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Testing for Hepatitis C Virus Infection Among Adults Aged ≥18 in the United States, 2013-2017

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Abstract

Objective: Approximately 2.4 million people in the United States are living with hepatitis C virus (HCV) infection. The objective of our study was to describe demographic and socioeconomic characteristics, liver disease–related risk factors, and modifiable health behaviors associated with self-reported testing for HCV infection among adults.

Methods: Using data on adult respondents aged ≥18 from the 2013-2017 National Health Interview Survey, we summarized descriptive data on sociodemographic characteristics and liver disease–related risk factors and stratified data by educational attainment. We used weighted logistic regression to examine predictors of HCV testing.

Results: During the study period, 11.7% (95% CI, 11.5%-12.0%) of adults reported ever being tested for HCV infection. Testing was higher in 2017 than in 2013 (adjusted odds ratio [aOR] = 1.27; 95% CI, 1.18-1.36). Adults with ≥some college were significantly more likely to report being tested (aOR = 1.60; 95% CI, 1.52-1.69) than adults with ≤high school education. Among adults with ≤high school education (but not adults with ≥some college), those who did not have health insurance were less likely than those with private health insurance (aOR = 0.78; 95% CI, 0.68-0.89) to get tested, and non–US-born adults were less likely than US-born adults to get tested (aOR = 0.77; 95% CI, 0.68-0.87).

Conclusions: Rates of self-reported HCV testing increased from 2013 to 2017, but testing rates remained low. Demographic characteristics, health behaviors, and liver disease–related risk factors may affect HCV testing rates among adults. HCV testing must increase to achieve hepatitis C elimination targets.

Keywords

hepatitis C, hepatitis C virus (HCV) infection, viral hepatitis, health care use, baby boomers

Hepatitis C adversely affects adults in the United States, causing substantial mortality despite availability of curative treatments.[1-4] Approximately 2.4 million people (1.0% of the US adult population) are living with chronic hepatitis C virus (HCV) infection.[1,5] HCV is transmitted by exposure to infectious blood or bodily fluids,[1] and chronic infection with HCV can lead to death and serious life-threatening liver disease.[6-12] Injection drug use is the largest risk factor for acquiring HCV infection in the United States.[1] In the United States in 2018, 15 713 people died of HCV-related illnesses.[1] From 2017 to 2018, the number of new cases of HCV infection in the United States rose by 13.0%; adults aged 20-39 had the highest rate of new HCV infection, coincident with increases in injection drug use.[1,13] Thus, identifying people living with HCV infection is critical to eliminating it as a public health threat in the United States.[14-16] Among adults, HCV testing has evolved from a risk-based strategy to a universal testing strategy.

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Since 1998, the Centers for Disease Control and Prevention (CDC) has recommended HCV testing for people at increased risk for HCV infection.[17,18] In 1999, HCV testing was also recommended for people infected with HIV.[19] In 2012, CDC and the US Preventive Services Task Force (USPSTF) expanded HCV testing recommendations to include onetime testing for people born during 1945-1965.[20,21] In 2020, CDC recommended universal onetime HCV testing for adults aged ≥18 and pregnant people.[22] Despite these recommendations, national testing rates among people born during 1945-1965, who account for most people living with chronic HCV infection, are low.[23] Only half of people in the United States with HCV infection have been diagnosed and are aware of their HCV infection.[24] An opportunity exists to treat and cure HCV infection—if testing is expanded—so that more people know their status and access to care is made more widely available.

An analysis of factors that affect whether people receive an HCV test can inform public health strategies to eliminate hepatitis C in this country. Health insurance, educational attainment, poverty status, social support (eg, marital status), country of origin, and other environmental factors may play a role in HCV testing and awareness among adults.[23-33] Because testing and treatment are cost-effective, can extend quality of life, and reduce transmission to others, it is imperative to examine the facilitators and barriers to testing.[34,35] Only a few studies have used the National Health Interview Survey (NHIS) to assess the social, economic, and other factors associated with HCV testing by education status among adults aged ≥18.[26-29] The objective of our study was to describe the demographic and socioeconomic characteristics, liver disease–related risk factors, and modifiable health behaviors associated with self-reported HCV testing among adults, stratified by educational attainment.

Methods

We obtained data for 2013-2017 from the NHIS, an annual survey conducted by the National Center for Health Statistics at CDC. The survey is a nationally representative, cross-sectional household interview of civilian, noninstitutionalized people in the United States.[36] Conducted through computer-assisted personal interviewing, NHIS uses geographically clustered sampling techniques to select each household, yielding approximately 27 000 sampled adults per year. For this study, we used data obtained from the Sample Adult Interview, the Imputed Adult Income File, and the Person File. Methodologic details, protocols, and research ethics review board approval are described elsewhere.[36] We restricted all analyses to adults aged ≥18.

