

# Vigilance for HIV/AIDS: a cross-sectional study of 2 million adults in the United States

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## Abstract

**Introduction:** This work aimed at studying human immunodeficiency virus (HIV) as well as the characteristics of individuals who have been tested for HIV in the United States during 2009-2018, with the ultimate goal to be found statistically significant predictors for HIV testing.

**Material and methods:** Statistical methods used to extract the results of this work were  $\chi^2$  and one-way analysis of variance (ANOVA) test. A multiple logistic regression analysis was applied with odds ratio (OR) to find statistically significant prognostic factors for HIV testing.

**Results:** As specified by multiple logistic regression analyses, individuals aged 18-44 were eight times more likely to be tested for HIV (OR = 8.18), while Black or African Americans were three times more likely to be tested for the virus (OR = 2.78). In addition, those who employ full-time (OR = 2.17), and living with a partner (OR = 1.80) were twice as likely to be tested for HIV. Finally, females (OR = 1.24), who live in a large metropolitan statistical area (OR = 1.61), with some college education status (OR = 1.05), and living in a poor financial situation (OR = 1.34) were more likely to be tested for the virus.

**Conclusions:** The results of this work highlight the prognostic characteristics of individuals, who are more likely to be tested for HIV, which reflects the vigilance for this incurable virus. Moreover, individuals with a higher degree of vigilance for HIV are more likely to be females in the age group of 18-44, financially independent, with a high level of education. On the contrary, individuals with a lower degree of vigilance for HIV, and therefore in high-risk groups, are more likely to be males, with less than a high school diploma education status, not poor, divorced or separated, with a private health insurance coverage, who do not employ and has never worked, living in the Midwest.

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**Key words:** human immunodeficiency virus, socio-economic factors, acquired immunodeficiency syndrome.

## Introduction

Human immunodeficiency virus (HIV) is a virus that targets the cells of immune system, specifically the white blood cells (CD4), making an individual more susceptible to other infections and some types of cancer [1]. In the United States, approximately 36,400 newly HIV-infected people were in 2018 only, and 1.2 million people were living with

this virus [2]. Due to the lack of access to HIV services, 15,820 individuals died from HIV-related causes in 2018 in the United States [2]. Socio-economic problems, such as poverty and poor education, can increase the risk of HIV infection [3]. The gender and race with the highest HIV prevalence are females and Black Africans, respectively [4-8]. Poverty is an overarching factor that increases the disparity

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**Table 1.** Characteristics of individuals, who have been tested for HIV: United States 2009-2018

Factor	n	%	p-value
<b>Gender</b>			
Male	488,198	45.0	< 0.05
Female	398,850	55.0	
<b>Age</b>			
18-44	516,428	58.2	< 0.05
45-64	300,658	33.9	
65-74	52,332	5.9	
≥ 75	17,627	2.0	
<b>Race</b>			
White	650,885	76.0	< 0.05
Black or African American	162,476	19.0	
Asian	42,859	5.0	
<b>Origin</b>			
Hispanic or Latino	151,650	9.2	< 0.05
Mexican or Mexican American	85,687	5.2	
Not Hispanic or Latino	735,395	44.7	
White, single-race	517,293	31.4	
Black or African American, single-race	155,055	9.4	
<b>Education</b>			
Less than a high school diploma	86,525	10.9	< 0.05
High school diploma	173,385	21.8	
Some college	253,869	32.0	
Bachelor's degree or higher	280,708	35.3	
<b>Employment</b>			
Employed	428,987	40.7	< 0.05
Full-time	355,948	33.8	
Part-time	67,574	6.4	
Not employed but has worked previously	178,651	16.9	
Not employed and has never worked	23,476	2.2	
<b>Family income</b>			
Less than \$35,000	262,409	18.8	< 0.05
≤ \$35,000	565,002	40.6	
\$35,000–\$49,999	103,550	7.4	
\$50,000–\$74,999	141,940	10.2	
\$75,000–\$99,999	100,912	7.2	
≥ \$100,000	218,601	15.7	
<b>Poverty status</b>			
Poor	123,327	14.7	< 0.05
Nearly poor	150,109	17.8	
Not poor	568,299	67.5	

