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Alcohol use and HIV testing in a national sample of women

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Abstract

The HIV/AIDS epidemic continues to disproportionately affect racial and ethnic minority groups and women in the United States. Prevention research suggests that reduced alcohol use and increased HIV testing are associated with lower incidence of HIV transmission among high-risk populations. Multivariable logistic regression analyses of the 2009 National Health Interview Survey (NHIS) data were performed for a national sample of 15,470 adult women to examine the relationship between alcohol use and likelihood of HIV testing.

There is a significant association between level of alcohol use and HIV testing. Women who identified as heavy drinkers and moderate drinkers were significantly less likely to report ever testing for HIV. Findings add to the limited literature on the association between alcohol use and HIV testing behaviors among women. Given the incidence of HIV among women, this study highlights the importance of HIV testing, especially for alcohol using women.

Keywords

Alcohol; HIV/AIDS; HIV Testing; National Health Interview Survey; Women

INTRODUCTION

Four decades after the first cases of HIV and AIDS were identified; reducing new HIV infections among vulnerable populations remains a major public health goal (1). The Centers for Disease Control and Prevention (CDC) estimates that 47,500 new HIV infections occur

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each year in the United States (2). Men who have sex with men, injection drug users, racial and ethnic minority groups, and women are among the most disproportionately affected by the HIV epidemic (1, 2). In 2010, heterosexual transmission accounted for a majority (84%) of new infections among women, including 87% for African American women, 86% for Latina women, and 76% for white women (1). While recent surveillance data show a slight decline in HIV incidence among women, African American and Latina women account for a growing proportion of new HIV infections (1, 2).

Women are particularly vulnerable to HIV infection because of increased biologic susceptibility to HIV transmission through heterosexual sexual contact (3–5). Women are also at increased risk of HIV because they face a host of structural barriers and contextual gender inequalities such as economic disempowerment, poverty, cultural inequities, increased risk of sexual violence, and gender power imbalance in sexual interactions (6, 7). Histories of childhood physical or sexual abuse have been shown to identify women at increased risk of HIV infection (8, 9).

Several studies have shown that illicit drug use, abuse and dependence are associated with HIV infection (10–13). Illicit drug use and heavy alcohol use can impair judgment and increase the likelihood of HIV transmission through high-risk behaviors such as sharing drug injection equipment, and engaging in unprotected vaginal or anal intercourse with partners who engage in high-risk behaviors or with partners who have HIV/AIDS. Research has also shown that unhealthy alcohol use, which includes the spectrum of drinking behaviors ranging from risky alcohol use to clinically diagnosed alcohol use disorders (14), has unintended consequences, including the transmission of HIV and other STIs (15, 16) as the result of unprotected sexual behaviors and having multiple sex partners (17–24). Other studies have shown that alcohol directly affects the brain resulting in reduced inhibitions and diminished risk perception (25–27). National data show that alcohol use among women is on the rise (28, 29), thereby increasing the negative consequences that result from unhealthy alcohol use.

HIV prevention and risk reduction interventions have been well established (30–33). HIV testing, an integral part of comprehensive HIV prevention strategies, facilitates prevention counseling to reduce HIV transmission. Individuals unaware of their HIV-positive status are at greater risk of transmitting HIV and unlikely to receive treatment early in their HIV treatment cascade (34, 35). Knowledge of HIV status can facilitate early treatment, potentially reducing morbidity and mortality from HIV/AIDS disease. Knowledge of HIV infection can also promote protective behavior and adoption of safer sexual practices (36–39).

Unhealthy alcohol use, alcohol abuse and dependence have been recognized as key mediators of HIV transmission and HIV testing has been identified as an important protective factor in the context of HIV prevention. However, there is limited research examining HIV testing practices among individuals who consume alcohol. Understanding the association between alcohol use and HIV testing practices is an important step in addressing the disproportionately high and increasing HIV rate among women. Therefore, this exploratory study examines the association between alcohol use and HIV testing for a

nationally representative sample of women to add to the literature on the link between alcohol use and HIV/AIDS and contribute specifically to our knowledgebase regarding HIV testing as a prevention and health promotion behavior.

