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The Impact of Mental Illness on HIV Testing Behavior in Men who Have Sex with Men (MSM) in the United States

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Michelle L. McKinlay

B.A., University of California, Berkeley, 2016

Faculty Thesis Advisor: Ann Do, M.D., M.P.H.

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Abstract

The Impact of Mental Illness on HIV Testing Behavior in Men who Have Sex with

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By Michelle L. McKinlay

Objective: Assess the impact of mental illness on HIV testing behavior in MSM in the United States.

Methods: We analyzed data from the 2018 American Men's Internet Survey (AMIS), an annual online survey conducted to explore HIV risk behaviors among men who have sex with men (MSM) in the US. The Kessler 6 (K6) Psychological Distress Scale was used to assess the exposure, and a question about HIV testing in the past 12 months was used to assess the outcome. Serious mental illness (SMI), the primary exposure, was defined by a K6 scale score of 13 or higher. Univariate and bivariate analyses were conducted, with calculation of prevalence ratios for the latter. Multivariate logistic regression was used to assess the relationship between SMI and HIV testing in the past 12 months, and potential confounders included age, race/ethnicity, education, illicit substance use, sexual orientation outness, experience of discrimination by friends and/or family, experience of discrimination in a healthcare setting, and health insurance.

Results: Among 9,946 individuals included in our analysis, 5,290 (53.3%) reported receiving an HIV test in the past 12 months and 2,390 (24.03%) had SMI. 86.5% of study participants reported seeing a healthcare provider in the past year. On average, individuals who reported not receiving an HIV test in the past 12 months had a higher psychological distress score ($\mu = 8.50$) compared to individuals who reported receiving an HIV test in the past 12 months ($\mu = 7.62$). Logistic regression analysis showed the odds of HIV testing in the past 12 months in MSM with SMI were 0.92 times the odds of HIV testing in the past 12 months in MSM without SMI, which was not statistically significant (p-value: 0.1334).

Conclusion: The burden of SMI among our population was substantial. Although we found a null relationship between SMI and HIV testing, there was evidence of a negative association. Most MSM in our study appeared engaged in healthcare, which might have modified this relationship. Further research is needed to better understand this relationship among MSM with mental illness who are not as engaged in healthcare, because they may be at greatest risk for HIV infection.

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Michelle L. McKinlay

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Background

In the United States an estimated 1.1 million individuals are living with HIV (1, 2). As a disease that is spread from person to person, it is of particular concern that approximately 1 in 7 individuals who have HIV are unaware of their infection status and may unknowingly transmit it; nearly 40% of new infections are transmitted by people who do not know they have HIV (1, 2). HIV testing is important as an entry point to care and prevention services. If diagnosed with HIV infection, individuals can be linked into care where they can receive antiretroviral treatment to suppress their HIV viral load and reduce the risk for onward transmission. Individuals living with HIV who are aware of their infection status would also have the knowledge and tools needed to manage their disease, remain healthy and avoid HIV risk behaviors (1, 2). HIV testing is not only important for individuals who are HIV positive, but also for those who test HIV negative, because they can still learn about important preventative measures to help reduce their risk of becoming infected with HIV and remain healthy (2). The epidemic has remained a national concern, and recent renewed interest has culminated in the announcement of the "Ending the HIV Epidemic: A Plan for America" initiative at the 2019 State of the Union address (3). The goal of this initiative is to reduce the incidence of HIV infections by 90% by the year 2030 through first targeting high risk communities and then expanding outward (3). A major focus of the initiative is to increase the uptake of CDC's recommendation for all people ages 13-64 to be tested for HIV at least once (2, 3). HIV testing is so important to this initiative because there are serious implications for delayed HIV testing and therefore delayed HIV treatment; early detection is necessary for both

reduced transmission of disease and for the individual to experience the best health outcomes (4, 5).

HIV disproportionately affects different subsets of the population. Most notably, men who have sex with men (MSM) account for the majority of individuals living with HIV (6, 7). This at-risk population accounts for 70% of new diagnoses each year, making individuals in this population at greatest risk for HIV infection among individuals of all risk populations (7). In addition to a high prevalence of HIV in this population, other HIV risk factors for MSM, who only about 4% of the U.S. male population, include age, race, multiple sexual partners, lower education, and inconsistent or no condom usage (8-10). Due to these statistics, MSM are a commonly studied population in the United States in regard to HIV as an outcome and a priority population for HIV prevention efforts because effective interventions in this population can have a large impact.

The high risk for HIV infection among MSM is compounded by both common and unique barriers to healthcare that also affect access to HIV testing. These include limited cultural competency (regarding the unique needs of sexual minorities) among healthcare practitioners, a lack of clinical guidelines for this subpopulation, increased stress due to being a sexual minority, as well as the lack of health insurance and other social determinants of health (7, 8). There is also evidence that underlying mental health problems can affect health seeking behaviors and exacerbate barriers to care, including HIV testing, but there is a great need for further research on this topic to better understand the relationship. Because mental illness and HIV infection frequently co-occur, the relationship between mental health and HIV testing in the MSM population is of particular interest because both conditions are more prevalent in this population than in

many other populations, and MSM are at increased risk for both conditions. Mental illness is a risk factor for HIV acquisition and transmission through its association with substance use and sexual risk behaviors (4, 11-14). Individuals with mental illness have a reduced ability to disengage with behaviors that are risk factors for HIV, such as substance use (12, 13). Additionally, individuals with serious mental illness (SMI) have been shown to engage in higher rates of risky sexual behavior than those without mental illness, including but not limited to inconsistent or no condom usage, multiple sexual partners, and sex with an HIV-positive or unknown status partner (4, 12).

The role that mental illness plays in the MSM population's access to and utilization of HIV testing is not clearly understood, and it is important that these relationships be further assessed. Recently, some researchers have shown interest in the way in which mental illness uniquely impacts HIV testing. Most of these studies have found that individuals with mental illness have higher HIV testing rates compared to those without mental illness, with nearly half of individuals reporting ever being tested for HIV (12, 15). Reasons for this finding have been hypothesized to be related to a greater desire to know their HIV status and more frequent visits to healthcare professionals due to having a mental illness (11, 12, 15). However, it is important to note that these studies have been performed in a mental healthcare setting. Individuals who have received a mental illness diagnosis have accessed healthcare resources and may be monitored more closely than those in the general population, which may explain more frequent HIV testing. Nevertheless, one study found that among individuals who reported receiving an HIV test, there was no statistically significant change in testing rates over the course of 9 years (15). An unchanged testing rate over nearly a decade suggests that

there are existing barriers to care that still need to be addressed among individuals living with mental illness. There are other studies that have found that individuals with mental illness experience greater barriers when accessing HIV testing (13, 16, 17). This relationship has been attributed to resource-limited settings these individuals are often in, mental disorders interfering with HIV prevention and treatment, increased healthcare costs, and the fact that HIV testing is not a common practice in mental health clinics (13, 17, 18). The mixed results from previous studies suggest a complex relationship between mental illness and HIV testing. Additional research is needed to better understand this relationship and improve access and delivery of HIV testing and prevention services among those at highest risk.

