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Unknown Human Immunodeficiency Virus Status and Associated Risk Factors among Pregnant Women in the United States: Findings from the 2013 Behavior Risk Factors Surveillance System

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Abstract

Background: Although prenatal Human Immunodeficiency Virus (HIV) infections are declining in the United States, many women of child bearing age are unaware of their HIV status. HIV testing before or during the early stages of pregnancy is a critical first step to reduce the risk of mother-to-child transmission.

Objective: The aim of this study was to estimate prevalence of women with unknown HIV status and to explore the associations between socio-demographic characteristics, health care access and HIV testing among pregnant women in the United States.

Methodology: Data from the 2013 Behavior Risk Factors Surveillance System (BRFSS) were used to calculate estimates of HIV testing prevalence among pregnant women in the United States (n=2,722). Pregnant women who never had an HIV test or had not been tested for HIV within the past year were considered as pregnant women with unknown HIV status. Descriptive statistics, Chi-square tests and logistic regression were done using SAS Proc Survey procedures, to account for BRFSS's multistage complex survey design and sample weights.

Results: Overall, 30.3% of pregnant women had never been tested for HIV and among these women, only 24% had past-year HIV testing. Non-Hispanic whites ($p<0.0001$), those aged 18-24 years ($p=0.02$), married women ($p=0.02$), those with no insurance ($p<0.001$) and no personal doctor ($p=0.02$) had significantly higher rates of no lifetime HIV testing. Pregnant women aged 35-44 years (39.2%), those with annual income of $50,000 or more (32.9%) and those who were married (31.4%) had significantly higher rate of no past-year HIV testing. Multiple logistic regressions showed that the likelihood of having never been tested for HIV was greater among non-Hispanic whites (aOR=2.1; 95% CI:1.3–3.4; reference=other races), married women (aOR=1.7; 95% CI:1.1–2.3; reference=unmarried), those aged 18-24 years (aOR=2.1; 95% CI:1.4–3.3; reference=35 years old or more), and those who had no insurance (aOR=2.2; 95% CI: 1.3–3.7; reference=covered by insurance). Among those who ever had an HIV test, married women were two times more likely to have no past-year HIV testing than unmarried women (aOR=2.0; 95% CI:1.3–3.1; reference=unmarried); while, younger women (18-24 years old) were less likely to have no past-year HIV testing (aOR=0.3; 95% CI: 0.2–0.7 reference=35-44 years old).

Conclusion: Our findings indicated that prevalence of unknown HIV status (lifetime and recent) was high, raising concerns about the prenatal HIV testing approaches in the United States. The likelihood of having never been tested for HIV was greater among non-Hispanic whites, married and younger (18-24 years old) women, and those who had no insurance after controlling for covariates. In addition, the results showed that married women had higher likelihood of having no recent HIV test; while, younger women (18-24 years old) were less likely to have no past-year HIV testing. Our findings highlight the need to continue and strengthen efforts to prevent perinatal HIV transmission in the United States through increasing HIV testing awareness. Health care providers should recommend HIV testing to all women of childbearing age, regardless of sociodemographic characteristics to reduce this mode of transmission.

Keywords: HIV; Mother-to-child transmission; Unknown HIV status; Prenatal HIV testing; Socio-demographic characteristics; Lifetime HIV testing; Health care access

Introduction

Transmission of human immunodeficiency virus (HIV) from mother to child during pregnancy, labor, delivery, or through breastfeeding is called as perinatal transmission and is the most common way of HIV infection in children [1]. Globally, the number of children younger than 15 years old living with HIV increased from 1.6 million in 2001 to 3.4 million in 2011, and an estimated 330,000 children were newly infected with HIV [2]. More than 90% of these infections were attributable to mother-to-child transmission [3]. Previous studies showed that the majority of mother-to-child transmission cases occurred in women who received no prenatal care or who had not been tested for HIV earlier in pregnancy [4].