The Gelberg-Andersen behavioral model for vulnerable populations

The Gelberg-Andersen behavioral model for vulnerable populations (40), a modified version of the Andersen behavioral health model of health services utilization (41–43), provides an important lens for examining factors that influence the relationship between alcohol use and HIV testing. The Andersen model posits that population characteristics categorized as predisposing, enabling, and need factors influence health behaviors and health service utilization. The modified Gelberg-Andersen model builds on the original Andersen model by adding variable domains that are particularly relevant for vulnerable populations at higher risk for illness. In this study, the Gelberg-Andersen model guides inclusion of variables for problems related to substance abuse, mental illness, and homelessness as covariates in an analysis of the relationship between alcohol use and HIV testing behaviors among women at greater risk for HIV infection (3–9).

The traditional variable domains of the behavioral health model include individual predisposing characteristics such as age, race, and education, as well as social structure factors such as marital status. These variables are retained in our analyses, as prior empirical and epidemiological research show that individual level differences among these variables are associated with HIV testing (44–47). Additional predisposing variables for substance abuse (specifically, level of alcohol use), mental health status in the past 30 days (feeling sad, nervous, restless, hopeless, effort, worthless), living condition (ever spending more than 24 hours on the streets, shelter, jail or prison), and housing arrangement were also included in our analyses because they are specifically relevant for vulnerable subgroups. The inclusion of both traditional and vulnerable variable domains within the predisposing category is important for understanding challenges that vulnerable populations face when accessing HIV prevention services such as HIV testing.

Enabling factors were composed of personal, family and resources such as family income, perceived barriers to care, health insurance, and geographic region. Low family income, being uninsured, and forgoing medical care, have been identified as risk factors for inadequate access to preventive health care (48–50). Further, research has shown that region is an important factor when accessing HIV testing services, and that individuals living in urban settings are more likely to test for HIV (44, 51). Need factors in our analyses consist of individuals' perceived and evaluated need for interactions with health service providers. Current pregnancy status was included in the model to account for women who may be tested for HIV while pregnant, general health status in the past 12 months was included as a measure of overall health service utilization, which might correlate with the likelihood of HIV testing, and lastly, having a sexually transmitted disease (STD) in the past five years was included to reflect a history of unsafe sexual behaviors and a greater potential need for HIV testing.

The Gelberg-Andersen model provides an individual and contextual theoretical framework for understanding alcohol use and HIV testing behaviors among alcohol using women.

Findings will contribute to our understanding of alcohol use and HIV testing, and pave the way for developing targeted interventions among the vulnerable population of women, who are at higher risk for HIV transmission.

METHODS

Study Design and Sample

Secondary data analyses of the 2009 National Health Interview Survey (NHIS) were performed to identify the association between alcohol use and HIV testing among adult women (N=15,470). The National Health Interview Survey (NHIS) uses a multistage probability sampling design to produce national estimates for several health domains, and oversamples Black, Hispanic and Asian persons through screenings and sampling from area segments with high concentrations of these racial/ethnic groups (52).

Analyses

Two comprehensive sets of analyses were conducted using different samples. The first analysis composed of the sample of individuals who had complete data on all variables used in the model, while the second analysis was based on a larger sample and used multiple imputation procedures to account for variables with greater than 10 percent of their data missing. In the latter case, preliminary analyses were conducted to determine the type and extent of missing data for outcome and predictor variables. Results indicated that there were no significant group differences and that data were missing completely at random (MCAR), inferring the missing and observed values will have similar distributions. Multivariable logistic regression techniques were used to model the association between alcohol use and HIV testing controlling for predisposing, enabling and need factors. In an effort to properly use all available information in our regressions, but at the same time avoid over-specification, we used a backward selection process to include in our models interaction terms based on our predisposing, enabling, and need factors, which were determined to be significant at the $p = 0.05$ level. While this decision had the potential to add a large number of interactions to our models, the criteria for inclusion turned out to be a stringent one, and only a few interactions met it. Analyses of both the unimputed and imputed samples used the weights provided by the survey to reflect national representation. Since differences between observed and unobserved values on respondent demographics and other relevant variables of which there was data in either sample was fairly minor, and since the assumption of MCAR could not be rejected, estimates based on weighted data should be close to unbiased. In addition, because results from the unimputed and imputed multivariable regressions were similar, only the former are shown in provided tables.