Mental health can influence decision-making and behavior, and it is important to understand the intricacies of how it affects behavioral patterns relevant to HIV prevention among MSM. We hypothesize that mental illness is negatively associated with HIV testing among MSM. We sought to examine this relationship in the context of other psychosocial characteristics that may also contribute to HIV testing behaviors (4). Our findings would contribute to current understanding of mental illness and HIV testing behaviors, which can inform current HIV prevention efforts.

Methods

Study design and population

The American Men's Internet Survey (AMIS) is conducted annually to explore HIV risk behaviors as well as access to and use of healthcare services among MSM in the United States (6). The sections of the survey regarding HIV testing, healthcare, and the Kessler 6 (K6) Psychological Distress Scale were used to assess the relationship between psychological distress and HIV testing behavior among MSM, and to examine the roles that demographic and socioeconomic characteristics, HIV behavioral risk factors, and healthcare access play in this relationship.

AMIS recruits eligible MSM through convenience sampling by using different types of targeted, digital ads; men who clicked on the ads were directed to the AMIS website. Participants were considered eligible to complete the online self-administered survey if they are age 15 years or older, were male sex at birth, reported residence in the US, and had sex (oral or anal) with a man at any point in their lifetime. Exclusion criteria included individuals who were male sex at birth but now identify as female or transgender, and not meeting any of the inclusion criteria. Once individuals met the inclusion criteria and gave informed consent to being part of the study, they were eligible to immediately proceed with the self-administered questionnaire. Participants were not provided with any incentives. AMIS received approval from the Emory University Institutional Review Board prior to conducting the survey. More detailed AMIS methods information is available in a previous report (6).

Measures

In this study, the primary exposure was serious mental illness (SMI), assessed by a validated cutoff score from the K6 scale. A secondary exposure this study also examined was any symptoms of mental illness (MI), assessed by a non-validated but previously utilized cutoff of the K6 scale. This scale is a shortened version of the K10 scale, originally developed to identify non-specific stress through a heterogeneous set of questions (19, 20). The K10 scale is a 10-item questionnaire that asks questions about how frequently respondents have experienced symptoms of psychological distress in the past month (20). The K6 scale is a 6-item questionnaire modified from the K10 scale, and specifically asks about feelings of nervousness, hopelessness, restlessness, depression, extra effort, and worthlessness in the past 30 days. Both scales have been well-validated and allow participants to respond using a five-point Likert scale, with possible scores ranging from 0-24 for the K6 scale (20). Psychological distress scores are then summed and categorized based on standard instrument cutoffs. For this study, individuals with a score of ≥13 were considered to have SMI, the primary exposure of interest. Individuals with a score of ≥5 were considered to have MI, the secondary exposure of interest. The cutoffs commonly used for the K6 instrument are: 0-4 (no or mild mental illness symptoms), 5-12 (moderate mental illness symptoms), ≥13 (serious mental illness symptoms) (21). While these cutoffs have been previously used, only the ≥13 cutoff has been validated for screening for SMI (20, 21). In the validation study, researchers concluded that the optimal K6 scale cutoff of 13 has a sensitivity of 0.36 for its ability to correctly identify individuals with SMI, a specificity of 0.96 for its ability to correctly identify those without SMI, and a total classification accuracy of 0.92; when compared to

other psychological distress screening instruments in the validation study, the K6 scale

was the most efficient in screening for SMI due to its ability to differentiate between

individuals with and without SMI when using a cutoff of 13 (20). For these reasons, the

primary exposure utilizes the 13 cutoff point which has been previously used to estimate

the 12-month prevalence of SMI, classified as severe nonspecific psychological distress,

in a population (20). All analysis completed for the secondary exposure was done so with

the knowledge that the lower cutoff has not yet been validated for assessing MI. The

secondary exposure analysis was performed in order to better understand the data and the

population of interest.

      The primary outcome measure in this study was receiving HIV testing in the past

12 months. Individuals who reported receiving an HIV test within that timeframe were

considered to have the outcome of interest. The 12-month timeframe was selected

because the CDC currently recommends that all persons likely to be at high risk for HIV,

such as MSM, get tested at least annually (2, 22). Due to this recommendation, it is

expected that MSM who follow the testing guidelines would most likely have been tested

within the past 12 months, and this study aimed to capture those individuals using the

selected timeline. Participants were excluded from the study if they were missing data for

the main exposure or outcome variables, and a comparative analysis was run on the

demographics of the excluded individuals and those who remained in the study in order

to assess potential bias.

      Several covariates were included in the study and considered as potential

confounders for the relationship between mental illness and HIV testing. Standard

individual demographic characteristics such as age, race/ethnicity, and education were

categorized as reported. Health insurance coverage was collapsed into four main categories. Illicit substance use measured use of any illicit substance in the past 12 months. The outness variable was constructed from a question that asked whether or not the participant had ever told someone about his sexual relations with another man. Experience of housing instability was measured by combining two questions that asked about irregular, inadequate housing and homelessness in the past 12 months. Community tolerance of gay individuals was analyzed as reported on the questionnaire, with the responses collapsed into three categories. The questionnaire section on stigma and discrimination was recoded by placing relevant questions into two main categories, discrimination by family and/or friends, and discrimination in healthcare setting. These two categories were identified as the most meaningful predictors of discrimination for the study's exposure and outcome of interest with discrimination by family and/or friends serving as a proxy for social support.

Univariate and Bivariate Statistical Analyses

Participants who did not have missing information for the K6 Psychological Distress Scale and for HIV testing were considered in the analysis. An alpha level of 0.05 was used to determine statistical significance for all statistical tests. First, overall counts and column percentages were calculated for each covariate, stratified by the primary exposure and then by the secondary exposure, in order to become familiar with the data and visualize the distribution of the exposure across covariates. Prevalence ratios and 95% confidence intervals (CI) were then obtained for each covariate, stratified by HIV testing, in order to illustrate the prevalence of the outcome of interest within different levels of the covariates of interest.

