

Hepatitis C Testing, Infection, and Linkage to Care Among Racial and Ethnic Minorities in the United States, 2009–2010

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Hepatitis C virus (HCV) infection affects almost 3 million Americans and is the leading cause of death associated with liver disease in the United States.^{1,2} Racial disparities in the prevalence of HCV infection have previously been documented: Non-Hispanic Blacks have the highest prevalence of HCV infection in the United States, about twice that reported among non-Hispanic Whites.¹ Fewer data exist on the prevalence of hepatitis C among the Latino population, and they have been derived mainly from the National Health and Nutrition Examination Survey, in which only Mexican Americans were represented.^{1,3,4} Even more limited data are available on the prevalence of HCV infection among Asians and American Indians/Alaska Natives (AI/ANs), with most of the studies localized to specific states or facilities.^{5–8} More important is the dearth of data regarding the prevalence of hepatitis C testing and access to care—information critical to public health planning and policy—among racial/ethnic minorities in the United States. Early identification and treatment of hepatitis C infection are essential to prevent liver cancer and associated health care costs.^{9,10} Over the 10-year period from 2010 to 2019, the direct medical cost of chronic HCV infection is projected to exceed \$10.7 billion, and the societal cost of premature mortality is estimated at \$54.2 billion.¹¹

Studies have reported that several minority communities have disproportionately lower socioeconomic status, greater barriers to access to health care, and greater risks for and burden of disease compared with Whites or the general population living in the same geographical area.^{12–14} Socioeconomic factors have been postulated to play a role in access to care and treatment of hepatitis C.^{15–17} However, very few studies have assessed the role played by socioeconomic factors in hepatitis C testing and infection among

Objectives. We estimated rates and determinants of hepatitis C virus (HCV) testing, infection, and linkage to care among US racial/ethnic minorities.

Methods. We analyzed the Racial and Ethnic Approaches to Community Health Across the US Risk Factor Survey conducted in 2009–2010 (n = 53 896 minority adults).

Results. Overall, 19% of respondents were tested for HCV. Only 60% of those reporting a risk factor were tested, with much lower rates among Asians reporting injection drug use (40%). Odds of HCV testing decreased with age and increased with higher education. Of those tested, 8.3% reported HCV infection. Respondents with income of \$75 000 or more were less likely to report HCV infection than those with income less than \$25 000. College-educated non-Hispanic Blacks and Asians had lower odds of HCV infection than those who did not finish high school. Of those infected, 44.4% were currently being followed by a physician, and 41.9% had taken HCV medications.

Conclusions. HCV testing and linkage to care among racial/ethnic minorities are suboptimal, particularly among those reporting HCV risk factors. Socioeconomic factors were significant determinants of HCV testing, infection, and access to care. Future HCV testing and prevention activities should be directed toward racial/ethnic minorities, particularly those of low socioeconomic status. (*Am J Public Health.* 2013;103:112–119. doi:10.2105/AJPH.2012.300858)

racial/ethnic minorities. Not all racial/ethnic minorities were included in these studies, and the majority failed to control for traditional HCV infection risk factors.^{1,4,18} The Centers for Disease Control and Prevention's recommendations for HCV testing are based on presence of HCV risk factors, hence the need to control for them while assessing the determinants of hepatitis C testing and infection.¹⁹

In 2006, 1 of every 4 US residents identified themselves as being a racial/ethnic minority,²⁰ and the US Census Bureau has projected that by 2050 minority populations will make up approximately 50% of the US population.²¹ Thus, a need exists for more information about hepatitis C among the different racial/ethnic groups in the United States to be able to design evidence-based prevention interventions and avoid the projected increases in medical expenses.¹¹

The objectives of this study were to assess hepatitis C testing, infection, and access to health care and treatment among racial/ethnic minorities in the United States and to examine whether demographic, socioeconomic, and hepatitis C risk factors influence hepatitis C testing, infection, and access to care in this population.

METHODS

Data for this study were drawn from the Racial and Ethnic Approaches to Community Health across the US Risk Factor Survey (REACH US RFS) conducted in May–November 2009 and December 2009–August 2010 in 28 minority communities located in 17 states (Arizona, California, Georgia, Hawaii, Illinois, Massachusetts, Michigan, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Virginia, West

Virginia, and Washington).¹⁴ The REACH US RFS monitored progress and achievements in the specific health priority areas of cardiovascular disease, diabetes mellitus, breast and cervical cancer, adult immunization, and hepatitis B and C. The racial/ethnic communities targeted were non-Hispanic Black, Hispanic, Asian (including Native Hawaiian and Pacific Islander), and AI/AN communities. Whites and nonminorities were not sampled in the REACH US RFS.

Sample Selection

A multimode address-based sampling design was used for sample selection.¹⁴ In summary, a sample of addresses was drawn in each of the 28 REACH communities using the US postal service delivery sequence file for residential addresses that receive mail; identification of a telephone number for the sampled addresses was attempted. People at addresses that were matched to telephone numbers were contacted through the computer-assisted telephone interview system. People at addresses that could not be matched to telephone numbers (landline or cellular) were sent a self-administered questionnaire booklet. Finally, in some communities, in-person interviews were conducted either because other modes of data collection had previously proved to be less productive in the community or because the sampled household was unable to be reached by the 2 other methods.

