0	75.1[b]	71.3[b]	9.6	33.8[b]	54.0[b]
Current smoker[12], %	36.9	21.6[b]	21.9[b]	20.8	8.2[b]	14.2[b]

[1]Elevated alanine aminotransferase (ALT) was defined as ALT > 40 IU/L for males and females; [2]Elevated alanine aminotransferase (AST) was defined as AST > 40 IU/L for males and females; [3]Metabolic syndrome was defined base on the Third Report of the National Cholesterol Education Program's Adult Treatment Panel Ⅲ criteria; [4]Elevated total cholesterol was defined as ⩾ 200 mg/dL; [5]Low High Density Lipoprotein-Cholesterol (HDL-C) was defined as < 40 mg/dL; [6]Elevated triglycerides was defined as ⩾ 150 mg/dL; [7]Diabetes was defined as having a plasma glucose level > 125 mg/dL after a more than 8 h fast, and/or a medical history of diabetes, and/or currently taking medication for diabetes, and/or a random glucose test >200 mg/dL; [8]Overweight was defined as having a body mass index (BMI) of ⩾ 25.0 kg/m^2; [9]Obesity was defined as having a BMI of ⩾ 30.0 kg/m^2; [10]Abdominal obesity was defined as having a waist circumference > 102 cm for males, and a waist circumference > 88 cm for females; [11]Heavy drinking was defined as two to four drinks per day for females and three to four drinks per day for males, and binge drinking was defined as having five or more drinks at one time for both males and females; [12]Current cigarette smoking was defined as having smoked at least 100 cigarettes and being a current smoker. [a]*P* value ⩽ 0.05; [b]*P* value ⩽ 0.001.

(Table 2).

Multivariate analyses and other effect measures

After controlling for age, marital status, and education level, the logistic regression results indicate that Mexico-born Mexican-American males are less likely to have HBV or HCV (OR: 0.2, 95%CI: 0.1-0.6), but are more likely to have high cholesterol (OR: 1.4, 95%CI: 1.1-1.8) than their counterparts in Mexico. US-born Mexican-American males are more likely to have metabolic syndrome (OR: 1.4, 95%CI: 1.1-1.9) and diabetes (OR: 3.0, 95%CI: 1.9-4.8) than males in Mexico. Regardless of where they were born, Mexican-American males are more likely to be obese, diabetic, have abdominal obesity, or be heavy/binge drinkers than Mexican males. The prevalence ratios and predicted probabilities confirm the results of our multivariate analyses and may provide more precise estimates of the increased risk of diabetes, obesity, abdominal obesity, and heavy/binge drinking observed among Mexican-American males, as compared with males in Mexico. The probability of having any of the aforementioned risk factors is significantly greater among US-born Mexican-Americans than among their Mexico-born counterparts (Table 3).

The adjusted multivariate results presented in Table 4 also indicate that Mexico-born Mexican-American females are significantly more likely to be diabetic (OR: 2.2, 95%CI: 1.4-3.4), obese (OR: 2.5, 95%CI: 1.8-3.5), have abdominal obesity (OR: 2.1, 95%CI: 1.2-3.6), or be heavy/binge drinkers (OR: 5.6, 95%CI: 4.2-7.3) than females in Mexico. The same is true for US-born Mexican-American females, who are also more likely to be diabetic (OR: 1.7, 95%CI: 1.2-2.6), obese (OR: 3.5, 95%CI: 2.5-4.9), have abdominal obesity (OR: 2.3, 95%CI: 1.4-3.8), or be heavy/binge drinkers (OR: 12.8, 95%CI: 10.0-16.3) than their counterparts in Mexico. The prevalence ratios and predicted probabilities mirror the multivariate analysis findings for the aforementioned risk factors, showing a greater risk among US-born as compared to Mexico-born Mexican-American females. However, the prevalence ratios indicate that Mexican-American females are significantly less likely to be infected with HBV or HCV than females in Mexico (Table 4).

Supplemental Tables 1 and 2 report the odds ratios and 95% confidence intervals for CLD risk factors among males and females, respectively, by country of birth/residence, age, marital status and education.