Prevention or early identification of HIV infection during pregnancy is recognized as a critical component in controlling mother-to-child transmission and reducing mortality. Evidence shows that with early diagnosis and appropriate interventions, transmission rates can be reduced to less than 1% [5]. The primary strategy for preventing

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perinatal mode of HIV transmission is HIV testing before or early in pregnancy. Knowing HIV status may enable HIV-infected women to access to appropriate health care services during pregnancy, as well as care for their newborn promptly after delivery [6]. In 1995, Centers for Disease Control and Prevention (CDC) issued guidelines recommending HIV testing as a routine part of prenatal care for all pregnant women in the United States [7]. According to the CDC, HIV testing and preventive interventions have reduced the incidence of perinatally HIV-infected children by 90% or more in the United States since the mid-1990s [1]. Estimating the prevalence of HIV testing before or during pregnancy is important for assessing HIV awareness and the effectiveness of HIV prevention efforts. Previous research showed that approximately 7,000 HIV-positive women give birth each year in the United States [8], and 30% of these women are unaware of their HIV-positive status prior to pregnancy [9]. In 2012, only 38% of pregnant women in low and middle-income countries were tested for HIV and received HIV counseling [10]; however, there are limited data available about prenatal HIV testing rates in the United States.

Identifying prevalence of HIV testing before or during pregnancy and understating factors related to receiving this test is critical to developing strategies to increase HIV testing rates for pregnant women and reduce mother-to-child transmission of HIV. The purpose of this research was to determine the percentage of pregnant women who had unknown HIV status and examine factors associated with HIV testing.

Methods

Data source and study sample

The 2012-2013 BRFSS data were used in this cross-sectional study. BRFSS is an ongoing, state-based survey conducted by state health departments in collaboration with the Center for Disease Control and Prevention (CDC). It uses a multistage cluster sampling design based on random-digit dialing (landline and cell phone) to select a representative sample from each state's non-institutionalized civilian residents aged 18 years or older. Data from each state are weighted to compensate for unequal probabilities of selection, adjust for non-response and non-coverage to match the sample to the population and to make representative **population**-based **estimates**. BRFSS questions are designed to gather information from adults on their health condition and health-related behaviors. The questionnaire has three parts: (1) the core component, (2) optional modules and (3) state-added questions. CDC requires states to ask all questions on the core questionnaire of each respondent. Optional modules are sets of questions on specific topics that states may choose to use on their questionnaires. Individual states may develop their own questions and add these questions to their questionnaires. These state-added questions are not edited or evaluated by CDC. Each year, the states and CDC agree on the content of the core component and optional modules. The HIV/AIDS questions used for this study were core questions [11].

The study population included all pregnant women aged 18 to 44 years who completed the HIV/AIDS Module administered in the United States.

Measures

The core component of BRFSS questionnaire included 3 questions about HIV testing: (1) "Have you ever been tested for HIV? Do not count tests you may have had as part of a blood donation. Include testing fluid from your mouth.", (2) "Not including blood donations, in what month and year was your last HIV test?", (3) "Where did you have your last HIV test — at a private doctor or HMO office, at a counseling and testing site, at a hospital, at a clinic, in a jail or prison, at a drug treatment facility, at home, or somewhere else?". In this study we used the first two questions. In order to examine knowledge of HIV status, we determined the lifetime and past-year HIV testing frequencies. Women who answered "no" to the question "Have you ever been tested for HIV" and those who did not receive their last HIV testing within the past year were considered as women with unknown HIV status. Respondents who had missing data on lifetime HIV testing were excluded from the analytical sample (n=322). We also examined respondents' characteristics related to HIV testing, which included socio-demographics (age, race-ethnicity, marital status, education, employment and income) and health care access (health care coverage and personal doctor). For socio-demographic characteristics, we used three age groups (18-24, 25-34, and 35-44 years), four levels of education (less than high school, high school, some college and college graduate), two categories of marital status (married and unmarried) and employment (employed and unemployed) and four race groups (non-Hispanic white, non-Hispanic black, Hispanic, and Other). Because a relatively large proportion (~14%) of adults had "don't know/refused/missing" responses for annual household income, we did not exclude these respondents from our analyses and we categorized annual household income as <$25,000, $25,000 to $49,999, and ≥$50,000, or did not know/refused/missing. **Missing data** for other **variables** were verified and found to be **less than 0.5**%.

Statistical analysis

We used χ^2 tests to examine differences in lifetime and past-year HIV testing prevalences by socio-demographic characteristic and health care access. Logistic regression models were used to predict the odds of never tested for HIV and no HIV test in the past year. We first examined the bivariate association between each predictor variable and HIV testing. Each predictor variable associated with HIV testing at $p<0.10$ in the bivariate analyses was retained in the initial multiple logistic regression models [12]. Correlations between all independent variables were examined prior to inclusion in the models, in order to avoid problems associated with multi-collinearity. Race, age, marital status, insurance and personal doctor were included in the final model for lifetime HIV testing. Among all predictor variables, only age and marital status significantly contribute to the final model for recent HIV testing. The sample weight variable was applied to all analyses to provide valid estimates for the civilian non-institutionalized adult population. All statistical analyses were performed using SAS 9.3 (SAS Institute, Cary, North Carolina) adjusting for the complex sample design of the BRFSS. Statistical tests were determined to be significant for **P** values < 0.05.

