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REVIEW

Hepatitis and liver disease knowledge and preventive practices among health workers in Mexico: a cross-sectional study

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Abstract
Objectives To assess the knowledge and preventive practices regarding hepatitis and liver disease among a sample of participants in the Mexican Health Worker Cohort Study.
Methods The study population consisted of 892 participants from Cuernavaca, Mexico. Demographic characteristics, knowledge about hepatitis B, hepatitis C, and liver disease in general, as well as information about prevention practices were obtained from self-reported questionnaires. Participants were grouped into categories that were created using information about their professional background and patient contact status. Knowledge and prevention practices were compared within these categories.
Results Inadequate levels of knowledge and preventive practices were found, even within the more highly educated group. Nearly 57 % of the participants had inadequate knowledge about liver disease in general, while 76 and 79 % had inadequate knowledge about Hepatitis B virus (HBV) and Hepatitis C virus (HCV), respectively. For general liver disease, the mean knowledge score increased significantly with education, history of HCV screening, and low alcohol consumption.
Conclusions Health workers should be better educated about hepatitis and liver disease so they can reduce their own risk and share their knowledge of how to prevent liver disease with patients.

Keywords Liver disease · Hepatitis · Knowledge · Health workers · Mexico

Abbreviations

BMI	Body mass index
HBV	Hepatitis B virus
HCV	Hepatitis C virus
IMSS	Instituto Mexicano del Seguro Social
MHWCS	Mexican Health Worker Cohort Study

Introduction

Cirrhosis and other forms of chronic liver disease are the fourth leading cause of general mortality in Mexico (Sistema Nacional de Información en Salud 2011). Recent

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mortality data indicate that there were nearly 29,000 deaths due to cirrhosis in 2008, and although this disease disproportionately affects men (75 % of all deaths are among males), it is the third cause of death among Mexican women aged 15–64 (Sistema Nacional de Información en Salud 2011). More importantly, chronic liver disease is the second leading cause of death among individuals aged 15–64, a key age group that includes the most economically productive members of society (Sistema Nacional de Información en Salud 2011). Accordingly, the morbidity and mortality impact of chronic liver disease is greatest among the economically active population of Mexico. In two separate cirrhosis mortality studies that examined data from 1950–1990 and 1980–2002, Mexico was cited as having one of the highest cirrhosis mortality rates, with little change in the rate between those time periods (La Vecchia et al. 1993; Bosetti et al. 2007).

Known risk factors for liver disease include infection with hepatitis B (HBV) (Alter 2003) or hepatitis C (HCV) (Lauer and Walter 2001), high alcohol consumption (Haber et al. 2003), being overweight or obese (Festi et al. 2004), and having diabetes (El-Serag et al. 2004). Globally, the impact of chronic liver disease, including infection with HBV and HCV is quite significant, as liver cancer is the third most common cause of death due to cancer (World Health Organization 2010). HCV is also the primary cause of liver transplants and liver cirrhosis cases in developed countries (Shepard et al. 2005; Zani et al. 2011), and is considered a major cause of liver disease in Mexico (Bosetti et al. 2007; Méndez-Sánchez et al. 2007). The risk factors for contracting HBV or HCV are similar to those of other blood-borne pathogens: exposure to blood or blood products, either sexually or percutaneously (Méndez-Sánchez et al. 2005; Berkman and Balakar 2000). In addition, HBV can be transmitted vertically from mother to child, making it imperative that prevention programs reach women of child-bearing age (Berkman and Balakar 2000). Factors that increase the risk of HBV or HCV infection include sexual contact with infected individuals; handling an infected person's blood; cuts or punctures in an environment with potentially infected blood or blood products; blood transfusions; and exposure to tainted needles (Berkman and Balakar 2000). Estimates indicate that the prevalence of HBV infection in Mexico is between 0.11 and 0.32 % (Valdespino et al. 2007; Méndez-Sánchez et al. 1999; Rivera-López et al. 2004); approximately 1.7 million Mexicans have been infected with HBV and 107,000 are chronic carriers (Valdespino et al. 2007). Reports indicate that the prevalence of HCV infection is between 0.47 and 1.47 % (Valdespino et al. 2007; Méndez-Sánchez et al. 1999; Rivera-López et al. 2004), and that there are 700,000 adults infected with HCV in Mexico (Valdespino et al. 2007).

Health workers share the same risk factors for infection with HBV or HCV as the general public, but their more frequent contact with blood and blood products increases their risk of infection (Reda et al. 2010). Annually, 3 million health workers worldwide are accidentally exposed to blood-borne pathogens, resulting in 66,000 HBV infections and 16,000 HCV infections (Kermode et al. 2005). Knowledge about HBV and HCV among health workers has been consistently described as subpar by various studies assessing the knowledge, attitudes, and occupational risks of acquiring hepatitis (Kermode et al. 2005; Shehab et al. 2002; Ansa et al. 2002; Zafar et al. 2008).

Infection with hepatitis B can effectively be prevented by the proper administration of the HBV vaccine, which is now universally offered to infants in Mexico. However, despite the existence of the vaccine, without proper knowledge among health workers, individuals in the population are less likely to receive the full course of the vaccine because they are not properly informed of the importance of receiving all three doses (Hoz et al. 2005). For HCV, there is neither a vaccine nor an approved post exposure prophylaxis regimen (Centers for Disease Control and Prevention 2007); as a result, hepatitis C prevention programs must focus on behavioral interventions (Soto-Salgado et al. 2010). Though the global prevalence of HCV is not as significant as HBV, individuals infected with HCV are more often asymptomatic, leading to a reservoir of people who are unaware that they are carriers and potentially facilitating the spread of HCV (Alter 2003).