Multivariate Statistical Analyses

Statistical modeling began with including all previously mentioned covariates of interest as exposure variables and SMI (the primary exposure of interest) – defined by severe psychological distress as previously described – as the outcome variable. After assessing previous literature and a constructing a directed acyclic graph (DAG) (Figure 1) specific to the relationship of interest, the following variables remained in the full model prior to interaction and confounding assessment: age, race/ethnicity, education, illicit substance use, sexual orientation outness, experience of discrimination of friends and/or family, and experience of discrimination in a healthcare setting, and health insurance. Interaction assessment was completed considering four interaction terms: SMI*education, SMI*race/ethnicity, SMI*age, and SMI*health insurance. We did not detect any statistically insignificant interaction and proceeded without including any interaction terms in the model. Next, confounding assessment was performed by running the gold standard, fully parameterized model, which is the model that includes all covariates of interest. Then, subsequent models that each removed a potential confounder were run to assess the effect of removing each potential confounding variable. If the new model estimate differed from the gold standard estimate by more than 10%, then the removed covariate was considered to be a significant confounder that must remain in the model. Based on the outcome of our confounding assessment, in which only the education variable was close to the threshold of statistical significance, we developed two final models. Model 1 is considered the gold standard, fully parameterized model; Model 2 adjusts only for education, age, race/ethnicity, and illicit substance use. The covariates in Model 2 were selected based on confounding assessment and trends in previous

literature. The final models were run using unconditional logistic regression. All analysis was performed using SAS 9.4 Analytics Software (SAS Institute, Cary, North Carolina).

Results

Characteristics of study sample (Tables 1A and 1B)

Among the 10,129 individuals who completed the 2018 AMIS questionnaire, 2 were excluded from this analysis due to implausible data and 181 were excluded due to missing or incomplete data on HIV testing or the K6 Psychological Distress Scale. Of the 9,946 remaining individuals, most were age 15-24 years old (n = 4,133 [41.6%]), white non-Hispanic (n = 6,892 [69.3%]), college or professional graduates (n = 4,223 [42.5%]). Individuals excluded due to implausible or missing data had similar demographic characteristics to the study sample with the majority being age 15-24 years old (n = 97 [53.6%]), white, Non-Hispanic (n = 118 [66.7%]) individuals with higher education levels (some college or technical degree: n = 53 [31.0%], college or professional degree: n = 51 [29.8%]); all other subcategories for age, race/ethnicity, and education followed the same trend as the study sample. In regard to healthcare utilization, 86.5% of respondents reported they have seen a healthcare provider in the past 12 months.

The prevalence of the mental illness exposure appeared to vary by demographic characteristics. Overall, 2,390 (24.03%) study participants had SMI according to the K6 scale (Table 1A). Individuals with SMI were most commonly 15-24 years old, Hispanic or Latino or multiracial/other, and with lower levels of education (Table 1A). A higher proportion of individuals with SMI than without SMI also reported either no insurance (13.8%) or public health insurance (17.1%), illicit substance use (46.6%), experiencing housing instability in the past 12 months (16.6%), disagreeing that their community is tolerant of gay or homosexual individuals (26.9%), and experiencing discrimination by friends and/or family (70.5%), and/or in a healthcare setting (41.1%) (Table 1A). Very

similar characteristics were seen among the 6,549 (65.85%) individuals with MI (Table 1B). Of the 9,946 individuals analyzed in this sample, 5,290 (53.2%) reported receiving an HIV test in the past 12 months.

Bivariate associations with HIV testing (Table 2)

Having received an HIV test in the past 12 months was positively associated with reported illicit substance use (PR = 1.08, 95% CI: 1.04, 1.13), as was experience of discrimination by friends and/or family (PR = 1.05, 95% CI: 1.01, 1.09).

Several factors were significantly associated with a decreased prevalence of HIV testing in the past 12 months, such as SMI (PR = 0.86, 95% CI: 0.82, 0.91) or MI (PR = 0.90, 95% CI: 0.86, 0.93) compared to no mental illness symptoms; age 15-24 years compared to 40 years or older (PR = 0.68, 95% CI: 0.65, 0.72); having less than a high school education (PR = 0.32, 95% CI: 0.28, 0.37), a high school education (PR = 0.65, 95% CI: 0.61, 0.70) or some college education or a technical degree (PR = 0.85, 95% CI: 0.82, 0.89), all compared to having a college degree or postgraduate education; having public health insurance (PR = 0.87, 95% CI: 0.82, 0.92) or no health insurance (PR = 0.83, 95% CI: 0.77, 0.89) compared to having private health insurance; never having told someone about intimate relations with another male compared to having told someone (PR = 0.62, 95% CI: 0.55, 0.70); feeling neutral whether their community is tolerant of gay or homosexual individuals (PR = 0.92, 95% CI: 0.88, 0.97) or disagreeing or strongly disagreeing that their community is tolerant of gay or homosexual individuals (PR = 0.83, 95% CI: 0.78, 0.88) compared to agreeing or strongly agreeing with that statement; and finally, having experienced compared to not having experienced discrimination in a healthcare setting (PR = 0.93, 95% CI: 0.89, 0.97).

K6 psychological distress scale (Tables 3 and 4)

Regarding individual K6 scale items, there was a higher proportion of participants who did not receive an HIV test in the past 12 months than there was of participants who did to respond, "most of the time" or "all of the time" to the K6 questions regarding nervousness, hopelessness, restlessness, effort, depression, and worthlessness (Table 3). There was a higher proportion of participants who received an HIV test in the past 12 months than there was of participants who did not to respond, "none of the time" for the K6 questions regarding nervousness, hopelessness, restlessness, depression, effort, and worthlessness (Table 3). In addition, individuals who reported they did not receive an HIV test in the past 12 months have a higher psychological distress score ($\mu = 8.50, \sigma = 5.92$) compared to individuals who had received an HIV test in the past 12 months ($\mu = 7.62, \sigma = 5.67$) (Table 4).