Results

The participants' characteristics are presented in Table 1. Most women self-identified as non-Hispanic white (52%), followed by Hispanic (26.8%) and non-Hispanic black (11.4%) or other (9.8%). Most respondents were married (56.4%), 25-34 years old (53.2%), employed (53.6%), and attended college or technical school (30.5%). In addition, 85.8% of respondents had health coverage, and 73.4% had at least one personal doctor. As shown in table 1, 30.3% of the sample had never been tested for HIV. Non-Hispanic whites ($p<0.0001$), those aged 18-24 years old ($p=0.02$), married women ($p=0.02$), those with no insurance ($p<0.001$) and no personal doctor ($p=0.02$) had significantly higher rates of having never been tested for HIV. There was no significant difference in lifetime HIV testing prevalence by education levels, annual household income and employment status.

Characteristics	Total (n=2,722)	No lifetime HIV Testing		No Past-year HIV Testing	
	N (Weighted %)	N (Weighted %)	p-value	N (Weighted %)	p-value
Never HIV Testing					
No lifetime HIV testing	923 (30.3)	-	-	-	-
No past-year HIV testing	434 (24.0)	-	-	-	-
Race					
White	1,757 (52.0)	650 (35.5)	<0.0001	294 (23.6)	0.71
Black	221 (11.4)	29 (13.3)		34 (21.4)	
Hispanic	455 (26.8)	138 (31.4)		62 (22.4)	
Other	289 (9.8)	106 (19.1)		44 (33.1)	
Education					
<High school	242 (17.2)	80 (34.1)	<0.15	29 (20.7)	<0.24
High school	623 (23.7)	197 (29.4)		99 (20.03)	
Some college	752 (30.5)	237 (25.8)		101 (21.3)	
College graduate	1,103 (28.6)	408 (33.5)		204 (31.5)	
Age (years)			0.02		0.0002
18-24	617 (30.0)	235 (35.0)		59 (13.2)	
25-34	1,585 (53.2)	533 (29.7)		269 (24.9)	
35-44	513 (16.8)	151(23.2)		106 (39.2)	
Annual Income			0.9		0.001
<$25,000	789(39.1)	218 (29.3)		111 (17.2)	
$25,000-$49999	566 (21.9)	204 (31.1)		99 (23.9)	
≥$50,000	1,066 (39.0)	380 (30.4)		191 (32.9)	
Employment			0.53		0.08
Employed	1,611 (53.6)	547 (29.5)		261 (27.4)	
Other	1,107 (46.4)	732 (68.7)		173 (19.9)	
Marital status			0.02		<0.0001
Married	1,724 (56.4)	665 (33.4)		307 (31.4)	
Unmarried	992 (43.6)	257 (26.5)		126 (15.2)	
Insurance			0.0007		0.5
Had insurance	2,418 (85.8)	803 (27.9)		378 (23.4)	
No insurance	299 (14.2)	118 (44.2)		58 (28.6)	
Personal doctor			0.02		0.39
Had personal doctor	2,144 (73.4)	711 (28.3)		349 (24.8)	
No personal doctor	567(23.9)	208 (36.5)		83 (21.2)	

Table 1: Respondents' Characteristics by HIV Testing Status, BRFSS 2013.

Among those pregnant women who ever had HIV test, only 24% had been tested for HIV during the past year. Pregnant women aged 35-44 years (39.2%), those with annual income of ≥$50,000 (32.9%) and those who were married (31.4%) had significantly higher rate of no past-year HIV testing.