**Table 1.** Cont.

Factor	n	%	p-value
<b>Health insurance coverage</b>			
<b>Under 65</b>			
Private	515,559	63.4	< 0.05
Medicaid	114,558	14.1	
Other coverage	45,762	5.6	
Uninsured	137,627	16.9	
<b>65 and over</b>			
Private	28,791	47.9	< 0.05
Medicare and Medicaid	6,426	10.7	
Medicare only	15,921	26.5	
Other coverage	8,976	14.9	
<b>Marital status</b>			
Married	90,237	50.8	< 0.05
Widowed	23,871	2.7	
Divorced or separated	123,262	13.9	
Never married	198,383	22.4	
Living with a partner	449,982	10.2	
<b>Place of residence (MSA: Metropolitan statistical area)</b>			
Large MSA (population size 1 million or more)	524,631	59.1	< 0.05
Small MSA (less than 1 million)	256,917	29.0	
Not in MSA	105,496	11.9	
<b>Region</b>			
Northeast	155,879	17.6	< 0.05
Midwest	172,991	19.5	
South	338,820	38.2	
West	219,357	24.7	

associated with HIV prevalence due to low coverage of HIV testing and counseling [9-12].

It is of utmost importance to acknowledge the seriousness of HIV infection, which in turn reflects the responsibility of underlying factors that lead to barriers in health services. For this purpose, this work studied HIV in the United States during the period 2009-2018 to evaluate prognostic factors for HIV testing.

## Material and methods

The data used in this work originate from the National Health Interview Survey dataset [13] and cover the period 2009-2018. To be identified, the adults, who have been tested for HIV, each household was asked to answer the question: "Except for tests you may have had as part of blood donations, have you ever been tested for HIV?". All adults

**Table 2.** Socio-economic characteristics: United States 2009-2018. Statistically significant predictors of HIV testing in the US using multivariate logistic regression

Factor	Cases	Controls	Odds ratio (95% CI)	p-value
<b>Gender</b>				
Female	488,198	691,062	1.24 (1.23-1.25)	< 0.05
Male	398,850	700,482	1.00	
<b>Age</b>				
18-44	516,428	562,309	8.18 (8.05-8.31)	< 0.05
45-64	300,658	482,278	5.55 (5.46-5.64)	
65-74	52,332	189,836	2.45 (2.41-2.50)	
≥ 75	17,627	157,122	1.00	
<b>Race</b>				
White	650,885	1,159,979	1.09 (1.08-1.10)	< 0.05
Black or African American	162,476	113,930	2.78 (2.74-2.81)	
Asian	42,859	83,554	1.00	
<b>Origin</b>				
Hispanic or Latino	151,650	194,862	0.54 (0.54-0.55)	< 0.05
Mexican or Mexican American	85,687	126,741	0.47 (0.47-0.48)	
Not Hispanic or Latino	735,395	1,196,682	0.43 (0.42-0.43)	
White, single-race	517,293	981,235	0.37 (0.36-0.37)	
Black or African American, single-race	155,055	108,940	1.00	
<b>Education</b>				
Less than a high school diploma	86,525	170,663	0.67 (0.66-0.67)	< 0.05
High school diploma	173,385	325,581	0.70 (0.70-0.71)	
Some college	253,869	319,602	1.05 (1.04-1.06)	
Bachelor's degree or higher	280,708	372,157	1.00	
<b>Employment</b>				
Employed	428,987	568,731	2.08 (2.05-2.11)	< 0.05
Full-time	355,948	452,947	2.17 (2.13-2.20)	
Part-time	67,574	107,201	1.74 (1.71-1.77)	
Not employed but has worked previously	178,651	348,864	1.41 (1.39-1.43)	
Not employed and has never worked	2,476	64,815	1.00	
<b>Family income</b>				
Less than \$35,000	262,409	395,827	1.01 (1.01-1.02)	< 0.05
\$35,000 or more	565,002	873,339	0.92 (0.91-0.92)	
\$35,000-\$49,999	103,550	168,874	0.87 (0.86-0.88)	
\$50,000-\$74,999	141,940	229,284	0.88 (0.87-0.89)	
\$75,000-\$99,999	100,912	163,471	0.88 (0.87-0.89)	
\$100,000 or more	218,601	311,706	1.00	
<b>Poverty status</b>				
Poor	123,327	148,358	1.34 (1.33-1.35)	< 0.05
Nearly poor	150,109	224,392	1.08 (1.07-1.09)	
Not poor	568,299	918,820	1.00	

Table 2. Cont.