DISCUSSION

This epidemiological study is the first to compare the risk factors for CLD in a cohort of Mexican health workers with nationally representative samples of US- and Mexico-born Mexican-Americans living in the US. The findings of our

Table 3 Effect measures comparing prevalence of risk factors among males by country of residence/birth

	Elevated ALT or AST[1]	Hepatitis B or C	Metabolic syndrome[2]	High cholesterol	Diabetes[3]	Obesity[4]	Abdominal obesity[5]	Heavy/binge drinker[6]
Odds ratios								
HWCS (Mexico)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
NHANES- Mexico-born	0.8 (0.5-1.2)	0.2 (0.1-0.6)[a]	0.8 (0.6-1.1)	1.4 (1.1-1.8)[a]	1.7 (1.0-2.8)	2.1 (1.7-2.6)[a]	3.3 (1.8-6.2)[a]	3.9 (3.2-4.7)[a]
NHANES- US-born	0.9 (0.6-1.4)	1.3 (0.7-2.4)	1.4 (1.1-1.9)[a]	0.9 (0.7-1.2)	3.0 (1.9-4.8)[a]	3.9 (3.1-4.9)[a]	5.4 (2.9-10.1)[a]	4.1 (3.4-5.1)[a]
Predicted probabilities								
HWCS (Mexico)	25.0	2.4	30.2	40.9	8.5	17.4	16.8	36.4
NHANES- Mexico-born	20.8	0.5	25.8	49.3	13.0	30.6	39.3	67.1
NHANES- US-born	24.0	3.2	38.0	39.6	20.4	44.7	51.1	68.5
Prevalence ratios (95%CI)								
NHANES- Mexico-born *vs* HWCS	0.8 (0.6, 1.1)	0.2 (0.0, 0.4)[a]	0.9 (0.7, 1.1)	1.2 (1.0, 1.4)[a]	1.5 (0.9, 2.2)[a]	1.8 (1.5, 2.0)[a]	2.3 (1.2, 3.5)[a]	1.8 (1.7, 2.0)[a]
NHANES- US-born *vs* HWCS	1.0 (0.7, 1.3)	1.3 (0.6, 2.0)	1.3 (1.0, 1.5)[a]	1.0 (0.8, 1.1)	2.4 (1.5, 3.3)[a]	2.6 (2.2, 2.9)[a]	3.0 (1.6, 4.5)[a]	1.9 (1.7, 2.0)[a]
Prevalence differences (95%CI)								
NHANES- Mexico-born *vs* HWCS	-4.2 (-11.5, 3.1)	-1.9 (-3.0, -0.9)[a]	-4.3 (-10.4, 1.7)	8.5 (2.4, 14.5)[a]	4.5 (0.0, 8.9)[a]	13.2 (9.0, 17.4)[a]	22.6 (13.2, 32.0)[a]	30.7 (26.4, 35.0)[a]
NHANES- US-born *vs* HWCS	-1.0 (-8.5, 6.5)	0.7 (-0.8, 2.3)	7.8 (1.4, 14.2)[a]	-1.3 (-6.9, 4.3)	11.8 (7.2, 16.5)[a]	27.3 (22.1, 32.4)[a]	34.4 (25.3, 43.5)[a]	32.1 (28.2, 36.0)[a]

Logistic regression models adjusted for age, marital status and education. Predicted probabilities, prevalence ratios and prevalence differences were produced using marginal standardization. [1]Elevated alanine aminotransferase (ALT) and elevated alanine aminotransferase (AST) were defined as > 40 IU/L; [2]Metabolic syndrome was defined base on the Third Report of the National Cholesterol Education Program's Adult Treatment Panel Ⅲ criteria; [3]Diabetes was defined as having a plasma glucose level > 125 mg/dL after a more than 8 h fast, a medical history of diabetes, currently taking medication for diabetes, and/or a random glucose test > 200 mg/dL; [4]Obesity was defined as having a body mass index (BMI) of ≥ 30.0 kg/m^2; [5]Abdominal obesity was defined as having a waist circumference > 102 cm for males, and a waist circumference > 88 cm for females; [6]Heavy drinking was defined as two to four drinks per day for females and three to four drinks per day for males, and binge drinking was defined as having five or more drinks at one time for both males and females. [a]P< 0.05 for testing the null hypothesis of no difference between groups.

bi-national study indicate that the HWCS participants in Mexico have fewer CLD risk factors than their counterparts in the US. Specifically, we found that Mexican-American males who were born in the US are more likely to be infected with HBV or HCV, have metabolic syndrome, diabetes, obesity, abdominal obesity, or being heavy/binge drinkers when compared to immigrant Mexican-American males or their counterparts in Mexico. Similar trends are observed among females, with US-born Mexican-American females having a greater probability of having elevated AST, obesity, abdominal obesity and heavy/binge drinking. Mexican-American females who were born in Mexico are more likely to have elevated total cholesterol or diabetes when compared to those born in the US or the HWCS participants in Mexico.