To be eligible for the REACH US RFS, a person had to be aged 18 years or older, live or stay in a household within the targeted geographical area, and be in the targeted racial/ethnic groups for that community. As many as 2 eligible people within the household were selected for interview, and on average 900 residents were interviewed in each community every year.

Questionnaire

A uniform questionnaire was used for all communities, and interviews were conducted in English, Spanish, Vietnamese, Chinese Mandarin, Chinese Cantonese, Khmer, or Haitian Creole. The content of the REACH US RFS questionnaire has previously been described.¹⁴

Information collected in 2009 and 2010 of interest to this study included basic demographic characteristics (age, gender, race, ethnicity,

birth outside the United States, language of interview) and socioeconomic characteristics (education, annual household income, insurance status), hepatitis C testing (ever having a hepatitis C test, reason for and location of testing), hepatitis C infection status (ever told to have hepatitis C by a health professional and duration of infection), and hepatitis C treatment (“currently seeing a doctor for hepatitis C” and “ever taken medications for hepatitis C”). Questions were similar for 2009 and 2010; however, in 2010 questions about traditional risk factors for hepatitis C (injection drug use, blood transfusion before 1992 or outside the United States, sexual contact with a hepatitis-positive person, and any of the previously mentioned risk factors but the respondent refused to specify) were added to the REACH US RFS questionnaire. All the collected information was self-reported.

Data Analysis

We aggregated and stratified the data collected from the 28 communities in 2009 and 2010 by the 4 racial/ethnic groups (non-Hispanic Black, Hispanic, Asian, and AI/AN). Each sample was weighted to reflect the probability of selection, the number of eligible members, and the number of selected members at the sampled address and was adjusted by age and gender population sizes of members of the surveyed minority population. We calculated the prevalence of hepatitis C testing, infection, and treatment and stratified them by demographic, socioeconomic, and hepatitis C risk factors for each of the 4 racial/ethnic groups.

We conducted multivariate logistic regression analysis to identify determinants for hepatitis C testing, infection, and access to care. Separate multivariate models were built for each of the 4 racial/ethnic groups to look at the determinants of HCV testing and infection; because of the smaller sample size and absence of significant differences between racial/ethnic groups, we built 1 model that included race as a cofactor to identify determinants for hepatitis C treatment and care among respondents who reported HCV infection. We used SUDAAN version 10.0.1 (RTI International, Research Triangle Park, NC) in the analysis to account for the complex sampling design. We considered $P < .05$ statistically significant.

RESULTS

A total of 53 896 interviews were conducted in 2009 ($n = 24\ 169$) and 2010 ($n = 29\ 727$) in 28 minority communities. The racial/ethnic distribution was as follows: 40.2% non-Hispanic Blacks ($n = 21\ 683$), 30.6% Hispanics ($n = 16\ 484$), 18.5% Asians ($n = 9972$), and 10.7% AI/ANs ($n = 5757$). Of the 53 896 respondents, 47.1% were men, and 31.5% were born outside the United States. The mean age of the overall sample was 44.9 years with variations by racial/ethnic group (non-Hispanic Blacks, 47.0 years; Hispanics, 41.7 years; Asians, 45.8 years; AI/ANs, 44.6 years). Asians had the highest proportions of college graduates (42.3%) and annual household income \$75 000 or more (27.0%), which were double the proportions found among other racial/ethnic groups. Health insurance coverage was 75.4%, with the highest proportion among Asians (84.5%) compared with other racial/ethnic groups.

Of the 53 896 respondents, 19.5% reported having been tested for hepatitis C, with variability among the 4 racial/ethnic groups (AI/ANs, 24.0%; non-Hispanic Blacks, 20.7%; Asians, 17.7%; Hispanics, 17.3%; Table 1). Most were tested at a physician's office, laboratory, or clinic. Reasons for HCV testing were different for each racial/ethnic community. Acute symptoms and abnormal blood tests were the least frequently reported reasons for testing among all minority communities (Table 1). Of the 10 483 respondents who reported being tested for hepatitis C, 8.3% reported being told they had hepatitis C infection by a health care provider. The highest hepatitis C infection rates were reported by non-Hispanic Blacks (9.2%), followed by Hispanics (8.3%), Asians (6.8%), and AI/ANs (6.4%). Of those infected, 44.4% were being followed by a physician for their hepatitis C infection (Hispanics, 53.0%; non-Hispanic Blacks, 42.7%; AI/ANs, 38.6%; and Asians, 37.5%), and 41.9% reported ever taking medications for HCV infection (Hispanics, 47.9%; Asians, 41.7%; non-Hispanic Blacks, 39.5%; AI/ANs, 37.5%; Table 1).