HCV Testing

The primary outcome variable was HCV testing, defined by using the question, "Ever had a blood test for hepatitis C?" The response options were yes, no, refused, not ascertained, or don't know. We created a single yes/no variable, where no included both no and don't know. We excluded refusals and responses that were not ascertained. We analyzed data for 2013-2017, when this question was asked.

Independent Variables

We included 5 demographic factors in our analyses: age (year of birth); sex (male or female); race/ethnicity (non-Hispanic White or "other," which included Hispanic, non-Hispanic Black, American Indian/Alaska Native, Asian, and multiple races); marital status (currently married, single/never married, and separated/widowed/divorced); and place of birth (United States, not United States). We classified respondents into 3 birth cohorts: those born before 1945, those born during 1945-1965, and those born after 1965. Respondents born during 1945-1965 were the only birth cohort that was recommended to be universally tested for HCV infection during our study period. For the purposes of our study, this age group will be referred to as the birth cohort.

We assessed the association of HCV testing with 3 socioeconomic factors: education, federal poverty level (FPL), and health insurance type. We measured education by highest degree attained. The NHIS question was, "What is the highest level of school completed or the highest degree received?" We categorized these data into high level of education (≥some college) and low level of education (≤high school graduate). To measure income, we estimated the poverty–income ratio, which is the ratio of annual family income to the appropriate FPL. We classified respondents into 2 groups: poverty–income ratio ≤100% FPL or poverty–income ratio >100% FPL. We also categorized respondents into 5 mutually exclusive health insurance types: private health insurance; Medicaid, Medicare, or both; military insurance; other; and uninsured.

We also assessed associations between testing and 2 modifiable health behaviors that are associated with liver disease: smoking status (current smoker, former smoker, never smoker) and alcohol drinking status (lifetime abstainer, former drinker, current nonexcessive drinker, current excessive drinker). Smoking status was determined by 2 questions: "Have you smoked at least 100 cigarettes in your entire life?" and "Do you now smoke cigarettes every day, some days, or not at all?" For alcohol drinking status, a lifetime abstainer was defined as not having >12 alcoholic drinks in a lifetime. Former drinkers were defined as those who indicated they had >12 alcoholic drinks in their lifetime but had none in the past year. Current nonexcessive drinkers were defined as those who had >12 alcoholic drinks in their lifetime, and for male drinkers, had on average <15 drinks per week in the past year; for female drinkers, on average had <8 alcoholic drinks per week in the past year. Current excessive

drinkers were defined as those who drink, on average, more than current nonexcessive drinkers in the past year.

We also examined body mass index (BMI), another known risk factor for liver-related disease. NHIS uses 2 questions to ascertain BMI ("How tall are you without shoes?" and "How much do you weigh without shoes?") and calculates BMI by dividing weight in kilograms by height in meters squared (kg/m^2). We categorized BMI data from the NHIS dataset into 2 categories: normal/underweight (<25.0 kg/m^2) and overweight/obese (≥25.0 kg/m^2).

Statistical Analysis

The NHIS uses a multistage probability design to obtain a sample; this design involves stratification, clustering, and oversampling. Accounting for the complex sampling design, we used weighted logistic regression to identify potential factors associated with HCV testing prevalence. We selected predictors a priori that we hypothesized might be associated with HCV testing prevalence. These predictors included demographic and socioeconomic characteristics, liver disease–related risk factors, and modifiable health behaviors. We did not set any criteria for removing variables from the models, given that we selected variables on the basis of plausible associations. After the initial analyses, we performed post hoc analyses for educational attainment for 2 reasons: (1) this factor was strongly associated with testing and (2) the factor is critical to designing messaging for the promotion of testing among groups at high risk of having HCV infection. We stratified our analyses by educational attainment (≥some college vs ≤high school graduate) to assess associations within each level. We calculated adjusted odds ratios (aORs), 95% CIs, and *P* values; we considered $P < .05$ to be significant. We used the *R* computing language version 3.35-1 (R Foundation for Statistical Computing) for all analyses.

Results

Based on weighted averages, 11.7% (95% CI, 11.5%-12.0%) of respondents reported receiving an HCV test (Table 1). HCV testing rates increased from 10.6% (95% CI, 10.1%-11.1%) in 2013 to 13.6% (95% CI, 13.0%-14.2%) in 2017 overall and among the birth cohort from 11.3% (95% CI, 10.6%-12.1%) to 15.8% (95% CI, 14.8%-16.7%) (Figure). Among respondents with ≥some college, 13.4% (95% CI, 13.1%-13.7%) reported testing; among respondents with ≤high school education, 9.1% (95% CI, 8.7%-9.5%) reported testing.