Factor		Control cases	Odds ratio (95% CI)	p-value
Health insurance coverage				
Under 65				
Private	515,559	726,945	0.91 (0.90-0.92)	< 0.05
Medicaid	114,558	95,557	1.54 (1.52-1.56)	
Other coverage	45,762	38,840	1.51 (1.49-1.54)	
Uninsured	137,627	177,365	1.00	
65 and over				
Private	28,791	170,285	0.42 (0.41-0.43)	< 0.05
Medicare and Medicaid	6,426	21,275	0.76 (0.73-0.79)	
Medicare only	15,921	91,514	0.43 (0.42-0.45)	
Other coverage	8,976	22,643	1.00	
Marital status				
Living with a partner	90,237	77,635	1.80 (1.78-1.82)	< 0.05
Widowed	23,871	109,128	0.91 (0.91-0.92)	
Divorced or separated	123,262	132,521	0.34 (0.33-0.34)	
Never married	198,383	307,994	1.44 (1.43-1.45)	
Married	449,982	762,523	1.00	
Place of residence (MSA: Metropolitan statistical area)				
Large MSA (population size 1 million or more)	524,631	716,581	1.61 (1.60-1.62)	< 0.05
Small MSA (less than 1 million)	256,917	442,183	1.28 (1.27-1.29)	
Not in MSA	105,496	232,781	1.00	
Region				
Northeast	155,879	246,940	0.89 (0.88-0.90)	< 0.05
Midwest	172,991	343,931	0.71 (0.70-0.71)	
South	338,820	490,001	0.97 (0.97-0.98)	
West	219,357	310,671	1.00	

examined were 2,278,592, while the number of individuals who have been tested for HIV was 887,048. The statistical methods used to extract the results of this work included  $\chi^2$  test for categorical and one-way analysis of variance (ANOVA) for continues variables, in order to verify the null hypothesis that the mean of adults in the United States, who have been tested for HIV did not differ according to their socio-economic characteristics, such as gender, age, race, origin, parent's education, family income, poverty status, health insurance coverage, current health status, family structure, place of residence, and region. A multiple logistic regression analysis was used with odds ratio (OR) to obtain statistically significant prognostic factors for HIV testing. A cross-sectional study was carried out, where individuals were classified into two groups: the case group and the control group. More specifically, the control group was all target population that has never been tested for HIV. In contrast, the case group was all adults with the same socio-economic characteristics as the control group, who has been tested for this virus. The data were weighted before analyzed. Predictors

were represented using OR and 95% confidence interval, and  $p < 0.05$  was considered as statistically significant. More precisely, OR has been used in order to be compared the relative odds of the occurrence of outcome of interest (characteristics of participants), given exposure to the variable of interest (HIV testing). An OR  $> 1$  means that the characteristic was associated with higher odds of outcome, and finally, an OR  $< 1$  implies that the characteristic was associated with lower odds of the outcome [14]. The study was carried out using IBM SPSS 25 software package for Windows.

## Results

To test the null hypothesis that the mean of US individuals, who have been tested for HIV, did not differ in accordance with their socio-economic characteristics, using  $\chi^2$  test and one-way analysis of variance (ANOVA). As shown in Table 1, most individuals who have been tested for HIV were females (55%), in the age group of 18-44 (58.2%), while the most common origin and race were not Hispanic or Lati-

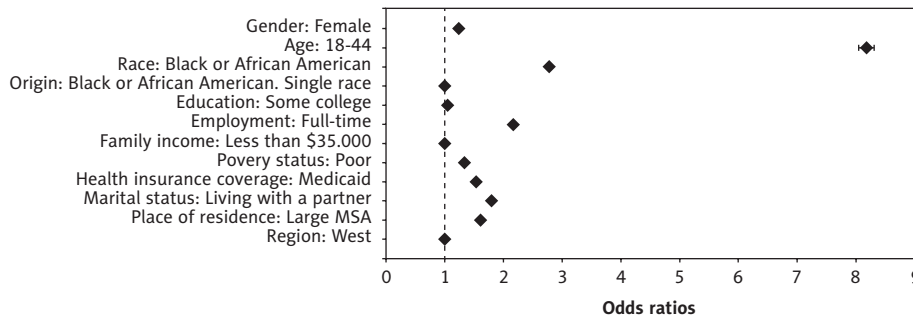


Figure 1. Prognostic factors for HIV testing with odds ratios

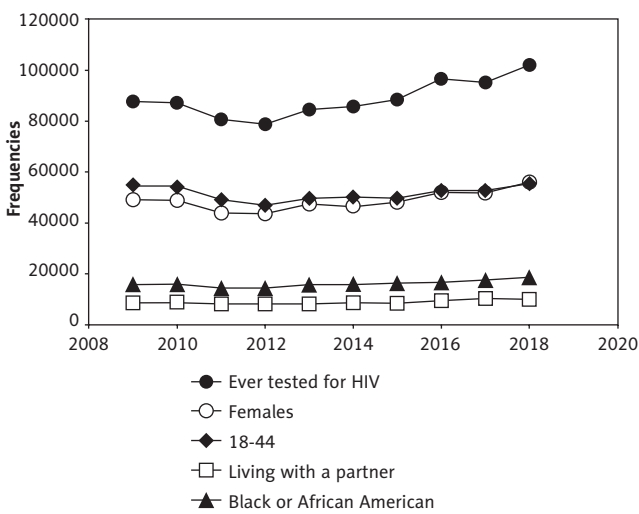


Figure 2. The trend in HIV as well as the trend in characteristics of individuals, who have been tested for HIV, with the highest odds ratios during the years 2009-2018 in the United States