Our results are consistent with other studies that report high rates of obesity, diabetes, and excessive alcohol consumption among Mexicans in both countries[29,33,42-44]. The high prevalence of obesity (30%-47%), diabetes (11%-16%), as well as heavy/binge drinking (34%-75%) we found among Mexican-Americans in this binational study are of particular concern, and are likely contributing to the liver disease disparities observed among Latinos in the US. Additionally, having a combination of certain factors, such as obesity and excessive drinking, or diabetes and HCV, has been shown to increase the risk of elevated aminotransferase levels and liver cancer[45,46]. More studies are needed to evaluate how the accumulation of specific risk factors may be contributing to the increased risk of CLD among Mexican-Americans.

Latinos are the largest ethnic or racial minority in the US. In 2016, an estimated 57.5 million Americans identified as Hispanic or Latino, representing 17.8% of the US population[47]. By 2060, the number of Latinos is projected to increase to 119 million and make up 29% of the US population. Mexican-Americans are the largest group of Latinos in the US (63%)[47]. Identifying ways to prevent CLD in this rapidly growing population is very important. As the Mexican-American population continues to grow, the challenges to address the high rates of CLD in this group will also increase. A keener awareness and deeper understanding of CLD risk factors is needed to help policy makers anticipate how changes in immigration policy, coupled with health trends in Mexico, are likely to affect the health and health care needs of the growing number of Mexican-Americans in the US. We hope our findings can be used to develop health policy strategies and programs to prevent CLD by addressing the specific risk factors that affect Mexicans in both countries.

This study has some limitations. First, unlike NHANES,

Table 4 Effect measures comparing prevalence of risk factors among females by country of residence/birth

	Elevated ALT or AST[1]	Hepatitis B or C	Metabolic syndrome[2]	High cholesterol	Diabetes[3]	Obesity[4]	Abdominal obesity[5]	Heavy/binge drinker[6]
Odds ratios								
HWCS (Mexico)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
NHANES- Mexico-born	0.8 (0.5, 1.1)	0.3 (0.1, 1.8)	0.7 (0.5, 1.1)	1.2 (1.0, 1.5)	2.2 (1.4, 3.4)[a]	2.5 (1.8, 3.5)[a]	2.1 (1.2, 3.6)[a]	5.6 (4.2, 7.3)[a]
NHANES- US-born	1.0 (0.8, 1.3)	0.4 (0.2, 1.1)	0.8 (0.6, 1.2)	1.1 (0.9, 1.4)	1.7 (1.2, 2.6)[a]	3.5 (2.5, 4.9)[a]	2.3 (1.4, 3.8)[a]	12.8 (10.0, 16.3)[a]
Predicted probabilities								
HWCS (Mexico)	10.2	2.2	34.9	41.2	8.3	20.0	51.1	8.4
NHANES- Mexico-born	8.2	0.7	28.8	45.8	15.4	38.4	67.8	32.1
NHANES- US-born	10.6	1.0	31.2	43.3	12.9	46.3	69.6	50.3
Prevalence ratios (95%CI)								
NHANES- Mexico-born *vs* HWCS	0.8 (0.5, 2.1)	0.3 (0.0, 0.9)[a]	0.8 (0.6, 1.0)	1.1 (1.0, 1.2)	1.9 (1.2, 2.5)[a]	1.9 (1.4, 2.4)[a]	1.3 (1.0, 1.6)[a]	3.8 (3.0, 4.6)[a]
NHANES- US-born *vs* HWCS	1.0 (0.8, 1.2)	0.4 (0.0, 0.8)[a]	0.9 (0.7, 1.1)	1.1 (0.9, 1.2)	1.6 (1.1, 2.1)[a]	2.3 (1.7, 2.9)[a]	1.4 (1.0, 1.7)[a]	6.0 (4.9, 7.1)[a]
Prevalence differences (95%CI)								
NHANES- Mexico-born *vs* HWCS	-2.1 (-4.7, 0.6)	-1.5 (-2.8, -0.2)[a]	-6.1 (-13.0, 0.8)	4.6 (-0.7, 9.8)	7.1 (1.8, 12.4)[a]	18.4 (12.5, 24.3)[a]	16.8 (4.6, 29.0)[a]	23.7 (19.4, 28.0)[a]
NHANES- US-born *vs* HWCS	0.3 (-1.7, 2.3)	-1.2 (-2.7, 0.0)	-3.7 (-10.2, 2.7)	2.2 (-2.9, 7.3)	4.7 (1.3, 8.0)[a]	26.2 (20.5, 31.9)[a]	18.5 (6.5, 30.6)[a]	41.9 (38.0, 45.9)[a]