Although chronic liver disease is a leading cause of death in Mexico, there is scarce information about the level of knowledge and preventive practices regarding this disease among health workers. To our knowledge, only one published study has investigated liver disease knowledge and preventive practices among a sample of non-health workers in Mexico (Flores et al. 2012). Health workers are an important source of information for the general population, and it is important that their level of knowledge and prevention practices be ascertained. A greater understanding of the knowledge and practices concerning liver disease risk among health workers will help guide the development of appropriate prevention strategies for this population. By generating data that could be used to develop interventions to promote preventive behaviors among health workers, the findings of this study may ultimately help to decrease the future morbidity and mortality due to liver disease among the general Mexican population. This is the first study to examine the knowledge about HBV, HCV, and general liver disease, as well as preventive practices such as screening and vaccination, in a sample of Mexican health workers.

Methods

Study population

Cross-sectional data from the baseline assessment of the Mexican Health Worker Cohort Study (MHWCS) were analyzed to identify hepatitis and liver disease knowledge and preventive practices among a sample of the adult participants. The study design, methodology, and baseline characteristics of the study participants have been described elsewhere (Méndez-Hernández et al. 2009; Denova-Gutiérrez et al. 2008). Briefly, the MHWCS is a long-term study that began in 1998. From 1998 to 1999, approximately 2,900 health workers from the Mexican Institute of Social Security (IMSS) participated in the initial enrollment activities. IMSS is one of the key institutions in the Mexican health system, which provides health care services to approximately 40 % of the population, and is also the largest social security institution in Latin America (Instituto Mexicano del Seguro Social 2008). More than 370,000 individuals are employed at IMSS, which include doctors, nurses, administrative staff, maintenance workers, technicians, etc.

During the 2004–2006 follow-up period, nearly 4,500 health workers between the ages of 20–85 enrolled in the MHWCS in the state of Morelos. The MHWCS participants are volunteers and are considered a convenience sample that is not representative of all health workers in Mexico. Study participants periodically complete a series of self-reported questionnaires that include demographic information, general state of health, and lifestyle factors (diet, physical activity, alcohol and tobacco consumption, etc.). Completing the questionnaires takes approximately 1–2 h, and participants were given two weeks to fill out the questionnaire. Participants were instructed to complete the questionnaire in a setting that would ensure the confidentiality of their responses. Participants also underwent a battery of clinical tests, and are being followed up as part of a longitudinal study that is investigating the role of certain lifestyle factors on the development of specific diseases, including chronic liver disease. Information was not obtained from non-respondents. The IRB committees of the participating institutions, the Mexican Institute of Social Security (IMSS) and the University of California, Los Angeles (UCLA) approved the study protocol and consent forms for this study.

Between 2004 and 2008, 1,463 adult MHWCS participants from the state of Morelos were selected to complete a detailed liver disease survey, based on their alanine aminotransferase (ALT) and aspartate aminotransferase (AST) test results. We defined an elevated ALT level as >40 U/L and AST >43 U/L for both males and females. A total of 756 participants with elevated ALT or AST levels and 707 participants with normal ALT and AST levels completed the liver disease survey. This questionnaire was designed to obtain additional information about hepatitis B, hepatitis C, and general knowledge of liver disease and preventive practices that was not collected as part of the main study questionnaire. The development of the questionnaire and selection of the study variables were both guided by the theoretical perspective of the Health Behavior Framework (Bastani et al. 2010) and previous liver disease studies by the authors (Bastani et al. 2007; Flores et al. 2012). For example, the hepatitis B and hepatitis C items were adapted from prior questionnaires designed by the authors (Bastani et al. 2007; Flores et al. 2012). Many of the perceived susceptibility items, as well as the questions regarding the knowledge and beliefs about the risk factors for liver disease and liver cancer, were also obtained from previous studies by the authors (Bastani et al. 2007; Flores et al. 2012). Information was obtained about the participants' knowledge regarding risk factors for liver disease (e.g., alcohol consumption and infection with HBV or HCV), as well as their histories of hepatitis screening and prevention activities. This information was supplemented with specific demographic data, anthropometric (weight and height to determine body mass index (BMI), as well as waist circumference), and clinical measures that were collected from all MHWCS participants.

We restricted our analysis to study participants who were between the ages of 20 and 70, because of the higher questionnaire response rates among this age group, and because this age range is more likely to include health workers who are currently active ($n = 1{,}376$). We excluded participants who were infected with HBV or HCV ($n = 12$) because they were likely to have an increased knowledge about hepatitis. We also excluded participants who were family members of the health workers ($n = 188$), retired health workers ($n = 145$), and participants who did not indicate their employment category ($n = 139$). The final study population consisted of 892 participants.

Definition of independent variables

For the main independent variables in this study, we categorized participants as clinicians or non-clinicians, and as having direct contact with patients or not having contact. "Clinicians" were defined as participants who indicated that they were, at the time they completed their survey or prior to retirement, family practice physicians, non-family practice physicians, nurses, or a clinician working at an IMSS lab. "Non-clinicians" were defined as participants who indicated that they were, at the time they completed their survey or prior to retirement, medical assistants, administrative aids, pharmacy aids, administrative personnel, maintenance workers, heads of service, researchers, cashiers, chauffeurs,

technical specialists, social workers, conservation personnel, physical education instructors, volunteer health promoters, students, or nutritionist/dieticians. The final four groups were: (1) non-clinicians without patient contact ($n = 529$), (2) non-clinicians with patient contact ($n = 116$), (3) clinicians without patient contact ($n = 71$), and (4) clinicians with patient contact ($n = 176$). These four categories were created to test our hypothesis that levels of knowledge about hepatitis B, hepatitis C, and liver disease in general would be lower among non-clinicians without patient contact than among the other groups. By comparing these four categories, we were able to assess the degree to which knowledge varies by patient contact status and employment category among this sample of health workers.