In addition to multivariable regressions based on the full sample of women, a subset multivariable analysis was conducted to model the association between alcohol use and HIV testing for women aged 18–49. This sub-analysis allowed for the inclusion of important variables, specifically, current pregnancy status and ever having a sexually transmitted disease (STD) in the past five years, two questions which were only asked for adults aged 18–49. Data were analyzed using SAS version 9.4 (53).

Dependent variable

As its main outcome variable, our study uses the response to the survey question, “Have you ever been tested for HIV separate from tests received as part of blood donations?” (0=never tested for HIV, 1=ever tested for HIV). This is a practically important and useful outcome to understand, because HIV testing is a protective practice well suited for behavior modification within the HIV care continuum.

Primary predictor

Two questions from the National Health Interview Survey (NHIS) were used to compute a measure for level of alcohol use. The first question, “In the past year, how often (days) did you drink any type of alcoholic beverage?” A second question, “In the past year, on how many days did you have 5 or more drinks of any alcoholic beverage?” was also used. A three category measure of alcohol consisting of: (1) no alcohol use, (2) moderate drinkers, and (3) heavy alcohol drinkers was derived. Moderate drinkers were defined as individuals who consumed some alcohol in the past year but no more than 5 or more drinks on any one day. Heavy alcohol drinkers were defined as individuals who had consumed five drinks or more on any one day in the past year. It should be noted that measures of moderate and heavy drinking are much less conservative than when compared to those defined by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) definition (54, 55). Specifically, NIAAA defines heavy drinking as drinking 5 or more drinks on the same occasion on each of 5 or more days in the past 30 days (55) The level of alcohol use measures in this exploratory study includes alcohol consumption at any point in the past year and not only in the past 30 days. Therefore, the risk drinking levels are much less conservative given the one-year duration time frame.

Control variables

Control variables consisted of predisposing, enabling and need factors as informed by the Gelberg-Andersen behavioral model for vulnerable populations (40). Predisposing level characteristics include age, race, marital status, education, mental health status, living condition, and housing arrangement; enabling factors include family income, forgoing medical care, health insurance, and geographic region; and need factors consist of current pregnancy status, general health status in the past 12 months and having a sexually transmitted disease (STD) in the past five years.

RESULTS

As shown in Table 1, the national sample consisted of 15,470 adult females.

Predisposing traditional factors

The mean age of study participants was 47 years. The largest proportion of participants identified as White (80%) compared to Black/African American (13%), Asian, (5%) and individuals of other racial groups (2%). More than half (53%) of the respondents reported having been married compared to never married (19%), previously married (22%), and living with a partner (6%). More than half of the women (59%) had completed some college

or were college graduates, 27% reported having a high school degree or GED, while 14% reporting less than high school education.

Predisposing vulnerable factors

More than half of the women (59%) reported experiencing an emotional problem in the past 30 days, that is, feeling at least sad, nervous, restless or fidgety, hopeless, that everything was an effort, or worthless. Four percent of the women reported ever living in the street, shelter, jail or prison for more than 24 hours. Most women (68%) reported owning their homes while 32% of women reported renting or having other housing arrangement. Nineteen percent of women reported heavy drinking (5+ drinks on any one day or more) in the past year. More than half of the women (61%) reported moderate alcohol use in the past year, while 21% of the women who reported never drinking any type of alcoholic beverage in the past year.

Enabling factors

Most of the women (36%) reported family incomes less than or equal to \$34,999. In addition, thirty-two percent of the women sampled reported incomes of \$75,000 and above. Ten percent of respondents reported forgoing needed medical care in the past year because they could not afford it, an indication of a lack of resources to access care. Additionally, 15% of the women reported not having health insurance coverage of any type. Participants were fairly distributed across geographic regions with most respondents residing in the South (36%) compared to the Midwest (24%), West (22%) and Northeast (18%).

Need characteristics

Most women (71%) reported that their health status was about the same as it was in the past 12 months, 19% who reported being in better health, and 10% reported being in worse health. Four percent of women aged 18–49 reported being currently pregnant at the time of the interview. Similarly, 4% of women aged 18–49 reported having a sexually transmitted disease other than HIV/AIDS in the past five years.