TABLE 1—Hepatitis C Testing, Infection, and Linkage to and Receipt of Care by Race/Ethnicity: Racial and Ethnic Approaches to Community Health Across the US Risk Factor Survey, 2009–2010

Variable	Total (n = 53 896), No. (%)	Non-Hispanic Black (n = 21 683), No. (%)	Hispanic (n = 16 484), No. (%)	Asian (n = 9972), No. (%)	American Indian/Alaska Native (n = 5757), No. (%)
Tested for HCV	10 483 (19.5)	4491 (20.7)	2849 (17.3)	1764 (17.7)	1379 (24.0)
Location where tested for HCV ^a					
Physician's office or lab	5168 (49.3)	2174 (48.4)	1349 (47.3)	1133 (64.2)	513 (37.2)
Clinic	2059 (19.6)	799 (17.8)	660 (23.2)	266 (15.1)	334 (24.2)
Hospital (O/N patient)	1847 (17.6)	856 (19.1)	506 (17.8)	202 (11.5)	282 (20.4)
Other site	1760 (16.8)	838 (18.7)	405 (14.2)	183 (10.4)	334 (24.2)
Reason tested for HCV ^a					
Symptoms	389 (3.7)	151 (3.4)	125 (4.4)	43 (2.4)	71 (5.1)
Abnormal blood tests	437 (4.2)	212 (4.7)	122 (4.3)	52 (2.9)	51 (3.7)
Donating blood	821 (7.8)	326 (7.3)	207 (7.3)	106 (6.0)	183 (13.3)
Self or someone else concerned	1265 (12.1)	416 (9.3)	339 (11.9)	320 (18.1)	190 (13.8)
Pregnancy	1230 (11.7)	601 (13.4)	335 (11.8)	128 (7.3)	166 (12.0)
Other	6405 (61.1)	2808 (62.5)	1728 (60.7)	1088 (61.7)	782 (56.7)
Ever told have Hepatitis C infection ^b	859 (8.3)	415 (9.2)	236 (8.3)	120 (6.8)	88 (6.4)
Age at diagnosis of hepatitis C infection, ^c y					
18–34	241 (28.1)	82 (19.8)	84 (35.6)	38 (31.7)	37 (42.0)
35–44	182 (21.2)	80 (19.3)	60 (25.4)	16 (13.3)	26 (29.5)
45–54	231 (26.9)	136 (32.8)	45 (19.1)	30 (25.0)	20 (22.7)
55–64	115 (13.4)	73 (17.6)	22 (9.3)	19 (15.8)	2 (2.3)
≥ 65	23 (2.7)	12 (2.9)	3 (1.3)	7 (5.8)	1 (1.1)
Currently seeing a physician for Hepatitis C infection ^c	381 (44.4)	177 (42.7)	125 (53.0)	45 (37.5)	34 (38.6)
Ever taken medications for hepatitis C infection ^c	360 (41.9)	164 (39.5)	113 (47.9)	50 (41.7)	33 (37.5)

Note. HCV = hepatitis C virus; O/N = overnight. Numbers may not add up to total because of missing responses; all percentages are weighted percentages. All the data are self-reported.

^aResponses were not mutually exclusive. Multiple answers could be given.

^bAmong those tested for hepatitis C.

^cAmong those who were ever told to have hepatitis C infection.

The distribution of hepatitis C testing and infection varied by demographic, socioeconomic, and risk factor characteristics in each of the 4 racial/ethnic groups (Table 2). The highest rates of HCV testing were reported by non-Hispanic Blacks (26%), Asians (21%), and AI/ANs (31%) aged 35 to 44 years and Hispanics (20%) aged 45 to 54 years. Conversely, prevalence rates of HCV infection were highest among non-Hispanic Blacks (25%), Hispanics (17%), and Asians (12%) aged 55 to 64 years, and AI/ANs (11%) aged 45 to 54 years (Table 2). Respondents with less than a high school education and those having a household income less than \$25 000 reported the highest prevalence rates of HCV infection, yet these same groups reported the lowest rates of HCV testing (Table 2). Rates of HCV testing among those born outside the US ranged from 14%

among Hispanics to 19% among Asians. Prevalence of reported HCV infection was higher among Asians born outside the United States (8%) versus those born in the United States (5%), whereas HCV infection rates were either similar or lower among Hispanics and non-Hispanic Blacks born outside the United States compared with their counterparts. As shown in Table 2, the presence of HCV risk factors was highly prevalent among those who were tested for hepatitis C. Almost 70% each of non-Hispanic Blacks and Hispanics who reported injection drug use were tested for hepatitis C, and about 80% reported hepatitis C infection. By comparison, only one third of Asians who reported injection drug use were tested for hepatitis C.