In the multivariate analysis (Table 2), compared with the birth cohort, respondents born before 1945 were less likely to receive an HCV test (aOR = 0.32; 95% CI, 0.29-0.35) and respondents born after 1965 were more likely to be tested (aOR = 1.19; 95% CI, 1.13-1.25). By educational status, respondents with ≥some college were more likely than

Table 1. Weighted descriptive statistics for self-reported HCV testing among adults aged ≥18, United States, 2013-2017[a]

Characteristic	Weighted estimates	
	Sample size, no.	% (95% CI)
Received an HCV test	27 933 983	11.7 (11.5-12.0)
Survey year		
2013	46 680 748	10.6 (10.1-11.1)
2014	47 093 859	10.9 (10.3-11.4)
2015	47 514 085	11.4 (10.8-11.9)
2016	48 236 246	12.1 (11.6-12.7)
2017	48 617 364	13.6 (13.0-14.2)
Birth year		
Born after 1965	130 983 282	12.6 (12.3-13.0)
Born 1945-1965	79 490 134	12.8 (12.4-13.2)
Born before 1945	27 668 885	4.5 (4.1-4.8)
Sex		
Female	123 355 575	11.2 (10.9-11.5)
Male	114 786 726	12.3 (11.9-12.6)
Race/ethnicity		
Non-Hispanic White	156 329 610	12.2 (11.9-12.5)
Other[b]	79 531 402	10.6 (10.2-11.0)
Marital status		
Married	126 250 466	11.4 (11.1-11.7)
Single	64 659 406	11.2 (10.8-11.6)
Separated/ widowed/ divorced	46 800 887	13.3 (12.8-13.8)
Education		
≤High school graduate	89 912 380	9.1 (8.7-9.5)
≥Some college	147 163 014	13.4 (13.1-13.7)
Federal poverty level		
≤100% poverty–income ratio	30 820 340	12.3 (11.7-12.9)
>100% poverty–income ratio	207 321 961	11.7 (11.4-11.9)
Health insurance		
Private	152 663 562	11.5 (11.2-11.8)
Medicaid/Medicare/ both	48 620 540	12.1 (11.6-12.6)
Military	4 683 655	23.9 (22.1-25.8)
Other	2 594 544	15.2 (12.9-17.4)
None	28 320 288	10.1 (9.5-10.6)
Place of birth		
United States	196 294 899	12.3 (12.0-12.5)
Not United States	41 661 068	9.3 (8.8-9.8)
Smoking status[c]		
Never	147 556 666	9.8 (9.6-10.1)
Former	52 638 352	13.2 (12.8-13.7)
Current	37 643 453	17.1 (16.5-17.8)
Alcohol consumption[d]		
Abstain	48 052 912	6.9 (6.5-7.3)
Former drinker	32 676 126	14.2 (13.5-14.8)

(*continued*)

Table 1. (continued)

Characteristic	Weighted estimates	
	Sample size, no.	% (95% CI)
Current drinker	142 433 183	12.6 (12.3-12.9)
Current excessive drinker	12 284 844	14.0 (13.0-15.0)
Body mass index		
Normal/ underweight (<25.0 kg/m^2)	82 855 506	10.8 (10.4-11.2)
Overweight/obese (≥25.0 kg/m^2)	148 0 792	12.4 (12.1-12.7)

Abbreviation: HCV, hepatitis C virus.
[a]Data source: Centers for Disease Control and Prevention.[36]
[b]Includes Hispanic, non-Hispanic Black, American Indian/Alaska Native, Asian, and multiple races.
[c]Smoking status determined by 2 questions: "Have you smoked at least 100 cigarettes in your entire life?" and "Do you now smoke cigarettes every day, some days, or not at all?" Never smokers were defined as those who said no to both questions. Former smokers were defined as those who said yes to the first question and no to the second question. Current smokers were defined as those who said yes to both questions.
[d]Alcohol status defined in the following manner: lifetime abstainer was defined as not having >12 alcoholic drinks in a lifetime. Former drinkers were defined as those who indicated they had >12 alcoholic drinks in their lifetime but had none in the past year. Current nonexcessive drinkers were defined as those who had >12 alcoholic drinks in their lifetime and, for male drinkers, had on average <15 drinks per week in the past year; for female drinkers, on average had <8 alcoholic drinks per week in the past year. Current excessive drinkers were defined as those who drink, on average, more than current nonexcessive drinkers in the past year.

respondents with ≤high school education to be tested (aOR = 1.60; 95% CI, 1.52-1.69).

Among demographic factors, in unadjusted analyses, all covariates except for place of birth were significantly associated with rates of HCV testing. After adjustment, respondents with Medicaid, Medicare, or both; military insurance; and other health insurance were more likely than respondents with private health insurance to be tested. Respondents with military health insurance were substantially more likely than respondents with private health insurance to be tested (aOR = 2.11; 95% CI, 1.90-2.34). Similarly, respondents enrolled in Medicaid, Medicare, or both had higher rates of HCV testing than respondents with private health insurance (aOR = 1.30; 95% CI, 1.23-1.38). Uninsured respondents were less likely than respondents with private health insurance to be tested (aOR = 0.87; 95% CI, 0.80-0.94).