Adjusted associations with HIV testing (Table 5)

Model 1 – fully parameterized:

$$\ln(odds\ of\ \_LASTHIVTEST12) = \alpha + \beta_1 MENTAL\_ILL\_SMI + \gamma_1 AGE\_CAT$$
$$+ \gamma_2\_EDUCAT + \gamma_3 NEWRACE + \gamma_4\_INSCAT + \gamma_5 ILLICIT$$
$$+ \gamma_6 OUTNESS + \gamma_7 SOC\_STIGMA + \gamma_8 HC\_STIGMAn$$

Model 2 – partially adjusted:

$$\ln(odds\ of\ \_LASTHIVTEST12) = \alpha + \beta_1 MENTAL\_ILL\_SMI + \gamma_1 AGE\_CAT$$
$$+ \gamma_2\_EDUCAT + \gamma_3 NEWRACE + \gamma_5 ILLICIT$$

Interaction testing did not yield statistically significant interaction by any covariate tested. Confounding testing and assessment revealed that insurance category, outness about one's sexual orientation, social stigma, or healthcare stigma were not

strongly associated with the relationship between mental illness and HIV testing, so these covariates were excluded from Model 2.

In Model 1 statistically significant associations were observed between HIV testing in the past 12 months and the following characteristics: being aged 15-24 years (aOR: 0.65) compared to being aged 40 years or older; having less than a high school diploma (aOR: 0.24), a high school diploma or GED (aOR = 0.57), or some college or a technical degree (aOR = 0.79) compared to having a college or professional degree; being black (aOR = 1.35), Hispanic or Latino (aOR = 1.30), or multiracial/other race (aOR = 1.21) compared to being white; having no health insurance (aOR = 0.70); reporting illicit substance use (aOR = 1.28); never having told someone about intimate relations with another male (aOR = 0.52); discrimination by family and/or friends (aOR = 1.11); and discrimination in a healthcare setting (aOR = 0.89) . In this model, no statistically significant relationship was found between SMI and HIV testing in the past 12 months (aOR = 0.95, p-value: 0.4890).

In Model 2 statistically significant associations were observed between HIV testing in the past 12 months and the following characteristics: being aged 15-24 years (aOR: 0.62); having less than a high school diploma (aOR: 0.20), a high school diploma or GED (aOR = 0.51), or some college or a technical degree (aOR = 0.76); being black, non-Hispanic (aOR = 1.27), Hispanic or Latino (aOR = 1.31), or multiracial/other (aOR = 1.22); and reporting illicit substance use (aOR = 1.34). In this model, a stronger relationship was found between SMI and HIV testing in the past 12 months, but it was not statistically significant (aOR = 0.92, p-value: 0.1334).

Discussion

Overall, 53.2% of MSM respondents reported receiving an HIV test in the past 12 months. Of the individuals who received an HIV test in that timeframe, 20.5% qualified as having SMI and 63.4% qualified as having any type of MI (including SMI), using the K6 Psychological Distress Scale. Among the individuals who did not receive an HIV test in the past 12 months, 25.9% qualified as having SMI and 68.7% qualified as having any type of MI. Since HIV testing in the past 12 months was not equally distributed between individuals with and without SMI in univariate analysis, this suggested that HIV testing may vary by SMI status, which warranted further examination. Although our results from logistic regression modeling did not show a statistically significant relationship, we found that the odds of HIV testing in the past 12 months in MSM with SMI were 0.92 times that of MSM without SMI (p-value: 0.1334) in a model that controlled for age, education, race/ethnicity, and illicit substance use.

Many of the findings from our analysis were similar to previous published research on mental health issues and HIV testing among MSM. Our study found significantly lower prevalence of HIV testing in younger age groups compared to the oldest age group as well as lower prevalence of HIV testing among individuals with less education, consistent with previous findings (23, 24). Also in alignment with other previous findings on this topic, we found lower prevalence of HIV testing among MSM who reported they were not open about their sexual orientation, those who disagreed that their community is tolerant of gay or homosexual individuals, and those who reported experiencing discrimination in a healthcare setting (25-27).

Although most of the findings regarding the role of stigma and discrimination in our study aligned with those from previous studies, our finding of higher HIV testing prevalence among MSM who reported experiencing discrimination by friends and/or family was surprising and seemed counterintuitive (25-27). However, there are potential explanations for this finding in our study. We noted that the measure for discrimination by friends and/or family in AMIS was based on a single survey question, rather than a validated scale for social stigma, and may not be comparable to other ways of assessing the same construct. Another possibility is that MSM who experienced discrimination specifically from their friends and/or family were eventually displaced into a more niche MSM community, in which HIV testing is less stigmatized and therefore encouraged.

The prevalence of psychological distress that is suggestive of mental illness in this study population is significantly higher than the prevalence of mental illness found in the general U.S. male population. In this study, the prevalence of any MI is 65.85%, compared to the reported estimate of 15.1% for U.S. adult men (28). Additionally, this study saw a prevalence of 24.0% for SMI which is much larger than the estimated 3.3% among adult men in the U.S. general population (28). This difference may be explained in part by the fact that the U.S. general population estimates are for male adults 18 years of age and older, and our study population included U.S. males 15 years of age and older, as there is evidence of higher prevalence of psychological distress in younger age groups in the United States, which might have also been captured in our study (28, 29). A previous study that examined an age cohort effect on psychological stressors found that symptoms of depression and anxiety were greater for millennials compared to baby boomers, in part, due to the ability of baby boomers to utilize active coping mechanisms

(29). Additionally, MSM may be at greater risk than others in the general population for mental illness, as an outcome of chronic psychosocial stressors related to discrimination, stigma, and lack of social support because of their sexual orientation (4, 11). Finally, this trend could be due to fact that although the K6 scale is known for its ability to capture nonspecific MI, it might be better at capturing some MIs compared to others (30). The high prevalence of SMI in this population might reflect a higher prevalence of specific psychiatric disorders that the K6 scale may be best at capturing. The high prevalence of mental illness in this population is important context to have when interpreting the results of this study. It may also have implications for the clinical care of and provision of services to MSM.

We observed a similar distribution in the prevalence of HIV testing in the past 12 months when examining our primary exposure (SMI) as we did when examining our secondary exposure (MI). The prevalence of HIV testing in the past 12 months was 0.86 times as high among MSM with SMI as it was among those with no SMI. Similarly, the prevalence of HIV testing in the past 12 months was 0.90 times as high among MSM with MI as it was among those with no MI. These differences were statistically significant in bivariate analysis. The stronger association between SMI and HIV testing in the past 12 months may reflect a dose-response effect suggesting an inverse relationship between psychological distress and HIV testing behavior.