Factors associated with HCV testing and infection were different in each racial/ethnic

group in the multivariate analysis (Table 3). Men were significantly more likely than women to get tested for HCV among non-Hispanic Black (OR = 1.17; 95% CI = 1.03, 1.32; $P < .01$) and Asian communities (OR = 1.21; 95% CI = 1.04, 1.39; $P < .05$). Age was a significant determinant of HCV testing among all racial/ethnic groups. Odds of HCV testing increased with higher education and were statistically significant among non-Hispanic Blacks, Hispanics, and AI/ANs. Non-Hispanic Blacks (OR = 0.44; 95% CI = 0.22, 0.88) and Asians (OR = 0.39; 95% CI = 0.16, 0.98) with a college education had significantly lower risk for HCV infection than those who had not finished high school ($P < .05$). Compared with respondents with an annual household income less than \$25 000, those with income \$75 000 or more had less likelihood for HCV

TABLE 2—Hepatitis C Testing and Infection by Race/Ethnicity, Socioeconomic, and Hepatitis C Risk Factors: Racial and Ethnic Approaches to Community Health Across the US Risk Factor Survey, 2009–2010

Characteristics	Non-Hispanic Black			Hispanic			Asian			American Indian/Alaska Native		
	Total, No.	Tested, No. (%)	HCV Positive, ^a %	Total, No.	Tested, No. (%)	HCV Positive, ^a %	Total, No.	Tested, No. (%)	HCV Positive, ^a %	Total, No.	Tested, No. (%)	HCV Positive, ^a %
Gender												
Female	12 165	2328 (19.1)	7.6	8273	1366 (16.5)	6.7	5098	823 (16.1)	5.5	2957	678 (22.9)	5.9
Male	9515	2163 (22.7)	10.9	8210	1483 (18.1)	9.8	4871	940 (19.3)	8.1	2799	701 (25.0)	6.7
Age, y												
18–34	6487	1592 (24.5)	2.3	6270	1098 (17.5)	3.5	2843	478 (16.8)	2.5	1915	493 (25.7)	2.8
35–44	3470	892 (25.7)	2.3	3764	664 (17.6)	5.7	1995	419 (21.0)	5.0	1064	334 (31.4)	6.0
45–54	3836	877 (22.9)	13.6	2613	524 (20.1)	14.5	1834	362 (19.7)	8.3	1075	297 (27.6)	11.4
55–64	3993	778 (19.4)	24.9	2255	386 (17.1)	17.1	1704	287 (16.8)	11.8	949	177 (18.6)	8.5
≥ 65	3737	329 (8.8)	13.7	1520	169 (11.1)	10.6	1486	202 (13.6)	11.4	740	77 (10.4)	6.5
Education level												
< high school	3346	549 (16.4)	18.0	4641	627 (13.5)	12.7	1173	187 (15.9)	12.8	869	186 (21.4)	9.1
High school graduate	6678	1282 (19.2)	11.2	4905	761 (15.5)	8.8	2110	281 (13.3)	9.2	2073	429 (20.7)	7.7
Some college	6897	1608 (23.3)	7.5	4109	863 (21.0)	6.0	2416	425 (17.6)	8.2	1748	475 (27.2)	6.5
College graduate	4637	1039 (22.4)	4.5	2740	583 (21.3)	6.0	4223	866 (20.5)	3.9	1052	289 (27.5)	2.1
Annual household income, \$												
< 25 000	10 176	2140 (21.0)	12.6	7682	1309 (17.0)	10.8	2850	429 (15.1)	11.9	2364	614 (26.0)	10.4
25 000–49 999	5363	1120 (20.9)	7.2	4169	737 (17.7)	6.2	2272	373 (16.4)	8.0	1570	344 (21.9)	3.5
50 000–74 999	2116	467 (22.0)	6.0	1643	290 (17.6)	6.2	1419	260 (18.3)	6.1	719	172 (23.9)	3.5
≥ 75 000	2416	562 (23.3)	3.4	1799	362 (20.1)	4.6	2692	608 (22.6)	2.9	779	201 (25.8)	2.0
Health insurance												
No	5023	1140 (22.7)	8.3	4402	558 (12.7)	4.5	1420	213 (15.0)	8.4	1702	451 (26.5)	7.1
Yes	16 344	3299 (20.2)	9.4	11 892	2263 (19.0)	9.1	8423	1529 (18.1)	6.5	3969	906 (22.8)	5.8
Born in the United States												
No	2018	356 (17.6)	3.9	7986	1122 (14.0)	8.2	6697	1299 (19.4)	7.5	49	8 (16.3)	0.0
Yes	19 580	4128 (21.1)	9.7	8402	1721 (20.5)	8.3	3253	462 (14.2)	4.5	5699	1371 (24.1)	6.3
Hepatitis C risk factors (yes)^b												
Injection drug use	160	109 (68.1)	77.1	90	61 (67.8)	78.7	29	10 (34.5)	20.0	77	46 (59.7)	32.6
Blood transfusion before 1992	408	116 (28.4)	37.9	222	76 (34.2)	38.2	141	39 (27.6)	15.4	157	46 (29.3)	8.7
Blood transfusion outside the United States	49	11 (22.4)	18.2	73	27 (37.0)	48.1	97	29 (29.9)	27.5	11	4 (36.4)	0.0
Sexual contact with hepatitis positive person	140	78 (55.7)	43.6	96	57 (59.4)	31.6	96	40 (41.7)	2.5	59	31 (52.5)	25.8
Any of the above but unspecified	158	80 (50.6)	33.7	78	31 (39.4)	41.9	44	17 (38.6)	17.6	58	24 (41.4)	33.3

Note. HCV = hepatitis C virus. Numbers might not add up to total because of missing responses; all percentages are weighted percentages. All the data are self-reported.