Health behavior

Results indicate that more than half (57%) of the women reported never having tested for HIV compared to (43%) who had tested for HIV.

Table 2 provides results from the multivariable logistic model on the association between HIV testing and level of alcohol use among females aged 18 and older controlling for predisposing, enabling and need factors. The results indicated a significant association between level of alcohol use and HIV testing. Older women, those with less than high school and with high school or GED education, and women living in the Midwest were less likely to report ever testing for HIV. Black/African American women were 2.9 times more likely to report ever testing for HIV compared to White women. Married, previously married, and women living with a partner were more likely to report testing for HIV compared to women who were never married. Women, who reported having an emotional problem within the past 30 days, had significant increased odds of reporting having tested for HIV (OR = 1.30, $p = 0.001$). Respondents who reported ever living in the street, shelter,

jail or prison for more than 24 hours were over 3 times more likely to report testing for HIV. Women who reported rental or other housing arrangements and those who had forgone medical care in the past 12 months were significantly more likely to report testing for HIV compared to their counterparts.

Controlling for predisposing, enabling and need level factors, women who identified as heavy drinkers (OR = 0.168, $p = 0.001$) and moderate drinkers (OR = 0.543, $p = 0.05$) were much less likely to report ever testing for HIV. Interactions between age and heavy drinking, and age and moderate drinking show that the odds ratio for ever testing for HIV increased by 4.0 percent per year increase in age among heavy alcohol users ($p = 0.001$), and 1.2 percent per year increase in age among moderate drinkers ($p = 0.05$). There were no significant interactions between level of alcohol use and other predisposing factors including race, marital status, education, mental health status, living condition, housing arrangement; level of alcohol use and enabling factors including family income, forgoing medical care, health insurance and region; and level of alcohol use and need factors, specifically, general health status.

Multivariable sub analyses of the nationally representative sample of women aged 18–49 is shown in Table 3. This sub analyses was conducted to include important variables that were only asked for women within this age group, specifically, pregnancy status and having a sexually transmitted disease in the past five years. Controlling for predisposing, enabling, and need level factors, there is a significant association between level of alcohol use and HIV testing. Older women were less likely to report ever testing for HIV. Black/African American women between ages 18–49 had an odds ratio of 3.4 with respect to ever testing for HIV compared to White women. Married, previously married, and women living with a partner were more likely to report testing for HIV compared to women who were never married. Women who reported having an emotional problem in the past 30 days showed an odds ratio of 1.27 with respect to testing for HIV, while respondents who reported ever living in the street, shelter, jail or prison for more than 24 hours had an odds ratio of 3.6 regarding testing for HIV. Women who reported rental or other housing arrangements and those who had forgone medical care in the past 12 months were more likely to report testing for HIV compared to their counterparts. Women who reported being currently pregnant had an odds ratio of almost 3.0 regarding testing for HIV. In addition, women who reported having a sexually transmitted disease other than HIV/AIDS in the past five years had an odds ratio of 2.2 with respect to testing for HIV.

Among the subsample of women aged 18–49, those who identified as heavy drinkers or moderate drinkers were even less likely to report ever testing for HIV than among the full sample (OR = 0.086, $p = 0.001$ for heavy drinkers and OR=0.234, $p = 0.01$ for moderate drinkers). Interactions between age and heavy drinking, and age and moderate drinking show that the odds ratios for ever testing for HIV increased by 6.9 percent per year increase in age among heavy alcohol users ($p = 0.001$) and 4.1 percent among moderate drinkers ($p = 0.01$). There were no significant interactions between level of alcohol use and other predisposing, enabling and need factors.

DISCUSSION

Promoting HIV protective behaviors, such as HIV testing, is important for reducing HIV transmission. This research provides valuable information about the association between alcohol use and HIV testing behavior from a national sample of women in the United States. Results indicate that among women, there is a negative relationship between level of drinking and likelihood of ever testing for HIV. Specifically, controlling for predisposing, enabling and need level factors, women who engaged in heavy drinking had an odds ratio of 0.17 regarding ever testing for HIV compared to women who did not drink any alcohol in the past year. Similarly, moderate drinkers had an odds ratio regarding ever testing for HIV of only 0.54. Among the subset of women aged 18–49 the results were even more startling. Women who engaged in heavy drinking had an odds ratio of 0.09 for ever testing for HIV compared to women who did not drink at all in the past year, while moderate drinkers in the same age group demonstrated an odds ratio of 0.23. These results show that higher levels of alcohol use are associated with less HIV testing protective behaviors, and that women between ages 18–49 who are moderate or heavy drinkers are even less likely to test for HIV than similar older women.