Logistic regression models adjusted for age, marital status and education. Predicted probabilities, prevalence ratios and prevalence differences were produced using marginal standardization. [1]Elevated alanine aminotransferase (ALT) and elevated alanine aminotransferase (AST) were defined as > 40 IU/L; [2]Metabolic syndrome was defined base on the Third Report of the National Cholesterol Education Program's Adult Treatment Panel Ⅲ criteria; [3]Diabetes was defined as having a plasma glucose level > 125 mg/dL after a more than 8 h fast, a medical history of diabetes, currently taking medication for diabetes, and/or a random glucose test > 200 mg/dL; [4]Obesity was defined as having a body mass index (BMI) of ≥ 30.0 kg/m^2; [5]Abdominal obesity was defined as having a waist circumference > 102 cm for males, and a waist circumference > 88 cm for females; [6]Heavy drinking was defined as two to four drinks per day for females and three to four drinks per day for males, and binge drinking was defined as having five or more drinks at one time for both males and females. [a]$P < 0.05$ for testing the null hypothesis of no difference between groups.

the HWCS is not a population-based study that is representative of the Mexican population. The HWCS participants are health workers who are younger, more educated, and predominantly female. However, to the best of our knowledge, the HWCS is the only longitudinal study in Mexico that includes ALT and AST measures as well as HBV and HCV results for a large number of Mexican adults, which is why we used the HWCS data for this binational study. In order to address this limitation, we compared some of the HWCS results to the findings of the 2012 Encuesta Nacional de Salud y Nutrición (ENSANUT)[48], a larger, population-based study that is representative of the Mexican population and can be considered a simplified version of NHANES. The prevalence of diabetes reported in the 2012 ENSANUT was 9.2%[48], while the prevalence of diabetes among the HWCS was 6.7%. Obesity was also higher among the male (26.8%) and female (37.5%) ENSANUT participants[48], as compared to the HWCS participants. The prevalence of heavy/binge drinking (42%) was also more common among the ENSANUT participants[48]. Nonetheless, even when compared to the ENSANUT results, the prevalence of these risk factors remains greater among the Mexican-Americans from the NHANES sample. Due to the limited generalizability of our study's results, they should be viewed as exploratory and preliminary.

Another limitation was our ability to control for confounding variables in the comparisons between Mexico and the US. To address this issue, all analyses were stratified by sex and controlled for age, marital status, and educational level in the regression analyses. We also limited the US sample to individuals with health insurance, since all the HWCS participants have health insurance. Our ability to control for potential confounders was restricted by the available data, and it is therefore possible that other unobserved differences between the two samples may be confounding our results.

In conclusion, the results of this bi-national study indicate that Mexican-Americans in the US have more risk factors for CLD than their counterparts in Mexico, and point to a critical need for prevention programs. Of particular concern are the high rates of heavy/binge drinking observed among Mexican-Americans. We hope these findings can be used by health professionals in Mexico and the US to tailor screening and prevention strategies to help reduce the risk of CLD among their patients. Our results could also be used to design and implement more effective health promotion programs to address the specific factors that put Mexicans at higher risk for developing CLD in both countries. These findings add to the relatively scarce literature on bi-national research, and provide preliminary data for future studies of migrant health in the US and Mexico. Other bi-national primary data collection projects with representative samples and comparable

demographic, socioeconomic and health status measures are needed to further investigate the growing problem of CLD among Mexicans in both countries. The results of this bi-national analysis indicate that Mexican-Americans in the US have more risk factors for CLD than their counterparts in Mexico. These results can be used to design and implement more effective health promotion programs and policies to address the specific factors that put Mexicans at higher risk of developing CLD in both countries. Our findings add to the relatively scarce literature on bi-national research, and provide preliminary data for future studies of migrant health in the US and Mexico. Other bi-national primary data collection projects with representative samples and comparable demographic, socioeconomic and health status measures are needed to further investigate the growing problem of CLD among Mexicans in both countries.