Respondents who reported smoking and excessive drinking were more likely than respondents who did not engage in these behaviors to receive an HCV test. Former smokers (aOR = 1.37; 95% CI, 1.30-1.44) and current smokers (aOR = 1.75; 95% CI, 1.65-1.86) were more likely than never smokers to be tested. Former drinkers (aOR = 1.83; 95% CI, 1.68-1.99), current drinkers (aOR = 1.45; 95% CI, 1.35-1.55), and current excessive drinkers (aOR = 1.45; 95% CI, 1.29-1.63) were more likely than lifetime abstainers to be tested. Finally, respondents who were overweight or obese were more likely than respondents who were normal weight or underweight to be tested (aOR = 1.13; 95% CI, 1.07-1.19).

We found differences in unadjusted prevalence estimates by survey year for both levels of educational attainment

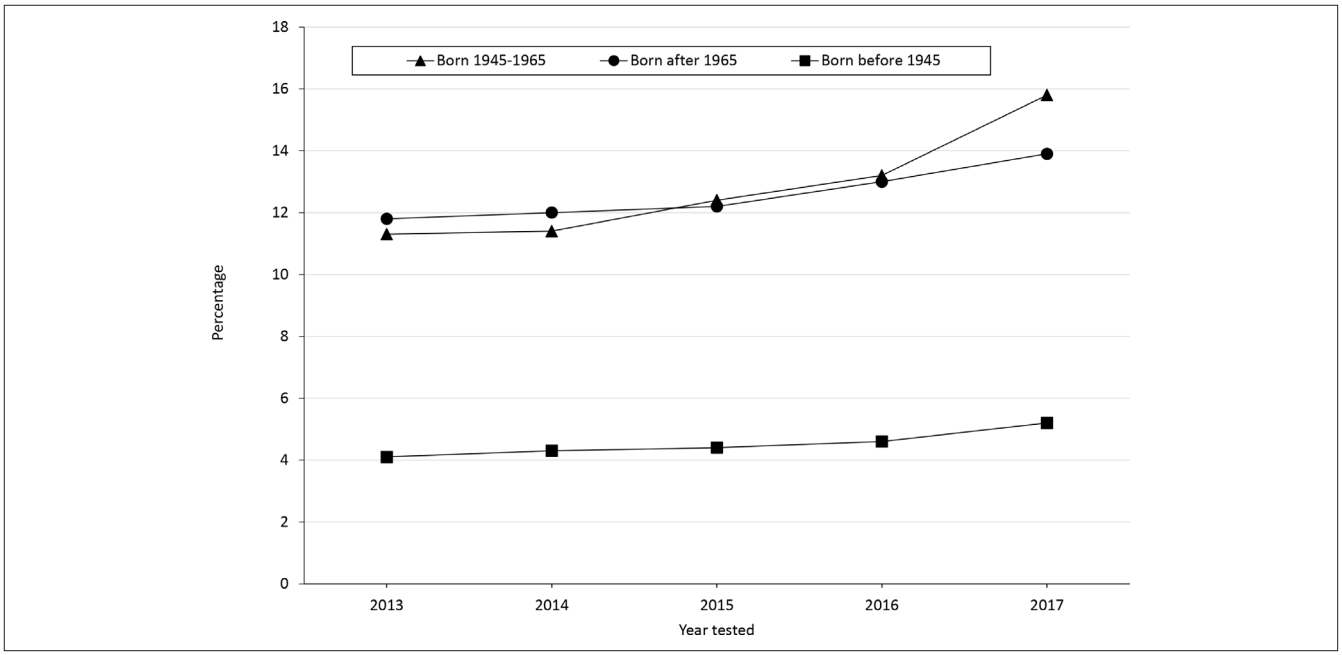

Figure. Percentage of adults aged ≥18 who self-reported being tested for hepatitis C virus infection, by birth cohort and year, United States, 2013-2017. Data source: Centers for Disease Control and Prevention.[36]

Table 2. Weighted adjusted odds ratios for self-reported HCV testing among adults aged ≥18, United States, 2013-2017[a]