Prior research has demonstrated that alcohol use is a mediator of HIV risk taking behaviors such as unprotected sexual contact (18, 21, 56, 57). For alcohol using women, HIV prevention activities such as HIV testing is essential for HIV diagnosis and HIV prevention. With increasing rates of HIV infection and transmission among subgroups of women, conducting alcohol screening as well as HIV testing is of critical importance. Given findings indicating that alcohol use is associated with reduced likelihood of HIV testing, it is critical that primary care providers conduct routine screening for unhealthy alcohol use. In addition, research has shown that alcohol use is prevalent among people living with HIV (PLWHIV) (58, 59), and is associated with HIV sex risk behaviors (60), rapid disease progression and complications in this population (61–63). While this study did not examine the relationship between alcohol screening and HIV testing, routine alcohol screening for women with HIV as well as those who are at risk for HIV infection could facilitate opportunities for brief interventions, and additional HIV testing opportunities to reduce HIV infection and progression across the HIV/AIDS care continuum.

Interactions between age and heavy drinking and age and moderate drinking moderated the association between alcohol use and HIV testing among older women. Specifically, among women who engaged in heavy drinking and also among women who consumed some alcohol, the older the respondent was, the more likely she was to have reported ever testing for HIV. Compared to younger women, older women appear to be more sensitive to the need for self-protection, probably as a product of their more extensive life experience, as well as probable heightened perception of HIV as a health risk. It is likely that older women have a greater ability to negotiate and adopt other protective behaviors beyond their own HIV testing. These findings demonstrate that more HIV prevention activities are needed among younger alcohol using women who are at greater risk for HIV infection and transmission. Multivariable results also demonstrate there were no other significant interactions between alcohol use and HIV testing by other predisposing, enabling and need level factors.

Results also indicate that Black or African American women who consumed some alcohol were more than twice as likely to report ever testing for HIV compared to white women who did not consume any alcohol at all. Younger Black or African American women (aged 18–49) had odds ratios of 3.0 for ever testing for HIV compared with similarly aged Whites. This is an interesting finding because current research shows that among women, African American women represent the majority of new combined HIV/AIDS cases compared with Whites and Latina women (1, 2). These findings show that among these women, personal concern about becoming infected with HIV has become a priority. Findings from this research support prior work by the Kaiser Family Foundation that African Americans (both males and females) are more likely to report that they have talked to their doctor about HIV than Whites and Latinos (64). Further, for the subset of women aged 18–49, level of education and region did not influence the relationship between level of alcohol use and HIV testing, unlike the overall model of all adult women 18 years of age and older.

This research contributes new findings specific to women based on a national sample and provides data about alcohol use and HIV testing as well as information about predisposing, enabling and need factors that influence the association between alcohol use and HIV testing. Age is a key predisposing factor that should be considered in HIV prevention interventions. HIV testing activities should be tailored to target and address younger women who may not be aware of the risks associated with risk drinking behaviors. This is even more important for younger women who identify themselves as moderate or heavy drinkers.

In the fight against HIV transmission, HIV testing is important for alcohol using women. Given the reduction in inhibitions and judgment and the increased chance of engaging in HIV risky behaviors after alcohol use, it is imperative for this population to continually recheck their HIV status. In addition, study findings indirectly attest to the importance of alcohol screening for women experiencing or at risk for problems with alcohol. Research shows that including routine alcohol screening in all preventive health care encounters has the potential to provide substantial improvements to patients' health (65–67). Increasing opportunities for routine alcohol screening in traditional clinical settings such as private physician offices and non-traditional settings such as community based and outreach settings could help identify problem drinking and in turn curtail HIV risk related behaviors that may lead to HIV infection (68).