^aOf those tested for hepatitis C.

^bRisk factor information was collected in 2010 only (n = 29 727), and numbers refer to people who answered “yes” to a hepatitis C risk factor.

infection among all racial/ethnic groups. Being born outside the United States was associated with lower likelihood of HCV testing among Hispanics and higher likelihood of testing among Asians. We found no statistically significant difference in HCV infection among those born outside the United States compared with their counterparts after adjusting for all variables. Injection drug use was significantly associated with higher likelihood for HCV

testing and infection among non-Hispanic Blacks and Hispanics (Table 3).

Among those who reported hepatitis C infection, age and having health insurance were significant determinants of being currently followed by a physician for HCV infection, whereas the odds for seeing a physician significantly decreased with increasing time since hepatitis C diagnosis (Table 4). Concerning medication intake for HCV infection,

respondents aged 45 years or older were significantly more likely to have ever taken medications for HCV infection than those younger than 35 years. In addition, respondents with an annual household income of \$50 000 or more had higher odds for ever taking medications for HCV infection than those with household income of \$25 000 or less. We found no statistically significant differences between racial/ethnic groups and birth

TABLE 3—Factors Associated With Hepatitis C Testing and Infection by Race/Ethnicity: Racial and Ethnic Approaches to Community Health Across the US Risk Factor Survey, 2009–2010

Characteristics	Non-Hispanic Black		Hispanic		Asian		American Indian/Alaska Native	
	HCV Testing, AOR (95% CI)	HCV Positive, AOR (95% CI)	HCV Testing, AOR (95% CI)	HCV Positive, AOR (95% CI)	HCV Testing, AOR (95% CI)	HCV Positive, AOR (95% CI)	HCV Testing, AOR (95% CI)	HCV Positive, AOR (95% CI)
Gender								
Female (Ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Male	1.17* (1.03, 1.32)	0.83 (0.57, 1.19)	1.10 (0.95, 1.27)	1.29 (0.79, 2.11)	1.21* (1.04, 1.39)	1.74* (1.02, 2.96)	0.95 (0.78, 1.16)	1.41 (0.69, 2.88)
Age, y								
18–34 (Ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
35–44	0.98 (0.81, 1.19)	0.39* (0.15, 0.97)	0.85 (0.69, 1.04)	0.93 (0.42, 2.03)	1.38* (1.09, 1.76)	1.88 (0.63, 5.58)	1.23 (0.92, 1.65)	3.59* (1.12, 11.50)
45–54	0.82* (0.69, 0.97)	2.05* (1.12, 3.76)	0.98 (0.81, 1.19)	1.99 (0.97, 4.07)	1.28* (1.01, 1.62)	2.67 (0.94, 7.57)	1.04 (0.80, 1.36)	5.41* (1.81, 16.17)
55–64	0.63* (0.53, 0.75)	5.12* (2.86, 9.17)	0.95 (0.77, 1.17)	2.03 (0.92, 4.46)	1.02 (0.79, 1.31)	2.23 (0.78, 6.41)	0.62* (0.46, 0.84)	6.12* (1.90, 19.72)