ARTICLE HIGHLIGHTS

Research background

United States (US) Latinos have greater morbidity and mortality from liver disease than non-Hispanic whites. Liver disease is the fifth leading cause of death in Mexico. In the US, Mexican-Americans have a greater risk of obesity, diabetes and heavy/binge drinking than in Mexico.

Research motivation

Over 30 million people are likely to have some form of chronic liver disease (CLD) in the US. CLD is the 12th leading cause of general mortality in the US.

Research objectives

To compare the prevalence of CLD risk factors in a representative sample of Mexican-Americans, born in the US or Mexico, to a sample of adults in Mexico.

Research methods

The main independent variables for this study classified individuals by country of residence and place of birth. Regression analyses were used to investigate CLD risk factors.

Research results

There is a greater risk among US-born *vs* Mexico-born Mexican-Americans.

Research conclusions

Mexican-Americans in the US had more risk factors for CLD.

Research perspectives

Our findings add to the relatively scarce literature on bi-national research, providing preliminary data for future studies of migrant health in the US and Mexico. Other bi-national primary data collection projects with representative samples and comparable demographic, socioeconomic and health status measures are needed to further investigate the growing problem of CLD among Mexicans in both countries.

REFERENCES

1 Surveillance for Viral Hepatitis-United States. 2017. Available from: URL: https://www.cdc.gov/hepatitis/statistics/2015surveillance/commentary.htm

2 **Le MH**, Devaki P, Ha NB, Jun DW, Te HS, Cheung RC, Nguyen MH. Prevalence of non-alcoholic fatty liver disease and risk factors for advanced fibrosis and mortality in the United States. *PLoS One* 2017; **12**: e0173499 [PMID: 28346543 DOI: 10.1371/journal.pone.0173499]

3 **Williams CD**, Stengel J, Asike MI, Torres DM, Shaw J, Contreras M, Landt CL, Harrison SA. Prevalence of nonalcoholic fatty liver disease and nonalcoholic steatohepatitis among a largely middle-aged population utilizing ultrasound and liver biopsy: a prospective study. *Gastroenterology* 2011; **140**: 124-131 [PMID: 20858492 DOI: 10.1053/j.gastro.2010.09.038]

4 **Kochanek KD**, Murphy SL, Xu J, Tejada-Vera B. Deaths: Final Data for 2014. *Natl Vital Stat Rep* 2016; **65**: 1-122 [PMID: 27378572]

5 **American Cancer Society**. Key Statistics about Liver Cancer. 2017. Available from: URL: https://www.cancer.org/cancer/liver-cancer/about/what-is-key-statistics.html

6 Ten Leading Causes of Death by Age Group, United States, 2014. Available from: URL: https://www.cdc.gov/injury/wisqars/leadingcauses.html

7 **Heron M**. Deaths: Leading Causes for 2014. *Natl Vital Stat Rep* 2016; **65**: 1-96 [PMID: 27376998]

8 Leading Causes of Death in Males, 2014. 2017. Available from: URL: https://www.cdc.gov/men/lcod/2014/hispanic/index.htm

9 **US Department of Health and Human Services**. Office of Minority Health. Chronic Liver Disease and Hispanic Americans. 2015. Available from: URL: http://minorityhealth.hhs.gov/omh/browse.aspx?lvl=4lvlid=62

10 **Browning JD**, Szczepaniak LS, Dobbins R, Nuremberg P, Horton JD, Cohen JC, Grundy SM, Hobbs HH. Prevalence of hepatic steatosis in an urban population in the United States: impact of ethnicity. *Hepatology* 2004; **40**: 1387-1395 [PMID: 15565570 DOI: 10.1002/hep.20466]