Characteristic	Weighted estimates	
	Adjusted odds ratio (95% CI)	*P* value[b]
Survey year		
2013	1 [Reference]	
2014	1.03 (0.95-1.11)	.46
2015	1.06 (0.98-1.14)	.15
2016	1.10 (1.03-1.19)	.007[c]
2017	1.27 (1.18-1.36)	<.001
Birth year		
Born 1945-1965	1 [Reference]	
Born after 1965	1.19 (1.13-1.25)	<.001
Born before 1945	0.32 (0.29-0.35)	<.001
Sex		
Female	1 [Reference]	
Male	1.06 (1.01-1.11)	.01[c]
Race/ethnicity		
Non-Hispanic White	1 [Reference]	
Other[d]	0.98 (0.93-1.03)	.47
Marital status		
Married	1 [Reference]	
Single	0.91 (0.86-0.96)	<.001[c]
Separated/widowed/ divorced	1.26 (1.20-1.33)	<.001
Education		
≤High school graduate	1 [Reference]	
≥Some college	1.60 (1.52-1.69)	<.001
Federal poverty level		
≤100% poverty–income ratio	1 [Reference]	
>100% poverty–income ratio	0.92 (0.86-0.98)	.009[c]
Health insurance		
Private	1 [Reference]	
Medicaid/Medicare/both	1.30 (1.23-1.38)	<.001
Military	2.11 (1.90-2.34)	<.001
Other	1.43 (1.19-1.72)	<.001
None	0.87 (0.80-0.94)	<.001
Place of birth		
United States	1 [Reference]	
Not United States	0.89 (0.83-0.96)	.002[c]
Smoking status[e]		
Never	1 [Reference]	
Former	1.37 (1.30-1.44)	<.001
Current	1.75 (1.65-1.86)	<.001
Alcohol consumption[f]		
Lifetime abstainer	1 [Reference]	
Former drinker	1.83 (1.68-1.99)	<.001
Current drinker	1.45 (1.35-1.55)	<.001
Current excessive drinker	1.45 (1.29-1.63)	<.001
Body mass index		
Normal/underweight (<25.0 kg/m^2)	1 [Reference]	
Overweight/obese (≥25.0 kg/m^2)	1.13 (1.07-1.19)	<.001

Abbreviation: HCV, hepatitis C virus.
[a]Data source: Centers for Disease Control and Prevention.[36]
[b]$P < .05$ was considered significant.
[c]Estimates considered unstable because the relative SE was ≥30% of the estimate.
[d]Includes Hispanic, non-Hispanic Black, American Indian/Alaska Native, Asian, and multiple races.
[e]Smoking status determined by 2 questions: "Have you smoked at least 100 cigarettes in your entire life?" and "Do you now smoke cigarettes every day, some days, or not at all?" Never smokers were defined as those who said no to both questions. Former smokers were defined as those who said yes to the first question and no to the second question. Current smokers were defined as those who said yes to both questions.
[f]Alcohol status defined in the following manner: lifetime abstainer was defined as not having >12 alcoholic drinks in a lifetime. Former drinkers were defined as those who indicated they had >12 alcoholic drinks in their lifetime but had none in the past year. Current nonexcessive drinkers were defined as those who had >12 alcoholic drinks in their lifetime and, for male drinkers, had on average <15 drinks per week in the past year; for female drinkers, on average had <8 alcoholic drinks per week in the past year. Current excessive drinkers were defined as those who drink, on average, more than current nonexcessive drinkers in the past year.

(Table 3). Respondents born before 1945 were significantly less likely than the birth cohort to be tested, but we found no differences between the birth cohort and respondents born after 1965 for either level of educational attainment. Among those with ≤high school education, respondents who were not non-Hispanic White were less likely than non-Hispanic White respondents to get tested. Among respondents who did not have health insurance, 7.5% (95% CI, 6.9%-8.1%) of respondents with ≤high school education reported being tested, compared with 13.9% (95% CI, 12.9%-14.9%) of respondents with ≥some college. In addition, among non–US-born respondents, the percentage of respondents who reported being tested was lower in the group with ≤high school education (6.1%; 95% CI, 5.5%-6.7%) than in the group with ≥some college (12.4%; 95% CI, 11.6%-13.1%).

After adjustment for analyses stratified by educational attainment (Table 4), among respondents with ≤high school education, we found significant differences by survey year, birth year, marital status, poverty status, health insurance type, place of birth, smoking status, drinking status, and BMI. Respondents with ≤high school education were more likely to report HCV testing in 2017 than in 2013 (aOR =

Table 3. Descriptive statistics for self-reported HCV testing stratified by education among adults aged ≥18, United States, 2013-2017[a]