Using binary and multiple logistic regressions, unadjusted and adjusted ORs for associations between socio-demographic characteristics and health care access and HIV testing are presented in Table 2. Model I (unadjusted model) showed that the women who were non-Hispanic white (aOR=2.3; 95% CI:1.4–3.9, reference=other races) or Hispanic (aOR=1.9; 95% CI:1.1–3.4, reference=other races), married (aOR=1.4; 95% CI:1.1–1.8, reference=unmarried), aged 18-24 years (aOR=1.8; 95% CI:1.2–2.7, reference=35-44 years old) and those who had no insurance (aOR=2.1; 95% CI:1.3–3.1, reference= covered by insurance) and no personal doctor (aOR=1.5; 95% CI:1.1–2.0, reference=had personal doctor) were at greater risk for having never been tested for HIV. Among socio-demographic variables, education, income and employment status were not significantly associated with never tested for HIV; therefore, we excluded them in the model building. After controlling for all covariates included in our final model, the likelihood of having never been tested for HIV was greater among non-Hispanic whites (aOR=2.1; 95% CI:1.3–3.4, reference=other races), married women (aOR=1.7; 95% CI:1.1–2.3; reference=unmarried), those aged 18-24 years (aOR=2.1; 95% CI:1.4–3.3; reference=35-44 years old), and had no insurance (aOR=2.2; 95% CI:1.3–3.7; reference=covered by insurance). When we limited the analysis to those who ever had HIV test only, married women were

	No Lifetime HIV Testing			No Past-year HIV Testing	
	Model I[a]	Model II[b]		Model I[a]	Model II[b]
Age (years)					
18-24	1.8 [1.2-2.7]	2.1 [1.4-3.3]		0.2 [0.1-0.5]	0.3 [0.2-0.7]
25-34	1.4 [1.0-1.02]	1.3 [0.9-1.9]		0.5 [0.3-1.0]	0.6 [0.3-1.1]
35-44	1.00 (ref)	1.00 (ref)		1.00 (ref)	1.00 (ref)
Marital status					
Married	1.4 [1.1-1.8]	1.7 [1.1-2.3]		2.6 [1.6-4.0]	2.0 [1.3-3.1]
Unmarried	1.00 (ref)	1.00 (ref)		1.00 (ref)	1.00 (ref)
Race					
White	2.3 [1.4-3.9]	2.1 [1.3-3.4]		0.6 [0.2-1.9]	-
Black	0.7 [0.3-1.3]	0.6 [0.3-1.3]		0.6 [0.2-1.9]	-
Hispanic	1.9 [1.1-3.4]	1.4 [0.8-2.5]		0.6 [0.2-2.0]	-
Other	1.00 (ref)	1.00 (ref)		1.00 (ref)	-
Education					
<High school	1.0 [0.7-1.6]	-		0.6 [0.3-1.3]	-
High school	0.8 [0.6-1.2]	-		0.6 [0.3-0.9]	-
Some college	0.7 [0.5-0.9]	-		0.6 [0.3-1.2]	-
College graduate	1.00 (ref)	-		1.00 (ref)	-
Annual Income					
<$25,000	1.0 [0.7-1.3]	-		0.4 [0.3-0.7]	-
$25,000-$49,999	1.0 [0.7-1.5]	-		0.6 [0.4-1.1]	-
≥$50,000	1.00 (ref)	-		1.00 (ref)	-
Employment					
Employed	1.00 (ref)	-		1.00 (ref)	-
Other	1.1 [0.8-1.4]	-		0.7 [0.4-1.1]	-
Insurance					
Had insurance	1.00 (ref)	1.00 (ref)		1.00 (ref)	-
No insurance	2.1[1.3-3.1]	2.2 [1.3-3.7]		1.3 [0.6-2.9]	-
Personal doctor					
Had personal doctor	1.00 (ref)	1.00 (ref)			-
No personal	1.5 [1.1-2.0]	1.4 [0.9-1.9]		0.8 [0.5-1.3]	-

a. Unadjusted Model
b. Adjusted for socio-demographic variables and health care access
Note: non- significant variables were excluded in the final model.

Table 2: Association between Socio-demographic Characteristics, Health Care Access and HIV Testing.

two times more likely to have no past-year HIV testing than unmarried women (aOR=2.0; 95% CI: 1.3–3.1, reference=unmarried), while younger women (18-24 years old) were less likely to have not been tested within the past year (aOR=0.3; 95% CI: 0.2–0.7; reference=35-44 years old).

Discussion

Our findings indicated that approximately 30% of women had never been tested for HIV. Of those who reported prior HIV testing, nearly a quarter of them had not been tested for HIV within the past year. Multiple logistic regressions showed that insurance was significantly associated with HIV testing, whereas having personal doctor had no significant relationship with HIV-testing after controlling for covariates. Consistent with other studies [13,14], our findings indicated that women who had no insurance were more likely to have never been tested for HIV compared to those covered by insurance. Lack of health insurance can affect health status by reducing access to the health care [15]. Insured individuals have more contact with health clinics and therefore more opportunities to get informed about HIV and receive an HIV test [16]. Among socio-demographic variables, age, marital status, and race were associated with HIV testing after controlling for covariates.