≥ 65	0.32* (0.26, 0.38)	2.53* (1.29, 4.97)	0.54* (0.42, 0.70)	1.51 (0.62, 3.68)	0.82 (0.63, 1.08)	2.25 (0.73, 6.97)	0.34* (0.23, 0.50)	3.24 (0.64, 16.41)
Education level								
< high school (Ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
High school graduate	0.98 (0.79, 1.21)	1.02 (0.58, 1.80)	1.00 (0.81, 1.24)	0.66 (0.34, 1.26)	0.87 (0.63, 1.20)	0.83 (0.32, 2.13)	0.79 (0.57, 1.10)	1.15 (0.38, 3.51)
Some college	1.30* (1.06, 1.61)	0.60 (0.34, 1.05)	1.49* (1.20, 1.85)	0.50 (0.24, 1.06)	1.24 (0.91, 1.69)	0.71 (0.27, 1.90)	1.35 (0.96, 1.89)	1.34 (0.38, 4.67)
College graduate	1.24 (0.97, 1.59)	0.44* (0.22, 0.88)	1.66* (1.30, 2.12)	0.73 (0.33, 1.62)	1.29 (0.95, 1.75)	0.39* (0.16, 0.98)	1.51* (1.03, 2.22)	0.43 (0.09, 2.10)
Annual household income, \$								
< 25 000 (Ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25 000–49 999	0.97 (0.83, 1.14)	0.89 (0.56, 1.40)	0.88 (0.73, 1.06)	0.90 (0.51, 1.58)	0.98 (0.78, 1.24)	0.48* (0.23, 0.97)	0.66* (0.51, 0.87)	0.40 (0.14, 1.12)
50 000–74 999	0.96 (0.77, 1.20)	0.91 (0.47, 1.76)	0.67* (0.51, 0.86)	0.36* (0.16, 0.81)	0.98 (0.75, 1.28)	0.43 (0.17, 1.07)	0.87 (0.61, 1.24)	0.98 (0.34, 2.81)
≥ 75 000	1.07 (0.85, 1.34)	0.43* (0.23, 0.81)	0.69* (0.53, 0.89)	0.30* (0.13, 0.70)	1.40* (1.10, 1.78)	0.25* (0.11, 0.60)	0.87 (0.62, 1.21)	0.12* (0.02, 0.61)
Health insurance								
No (Ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Yes	1.10 (0.92, 1.31)	0.88 (0.54, 1.44)	1.67* (1.35, 2.08)	2.36* (1.07, 5.21)	1.20 (0.92, 1.57)	1.16 (0.43, 3.13)	0.99 (0.78, 1.26)	1.14 (0.48, 2.74)
Born in the United States ^a								
No (Ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Yes	1.01 (0.79, 1.29)	1.20 (0.47, 3.05)	1.37* (1.14, 1.64)	0.89 (0.54, 1.45)	0.81* (0.67, 0.99)	0.62 (0.27, 1.45)	1.00	1.00
Hepatitis C risk factors (reference is “no”)								
Injection drug use	3.67* (2.25, 6.38)	8.05* (3.74, 17.33)	2.61* (1.38, 4.85)	22.61* (6.19, 82.55)	0.91 (0.33, 2.52)	2.28 (0.30, 17.16)	1.96 (0.81, 4.70)	4.43 (0.82, 23.95)
Blood transfusion before 1992	0.71 (0.45, 1.11)	1.24 (0.63, 2.43)	0.69 (0.42, 1.14)	1.82 (0.58, 5.73)	0.69 (0.41, 1.18)	0.82 (0.18, 3.68)	0.75 (0.31, 1.80)	0.41 (0.07, 2.44)
Blood transfusion outside the US	0.26* (0.11, 0.64)	0.10* (0.01, 0.84)	1.08 (0.53, 2.23)	4.34* (1.01, 18.76)	0.98 (0.54, 1.76)	2.44 (0.67, 8.98)	1.04 (0.17, 6.46)	1.00
Sexual contact with hepatitis positive person	1.52 (0.91, 2.55)	1.43 (0.63, 3.26)	1.99* (1.11, 3.56)	0.97 (0.25, 3.71)	1.33 (0.77, 2.31)	0.16 (0.02, 1.35)	1.31 (0.58, 2.99)	1.02 (0.25, 4.17)
Any of the above but unspecified	1.46 (0.86, 2.50)	1.76 (0.73, 4.26)	1.21 (0.61, 2.40)	3.43 (0.75, 15.72)	1.13 (0.53, 2.41)	0.80 (0.18, 3.65)	0.98 (0.34, 2.85)	2.65 (0.43, 16.4)