Other socio-demographic variables examined included age, sex, education, monthly household income (reported in Mexican pesos), and marital status. Approximately 3.4 % of subjects were missing education and 7.9 % were missing income data. Proxies were used to assess missing answers for education and income by cross referencing the employment category of those who were missing, looking at the average education and monthly income of those who provided answers in each employment category, and then fitting the missing answer into one of the subcategories. There are potential biases for using proxies for missing data, however, it is unlikely that this will significantly impact our results because the proportion of missing data is relatively small. Furthermore, since the reported years of education and income were similar among participants within a single employment category, we expect few incorrectly estimated proxies.

Definition of risk factor variables

Body Mass Index (*BMI*) Participants were categorized according to BMI (kg/m^2) following the recommendations of the National Heart, Lung and Blood Institute: normal (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese ($\geq$30.0 kg/m^2) (National Heart, Lung, and Blood Institute 2011).

Abdominal obesity The National Cholesterol Education Program's Adult Treatment Panel III report (ATP III) definition of abdominal obesity was used: waist circumference greater than 88 cm for women and greater than 102 cm for men (Grundy et al. 2004).

Alcohol consumption Moderate drinkers were defined as having no more than one drink per day for women and no more than two drinks per day for men. Heavy drinkers were defined as having 2–4 drinks per day for women, and 3–4 drinks per day for men. Binge drinkers were defined as having five or more drinks per drinking episode for both men and women (Centers for Disease Control and Prevention 2007).

These known risk factors for liver disease were included in our analyses to determine differences in the prevalence of these risk factors among the participants in each of the four employment/patient contact categories. We also wanted to investigate if level of knowledge varied depending on BMI, waist circumference, degree of alcohol consumption, and lifetime number of sexual partners, as explored in the Soto-Salgado study (Soto-Salgado et al. 2010).

Assessment of knowledge variables

Knowledge about hepatitis B (12 items), hepatitis C (10 items), and liver disease (8 items) was assessed using a series of questions that were considered an appropriate measure of the participants' knowledge about risk factors, modes of transmission, prevention methods, and clinical sequelae. The percentage of total participants who answered each item correctly for each of the three knowledge domains was calculated and compared based on the four employment category/patient contact status groups. These results were compared to determine if there were any significant differences between the four categories, using "non-clinicians without patient contact" as the reference. A score of 70 % or higher was considered "adequate knowledge", as defined in previous studies (Soto-Salgado et al. 2010; Flores et al. 2012). A mean score was determined for each of the three knowledge domains, which was compared by a series of variables of interest, including socio-demographic characteristics, hepatitis screening and prevention practices, and known risk factors for liver disease. Mean scores were calculated by averaging the number of correct answers, and Cronbach's alpha was used to measure internal consistency reliability for the three knowledge scales (data not shown). A correct answer was awarded 1 point, while an incorrect answer, answering "not sure/don't know", or leaving the question blank was given 0 points. The possible knowledge score ranges were as follows: 0–12 points for hepatitis B, 0–10 points for hepatitis C, and 0–8 points for liver disease in general.

Statistical analysis

A descriptive analysis of the variables of interest was performed, and statistical analyses were conducted to compare these variables by the four employment category/patient contact groups, using "non-clinicians without patient contact" as the reference group. A two-sample test of proportions was used to examine the characteristics of the study population, using "non-clinicians without patient contact" as the reference. The Chi-square test and Fisher's exact test were also used to compare proportions between

the four groups. *P* values were calculated for the three knowledge domains using multiple linear regression models that adjusted for age, sex, education, income, and job title/employment category. The percentage answering "not sure/don't know" and the percentage with missing answers were classified as incorrect answers. Stata 10 was used for all statistical analyses (StataCorp. Stata Statistical Software 2007).

Results

Some significant differences were observed between the final study population that was selected ($n = 892$) and the participants who were excluded ($n = 571$). Excluded individuals were more likely to be single, less educated, and less likely to report their insurance status or their monthly income. There were no differences between the study population and those excluded by gender. The mean knowledge scores for hepatitis B and hepatitis C were significantly higher for the study population than for the excluded participants, while the liver disease knowledge score did not differ significantly (data not shown).

Socio-demographic characteristics and prevalence of risk factors

Table 1 presents the socio-demographic characteristics, history of hepatitis screening and vaccination activities, and prevalence of risk factors in the study population by employment category and patient contact status. Half of the participants were between the ages of 35 and 49 and nearly 70 % were female. The mean age of the population ranged from 41.3 years for non-clinicians with patient contact to 54.8 years for clinicians without patient contact. On average, clinicians had 15 or more years of education, while non-clinicians had approximately 13 years (data not shown). Clinicians also had a higher income than non-clinicians.

A total of 15.5 % participants had a previous HBV test, 8.2 % had a HCV test, and 38.6 % had been vaccinated for HBV. Clinicians with patient contact were more likely to have been screened for HBV, vaccinated for hepatitis B, and screened for HCV. Less than 0.5 % of the entire population reported a history of IV drug use and 13.1 % of the study population reported a history of a blood transfusion (data not shown) (Table 1).

Hepatitis B knowledge

Table 2 reports the results of the items that were used to assess the participants' knowledge about HBV, HCV, and liver disease in general. A total of 24.7 % of the study population had adequate knowledge about HBV, 21.64 % had adequate knowledge about HCV, and 43.16 % had adequate knowledge about liver disease in general (data not shown). More than 90 % of the clinicians with patient contact correctly indicated that a vaccine to prevent HBV exists. However, the proportion of correct responses to this item was much lower in the other groups, especially among non-clinicians without patient contact (44 %). Overall, clinicians with patient contact were significantly more likely to correctly respond to the questions about HBV. Less than half of the participants knew that infection with HBV can last a lifetime, can cause liver cancer, and that HBV can also be cured. Over 50 % of the respondents correctly indicated that HBV can be spread by asymptomatic, infected individuals and that hepatitis B can be spread sexually, with 80 and 75 % of clinicians with patient contact answering these two items correctly, respectively (Table 2).