Similar to other studies [16,17], we found non-Hispanic whites and Hispanics were more likely to have never been tested for HIV compared to other races. Racial disparities in HIV testing may either be a result of differences in risk perception or cultural attitudes toward HIV and

HIV testing. Non-Hispanic blacks are more likely to be diagnosed with HIV compared to non-Hispanic Whites and Hispanics and have higher perception of HIV risk consequently as well as higher chance of being recommended for HIV testing by health care providers. On the other hand, non-Hispanic Whites may delay the HIV testing due to the lower risk perception compared to Blacks, and Hispanics may avoid to visit medical centers for an HIV test because of cultural barriers related to the sexual issues [16,21] or lack of awareness about HIV and its routine screening [20]. Further research is needed to understand the factors underlying racial differences in HIV testing.

Additionally, the results suggested that younger (18-24 years old) were at increased risk of never receiving an HIV test compared to those who were aged 35-44 years. Prior studies have shown that the lower rates of lifetime testing among older women may be a result of decreased perception of HIV risk [16,18,19] and not being offered an HIV test by health care providers [21]. Also there is some evidence indicating that low perception of risk as an important barrier to accepting recommended HIV testing even when it is offered routinely in health care settings [19].

Unlike no lifetime HIV testing, prevalence of no recent HIV testing increased linearly with age. Our finding indicated that women aged 18-24 years were three times and those aged 25-34 years were two times less likely to have not been tested for HIV within the past year compared to older ones (35-44 years) which is in line with previous studies [22-24]. Research show that younger adults are more likely to engage in high risk sexual behaviors including unprotected sexual intercourse, multiple and more sexual partners; therefore, they may have higher HIV risk perception encouraging them to seek for an HIV test [25]. In addition, health care providers may believe that younger people are at greater risk of HIV infection and they may recommend an HIV test to younger women more than older ones.

Consistent to the previous studies [16,26], our findings also indicated that married women were more likely to have no lifetime HIV testing or no HIV test in the past year than those who were unmarried. A plausible explanation for this finding could be that there is a lower probability that married women to get involved in high risk sexual behaviors; therefore, they may have lower HIV risk perception and delay seeking HIV testing. Since married women have an established relationship, they are also less likely to get offered an HIV test by their health care provider. In addition, some married women may believe that HIV testing is incompatible with marriage because it may question love and fidelity [27] or they may not need for HIV testing because of trust in their partners [28].

This research presents a new insight into the prevalence of unknown HIV status among pregnant women in the United States. The results provide public health professionals with valuable information about pregnant women who are at higher risk for mother-to-child HIV transmission and highlight a need for prenatal screening. A major strength of BRFSS data is that it produces national estimates. In this study, data were weighted so that results could be generalized to the entire population of pregnant women in the United States. The findings in this study are subject to at least three limitations. First, identifying of unknown HIV status was based on the mother's self-report of her HIV testing, and not on her medical records. Further research is needed to obtain better estimation of HIV testing. Second, self-reported information may be subject to recall and social desirability biases. The women may not recall whether they have received HIV testing in the past. Further limitation to this analysis is the inability to evaluate the association between respondents' perception of HIV risk and HIV testing. Perception of risk may be an important predictor of HIV testing among different population subgroups.

Conclusion

Our findings show that prevalence of unknown HIV status (lifetime and past-year) was high, raising concerns about the effectiveness of the prenatal HIV testing approaches in the United States. The likelihood of having never been tested for HIV was higher among non-Hispanic whites, married and younger (18-24 years old) women, and those who had no insurance. In addition, married women were more likely to have no recent HIV testing while younger women (18-24 years old) were less likely to have not been tested for HIV within the past year. These findings indicate that perception and awareness could be underlying factors associated with HIV testing. Further research is needed to understand this association, such as racial and age differences in HIV risk perception, as well as providers' attitudes towards HIV testing for different clients. Since unprotected sex is more common in marriage, greater efforts are needed to encourage more married individuals to undergo HIV testing.

Funding and Competing Interests

Authors have no financial support or competing interest to declare.

Authors' contributions

AD designed the study, performed the literature search, extracted data, performed statistical analysis, interpreted the results and draft the manuscript. MQ designed the study, interpreted the results and wrote the manuscript. All authors read and approved the final manuscript.

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