Promoting early knowledge of HIV status through HIV testing provides an opportunity to early detection and engagement in HIV care. For alcohol using women who are at increased risk for HIV infection, opportunities for improving HIV screening and testing should entail having access to HIV testing as well as access to appropriate medical, preventive, and psychosocial support services (69). The conversation and messaging around HIV testing and alcohol use should be tailored to the needs of this population, as well as reflect the communities in which these women reside taking into account community level resources that are available to leverage HIV testing practices.

LIMITATIONS

A few study limitations arising from this research should be noted. Data are cross sectional and time order cannot be established. Future research using longitudinal data could allow for measurement of HIV risk and protective behaviors over time. Data are predominantly self-reported and therefore are subject to inaccurate reporting problems. In addition, this study examines life history of HIV testing and alcohol use in the past year and does not assess encounter level HIV testing and alcohol use measures. Due to the nature of the NHIS survey, the study does not examine HIV risk behaviors such as current or past injection drug use and sexual activity, and HIV status of respondents, which are important factors in the transmission of HIV.

CONCLUSIONS

Findings add to the limited literature on the association between alcohol use and HIV testing behaviors among the nation's women. Given the rapidly increasing incidence of HIV among women, this study highlights the importance of educating women who drink, particularly women who drink heavily, about HIV testing. Public health policymakers should consider targeting resources for more comprehensive HIV prevention efforts with alcohol-using women.

The continuum of HIV prevention interventions to date have focused on reaching out to the most-at-risk populations such as injecting drug users, men who have sex with men, and female sex workers. While targeting HIV prevention at high-risk groups is an important strategy for curtailing the HIV epidemic, it is also important to survey and examine risk and protective behaviors in broader populations that are not traditionally identified as HIV high-risk groups. Current national survey data collection mechanisms such as the National Health Interview Survey (NHIS) provide an avenue for monitoring and tracking health behaviors, and provide the means for informative research about the broader population.

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Table I

Sample characteristics of female respondents (N=15,470)

Characteristic	N (%) or Mean (SD)
Pre-disposing	
Traditional Domains	
Age	46.88 (27.66)
Race	
White	11,371 (80.0%)
Black/African American	2,814 (12.9%)
Asian	894 (4.8%)
Other	391 (2.3%)
Marital Status	
Never married	3,324 (19.0%)
Married	6,524 (52.9%)
Previously married	4,796 (21.7%)
Living with a partner	785 (6.4%)
Highest Level of Education Completed	
Less than high School	2,587 (13.9%)
High school or GED	4,094 (27.3%)
Some college or more	8,709 (58.8%)
Vulnerable Domains	
Mental Health Status (sad, nervous, restless, hopeless, effort, worthless) past 30 days	
No	6,375 (41.0%)
Yes	9,019 (59.0%)
Living Condition (ever living in street, shelter, jail/prison) for more than 24 hours	
No	14,617 (96.5%)
Yes	601 (3.5%)
Housing Arrangement	
Rented or other arrangement	6,219 (32.2%)
Owned or being bought	9,225 (67.8%)
Level of alcohol use	
Heavy (5+ drinks or more)	1,973 (18.9%)
Moderate	6,538 (60.6%)
None (No/never alcohol use)	2,397 (20.5%)
Enabling	
Family Income	
\$0 – \$34,999	6,755 (36.3%)
\$35,000 – \$49,999	2,055 (14.1%)
\$50,000 – \$74,999	2,262 (17.7%)
\$75,000 and over	3,506 (31.9%)

Characteristic	N (%) or Mean (SD)
Forgoing medical care in past 12 months because I could not afford it	
No	13,792 (90.4%)
Yes	1,671 (9.6%)
Health Insurance of any type	
No	2,486 (15.2%)
Yes	12,950 (84.8%)
Geographic region	
Northeast	2,647 (18.0%)
Midwest	3,480 (24.3%)
South	5,674 (35.7%)
West	3,669 (22.0%)
Need Factors	
General Health Status past 12 months	
Better	2,899 (19.0%)
Worse	1,580 (9.7%)
About the same	10,968 (71.3%)
Currently pregnant *	
No	8,142 (96.4%)
Yes	295 (3.6%)
Sexually Transmitted Disease other than HIV/AIDS in past five years *	
No	7,900 (96.0%)
Yes	379 (4.0%)
Health Behavior	
Ever testing for HIV	
No	8,138 (56.8%)
Yes	6,814 (43.2%)