The K6 Psychological Distress Scale includes six questions about both depression and anxiety symptoms, and we observed a similar trend of HIV testing across all scale items, with responses of having these symptoms "most of the time" or "all of the time" seen more frequently among participants who did not test for HIV in the past 12 months

than among those who did. This trend suggests that greater levels of psychological distress are experienced by MSM who did not receive an HIV test.

Overall, the average psychological distress score was 0.8 points higher for individuals who reported not receiving an HIV test in the past 12 months than for those who did. A similar pattern held true across nearly all categories of demographics and other characteristics examined. The contrast was most prominent among participants who were black non-Hispanic or Hispanic or Latino, those with public health insurance, those who reported illicit substance use, those who reported being open about their sexual orientation, and those who had experienced discrimination by friends and/or family. For each of these subgroups, the mean psychological distress score for individuals who reported not receiving an HIV test in the past 12 months was greater than 1 point higher than the score for those who reported having received an HIV test in the past 12 months. This suggests that the relationship between mental illness and HIV testing behavior is stronger in these specific subpopulations.

Our findings suggest that the relationships between psychological distress and HIV testing behavior may not be as strong in this population as hypothesized, and it appears that other factors might have played more prominent roles in regard to HIV testing behaviors in our study population. We noted that the participants in this study appear to be high utilizers of healthcare resources, with 86.5.% of individuals reported seeing a healthcare provider in the past 12 months regarding their own personal health. The 2018 National Health Interview Survey, conducted in the general U.S. population, found that only 77.6% of men reported seeing or talking with a healthcare provider in the past 12 months (31). It is plausible that a population with higher than average utilization

of healthcare resources would also have a higher than usual uptake in HIV testing, given

the larger number of opportunities for delivery of preventive services with more frequent

access to healthcare. Previous studies have mostly focused on the relationship between

mental illness and HIV testing among individuals who are in care for their diagnosed

mental illness, but more research is needed to better understand this relationship among

individuals with mental illness who are not yet diagnosed, entered care, or engaged in

care, because these individuals may be at even greater risk for HIV infection.

Another notable observation was that the relationship between SMI and HIV

testing appears to be modified by health insurance coverage. A similar pattern was

observed among individuals with public health insurance and those with no health

insurance, which differed from another pattern seen among individuals with private or

with other health insurance coverage. An average of 42.7% of individuals with SMI who

had public or no health insurance reported receiving HIV test in the past 12 months,

while an average of 53.1% of individuals with SMI who had private or other health

insurance reported receiving HIV test in the past 12 months. Our study showed

substantially lower odds of HIV testing in the past 12 months for individuals with SMI

among those with public or no health insurance coverage compared to those with private

or other health insurance coverage, but the 95% confidence intervals overlapped for the

odds ratios, demonstrating no statistically significant interaction. Although not

statistically significant, there is a clear pattern of an effect modification that might be

more prominent in another sample with larger number of individuals with SMI. We were

also limited in our ability to examine variables related to healthcare utilization, given the

high frequency of utilization among our study population, with 86.5% participants

reporting they have seen a healthcare provider in the past 12 months. Both access to healthcare (insurance coverage) and use of healthcare are important factors that likely affect HIV testing, especially among individuals with mental health problems, and they deserve closer examination in future studies.

Strengths

One strength of this study is the large sample size of MSM. This means that the data is more robust and less sensitive to outliers and missing data. Additionally, a larger sample size means a smaller margin of error and therefore more precise statistical results. Though AMIS is not a nationally representative survey, it is still a large convenient sample that is demographically diverse, which adds strength to this specific study. Additionally, AMIS collects a large amount of psychosocial data that are especially important for the exposure outcome relationship in this study and allowed for more accurate statistical modeling and a deeper exploration into potential effect modifiers and confounding factors. Most self-reported surveys are subject to social desirability bias, which is a type of response bias that occurs when participants feel inclined to respond to questions in a way that is favorably viewed by society. However, the online administering of AMIS might have reduced this bias since individuals who aren't reporting directly to another person feel that they have more anonymity. Finally, a huge strength of this specific study is the gap it fills in the existing literature. The majority of existing studies examining the relationship between mental illness and HIV testing were conducted in mental healthcare settings, which limited the understanding of this relationship as an indicator of HIV testing practices to such settings only (11, 12, 15). With AMIS we were able to examine mental illness and HIV testing in a large sample of

MSM outside of the mental healthcare setting. Given the underdiagnosis of mental illness and the higher prevalence of HIV among those with mental illness, an understanding of its potential influence on HIV testing behaviors is crucial to HIV prevention efforts (4, 11, 32). The K6 Psychological Distress Scale is a useful tool that allowed us to broadly assess SMI in our study population, whether or not all those with a mental illness have been diagnosis and received care for their condition.

Limitations

In addition to the strengths of this study, it is also important to mention the limitations. First, consistent with other large survey studies, a limitation of the AMIS study is its cross-sectional study design. Due to the exposure and outcome variable data being collected at the same time, it is difficult to establish temporality. Specific to this study, the exposure and outcome variables are retrospectively measured over a different time period. The exposure, measured by the K6 scale, asks participants to respond to the 6-item questionnaire regarding their feelings and emotions over the past 30 days. The outcome variable asks participates to answer whether or not they have received an HIV test in the past 12 months. While it cannot be confirmed whether mental illness or HIV testing came first in the relationship this study assessed, SMI was selected as the primary exposure due to the chronic nature of psychiatric disorders. Severe psychological distress as determined by the K6 has been found to strongly correlate with the presence of SMI, which represents severe manifestations of different psychiatric disorders, and the chronic nature of these disorders minimizes the temporality concern in this study (20). A second limitation in this study is that all data is self-reported online by the study participants, which makes the responses subject to recall bias. Recall bias occurs when participants are

unable to accurately recall information regarding past behaviors. It is likely that recall

bias did not play a large role in this study, since most of the questions only asked

participants to recall information on behaviors within the last 12 months. However, self-

selection bias might have been an issue in this convenient sample of MSM with internet

access who chose to participate in AMIS, who may differ from their nonparticipating

counterparts in ways that we were not able to assess. Another limitation of this study is

the use of variables and scales that were not validated. The variables on experience of

discrimination of friends and/or family and experience of discrimination in a healthcare

setting were constructed from questions on these topics but did not utilize a validated

discrimination or stigma scale. Additionally, the variable measuring sexual orientation

outness was based on responses to one question about whether participants had ever told

another individual about their sexual relations with another male. Typically, outness is

understood as being generally open about one's sexual orientation, rather than having

specifically told another person about one's sexual experiences. Lastly, our results may

not be generalizable to all MSM. As previously mentioned, the population in this study is

very engaged in the healthcare system, and respondents appear to be higher utilizers of

healthcare resources than the general U.S. population. This study population might also

differ from the general MSM population in the U.S. in other ways that are currently

unknown.