Note. AOR = adjusted odds ratio; CI = confidence interval; HCV = hepatitis C virus. The model is adjusted for all of the variables listed in this table in addition to language of interview for Hispanics and Asians only. HCV risk factor information was collected in 2010 only (n = 29 727). Therefore, the AOR and 95% CI correspond to the sample collected in 2010.

^aAlmost all American Indians/Alaska Natives were born in the United States; therefore, we did not include this variable in the model for this group.

*P < .05.

TABLE 4—Factors Associated With Access to Care and Treatment of Hepatitis C: Racial and Ethnic Approaches to Community Health Across the US Risk Factor Survey, 2009–2010

Variable	Currently Seeing a Physician for Hepatitis C Infection			Ever Took Medications for Hepatitis C Infection		
	Seeing Physician (n = 381), No. (%)	Not Seeing Physician (n = 454), No. (%)	AOR (95% CI)	Ever took Medications (n = 360), No. (%)	Never Took Medications (n = 484), No. (%)	AOR (95% CI)
Race/ethnicity						
Non-Hispanic Black (Ref)	177 (43.9)	226 (56.1)	1.00	164 (40.2)	243 (59.8)	1.00
Hispanic	125 (54.1)	106 (45.9)	1.14 (0.73, 1.79)	113 (48.5)	121 (51.5)	1.46 (0.95, 2.24)
Asian	45 (38.9)	70 (61.1)	0.53 (0.26, 1.05)	50 (42.7)	67 (57.3)	0.76 (0.40, 1.44)
American Indian/Alaska Native	34 (40.0)	52 (60.0)	1.36 (0.75, 2.47)	33 (38.3)	53 (61.7)	1.30 (0.72, 2.34)
Gender						
Female (Ref)	155 (45.2)	188 (54.8)	1.00	133 (38.4)	214 (61.6)	1.00
Male	226 (45.9)	267 (54.1)	1.09 (0.78, 1.52)	227 (45.7)	270 (54.3)	1.16 (0.84, 1.59)
Age, y						
18–34 (Ref)	27 (27.5)	71 (72.5)	1.00	27 (27.5)	72 (72.5)	1.00
35–44	45 (45.7)	54 (54.3)	3.17* (1.32, 7.63)	36 (36.3)	63 (63.7)	1.93 (0.83, 4.49)
45–54	118 (46.2)	137 (53.8)	3.91* (1.86, 8.21)	119 (46.4)	137 (53.6)	2.91* (1.44, 5.87)
55–64	151 (50.8)	146 (49.2)	4.58* (2.23, 9.42)	138 (45.9)	163 (54.1)	3.16* (1.57, 6.34)
≥ 65	41 (46.9)	46 (53.1)	3.59* (1.60, 8.05)	40 (45.2)	48 (54.8)	2.89* (1.32, 6.32)
Education level						
< high school (Ref)	105 (49.0)	109 (51.0)	1.00	93 (43.1)	123 (56.9)	1.00
High school graduate	127 (48.3)	135 (51.7)	1.21 (0.77, 1.90)	122 (46.0)	143 (54.0)	1.01 (0.66, 1.54)
Some college	110 (46.4)	127 (53.6)	1.15 (0.72, 1.84)	91 (38.6)	145 (61.4)	0.78 (0.50, 1.21)
College graduate	38 (32.1)	80 (67.9)	0.72 (0.39, 1.33)	52 (43.2)	68 (56.8)	0.66 (0.37, 1.15)
Annual household income, \$						
< 25 000 (Ref)	241 (47.0)	271 (53.0)	1.00	199 (38.4)	319 (61.6)	1.00
25 000–49 999	71 (42.8)	94 (57.2)	0.83 (0.54, 1.27)	76 (45.9)	89 (54.1)	1.27 (0.85, 1.91)
50 000–74 999	33 (49.8)	33 (50.2)	1.24 (0.67, 2.27)	34 (51.0)	33 (49.0)	1.86* (1.01, 3.43)
≥ 75 000	19 (33.8)	37 (66.2)	0.58 (0.30, 1.12)	32 (56.2)	25 (43.8)	2.20* (1.17, 4.15)
Health insurance						
No (Ref)	48 (29.2)	117 (70.8)	1.00	63 (37.9)	103 (62.1)	1.00
Yes	326 (50.2)	324 (49.8)	2.11* (1.29, 3.46)	290 (44.2)	366 (55.8)	0.94 (0.59, 1.49)
Born in the US						
No (Ref)	109 (54.3)	92 (45.7)	1.00	98 (49.0)	102 (51.0)	1.00
Yes	271 (42.9)	361 (57.1)	0.63 (0.36, 1.10)	261 (40.7)	380 (59.3)	0.69 (0.39, 1.23)
Time elapsed since hepatitis C diagnosis, y						
< 2 (Ref)	60 (65.2)	32 (34.8)	1.00	40 (43.6)	52 (56.4)	1.00
2–4	57 (44.6)	71 (55.4)	0.35* (0.17, 0.71)	45 (34.7)	85 (65.3)	0.55 (0.29, 1.04)
5–9	82 (40.7)	119 (59.3)	0.25* (0.13, 0.49)	87 (43.5)	113 (56.5)	0.77 (0.43, 1.39)
10–19	115 (46.6)	132 (53.4)	0.36* (0.19, 0.69)	96 (38.9)	152 (61.1)	0.64 (0.36, 1.12)
≥ 20	36 (30.7)	81 (69.3)	0.13* (0.06, 0.27)	55 (47.3)	62 (52.7)	0.79 (0.42, 1.46)

Note. AOR = adjusted odds ratio; CI = confidence interval; HCV = hepatitis C virus; Of those who reported HCV infection; the numbers do not add up to 859 because of missing responses; the model is adjusted for all of the variables listed in this table. **P* < .05.

outside the United States with regard to access to care and treatment.

DISCUSSION

This study is the first to our knowledge to assess the prevalence of hepatitis C testing, infection, and access to care in a large sample of racial/ethnic minorities in the United States and to evaluate their association with both socioeconomic and traditional hepatitis C risk factors. Findings revealed low testing rates across all racial/ethnic groups, notably among people reporting hepatitis C risk factors. In addition, higher hepatitis C infection rates were reported among non-Hispanic Blacks and Hispanics. Presence of risk factors, particularly injection drug use, was the main driver for having a hepatitis C test, yet overall almost 40% of people who reported a hepatitis C risk factor and 60% of Asians who reported injection drug use were not tested for hepatitis C, as recommended by the Centers for Disease Control and Prevention.¹⁹ Therefore, actual rates of HCV infection could be higher than reported because many people might have been unaware of their infection because they had not been tested. Lack of inquiry about HCV risk factors and suboptimal testing for hepatitis C infection have previously been documented in primary care.^{18,22–24} A study conducted in several clinics in Philadelphia showed that a history of injection drug use or blood transfusion was documented for only 12% and 2% of HCV patients, respectively; among those with a known risk factor, minorities were less likely to get tested for HCV than Whites (23% vs 35%; $P = .004$).¹⁸ Therefore, training and educating physicians to ask about hepatitis C risk factors and to test those at higher risk for infection is essential.