Hepatitis C knowledge

As with the HBV items, clinicians with patient contact were significantly more likely to provide correct responses to the questions about HCV. However, the overall knowledge about HCV was lower than the knowledge about HBV for all four groups. Only one-third of the clinicians with patient contact, and less than 20 % of the other participants responded correctly that a HCV vaccine does not exist. Again, less than half of the participants knew that infection with HCV can last a lifetime, cause liver cancer and be cured in some cases. More than 50 % of the respondents were aware that HCV can be spread by asymptomatic individuals and that it can be spread during sexual intercourse, with 77 and 69 % of clinicians with patient contact answering these two items correctly, respectively (Table 2).

General liver disease knowledge

Non-clinicians without patient contact consistently had the lowest levels of knowledge about liver disease in general, while clinicians with patient contact had the highest proportion of correct responses. Almost all participants (over 90 % in each of the four groups) correctly identified that drinking alcohol in excess can increase an individual's risk of liver disease. Only half of the respondents were aware that being overweight, obese or having diabetes are also risk factors for developing liver disease. Approximately 75 % of clinicians correctly indicated that getting vaccinated for HBV can lower one's risk of liver disease (as compared to 50 % of non-clinicians without patient contact and 65 % of non-clinicians with patient contact). Most

Table 1 Characteristics of study population by employment category and patient contact status

	Total ($n = 892$)	Non-clinicians without patient contact[a] ($n = 529$)	Non-clinicians with patient contact ($n = 116$)	Clinicians without patient contact ($n = 71$)	Clinicians with patient contact ($n = 176$)	*P* value**
Age group in years						
20–34	16.5	15.7	25.0*	4.2*	18.2	
35–49	50.2	50.9	56.9	16.9*	57.4	0.000
50–70	33.3	33.5	18.1*	78.9*	24.4*	
Sex						
Female	67.8	63.1	60.3	69.0	86.4*	0.000
Male	32.2	36.9	39.7	31.0	13.6*	
Education in years						
≤12	45.5	54.3	57.8	28.2*	18.2*	
>12	54.5	45.7	42.2	71.8*	81.8*	0.000
Monthly household income (pesos)						
<$10,000	61.1	60.5	76.7*	52.1	56.3	
$10,000–20,000	29.5	30.4	17.2*	33.8	33.0	0.009
>$20,000	9.4	9.1	6.0	14.1	10.8	
Marital status						
Married	67.5	67.8	66.4	67.6	67.0	
Single	17.9	17.6	18.1	15.5	19.9	0.972
Separated/divorced/widowed	14.6	14.6	15.5	16.9	13.1	
History of hepatitis B blood test[b]						
Yes	15.5	13.0	12.1	21.1	22.7*	
No	79.9	81.5	83.6	73.2	75.6	0.001
History of hepatitis B vaccination[b]						
Yes	38.6	26.7	52.6*	19.7	72.7*	
No	23.3	24.4	20.7	35.2*	17.1*	0.000
History of hepatitis C blood test[b]						
Yes	8.2	5.9	6.9	12.7*	14.2*	
No	87.1	87.7	91.4	83.1	84.1	0.004
History of blood transfusion[b]						
Yes	13.1	13.2	14.7	16.9	10.2	
No	81.2	80.5	79.3	74.7	86.9	0.386
History of STI treatment[b]						
Yes	9.8	9.3	13.8	11.3	8.0	0.323
No	77.5	75.1	75.0	76.1	86.9*	
Lifetime number of sexual partners						
0–1	33.4	31.6	25.0	38.0	42.6*	
2–9	43.5	41.2	51.7*	38.0	47.2	0.000
≥10	23.1	27.2	23.3	23.9	10.2*	
BMI						
Overweight (25–29.9 kg-m^2)	43.3	42.9	45.7	35.2	46.0	0.091
Obese (≥30 kg/m^2)	25.2	24.8	29.3	36.6*	19.3	
Waist circumference[b]						
Abdominal obesity[c]	43.3	41.4	42.2	60.6*	42.6	0.025

Table 1 continued

	Total ($n = 892$)	Non-clinicians without patient contact[a] ($n = 529$)	Non-clinicians with patient contact ($n = 116$)	Clinicians without patient contact ($n = 71$)	Clinicians with patient contact ($n = 176$)	*P* value**
Alcohol consumption[b, d]						
Heavy/binge[c]	24.0	28.9	30.2	15.5*	8.5*	0.000

Morelos, Mexico 2004–2008 (%)

* $P < 0.05$ determined using a two-sample test of proportions

** *P* value determined using Chi-square test and Fisher's exact test

[a] "Non-clinicians without patient contact" was used as the reference group for statistical tests

[b] "Not sure/don't know" and missing answers not included; column percentages may be <100 %

[c] Abdominal obesity was defined as having a waist circumference >102 cm for males, and a waist circumference >88 cm for females

[d] Alcohol consumption was defined as : heavy (3–4 drinks/per day for males and 2–4 drinks/per day for females); binge (5 or more drinks/per day for males and females)

participants (82 %) reported that screening for HBV and HCV can help to prevent liver disease (data not shown).