11 **Instituto Nacional de Estadística y Geografía (INEGI)**. Principales causas de mortalidad por residencia habitual, grupos de edad y sexo. 2016. Available from: URL: http://www.inegi.org.mx/est/contenidos/proyectos/registros/vitales/mortalidad/tabulados/ConsultaMortalidad.asp

12 **Panduro A**, Escobedo Meléndez G, Fierro NA, Ruiz Madrigal B, Zepeda-Carrillo EA, Román S. Epidemiology of viral hepatitis in Mexico. *Salud Publica Mex* 2011; **53** Suppl 1: S37-S45 [PMID: 21877071]

13 **Méndez-Sánchez N**, Villa AR, Chávez-Tapia NC, Ponciano-Rodriguez G, Almeda-Valdés P, González D, Uribe M. Trends in liver disease prevalence in Mexico from 2005 to 2050 through mortality data. *Ann Hepatol* 2005; **4**: 52-55 [PMID: 15798662]

14 **El-Serag HB**. Hepatocellular carcinoma: recent trends in the United States. *Gastroenterology* 2004; **127**: S27-S34 [PMID: 15508094 DOI: 10.1053/j.gastro.2004.09.013]

15 **Clark JM**. The epidemiology of nonalcoholic fatty liver disease in adults. *J Clin Gastroenterol* 2006; **40** Suppl 1: S5-10 [PMID: 16540768]

16 **Ascha MS**, Hanouneh IA, Lopez R, Tamimi TA, Feldstein AF, Zein NN. The incidence and risk factors of hepatocellular carcinoma in patients with nonalcoholic steatohepatitis. *Hepatology* 2010; **51**: 1972-1978 [PMID: 20209604 DOI: 10.1002/hep.23527]

17 **Davila JA**. Diabetes and hepatocellular carcinoma: what role does diabetes have in the presence of other known risk factors? *Am J Gastroenterol* 2010; **105**: 632-634 [PMID: 20203644 DOI: 10.1038/ajg.2009.715]

18 **Regimbeau JM**, Colombat M, Mognol P, Durand F, Abdalla E, Degott C, Degos F, Farges O, Belghiti J. Obesity and diabetes as a risk factor for hepatocellular carcinoma. *Liver Transpl* 2004; **10**: S69-S73 [PMID: 14762843 DOI: 10.1002/lt.20033]

19 **Bellentani S**, Scaglioni F, Marino M, Bedogni G. Epidemiology of non-alcoholic fatty liver disease. *Dig Dis* 2010; **28**: 155-161 [PMID: 20460905 DOI: 10.1159/000282080]

20 **Weston SR**, Leyden W, Murphy R, Bass NM, Bell BP, Manos MM, Terrault NA. Racial and ethnic distribution of nonalcoholic fatty liver in persons with newly diagnosed chronic liver disease. *Hepatology* 2005; **41**: 372-379 [PMID: 15723436 DOI: 10.1002/hep.20554]

21 **Flegal KM**, Kruszon-Moran D, Carroll MD, Fryar CD, Ogden CL. Trends in Obesity Among Adults in the United States, 2005 to 2014. *JAMA* 2016; **315**: 2284-2291 [PMID: 27272580 DOI: 10.1001/jama.2016.6458]

22 National Diabetes Statistics Report, 2017. Estimates of Diabetes and Its Burden in the United States. Atlanta, GA: Centers for Disease

Control and Prevention, US Dept of Health and Human Services; 2017. Available from: URL: https://www.cdc.gov/diabetes/data/statistics-report/index.html

23 **Mozaffarian D**, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, de Ferranti S, Després JP, Fullerton HJ, Howard VJ, Huffman MD, Judd SE, Kissela BM, Lackland DT, Lichtman JH, Lisabeth LD, Liu S, Mackey RH, Matchar DB, McGuire DK, Mohler ER 3rd, Moy CS, Muntner P, Mussolino ME, Nasir K, Neumar RW, Nichol G, Palaniappan L, Pandey DK, Reeves MJ, Rodriguez CJ, Sorlie PD, Stein J, Towfighi A, Turan TN, Virani SS, Willey JZ, Woo D, Yeh RW, Turner MB; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics--2015 update: a report from the American Heart Association. *Circulation* 2015; **131**: e29-e322 [PMID: 25520374 DOI: 10.1161/CIR.0000000000000152]