no (44.7%) and white (76%), respectively. Moreover, most of them had a bachelor’s degree or higher (35.3%), were employed (40.7%), were not poor (67.5%), having a family income of \$35,000 or more (40.6%), and a private health insurance coverage (63.4%). Finally, the region with the most frequent occurrence of HIV testing was the South (38.2%), with a population size of one million or more (59.1%).

Table 2 represents the multiple logistic regression analysis using odds ratios, with the ultimate goal to be found statistically significant predictors for HIV testing. As can be seen in Table 2, all prognostic factors were statistically significant ( $p < 0.05$ ). Based on multiple logistic regression, females (OR = 1.24), in the age group of 18-44 (OR = 8.18) were eight times more likely to be tested for HIV. Black or African Americans were three times more likely to be tested for HIV (OR = 2.78), while those living with a partner (OR = 1.80) and employed full-time (OR = 2.17) were twice as likely to be tested for the disease. Finally, individuals who live in a large metropolitan statistical area (OR = 1.61), with

some college education status (OR = 1.05), and living in a poor financial situation (OR = 1.34), and Medicaid health insurance coverage (OR = 1.54) were more likely to be tested for HIV.

Figure 1 represents the trend in HIV testing as well as the trend in characteristics of individuals, who have been tested for HIV, with the highest OR during the years 2009-2018 in the United States. HIV testing has increased during the years 2009 to 2018. Figure 2 shows the prognostic factors for HIV testing with odds ratios, including age, which ranks first, followed by race, employment, and marital status.

### Discussion

It is worth noting that the frequencies of HIV testing in the United States during the years 2009-2018 were rising, reflecting a higher degree of awareness for HIV. It was also noted that females, aged 18-44, Black or African-Americans, poor, employing full time, living with a partner, and having some college education were more likely to be tested for HIV. High level of education of females combined with their financial independence reflects the ability to choose low-risk sexual partners, thus reducing the risk of HIV infection. This is consistent with other studies showing that improving educational and economic status of women determine their bargaining power in partner’s decision [15, 16].

On the contrary, males, divorced or separated, who were not employed and had never worked, with a low level of education had the lowest odds ratio for vigilance for HIV testing. Prior studies have linked low education levels, unemployment, appreciably reduced marital rates, and upcoming increase of one-person households, with greater HIV prevalence [17]. Moreover, individuals who have been socially or economically marginalized proved to be more vulnerable to HIV infection [18].

Effective HIV prevention strategies include substance abuse treatment as well as mental health treatment. More specifically, amphetamine and methamphetamine derivative have been found to be associated with high-risk sexual behaviors, such as having multiple sexual partners [19]. Furthermore, individuals who have been recently diagnosed with HIV were found to have fewer supportive families, and

had more negative self-image as well as premorbid trauma experiences, such as childhood sexual abuse [20].

HIV test is the necessary first step in involving infected people in HIV-related healthcare. Testing later during HIV infection translates into medical care later, and therefore possible delays in treatment resulting in serious effects on the risk of HIV transmission.

This study's importance lies in the interaction of multiple socio-economic variables with HIV testing, which demonstrates the complexity and multi-dimensional nature of vigilance as well as the various roles of these dimensions during the course of life, which in turn reflects the risk of HIV infection.

One limitation of the present study is that data were collected through personal household interviews. Non-disclosure of such information by participants was possible due to memory and/or social bias.

## Conclusions

This paper emphasizes the prognostic characteristics of individuals, who are more likely to be tested for HIV, which indicates the vigilance for this incurable virus. Moreover, individuals with a higher degree of vigilance for HIV are more likely to be females, in the age group of 18-44, poor, Black or African Americans, financially independent, and with a high level of education. On the contrary, individuals with a lower degree of vigilance for HIV, and therefore high-risk groups, are more likely to be males, with less than a high school diploma education status, not poor, divorced or separated, with a private health insurance coverage, who do not employ and has never worked, and living in the Midwest.

## Conflict of interest

The authors declare no conflict of interest with respect to the research, authorship, and/or publication of this article.

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