Mean knowledge score variation by subgroup

Table 3 indicates the mean knowledge scores for the study population, which were 6.2 ± 3.0 for HBV (range 0–12), 4.1 ± 2.7 for HCV (range 0–10), and 4.8 ± 1.9 for liver disease (range 0–8). Clinicians with patient contact as well as participants with a higher level of education, a history of HCV screening, and no/low alcohol consumption had a higher mean knowledge score in all three domains. The mean knowledge scores for HBV were greatest among participants who had 12 or more years of education, a higher income, were clinicians with patient contact, had a history of HBV or HCV screening, had been vaccinated for HBV, and were non-drinkers or moderate alcohol drinkers. Hepatitis C knowledge scores were greater among participants who had 12 or more years of education, a greater income, were clinicians with patient contact, had a history of the HBV or HCV test, had a history of prior HBV vaccination, and had no or moderate alcohol consumption. Mean knowledge scores for liver disease in general were highest among participants who had a higher level of income or education, a history of HCV screening, and no or low alcohol consumption.

Discussion

This study is the first to assess the knowledge and preventive practices related to hepatitis B, hepatitis C, and general liver disease among a sample of adult health workers in Mexico. Our findings indicate that overall, the study participants had inadequate levels of knowledge about liver disease and preventative practices, even within the more highly educated group: clinicians with patient contact. Knowledge differed by disease category, with nearly 57 % of the population reporting inadequate knowledge about general liver disease, and 76 and 79 % having inadequate knowledge about HBV and HCV, respectively. We also found that heavy/binge drinkers had lower levels of knowledge about hepatitis B, hepatitis C, and liver disease in general. These results are consistent with other studies that report inadequate levels of knowledge among health workers (Hoz et al. 2005; Chao et al. 2010; Van de Mortel 2002; Cox et al. 2011; Frazer et al. 2011) and the general population (Soto-Salgado et al. 2010; Flores et al. 2012; Taylor et al. 2002, 2005; Buffington et al. 2000; Cheung et al. 2005).

The clinicians in our sample had a higher level of knowledge about HBV, HCV, and liver disease in general than non-clinicians; respondents with patient contact usually were more knowledgeable than those without patient contact. The knowledge levels of our study population were substantially lower than those reported in an evaluation of HBV and liver disease knowledge among a sample of Chinese health workers (Chao et al. 2010). More than 81 % of the Chinese health worker population had an adequate HBV knowledge score (13 correct out of a total of 16 questions), considerably higher than the 25 % (8 correct out of a total of 12 questions) in our study population. Although both study populations were comprised of different types of health professionals, the Chinese health worker sample was mostly clinicians who were not classified by employment category or patient contact status. Even when compared to the more educated group of Mexican clinicians with patient contact, the Chinese health worker population had a higher overall HBV knowledge (81 vs. 56 %) and knowledge that HBV causes liver disease (66 vs. 57 %). Regarding prevention practices, 73 % of the clinicians with patient contact in Mexico reported a

Table 2 Proportion of correct answers to select questions by employment category and patient contact status

	Non-clinicians without patient contact[a] ($n = 529$)	Non-clinicians with patient contact ($n = 116$)	Clinicians without patient contact ($n = 71$)	Clinicians with patient contact ($n = 176$)	P value
Hepatitis B					
1. A vaccine to prevent infection with hepatitis B exists. (***Agree***)	43.7	66.4*	50.7	90.9*	0.000
2. Hepatitis B cannot be spread by eating food prepared by an infected person. (***Agree***)	26.1	26.7	35.2	60.2*	0.000
3. Hepatitis B can be spread by sharing tooth-brushes. (***Disagree***)	63.9	72.4	71.8	81.8*	0.000
4. Hepatitis B can be spread by eating food that has been prechewed by an infected person. (***Agree***)	54.8	54.3	62.0	62.5	0.236
5. Hepatitis B cannot be spread from person to person by coughing. (***Agree***)	16.8	15.5	31.0*	46.6*	0.000
6. Hepatitis B can be spread during sexual intercourse? (***Agree***)	53.5	58.6	57.8	75.0*	0.000
7. Hepatitis B cannot be spread from person to person by holding hands. (***Agree***)	57.1	55.2	69.0	88.1*	0.000
8. Infection with hepatitis B can last for a lifetime. (***Agree***)	27.8	43.1*	38.0	59.1*	0.000
9. Hepatitis B can cause liver cancer. (***Agree***)	37.2	46.6	43.7	56.8*	0.000
10. A person can die from having a hepatitis B infection.	56.3	71.6*	60.6	75.6*	0.000
11. Hepatitis B can be cured. (***Agree***)	48.6	49.1	57.8	47.7	0.511
12. If someone is infected with hepatitis B but they look and feel healthy, that person can spread hepatitis B. (***Agree***)	53.9	67.2*	62.0	80.1*	0.000
Hepatitis C					
1. A vaccine to prevent infection with hepatitis C exists. (***Agree***)	10.6	12.9	19.7*	31.8*	0.000
2. Hepatitis C cannot be spread by eating food prepared by an infected person. (***Agree***)	22.3	27.6	35.2*	57.4*	0.000
3. Hepatitis C cannot be spread from person to person by coughing. (***Agree***)	15.9	16.4	29.6*	42.6*	0.000
4. Hepatitis C can be spread during sexual intercourse. (***Agree***)	47.8	51.7	53.5	69.3*	0.000
5. Hepatitis C cannot be spread from person to person by holding hands. (***Agree***)	50.3	50.0	59.2	80.7*	0.000
6. Infection with hepatitis C can last for a lifetime. (***Agree***)	28.5	40.5*	38.0	62.5*	0.000
7. Hepatitis C can cause liver cancer. (***Agree***)	35.0	47.4*	47.9*	60.2*	0.000
8. A person can die from having a hepatitis C infection. (***Agree***)	55.2	68.1*	62.0	80.7*	0.000
9. Hepatitis C can be cured. (***Agree***)	33.3	37.1	45.1*	33.0	0.224
10. If someone is infected with hepatitis C but they look and feel healthy, that person can spread hepatitis C. (***Agree***)	47.4	61.2*	56.3	76.7*	0.000
Liver disease					
1. Drinking alcohol in excess can increase a person's risk of liver disease. (***Agree***)	94.0	98.3	100*	96.0	0.040
2. Drinking any amount of alcohol, even in moderation, can increase a person's risk of liver disease. (***Disagree***)	9.3	6.0	9.9	11.4	0.000