24 **Gutiérrez JP,** Rivera-Dommarco J, Shamah-Levy T, Villalpando-Hernández S, Franco A, Cuevas-Nasu L, Romero-Martínez M, Hernández-Ávila M. Encuesta Nacional de Salud y Nutrición 2012. Resultados Nacionales. Cuernavaca, México: Instituto Nacional de Salud Pública (MX), 2012. Available from: URL: https://ensanut.insp.mx/informes/ENSANUT2012ResultadosNacionales.pdf

25 **Rojas R**, Aguilar-Salinas CA, Jiménez-Corona A, Shamah-Levy T, Rauda J, Avila-Burgos L, Villalpando S, Ponce EL. Metabolic syndrome in Mexican adults: results from the National Health and Nutrition Survey 2006. *Salud Publica Mex* 2010; **52** Suppl 1: S11-S18 [PMID: 20585723 DOI: 10.1590/S0036-36342010000700004]

26 **González-Villalpando C**, Dávila-Cervantes CA, Zamora-Macorra M, Trejo-Valdivia B, González-Villalpando ME. Incidence of type 2 diabetes in Mexico: results of the Mexico City Diabetes Study after 18 years of follow-up. *Salud Publica Mex* 2014; **56**: 11-17 [PMID: 24912516 DOI: 10.21149/spm.v56i1.7318]

27 **Oh RC**, Hustead TR. Causes and evaluation of mildly elevated liver transaminase levels. *Am Fam Physician* 2011; **84**: 1003-1008 [PMID: 22046940]

28 **Tsai J**, Ford ES, Li C, Zhao G. Past and current alcohol consumption patterns and elevations in serum hepatic enzymes among US adults. *Addict Behav* 2012; **37**: 78-84 [PMID: 21975024 DOI: 10.1016/j.addbeh.2011.09.002]

29 **Flores YN**, Yee HF Jr, Leng M, Escarce JJ, Bastani R, Salmerón J, Morales LS. Risk factors for chronic liver disease in Blacks, Mexican Americans, and Whites in the United States: results from NHANES IV, 1999-2004. *Am J Gastroenterol* 2008; **103**: 2231-2238 [PMID: 18671818 DOI: 10.1111/j.1572-0241.2008.02022.x]

30 **Ioannou GN**, Boyko EJ, Lee SP. The prevalence and predictors of elevated serum aminotransferase activity in the United States in 1999-2002. *Am J Gastroenterol* 2006; **101**: 76-82 [PMID: 16405537 DOI: 10.1111/j.1572-0241.2005.00341.x]

31 **Abraído-Lanza AF**, Dohrenwend BP, Ng-Mak DS, Turner JB. The Latino mortality paradox: a test of the "salmon bias" and healthy migrant hypotheses. *Am J Public Health* 1999; **89**: 1543-1548 [PMID: 10511837 DOI: 10.2105/AJPH.89.10.1543]

32 **Rubalcava LN**, Teruel GM, Thomas D, Goldman N. The healthy migrant effect: new findings from the Mexican Family Life Survey. *Am J Public Health* 2008; **98**: 78-84 [PMID: 18048791 DOI: 10.2105/AJPH.2006.098418]

33 **Morales LS**, Flores YN, Leng M, Sportiche N, Gallegos-Carrillo K, Salmerón J. Risk factors for cardiovascular disease among Mexican-American adults in the United States and Mexico: a comparative study. *Salud Publica Mex* 2014; **56**: 197-205 [PMID: 25014426 DOI: 10.21149/spm.v56i2.7335]

34 National Health and Nutrition Examination Survey, 2013-2014. Available from: URL: http://www.cdc.gov/nchs/nhanes/about_nhanes.htm

35 **Denova-Gutiérrez E**, Flores YN, Gallegos-Carrillo K, Ramírez-Palacios P, Rivera-Paredez B, Muñoz-Aguirre P, Velázquez-Cruz R, Torres-Ibarra L, Meneses-León J, Méndez-Hernández P, Hernández-López R, Salazar-Martínez E, Talavera JO, Tamayo J, Castañón S, Osuna-Ramírez I, León-Maldonado L, Flores M, Macías N, Antúnez D, Huitrón-Bravo G, Salmerón J. Health workers cohort study: methods and study design. *Salud Publica Mex* 2016; **58**: 708-716 [PMID: 28225947 DOI: 10.21149/spm.v58i6.8299]