	Weighted estimates			
	≤High school graduate		≥Some college	
Characteristic	**Sample size, no.**	**% (95% CI)**	**Sample size, no.**	**% (95% CI)**
Received an HCV test	8 186 633	9.1 (8.7-9.5)	19 681 742	13.4 (13.1-13.7)
Survey year				
2013	18 490 363	8.2 (7.6-8.9)	27 981 878	12.2 (11.6-12.9)
2014	18 406 349	8.1 (7.3-8.9)	28 446 963	12.7 (12.0-13.3)
2015	17 652 050	9.1 (8.3-9.8)	29 616 983	12.8 (12.1-13.4)
2016	17 908 193	9.7 (9.0-10.4)	30 142 707	13.6 (13.0-14.3)
2017	17 455 425	10.5 (9.7-11.3)	30 974 482	15.4 (14.7-16.1)
Birth year				
Born after 1965	46 099 059	10.1 (9.5-10.7)	84 427 474	14.0 (13.6-14.4)
Born 1945-1965	29 683 895	10.1 (9.6-10.7)	49 430 968	14.5 (14.0-15.0)
Born before 1945	14 129 426	3.8 (3.3-4.2)	13 304 572	5.3 (4.8-5.8)
Sex				
Female	45 057 509	8.7 (8.3-9.2)	77 771 924	12.7 (12.3-13.1)
Male	44 854 871	9.5 (9.0-10.0)	69 391 090	14.2 (13.7-14.6)
Race/ethnicity				
Non-Hispanic White	51 258 802	9.9 (9.4-10.5)	104 579 612	13.4 (13.0-13.7)
Other[b]	37 596 925	7.9 (7.4-8.4)	41 367 925	13.2 (12.6-13.8)
Marital status				
Married	42 930 726	8.5 (8.1-8.9)	82 820 904	13.0 (12.6-13.4)
Single	25 616 331	9.2 (8.5-9.9)	38 794 842	12.5 (12.0-13.0)
Separated/widowed/ divorced	21 218 489	10.2 (9.6-10.8)	25 291 458	16.0 (15.4-16.6)
Federal poverty level				
≤100% poverty–income ratio	18 536 509	10.7 (9.9-11.4)	12 017 074	14.9 (13.9-15.9)
>100% poverty–income ratio	71 375 871	8.7 (8.3-9.1)	135 145 940	13.2 (12.9-13.6)
Health insurance				
Private	42 500 169	8.4 (7.9-8.9)	109 781 042	12.7 (12.4-13.1)
Medicaid/Medicare/both	27 443 443	10.5 (9.9-11.1)	20 791 058	14.4 (13.7-15.2)
Military	1 287 489	22.5 (18.4-26.5)	3 386 354	24.5 (22.5-26.6)
Other	1 321 140	10.3 (7.7-12.9)	1 256 033	20.5 (16.8-24.2)
None	16 771 364	7.5 (6.9-8.1)	11 368 012	13.9 (12.9-14.9)
Place of birth				
United States	70 152 993	10.0 (9.5-10.4)	125 523 319	13.6 (13.2-13.9)
Not United States	19 696 059	6.1 (5.5-6.7)	21 540 936	12.4 (11.6-13.1)
Smoking status[c]				
Never	49 450 698	6.3 (5.9-6.7)	97 491 937	11.7 (11.3-12.0)
Former	20 078 211	10.3 (9.6-10.9)	32 323 025	15.1 (14.5-15.7)
Current	20 229 016	14.9 (14.0-15.8)	17 223 089	19.8 (18.9-20.7)
Alcohol consumption[d]				
Abstain	24 777 362	5.4 (4.9-5.9)	22 889 796	8.7 (8.1-9.3)
Former drinker	16 290 412	11.6 (10.8-12.4)	16 201 820	16.8 (15.9-17.7)
Current drinker	43 306 797	10.0 (9.4-10.5)	98 731 339	13.8 (13.5-14.2)
Current excessive drinker	4 282 540	12.8 (11.2-14.5)	7 971 077	14.6 (13.3-15.9)

(*continued*)

Table 3. (continued)

Characteristic	Weighted estimates			
	≤High school graduate		≥Some college	
	Sample size, no.	% (95% CI)	Sample size, no.	% (95% CI)
Body mass index				
Normal/underweight (<25.0 kg/m^2)	28 313 497	8.6 (8.0-9.2)	54 186 538	12.0 (11.5-12.5)
Overweight/obese (≥25.0 kg/m^2)	58 829 090	9.5 (9.0-9.9)	89 212 973	14.4 (13.9-14.8)

Abbreviation: HCV, hepatitis C virus.
[a]Data source: Centers for Disease Control and Prevention.[36]
[b]Includes Hispanic, non-Hispanic Black, American Indian/Alaska Native, Asian, and multiple races.
[c]Smoking status determined by 2 questions: "Have you smoked at least 100 cigarettes in your entire life?" and "Do you now smoke cigarettes every day, some days, or not at all?" Never smokers were defined as those who said no to both questions. Former smokers were defined as those who said yes to the first question and no to the second question. Current smokers were defined as those who said yes to both questions.
[d]Alcohol status defined in the following manner: lifetime abstainer was defined as not having >12 alcoholic drinks in a lifetime. Former drinkers were defined as those who indicated they had >12 alcoholic drinks in their lifetime but had none in the past year. Current nonexcessive drinkers were defined as those who had >12 alcoholic drinks in their lifetime and, for male drinkers, had on average <15 drinks per week in the past year; for female drinkers, on average had <8 alcoholic drinks per week in the past year. Current excessive drinkers were defined as those who drink, on average, more than current nonexcessive drinkers in the past year.