Table 2 continued

	Non-clinicians without patient contact[a] ($n = 529$)	Non-clinicians with patient contact ($n = 116$)	Clinicians without patient contact ($n = 71$)	Clinicians with patient contact ($n = 176$)	P value
3. Being overweight or obese can increase a person's risk of liver disease. (***Agree***)	41.6	55.2*	64.8*	66.5*	0.000
4. Having diabetes can increase a person's risk of liver disease. (***Agree***)	42.5	56.9*	60.6*	63.1*	0.000
5. The type of food one eats can increase a person's risk of liver disease. (***Agree***)	57.1	61.2	76.1*	74.4*	0.000
6. Getting vaccinated for hepatitis B can prevent liver disease. (***Agree***)	50.5	64.7*	74.6*	76.1*	0.000
7. Getting screened for hepatitis B and C can help to prevent the development of liver disease? (***Agree***)	78.3	85.3	91.5*	88.6*	0.001
8. Between HBV, HCV, and HIV, HBV is more easily spread from person to person. (***Agree***)	5.1	10.3*	7.0	9.7*	0.051

Reported in Morelos, Mexico during 2004–2008 ($n = 892$) (%)

* $P < 0.05$ determined using a two-sample test of proportions

** P value determined using Chi-square test and Fisher's exact test

[a] "Non-clinicians without patient contact" was used as the reference group for statistical tests

history of HBV vaccination, which was similar to the Chinese health worker population (81.6 %), and higher than the professional staff in an Egyptian health worker population (38 %) (Talaat et al. 2003). However, the overall proportion of Mexican health workers who reported having been vaccinated against HBV (39 %) was closer to the Egyptian population's results than the Chinese. The Chinese health worker population also had a greater percentage of participants with a history of HBV screening (94.9 %) compared to the Mexican clinicians with patient contact group (22.7 %), and the total Mexican health worker population (16 %).

A recent study of an Irish registered nurse population also found inadequate levels of HCV knowledge, and supports our finding that HCV knowledge increases with patient contact (Frazer et al. 2011). Our study population's mean HCV knowledge score (4.1 correct responses out of 10 questions) is similar to a study of HCV knowledge among Australian health workers consisting of nurses, physicians, wards persons, and physiotherapists (4.6 correct responses out of 10 questions) (Van de Mortel 2002), but lower than the Irish nurse population (16.7 out of 27 questions). When comparing the more educated group in both the Irish nurse and Mexican health worker populations, our "clinicians with patient contact" group had a mean HCV knowledge score of 5.9 out of 10 questions (59 % correct responses), while the group of "addiction nurses" had a mean of 22.5 out of 27 questions (83 % correct responses). Roughly 47–77 % of our population is aware that asymptomatic, HCV infected individuals can infect others, vs. 82.3–98.0 % of the Irish nurse population. Similarly, 10.6–31.8 % of the Mexican health worker population correctly answered that there is no HCV vaccine, which is substantially lower than the 60.9–95.9 % correct response rate among the Irish nurse population (Frazer et al. 2011) and 76 % among the Australian health worker population (Van de Mortel 2002).

We also compared our findings to similar studies conducted with other Latino populations. The clinicians with patient contact in our study had a higher level of knowledge about hepatitis and liver disease than the non-clinician participants evaluated in these other studies. For example, 91 % of the clinicians with patient contact stated that a hepatitis B vaccine exists, as compared to 36 % of participants in a bi-national study of Mexicans in the US and Mexico (Flores et al. 2012), and 53 % of participants in Puerto Rico (Soto-Salgado et al. 2010). However, when we compare all four of our study groups with these more general population studies, the results are not as varied. Between 54 and 74 % of this Mexican health worker population reported that hepatitis B can spread through sexual intercourse, as compared to 53 % of the Mexican bi-national study (Flores et al. 2012), and 74 % in the Puerto Rican population (Soto-Salgado et al. 2010). In the Mexican bi-national study, 60 % of the participants were aware that being overweight or obese is a risk factor for liver disease, which is higher than the percentage of non-clinicians who were aware of this risk factor in our sample (42–55 %) and lower than the percentage found for the two clinician groups (65–67 %).

For comparison purposes, we considered non-clinicians without patient contact as a more representative group of

Table 3 Mean knowledge score and standard deviations (SD) for hepatitis B, hepatitis C, and liver disease questions