Future Direction

The results of this study provide valuable context for future studies that aim to

analyze the relationship between mental illness and HIV testing. First, this study should

be duplicated in an MSM population that is more characteristic of the U.S. population

when it comes to healthcare utilization. This would help to illuminate the relationship between mental illness and HIV testing and might also present the opportunity to further explore any interactions between mental illness and factors related to healthcare access and utilization. Additionally, using different approaches to assessing mental illness may be helpful. The K6 Psychological Distress Scale include questions that pertain to both depression and anxiety; it would be interesting to be able to look at each of these separately in order to assess whether they have a different impact on the outcome of HIV testing. In regard to outcome measurement, future studies should consider looking at factors that may influence time to HIV testing following a reference point – such as last sexual intercourse or previous HIV test. This study looked at HIV testing as a dichotomous outcome variable in the past 12 months, but future studies could look more deeply at timeliness and frequency of HIV testing behavior in MSM with and without mental illness. Looking at HIV testing at different time points or intervals (other than past 12 months) might also add to the understanding of the relationship between mental illness and HIV testing.

In summary, this study provides some evidence that symptoms indicative of serious mental illness are common among MSM. Although we did not detect a statistically significant relationship between SMI and HIV testing, there was a clear pattern suggesting that SMI was associated with less HIV testing among MSM with no insurance or public health insurance, compared to those with private or other insurance. However, we were not able to fully explore the role of healthcare utilization in the relationship between SMI and HIV testing because a vast majority of our study population reported they have accessed healthcare in the past year. These findings add to

the current understanding between mental health and HIV testing behaviors and provide some clear directions for further study. Given the potential impact of mental health on behaviors, more research is needed to better understand the relationship between mental health issues and HIV-related behaviors so that the potential impact of HIV prevention efforts can be fully realized.

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Figure 1. Directed Acyclic Graph (DAG)
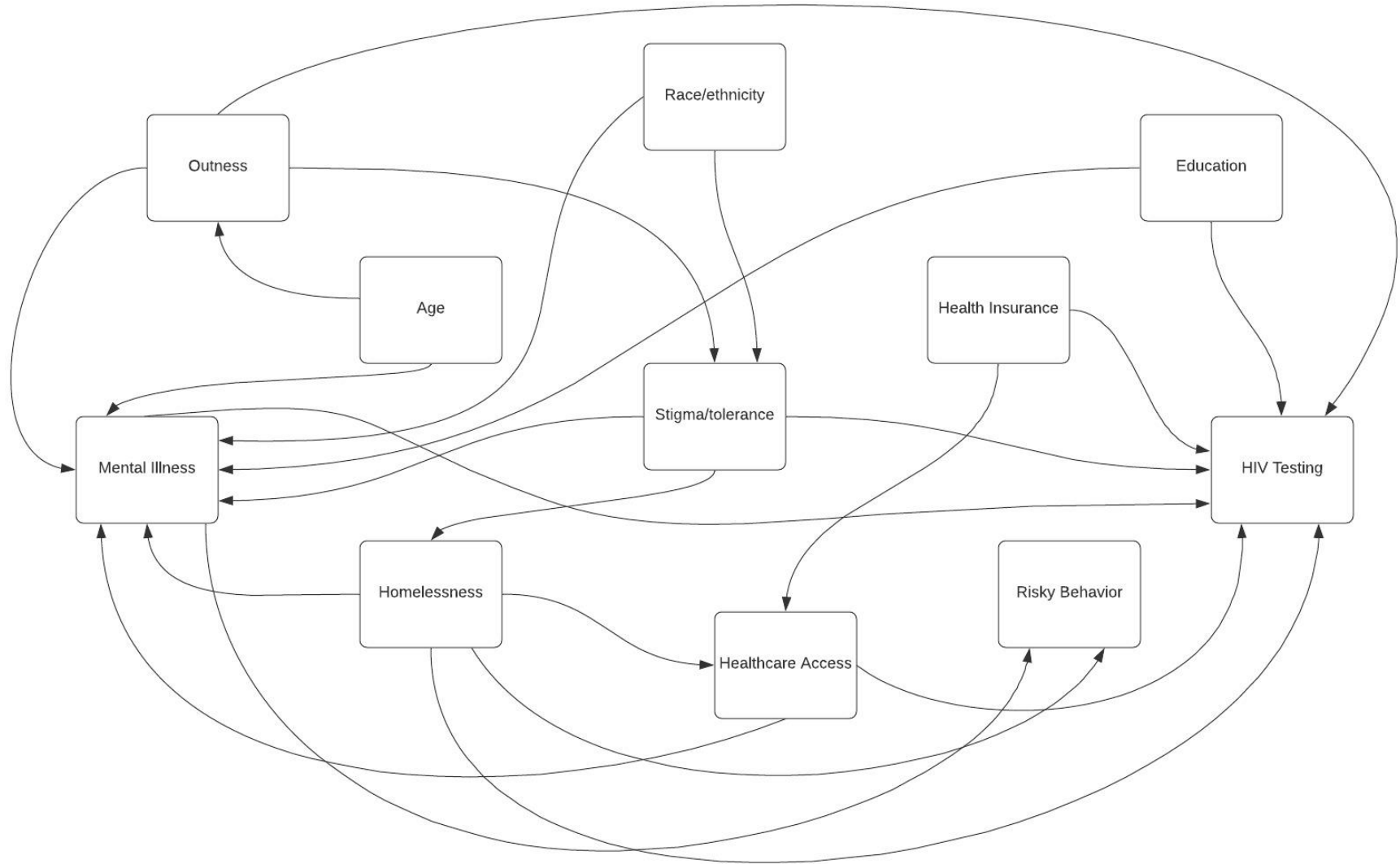
Table 1A. Characteristics of Participants with Presence of Psychological Distress Indicative of Serious Mental Illness (SMI), American Men's Internet Survey *, 2018