1.26; 95% CI, 1.10-1.43). Compared with the birth cohort, respondents born before 1945 were less likely to report testing (aOR = 0.34; 95% CI, 0.29-0.39) and respondents born after 1965 were more likely to report testing (aOR = 1.27; 95% CI, 1.15-1.41). Respondents who were separated, widowed, or divorced were more likely than married respondents to report testing (aOR = 1.20; 95% CI, 1.10-1.32). Respondents with a poverty–income ratio >100% FPL were less likely than respondents with a poverty–income ratio ≤100% FPL to get tested. Respondents with military health insurance were more likely than respondents with private health insurance to report testing (aOR = 2.65; 95% CI, 2.11-3.32). In addition, respondents enrolled in Medicaid, Medicare, or both were more likely than respondents with private health insurance to report testing (aOR = 1.35; 95% CI, 1.22-1.50). Uninsured respondents were less likely than respondents with private health insurance to be tested (aOR = 0.78; 95% CI, 0.68-0.89). Non–US-born respondents were less likely than US-born respondents to report testing (aOR = 0.77; 95% CI, 0.68-0.87). For smoking and alcohol use, effect sizes were similar to effect sizes for the overall sample. The difference by BMI status was not a stable estimate because the relative SE was >30%.

Among respondents with ≥some college, we found several differences relative to the group with ≤high school education. Respondents who were single were less likely than respondents who were separated, widowed, or divorced to report HCV testing. We found no difference by poverty–income ratio. In addition, compared with respondents with private health insurance, respondents with "other" health insurance were more likely to report testing, whereas uninsured respondents were not less likely to get tested. Finally, the testing rates of non–US-born respondents did not differ from the testing rates of US-born respondents. Smoking status, drinking status, and BMI were all significant predictors in the expected direction.

Discussion

Our findings demonstrated significant increases in self-reported HCV testing rates from 2013 to 2017. However, overall self-reported testing rates were relatively low, approximately 12%. On a positive note, these self-reported testing rates increased more among the birth cohort, for whom universal testing is recommended, than among the other 2 groups. HCV testing rates among people born after 1965 were on average higher than the rates among the birth cohort, whereas rates among people born before 1945 were lower than among the birth cohort. The overall low rates of testing are consistent with findings of other studies showing late diagnosis and limited testing among people in the birth cohort and other age cohorts.[26-29,37,38] Low testing rates and late diagnosis among the birth cohort may also be the result of lack of awareness about hepatitis C.[25] Thus, educational campaigns and strategies that promote HCV testing may be warranted.

We found large differences in testing rates by educational attainment. HCV testing also varied by race/ethnicity and place of birth, with lower rates of testing among non–US-born people than among US-born people. Similar results have been reported in other studies.[26-29,37,38] We also found that health insurance played an important role in testing differences. Respondents with public health insurance were tested at higher rates than respondents with private health insurance, and respondents without health insurance were tested at lower rates than respondents with "other" health insurance. Future research should be

Table 4. Weighted adjusted odds ratios for self-reported HCV testing stratified by education among adults aged ≥18, United States, 2013-2017[a]

	Weighted estimates			
	≤High school graduate		≥Some college	
Characteristic	**Adjusted odds ratio (95% CI)**	***P* value[b]**	**Adjusted odds ratio (95% CI)**	***P* value[b]**
Survey year				
2013	1 [Reference]		1 [Reference]	
2014	0.97 (0.85-1.12)	.71	1.06 (0.97-1.15)	.23
2015	1.09 (0.95-1.24)	.21	1.05 (0.96-1.14)	.30
2016	1.13 (1.00-1.29)	.06	1.10 (1.01-1.19)	.03[c]
2017	1.26 (1.10-1.43)	<.001	1.28 (1.17-1.39)	<.001
Birth year				
Born 1945-1965	1 [Reference]		1 [Reference]	
Born after 1965	1.27 (1.15-1.41)	<.001	1.16 (1.09-1.23)	<.001
Born before 1945	0.34 (0.29-0.39)	<.001	0.31 (0.28-0.35)	<.001
Sex				
Female	1 [Reference]		1 [Reference]	
Male	0.97 (0.90-1.05)	.42	1.09 (1.04-1.15)	<.001
Race/ethnicity				
Non-Hispanic White	1 [Reference]		1 [Reference]	
Other[d]	0.94 (0.85-1.03)	.19	1.01 (0.94-1.08)	.81
Marital status				
Married	1 [Reference]		1 [Reference]	
Single	0.95 (0.85-1.05)	.30	0.90 (0.84-0.95)	<.001
Separated/widowed/divorced	1.20 (1.10-1.32)	<.001	1.29 (1.21-1.38)	<.001
Federal poverty level				
≤100% poverty–income ratio	1 [Reference]		1 [Reference]	
>100% poverty–income ratio	0.85 (0.78-0.94)	.002	0.97 (0.89-1.06)	.50
Health insurance				
Private	1 [Reference]		1 [Reference]	
Medicaid/Medicare/both	1.35 (1.22-1.50)	<.001	1.25 (1.16-1.35)	<.001
Military	2.65 (2.11-3.32)	<.001	1.96 (1.74-2.21)	<.001
Other	1.12 (0.84-1.49)	.45	1.70 (1.34-2.14)	<.001
None	0.78 (0.68-0.89)	<.001	0.98 (0.89-1.08)	.72
Place of birth				
United States	1 [Reference]		1 [Reference]	
Not United States	0.77 (0.68-0.87)	<.001	0.98 (0.90-1.07)	.68
Smoking status[e]				
Never	1 [Reference]		1 [Reference]	
Former	1.56 (1.40-1.73)	<.001	1.30 (1.22-1.39)	<.001
Current	1.98 (1.77-2.20)	<.001	1.61 (1.50-1.72)	<.001
Alcohol consumption[f]				
Abstainer	1 [Reference]		1 [Reference]	
Former drinker	1.85 (1.63-2.11)	<.001	1.82 (1.64-2.03)	<.001
Current drinker	1.49 (1.33-1.67)	<.001	1.43 (1.31-1.56)	<.001
Current excessive drinker	1.64 (1.36-1.99)	<.001	1.39 (1.21-1.59)	<.001
Body mass index				
Normal/underweight (<25.0 kg/m^2)	1 [Reference]		1 [Reference]	
Overweight/obese (≥25.0 kg/m^2)	1.10 (1.01-1.20)	.033[c]	1.14 (1.07-1.22)	<.001