	Hepatitis B 12 points possible		Hepatitis C 10 points possible		Liver disease 8 points possible	
	Mean ± SD	*P* value*	Mean ± SD	*P* value*	Mean ± SD	*P* value*
Overall	6.2 ± 3.0	-	4.1 ± 2.7	-	4.8 ± 1.9	-
Age group in years						
20–34[a]	6.1 ± 3.0		4.7 ± 2.6		4.6 ± 1.9	
35–49	6.2 ± 2.9	0.582	4.1 ± 2.6	0.040	4.8 ± 1.9	0.279
50–70	6.1 ± 3.1	0.558	3.9 ± 2.9	0.057	5.1 ± 1.8	0.012
Sex						
Female[a]	6.3 ± 3.0		4.1 ± 2.7		4.9 ± 1.9	
Male	5.8 ± 3.0	0.291	4.1 ± 2.6	0.197	4.8 ± 1.9	0.464
Education in years						
≤12[a]	5.5 ± 3.0		3.5 ± 2.5		4.5 ± 1.9	
>12	6.7 ± 2.9	0.003	4.6 ± 2.8	0.019	5.1 ± 1.8	0.002
Monthly household income (pesos)						
<$10,000[a]	5.9 ± 3.0		3.9 ± 2.7		4.7 ± 1.9	
$10,000–20,000	6.4 ± 2.9	0.493	4.5 ± 2.6	0.133	5.1 ± 1.8	0.161
>$20,000	6.7 ± 3.1	0.393	4.8 ± 3.0	0.183	5.1 ± 2.0	0.665
Job title/employment category						
Non-clinicians without patient contact[a]	5.4 ± 2.9		3.5 ± 2.5		4.4 ± 1.9	
Non-clinicians with patient contact	6.3 ± 2.9	0.002	4.1 ± 2.6	0.012	5.2 ± 1.8	0.000
Clinician without patient contact	6.4 ± 2.9	0.015	4.5 ± 2.8	0.008	5.6 ± 1.3	0.001
Clinician with patient contact	8.2 ± 2.1	0.000	5.9 ± 2.5	0.000	5.6 ± 1.5	0.000
History of hepatitis B blood test**						
Yes[a]	7.3 ± 2.5		5.2 ± 2.6		5.1 ± 1.8	
No	6.0 ± 3.0	0.000	4.0 ± 2.7	0.000	4.8 ± 1.9	0.657
History of hepatitis B vaccination**						
Yes[a]	7.4 ± 2.5		4.8 ± 2.8		5.2 ± 1.7	
No	6.3 ± 2.9	0.003	4.1 ± 2.6	0.204	5.1 ± 1.7	0.765
History of hepatitis C blood test**						
Yes[a]	8.0 ± 2.5		5.7 ± 2.6		5.4 ± 1.7	
No	6.0 ± 3.0	0.000	4.0 ± 2.7	0.000	4.8 ± 1.9	0.087
History of STI treatment**						
Yes[a]	6.0 ± 2.9		3.9 ± 2.6		5.0 ± 2.0	
No	6.2 ± 3.0	0.688	4.2 ± 2.7	0.433	4.9 ± 1.9	0.578
Lifetime number of sexual partners						
0–1[a]	6.4 ± 3.1		4.2 ± 2.8		4.9 ± 1.9	
2–9	6.2 ± 2.9	0.748	4.3 ± 2.6	0.944	4.9 ± 1.9	0.353
≥10	5.7 ± 3.1	0.689	3.7 ± 2.7	0.401	4.7 ± 1.9	0.256
BMI						
Normal (<25 kg/m^2)[a]	6.4 ± 3.0		4.3 ± 2.8		4.7 ± 1.8	
Overweight (25–29.9 kg-m^2)	6.1 ± 3.1	0.028	4.1 ± 2.8	0.304	4.8 ± 1.9	0.502
Obese (≥30 kg/m^2)	6.0 ± 2.9	0.201	4.0 ± 2.6	0.705	5.1 ± 1.8	0.018
Waist circumference**						
Normal[a]	6.2 ± 3.0		4.2 ± 2.7		4.8 ± 1.8	
Abdominal obesity	6.1 ± 3.0	0.267	4.0 ± 2.7	0.791	4.9 ± 1.9	0.689
Alcohol consumption**						
Non-drinker/moderate[a]	6.4 ± 2.9		4.3 ± 2.7		4.9 ± 1.9	
Heavy/binge	5.4 ± 3.1	0.036	3.6 ± 2.7	0.011	4.6 ± 1.9	0.160

Reported in Morelos, Mexico from 2004–2008 ($n = 892$)

* *P* values calculated using a multiple linear regression model that adjusted for age, sex, education, income and job title/employment category

** "Not sure/don't know" and missing answers not included

[a] Reference group used for statistical tests

the general population. The non-clinicians without patient contact in our study had a higher knowledge of the potential for hepatitis B to be cured (48.6 %) vs. 35 % in the Puerto Rican study (Soto-Salgado et al. 2010) and 20 % in the Mexican bi-national study (Flores et al. 2012). In the Puerto Rican study, 17 % reported that asymptomatic HBV infected individuals can spread the virus (Soto-Salgado et al. 2010), vs. 54 % of our non-clinicians without patient contact who answered this question correctly. The percentage of non-clinicians without patient contact who reported that HBV is spread more easily than HIV (5.1 %) is similar to the results of the bi-national study (<10 %) (Flores et al. 2012), but lower than in other studies that report correct response rates between 19–27 % (Soto-Salgado et al. 2010; Cox et al. 2011).

Mean knowledge scores for the Mexican health worker population differed in terms of significance within population categories when compared to the Soto-Salgado et al. study (Soto-Salgado et al. 2010). The mean hepatitis B (6.1 out of 12 questions) and hepatitis C (3.6 out of 8 questions) scores for the Puerto Rican population were similar to this Mexican health worker population (6.2 out of 12 HBV questions; 4.1 out of 10 HCV questions). However, while there were significant differences in the mean score by gender and education in the Mexican health worker population, no difference was found in the Puerto Rican population. Also, while having greater than 10 sexual partners showed significantly lower HBV and HCV knowledge in the Mexican health worker population, there was no significant difference observed in the Puerto Rican population.