* Note that the pregnancy and sexually transmitted disease questions were only asked for adults aged 18–49

Table II

The association of level of alcohol use and HIV testing among females aged 18 and older controlling for predisposing, enabling and need factors

	HIV Testing (N=10,004)
Characteristic	Odds Ratio (95% CI)
Pre-disposing	
Traditional Domains	
Age	0.933 (0.925, 0.941) ***
Race	
White ^a	Ref.
Black/African American	2.925 (2.409, 3.551) ***
Asian	0.963 (0.712, 1.304)
Other	1.179 (0.720, 1.932)
Marital Status	
Never married ^a	Ref.
Married	2.150 (1.770, 2.610) ***
Previously married	2.702 (2.206, 3.309) ***
Living with a partner	2.087 (1.585, 2.747) ***
Highest Level of Education Completed	
Less than high School	0.730 (0.579, 0.921) **
High school or GED	0.813 (0.698, 0.947) **
Some college or more ^a	Ref.
Vulnerable Domains	
Mental Health Status (sad, nervous, restless, hopeless, effort, worthless) past 30 days	
No ^a	Ref.
Yes	1.299 (1.153, 1.463) ***
Living Condition (ever living in street, shelter, jail/prison) for more than 24 hours	
No ^a	Ref.
Yes	3.420 (2.518, 4.645) ***
Housing Arrangement	
Rented or other arrangement	1.390 (1.191, 1.622) ***
Owned or being bought ^a	Ref.
Level of alcohol use	
Heavy (5+ drinks or more)	0.168 (0.087, 0.326) ***
Moderate (Some alcohol use)	0.543 (0.320, 0.920) *
None (No/never alcohol use) ^a	Ref.
Enabling	

	HIV Testing (N=10,004)
Characteristic	Odds Ratio (95% CI)
Family Income	
\$0 – \$34,999	0.939 (0.768, 1.148)
\$35,000 – \$49,999	1.023 (0.848, 1.233)
\$50,000 – \$74,999	0.874 (0.729, 1.048)
\$75,000 and over ^a	Ref.
Forgoing medical care in past 12 months because I could not afford it	
No ^a	Ref.
Yes	1.451 (1.180, 1.785) ***
Health Insurance of any type	
No	1.092 (0.913, 1.307)
Yes ^a	Ref.
Geographic region	
Northeast	1.136 (0.929, 1.389)
Midwest	0.826 (0.704, 0.969) *
South	1.111 (0.942, 1.310)
West ^a	Ref.
Need Factors	
General Health Status past 12 months	
Better	1.095 (0.951, 1.261)
Worse	1.124 (0.896, 1.411)
About the same ^a	Ref.
Interactions of level of alcohol use on HIV testing by Pre-disposing factors	
Traditional Domains	
Alcohol level and Age	
Heavy alcohol use and Age	1.040 (1.025, 1.055) ***
Moderate alcohol use and Age	1.012 (1.002, 1.023) *
No alcohol use and Age ^a	Ref.
Alcohol level and Race	n.s.
Alcohol level and Marital Status	n.s.
Alcohol level and Education	n.s.
Vulnerable Domains	
Alcohol level and Mental Health Status	n.s.
Alcohol level and Living Condition	n.s.
Alcohol level and Housing Arrangement	n.s.
Interactions of level of alcohol use on HIV testing by Enabling factors	
Alcohol level and Family Income	n.s.
Alcohol level and Forgoing Medical Care	n.s.

	HIV Testing (N=10,004)
Characteristic	Odds Ratio (95% CI)
Alcohol level and Health Insurance	n.s.
Alcohol level and Region	n.s.
Interactions of level of alcohol use on HIV testing by Need factors	
Alcohol level and General Health Status	n.s.