Abbreviation: HCV, hepatitis C virus.
[a]Data source: Centers for Disease Control and Prevention.[36]
[b]*P* < .05 was considered significant.
[c]Estimates considered unstable because the relative SE was ≥30% of the estimate.
[d]Includes Hispanic, non-Hispanic Black, American Indian/Alaska Native, Asian, and multiple races.
[e]Smoking status determined by 2 questions: "Have you smoked at least 100 cigarettes in your entire life?" and "Do you now smoke cigarettes every day, some days, or not at all?" Never smokers were defined as those who said no to both questions. Former smokers were defined as those who said yes to the first question and no to the second question. Current smokers were defined as those who said yes to both questions.
[f]Alcohol status defined in the following manner: lifetime abstainer was defined as not having >12 alcoholic drinks in a lifetime. Former drinkers were defined as those who indicated they had >12 alcoholic drinks in their lifetime but had none in the past year. Current nonexcessive drinkers were defined as those who had >12 alcoholic drinks in their lifetime and, for male drinkers, had on average <15 drinks per week in the past year; for female drinkers, on average had <8 alcoholic drinks per week in the past year. Current excessive drinkers were defined as those who drink, on average, more than current nonexcessive drinkers in the past year.

conducted with the goal of developing interventions that increase HCV testing among groups that have low rates of HCV testing. When we stratified our analyses by education, we found that health insurance status was an important predictor of testing. Being uninsured was a significant predictor only for the group with ≤high school education. Together, our results suggest that education and other social determinants of health are affecting whether people are tested for HCV infection.

We found significant differences in HCV testing among modifiable health behaviors. Smoking and drinking excessive amounts of alcohol were associated with higher testing rates; this result might be expected, because people who have these behaviors may have more interactions with health care providers and, therefore, more opportunities to test, compared with people who do not smoke or drink excessively. Furthermore, obesity and excessive alcohol use can adversely affect the liver and result in laboratory findings that may prompt testing for viral hepatitis, including hepatitis C.

Future research and additional resources need to be directed toward examining how public health strategies, interventions, and policies could increase testing rates for HCV infection in the United States. Furthermore, research should be conducted to assess barriers to HCV testing. This research could include evaluation of physicians' knowledge and awareness of CDC's and USPSTF's recent expansion of HCV testing recommendation to all adults aged ≥18.[22,39,40] Along with research, opportunities exist to improve health care provider education about HCV infection and the care and treatment of patients with the disease. In a 2018 study, health care providers reported limited knowledge about whom to test and how to discuss testing with their patients.[41] Offering a more detailed curriculum on hepatitis C during medical or nursing school training, continuing education opportunities for hepatitis C and patient consultation techniques, and ongoing testing campaigns can help to promote HCV testing. To encourage people to get tested for HCV infection, CDC has conducted national promotional campaigns targeted toward all adults with messages about getting tested. Other sectors outside the health care sector, such as education, could consider the Health in All Policies approach, which promotes the inclusion of health policies designed to improve health across all communities and for all people.[42] Including health messages at schools and in the workplace can help to increase opportunities for encouraging testing for HCV infection and other important infectious diseases.

Limitations

Our study had several limitations. First, NHIS uses a cross-sectional study design; therefore, test–retest reliability and causal inferences cannot be made.[36] Second, NHIS excludes institutionalized populations and people not living in households (eg, incarcerated, homeless) who are more likely not to have health insurance and are at increased risk for HCV infection; thus, our results are not generalizable to the entire US population.[5,43] Lastly, we used self-reported data on testing, which could have resulted in recall or social desirability biases. Despite these limitations, our results provide some evidence that demographic characteristics, health behaviors, and liver disease–related factors may affect HCV testing rates.

Conclusion

Rates of self-reported HCV testing increased from 2013 to 2017, but testing rates remained low. Demographic characteristics, health behaviors, and liver disease–related factors may affect HCV testing rates among adults. HCV testing must increase to achieve hepatitis C elimination targets.[14-16]

Disclaimer

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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