This study has several strengths, including the classification of the study population by employment category and patient contact status. Since both clinicians and non-clinicians were included in the study population, the participants represent a variety of backgrounds, including different levels of education, income, age, knowledge, and prevention practices, which may be more generalizable to the Mexican population at large. Furthermore, we were able to assess level of knowledge based on certain health characteristics and risk factors for liver disease, including BMI, waist circumference, and alcohol consumption. However, because these findings are specific to health care workers, they are not representative of the general Mexican population. The high percentage of missing answers, which were assumed to indicate a lack of knowledge, may have led our analysis to underestimate the hepatitis and liver disease knowledge in this population. Numerous other factors also could have influenced the decision to not answer a question, including time restraints and not properly understanding the question. Another shortcoming of this study is the limited amount of information about the health workers knowledge regarding liver disease. The study questionnaire focused specifically on knowledge about hepatitis B, hepatitis C, and general liver disease. Future studies should be conducted to confirm our findings, to further explore knowledge about other determinants of liver disease, and to investigate the socio-cultural health promotion and educational aspects of liver disease in Mexico.

Despite these limitations, this study provides important information regarding the low levels of knowledge about HBV, HCV, and liver disease in general among a sample of Mexican health workers. Our findings support the need for more hepatitis and liver disease education among health workers in Mexico, especially because health workers are key informants who can provide disease prevention information to their patients. Measures must be taken to establish health education workshops that emphasize the key risk factors, transmission routes, and disease sequelae of HBV, HCV, and other forms of liver disease. Health workers also need to be counseled on the importance of maintaining their own health, including adopting appropriate behavioral, environmental, and social practices that will decrease their risk of acquiring HBV or HCV. Lastly, health workers should be encouraged to educate their patients, peers, and the general population about liver disease risk factors, including HBV and HCV transmission routes to increase the population's awareness and reduce their risk of acquiring HBV or HCV.

Conclusions

Our study results indicate that this sample of Mexican health workers has an inadequate level of knowledge and preventative practices in relation to hepatitis B, hepatitis C, and liver disease in general. This finding points to the importance of developing and implementing prevention programs that specifically target this population's areas of weakness. The increasing rates of liver disease in Mexico make it imperative to identify the specific populations that need to be prioritized for prevention interventions, especially among health workers. This group has both an increased risk of liver disease and the added responsibility to provide health advice to their patients. The primary prevention of hepatitis B, hepatitis C, and other forms of chronic liver disease can be achieved by increasing the knowledge and awareness of specific risk factors. Promoting practices such as screening and vaccination to prevent infection with hepatitis B, as well as other healthy behavioral changes like weight loss and moderate alcohol consumption, can help to reduce a person's risk of developing chronic liver disease.

Some excellent health policy measures are already in place in Mexico. Most notable is the health reform that has been ongoing for the past decade, which has increased the number of individuals with health insurance and access to

health services for the entire population (Knaul et al. 2006). Out-of-pocket spending for health care has reduced as a result of these policy measures. Mexico's National Institute of Public Health also has many research centers, including the Center for Infectious Disease Research and the Center for Nutrition and Health Research that are making progress to prevent liver disease and hepatitis in Mexico (National Institute of Public Health 2012). However, we are not aware of any published papers that describe or evaluate existing liver disease and hepatitis interventions in Mexico, or any information on initiatives and public health programs currently in place to specifically decrease liver disease and hepatitis.

There are a variety of methods that can be used to promote liver disease prevention in the general population. Social media networks can be utilized to discourage heavy alcohol consumption and to encourage hepatitis B vaccination. Liver disease prevention information can be disseminated to students on secondary school and university campuses via flyers and posters to target younger individuals. Health care workers should provide detailed prevention information to at-risk patients, including moderate alcohol consumption, hepatitis B vaccinations, maintaining a proper weight, etc. Hospitals and health clinics can also take the initiative to create hepatitis and liver disease education workshops or mobile clinics that provide the information to willing and interested individuals. Lastly, needle exchange programs can be implemented in areas with high IV drug use, as well as spreading prevention knowledge. These are just a few recommendations that should be considered by health policy officials and program coordinators when developing and implementing programs to promote preventive practices within the general population.

More specific and specialized techniques should be used to educate health workers (vs. the general population) for a multitude of reasons: (1) health workers are the ones providing health care to the general population and (2) health workers are a primary source of information about hepatitis and liver disease for their patients. Strategies such as having hospitals and clinics provide annual refresher courses on the epidemiology of hepatitis and liver disease will undoubtedly benefit health workers who deal with these types of patients, as well as those who do not. Health care agencies and hospitals can adopt a system that evaluates the level of health workers' knowledge of these diseases. Workshops and lectures can also be offered for employees who want to improve their interactive skills to effectively disseminate information to their patients. A study conducted among health care workers in Denmark, Norway, and Sweden regarding nutrition knowledge among health workers advocates for increasing the nutrition curriculum while the health worker is receiving his/her education, as well as creating post-graduation/training education sessions to ensure continued learning (Mowe et al. 2008). Considering the impact of hepatitis and liver disease on the Mexican population, similar modifications could be made to the medical and health curriculum in Mexico. Another effective intervention could be to increase health worker knowledge through peer-led training sessions. An HIV/AIDS knowledge intervention that involved peer-led trainings with health workers in Nigeria found a significant increase in HIV/AIDS knowledge (Ezendinachi et al. 2002). There were a variety of subsequent benefits, for example, these newly trained health workers were more willing to educate others, had a better understanding of the clinical nature of HIV/AIDS, and they were able to create a more professional atmosphere, which replaced the previously fearful and stigma-enveloped environment.

These ideas for improving liver disease and hepatitis knowledge within the general and health worker populations will only remain suggestions, unless appropriate people take action to start changing liver disease and hepatitis education in Mexico. By increasing education about liver disease, the beliefs and attitudes of the population will change as well. Considering the high rates of morbidity and mortality from liver disease in Mexico, immediate action must be taken.

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Conflict of interest The authors declare that they have no competing interests to disclose.

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