	Psychological Distress[t]				
	Total	**No SMI**		**SMI**	
	(n = 9946)	**(n = 7656)**		**(N = 2390)**	
	N	n	Col %	n	Col %
HIV Testing in Past 12 Months					
No	4656	3452	45.1	1204	52.6
Yes	5290	4204	54.9	1086	47.4
Education					
Less than high school diploma	767	464	6.1	303	13.4
High school diploma or GED	1489	1017	13.4	472	20.8
Some college or technical degree	3366	2475	32.7	891	39.3
College or postgraduate education	4223	3621	47.8	602	26.5
Age (years)					
15-24	4133	2796	36.5	1337	58.4
25-29	1296	1016	13.3	280	12.2
30-39	1495	1198	15.7	297	13.0
≥ 40	3022	2646	34.6	376	16.4
Race/Ethnicity					
White, non-Hispanic	6892	5433	72.2	1459	65.1
Black, non-Hispanic	543	440	5.9	103	4.6
Hispanic or Latino	1592	1118	14.9	474	21.1
Multiracial/Other	737	531	7.1	206	9.2
Health Insurance Coverage					
Private	6413	5208	72.6	1205	60.1
Public	1184	842	11.7	342	17.1
Other/multiple	779	597	8.3	182	9.1
None	803	527	7.4	276	13.8
Illicit Substance Use					
No	6301	5077	66.3	1224	53.5
Yes	3645	2579	33.7	1066	46.6

Outness (sexual orientation)

Has told someone	9031	6924	94.1	2107	94.9
Has never told someone	548	435	5.9	113	5.1

Experienced Housing Instability

No	7938	6277	94.6	1661	83.4
Yes	692	361	5.4	331	16.6

Community Tolerance of Gay or Homosexual Individuals

Agree or strongly agree	5869	4781	66.0	1088	50.2
Neutral	2035	1539	21.3	496	22.9
Disagree or strongly disagree	1504	921	12.7	583	26.9

Experience of Discrimination by Friends and/or Family

No	4373	3706	49.5	667	29.5
Yes	5372	3779	50.5	1593	70.5

Experience of Discrimination in Healthcare Setting

No	6818	5475	71.9	1343	58.9
Yes	3077	2140	28.1	937	41.1

*participants were considered eligible to complete the American Men's Internet Survey (AMIS) self-administered survey if they were age 15 years or older, were male sex at birth, reported residence in the US, and had sex (oral or anal) with a man at any point in their lifetime

ᵗthis measure was based on the use of the K6 Psychological Distress scale, with SMI defined by a total score of ≥13

Table 1B. Characteristics of Participants with Presence of Moderate/Severe Psychological Distress, American Men's Internet Survey*, 2018

	Total (n = 9946)	No (n = 3397)		Yes (N = 6549)	
	N	n	Col %	n	Col %
HIV Testing in Past 12 Months					
No	4656	1459	43.0	3197	48.8
Yes	5290	1938	57.1	3352	51.2
Education					
Less than high school diploma	767	140	4.2	627	9.7
High school diploma or GED	1489	394	11.8	1095	16.9
Some college or technical degree	3366	1019	30.4	2347	36.2
College or postgraduate education	4223	1801	53.7	2422	37.3
Age (years)					
15-24	4133	887	26.1	3246	49.6
25-29	1296	387	11.4	909	13.9
30-39	1495	551	16.2	944	14.4
≥ 40	3022	1572	46.3	1450	22.1
Race/Ethnicity					
White, non-Hispanic	6892	2492	74.5	4400	68.5
Black, non-Hispanic	543	222	6.6	321	5.0
Hispanic or Latino	1592	427	12.8	1165	18.2
Multiracial/Other	737	203	6.1	534	8.3
Health Insurance Coverage					
Private	6413	2369	73.1	4044	68.1
Public	1184	363	11.2	821	13.8
Other/multiple	779	291	9.0	488	8.2
None	803	217	6.7	586	9.9
Illicit Substance Use					
No	6301	2457	72.3	3844	58.7
Yes	3645	940	27.7	2705	41.3

The column header "Moderate/Severe Psychological Distress†" spans the No and Yes columns.

Outness (sexual orientation)

Has told someone	9031	2976	92.1	6055	95.4
Has never told someone	548	254	7.9	294	4.6

Experienced Housing Instability

No	7938	2803	96.3	5135	89.8
Yes	692	108	3.7	584	10.2

**Community Tolerance of
Gay or Homosexual Individuals**

Agree or strongly agree	5869	2208	69.5	3661	58.8
Neutral	2035	644	20.3	1391	22.3
Disagree or strongly disagree	1504	326	10.3	1178	18.9

**Experience of Discrimination by
Friends and/or Family**

No	4373	1983	59.7	2390	37.2
Yes	5372	1340	40.3	4032	62.8

**Experience of Discrimination in
Healthcare Setting**

No	6818	2622	77.6	4196	64.4
Yes	3077	756	22.4	2321	35.6

*participants were considered eligible to complete the American Men's Internet Survey (AMIS) self-administered survey if they were age 15 years or older, were male sex at birth, reported residence in the US, and had sex (oral or anal) with a man at any point in their lifetime

ᵗthis measure was based on the use of the K6 Psychological Distress scale, with moderate/severe psychological distress defined by a total score of ≥5

Table 2. Bivariate Analysis: Factors Associated with HIV Testing Behavior among Men Who Have Sex with Men, American Men's Internet Survey*, 2018

	HIV Testing in Past 12 Months		
	PR	95% CI	p-value
Psychological Distresst			
No serious mental illness	Ref.	-- --	--
Serious mental illness	0.86	0.82 0.91	< 0.0001
Psychological Distress±			
Mild or none	Ref.	-- --	--
Moderate or Severe	0.90	0.86 0.93	< 0.0001
Education			
Less than high school diploma	0.32	0.28 0.37	< 0.0001
High school diploma or GED	0.65	0.61 0.70	< 0.0001
Some college or technical degree	0.85	0.82 0.89	< 0.0001
College or postgraduate education	Ref.	-- --	--
Age (years)			
15-24	0.68	0.65 0.72	< 0.0001
25-29	0.99	0.94 1.04	0.6325
30-39	1.05	1.00 1.10	0.0658
≥ 40	Ref.	-- --	--
Race/Ethnicity			
White, non-Hispanic	Ref.	-- --	--
Black, non-Hispanic	1.06	0.98 1.14	0.1412
Hispanic or Latino	0.99	0.94 1.04	0.6333
Multiracial/Other	1.01	0.94 1.08	0.8836
Health Insurance Coverage			
Private	Ref.	-- --	--
Public	0.87	0.82 0.92	< 0.0001
Other/multiple	0.92	0.86 0.99	0.0180
None	0.83	0.77 0.89	< 0.0001