In addition, fewer than half of respondents with hepatitis C infection were being followed by a physician or had ever received medications for their hepatitis C infection. Physician and patient factors may play a role in low treatment rates among racial/ethnic minorities.^{15,16,25–29} Even when Black patients had the same characteristics as their White counterparts, including infection with the difficult-to-treat HCV genotype 1, physicians were more likely to initiate treatment with White patients.^{16,24,25,27} Our findings show that access to treatment and

care was mainly associated with availability of health insurance and higher income. Similar findings have been reported in previous studies, in which lack of health insurance and low household income played significant roles in the treatment of hepatitis C among racial/ethnic minorities.^{15–17} Moreover, people with hepatitis C infection have been found to have low rates of insurance coverage compared with those who are not infected, which might also explain lack of access to care.¹⁷ Delaying treatment for or not providing treatment to HCV-infected people ultimately lead to higher rates of end-stage liver disease and subsequent significant increases in health care costs, which have been projected to exceed \$10 billion in direct medical costs and \$70 billion in indirect costs between 2010 and 2019.^{11,30}

Demographic and socioeconomic factors played an important role in referral for hepatitis C testing and infection status despite the adjustment for hepatitis C risk factors. The most commonly reported age at first diagnosis of hepatitis C infection was 18 to 34 years for Hispanic, Asian, and AI/AN communities compared with 45 to 54 years for Black communities. Moreover, the highest prevalence rates of HCV infection were reported by Blacks, Hispanics, and Asians aged 55 to 64 years and AI/ANs aged 45 to 54 years, and we found a gradual increase in the risk for HCV infection with increased age. These findings suggest that testing people aged 45 to 64 years for hepatitis C irrespective of previous history of exposure to risk factors would probably help to detect most undiagnosed infections, initiate treatment, and prevent future complications and transmission. A seroprevalence study conducted among a cohort of AI/ANs living in Alaska reported the highest HCV seroprevalence among those aged 40 to 59 years,⁸ which was similar to findings among AI/AN respondents in our study who were not living in Alaska.

Two significant socioeconomic determinants for hepatitis C testing and infection were educational level and annual household income. Non-Hispanic Blacks, Hispanics, and AI/ANs with a college education were significantly more likely to get tested for hepatitis C and had lower risks for infection than those with less than a high school education. In addition, Hispanics, Asians, and AI/ANs with

an annual household income of \$75 000 or more were less likely to be infected with hepatitis C than were those with an income less than \$25 000. Health insurance was a significant determinant for HCV testing and infection only among Hispanics. These findings highlight the need to address socioeconomic determinants of health in interventions targeting hepatitis C, particularly in promoting testing among minorities of lower socioeconomic levels. The National Health and Nutrition Examination Survey IV also reported a higher prevalence of HCV infection among people of lower socioeconomic status in the overall US population;¹ however, similar to other previous studies, it did not adjust for risk factors of HCV infection.⁴

This study has several limitations. First, reliance on self-report and unavailability of serum specimens to ascertain infection or detect new infections could have led to recall or social desirability bias, and the prevalence of HCV infection and use of preventive services might have been under- or overestimated. However, the inclusion of such a large sample size would have been difficult in a serosurvey. Second, the cross-sectional design of this study did not allow us to draw causal inferences, and the lack of clinical data on medical comorbidities, liver function tests, and biopsy results as well as HCV genotypes precludes the identification of people who were ineligible for treatment because of their comorbidities. Because around 20% of people with hepatitis C clear their infection, we were also unable to identify people who were not eligible for treatment for this reason. Third, significant ethnic, cultural, and social diversity exists within any racial/ethnic minority population because minority populations are not homogeneous. For example, Hispanics encompass multiple diverse subpopulations (e.g., Mexicans, Puerto Ricans, Cubans, and Dominicans) and Asians include Native Hawaiian and Pacific Islanders in addition to other Asian groups (e.g., Chinese, Koreans, Vietnamese, Cambodians, and Filipinos). Finally, unavailability of a comparison group from a nonminority community precludes the study of racial/ethnic disparities in this sample. However, we compared our findings with those of other national surveys.

Despite these limitations, this study is the first to our knowledge assess hepatitis C testing,

infection, and linkage to care in a large sample of racial/ethnic minorities in the United States. Demographic and socioeconomic factors were significant determinants of HCV testing, infection, and linkage to care even after controlling for established risk factors of hepatitis C infection. HCV testing and prevention activities should be improved among people of minority race/ethnicity, particularly those of lower socioeconomic status, to reduce the racial/ethnic gaps in HCV infections and prevent significant increases in health care costs and increased mortality resulting from end-stage liver disease. The newly enacted Patient Protection and Affordable Health Care Act³¹ could facilitate access to care for infected people, which would ultimately decrease the projected increases in health care costs. ■

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Contributors

R. A. Tohme designed the study, analyzed the data, and drafted the article. J. Xing assisted with statistical analysis. Y. Liao helped conceptualize the study. S. D. Holmberg conceptualized the study and provided critical appraisal of the article. All authors helped to conceptualize ideas, interpret findings, and review drafts of the article.

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Human Participant Protection

This project was approved by the institutional review board of the Centers for Disease Control and Prevention.

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