^aReference category;

P 0.001;

**

P 0.01;

*

P 0.05

n.s. = Not Significant

Model statistical summary (N=10,004): Model Wald $\chi^2 = 1345.32$; df=26; p<0.0001, C-Statistic=0.769

Table III

The association of level of alcohol use and HIV testing among females aged 18–49 controlling for predisposing, enabling and need factors

	HIV Testing (N=5,791)
Characteristic	Odds Ratio (95% CI)
Pre-disposing	
Traditional Domains	
Age	0.943 (0.919, 0.968) ***
Race	
White ^a	Ref.
Black/African American	3.410 (2.622, 4.434) ***
Asian	0.888 (0.622, 1.269)
Other	0.859 (0.532, 1.388)
Marital Status	
Never married ^a	Ref.
Married	2.060 (1.670, 2.542) ***
Previously married	2.351 (1.797, 3.076) ***
Living with a partner	1.625 (1.215, 2.175) **
Highest Level of Education Completed	
Less than high School	0.723 (0.519, 1.007)
High school or GED	0.851 (0.711, 1.018)
Some college or more ^a	Ref.
Vulnerable Domains	
Mental Health Status (sad, nervous, restless, hopeless, effort, worthless) past 30 days	
No ^a	Ref.
Yes	1.266 (1.082, 1.482) **
Living Condition (ever living in street, shelter, jail/prison) for more than 24 hours	
No ^a	Ref.
Yes	3.591 (2.351, 5.485) ***
Housing Arrangement	
Rented or other arrangement	1.407 (1.168, 1.695) ***
Owned or being bought ^a	Ref.
Level of alcohol use	
Heavy (5+ drinks or more)	0.086 (0.026, 0.279) ***
Moderate (Some alcohol use)	0.234 (0.078, 0.702) **
None (No/never alcohol use) ^a	Ref.
Enabling	

	HIV Testing (N=5,791)
Characteristic	Odds Ratio (95% CI)
Family Income	
\$0 – \$34,999	0.979 (0.763, 1.255)
\$35,000 – \$49,999	0.875 (0.692, 1.108)
\$50,000 – \$74,999	0.857 (0.674, 1.090)
\$75,000 and over ^a	Ref.
Forgoing medical care in past 12 months because I could not afford it	
No ^a	Ref.
Yes	1.375 (1.058, 1.786) *
Health Insurance of any type	
No	1.138 (0.919, 1.410)
Yes ^a	Ref.
Geographic region	
Northeast	1.223 (0.963, 1.552)
Midwest	0.845 (0.685, 1.043)
South	1.086 (0.887, 1.328)
West ^a	Ref.
Need Factors	
General Health Status past 12 months	
Better	1.086 (0.918, 1.285)
Worse	0.994 (0.720, 1.370)
About the same ^a	Ref.
Currently pregnant	
No ^a	Ref.
Yes	2.522 (1.572, 4.047) ***
Sexually Transmitted Disease other than HIV/AIDS in past five years	
No ^a	Ref.
Yes	2.180 (1.292, 3.678) **
Interactions of level of alcohol use on HIV testing by Pre-disposing factors	
Traditional Domains	
Alcohol level and Age	
Heavy alcohol use and Age	1.069 (1.036, 1.104) ***
Moderate alcohol use and Age	1.041 (1.010, 1.072) **
No alcohol use and Age ^a	Ref.
Alcohol level and Race	n.s.
Alcohol level and Marital Status	n.s.
Alcohol level and Education	n.s.

	HIV Testing (N=5,791)
Characteristic	Odds Ratio (95% CI)
Vulnerable Domains	
Alcohol level and Mental Health Status	n.s.
Alcohol level and Living Condition	n.s.
Alcohol level and Housing Arrangement	n.s.
Interactions of level of alcohol use on HIV testing by Enabling factors	
Alcohol level and Family Income	n.s.
Alcohol level and Forgoing Medical Care	n.s.
Alcohol level and Health Insurance	n.s.
Alcohol level and Region	n.s.
Interactions of level of alcohol use on HIV testing by Need factors	
Alcohol level and General Health Status	n.s.
Alcohol level and Currently Pregnant	n.s.
Alcohol level and STD other than HIV/AIDS in past five years	n.s.

^aReference category;

*** P 0.001;

** P 0.01;

* P 0.05

n.s. = Not Significant

Model statistical summary (N=5,791): Model Wald $\chi^2 = 324.07$; df=28; p<0.0001, C-Statistic=0.679