36 **National Health and Nutrition Examination Survey (NHANES).** 2013-2014 MEC Laboratory Procedures Manual. Available from: URL: https://wwwn.cdc.gov/nchs/data/nhanes/2013-2014/manuals/2013_MEC_Laboratory_Procedures_Manual.pdf

37 Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel Ⅲ). *JAMA* 2001; **285**: 2486-2497 [PMID: 11368702 DOI: 10.1001/jama.285.19.2486]

38 American Diabetes Association. Screening for type 2 diabetes. *Diabetes Care* 2004; **27** Suppl 1: S11-S14 [PMID: 14693922 DOI: 10.2337/diacare.27.2007.S11]

39 Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: executive summary. Expert Panel on the Identification, Evaluation, and Treatment of Overweight in Adults. *Am J Clin Nutr* 1998; **68**: 899-917 [PMID: 9771869 DOI: 10.1093/ajcn/68.4.899]

40 **Sundquist J**, Winkleby MA, Pudaric S. Cardiovascular disease risk factors among older black, Mexican-American, and white women and men: an analysis of NHANES Ⅲ, 1988-1994. Third National Health and Nutrition Examination Survey. *J Am Geriatr Soc* 2001; **49**: 109-116 [PMID: 11207863 DOI: 10.1046/j.1532-5415.2001.49030.x]

41 **Jiles R**, Hughes E, Murphy W, Flowers N, McCracken M, Roberts H, Ochner M, Balluz L, Mokdad A, Elam-Evans L, Giles W. Surveillance for certain health behaviors among states and selected local areas--Behavioral Risk Factor Surveillance System, United States, 2003. *MMWR Surveill Summ* 2005; **54**: 1-116 [PMID: 16319816]

42 **Flores YN**, Lang CM, Salmerón J, Bastani R. Risk factors for liver disease and associated knowledge and practices among Mexican adults in the US and Mexico. *J Community Health* 2012; **37**: 403-411 [PMID: 21877109 DOI: 10.1007/s10900-011-9457-4]

43 **Vega WA**, Rodriguez MA, Gruskin E. Health disparities in the Latino population. *Epidemiol Rev* 2009; **31**: 99-112 [PMID: 19713270 DOI: 10.1093/epirev/mxp008]

44 **Islam N**, Flores YN, Ramirez P, Bastani R, Salmerón J. Hepatitis and liver disease knowledge and preventive practices among health workers in Mexico: a cross-sectional study. *Int J Public Health* 2014; **59**: 381-394 [PMID: 24097058 DOI: 10.1007/s00038-013-0515-9]

45 **Mahli A**, Hellerbrand C. Alcohol and Obesity: A Dangerous Association for Fatty Liver Disease. *Dig Dis* 2016; **34** Suppl 1: 32-39 [PMID: 27548267 DOI: 10.1159/000447279]

46 **Hammerstad SS**, Grock SF, Lee HJ, Hasham A, Sundaram N, Tomer Y. Diabetes and Hepatitis C: A Two-Way Association. *Front Endocrinol* (Lausanne) 2015; **6**: 134 [PMID: 26441826 DOI: 10.3389/fendo.2015.00134]

47 **United States Census Bureau.** Facts for Features: Hispanic Heritage Month 2017. Available from: URL: https://www.census.gov/newsroom/facts-for-features/2017/hispanic-heritage.html

48 **Encuesta Nacional de Salud y Nutrición.** Resultados Nacionales. 2012. Available from: URL: http://ensanut.insp.mx/informes/ENSANUT2012ResultadosNacionales.pdf

P- Reviewer: Abenavoli L, Trovato GM **S- Editor**: Wang XJ
L- Editor: Filipodia **E- Editor**: Bian YN

Published by **Baishideng Publishing Group Inc**
7901 Stoneridge Drive, Suite 501, Pleasanton, CA 94588, USA
Telephone: +1-925-223-8242
Fax: +1-925-223-8243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.f6publishing.com/helpdesk
http://www.wjgnet.com

ISSN 1007-9327