Illicit Substance Use

No	Ref.	--	--	--
Yes	1.08	1.04	1.13	< 0.0001

Outness (sexual orientation)

Has told someone	Ref.	--	--	--
Has never told someone	0.62	0.55	0.70	< 0.0001

Experienced Housing Instability

No	Ref.	--	--	--
Yes	1.05	0.98	1.12	0.1917

**Community Tolerance of
Gay or Homosexual Individuals**

Agree or strongly agree	Ref.	--	--	--
Neutral	0.92	0.88	0.97	0.0013
Disagree or strongly disagree	0.83	0.78	0.88	< 0.0001

**Experience of Discrimination by
Friends and/or Family**

No	Ref.	--	--	--
Yes	1.05	1.01	1.09	0.0093

**Experience of Discrimination in
Healthcare Setting**

No	Ref.	--	--	--
Yes	0.93	0.89	0.97	0.0005

*participants were considered eligible to complete the American Men's Internet Survey (AMIS) self-administered survey if they were age 15 years or older, were male sex at birth, reported residence in the US, and had sex (oral or anal) with a man at any point in their lifetime

tthis measure was based on the use of the K6 Psychological Distress scale, with serious mental illness defined by a total score of ≥13

±this measure was based on the use of the K6 Psychological Distress scale, with moderate/severe psychological distress defined by a total score of ≥5

Table 3. Responses to Kessler 6 Psychological Distress Scale Items by HIV Testing Behavior among Men Who Have Sex with Men, American Men's Internet Survey*, 2018

During the past 30 days, how often did you feel…	None of the time n (row %)		A little of the time n (row %)		Some of the time n (row %)		Most of the time n (row %)		All of the time n (row %)	
	HIV Testing in Past 12 Months									
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Nervous	649 (13.9)	857 (16.2)	1202 (25.8)	1631 (30.9)	1642 (35.3)	1758 (33.3)	799 (17.2)	742 (14.0)	348 (7.5)	287 (5.4)
Hopeless	1443 (32.2)	1878 (37.0)	1147 (25.6)	1357 (26.7)	1091 (24.3)	1168 (23.0)	547 (12.2)	459 (9.0)	240 (5.4)	200 (3.9)
Restless	692 (15.5)	868 (17.2)	1040 (23.3)	1380 (27.3)	1437 (32.1)	1632 (32.3)	856 (19.1)	794 (15.7)	426 (9.5)	366 (7.2)
Depressed	1851 (41.5)	2321 (46.0)	1175 (26.3)	1263 (25.0)	828 (18.6)	919 (18.2)	411 (9.2)	371 (7.4)	176 (3.9)	149 (3.0)
Everything was an effort	959 (21.5)	1193 (23.7)	1159 (26.0)	1416 (28.1)	1086 (24.4)	1249 (24.8)	785 (17.6)	780 (15.5)	399 (9.0)	335 (6.7)
Worthless	1910 (42.9)	2386 (47.6)	955 (21.5)	1093 (21.8)	803 (18.0)	839 (16.7)	457 (10.3)	433 (8.6)	304 (6.8)	244 (4.9)

*participants were considered eligible to complete the American Men's Internet Survey (AMIS) self-administered survey if they were age 15 years or older, were male sex at birth, reported residence in the US, and had sex (oral or anal) with a man at any point in their lifetime

Table 4. Average Kessler 6 (K6) Psychological Distress Score of Participants by HIV Testing Behavior, American Men's Internet Survey*, 2018

	K6 Psychological Distress Score Mean (SD)	
	HIV Testing in Past 12 Months	
	No	**Yes**
Total	8.50 (5.92)	7.62 (5.67)
Education		
Less than high school diploma	10.83 (5.86)	10.32 (6.24)
High school diploma or GED	9.68 (6.14)	9.19 (6.25)
Some college or technical degree	8.90 (5.98)	8.46 (5.96)
College or postgraduate education	6.54 (5.13)	6.56 (5.03)
Age (years)		
15-24	10.09 (5.83)	9.43 (5.78)
25-29	8.12 (5.58)	8.24 (5.39)
30-39	7.62 (5.63)	7.55 (5.51)
≥ 40	5.84 (5.29)	5.71 (5.13)
Race/Ethnicity		
White, non-Hispanic	8.10 (5.82)	7.35 (5.51)
Black, non-Hispanic	7.76 (5.82)	6.71 (5.99)
Hispanic or Latino	9.93 (6.10)	8.75 (6.00)
Multiracial/Other	9.29 (5.99)	8.42 (5.73)
Health Insurance Coverage		
Private	7.62 (5.43)	7.21 (5.37)
Public	9.48 (6.75)	8.32 (6.07)
Other/multiple	8.33 (5.97)	7.64 (6.05)
None	10.31 (6.52)	9.39 (6.46)
Illicit Substance Use		
No	7.76 (5.79)	6.93 (5.54)
Yes	9.91 (5.93)	8.74 (5.70)

Outness (sexual orientation)

Has told someone	8.65 (5.85)	7.71 (5.62)
Has never told someone	7.49 (6.61)	6.38 (6.52)

Experienced Housing Instability

No	8.21 (5.76)	7.33 (5.44)
Yes	12.38 (6.22)	11.51 (6.55)

Community Tolerance of
Gay or Homosexual Individuals

Agree or strongly agree	7.76 (5.58)	6.96 (5.25)
Neutral	8.79 (6.01)	8.05 (5.72)
Disagree or strongly disagree	10.74 (6.20)	10.26 (6.36)

Experience of Discrimination by
Friends and/or Family

No	6.92 (5.61)	6.08 (5.24)
Yes	9.91 (5.85)	8.85 (5.70)

Experience of Discrimination in
Healthcare Setting

No	7.83 (5.78)	7.04 (5.50)
Yes	9.86 (5.96)	9.02 (5.82)

*participants were considered eligible to complete the American Men's Internet Survey (AMIS) self-administered survey if they were age 15 years or older, were male sex at birth, reported residence in the US, and had sex (oral or anal) with a man at any point in their lifetime

Table 5. Logistic Regression Analysis: Factors Associated HIV Testing in Past 12 Month, American Men's Internet Survey*, 2018

	Model 1 - fully parameterized				Model 2 - partially adjusted			
	β	SE	Adj. OR	P-value	β	SE	Adj. OR	P-value
Psychological Distresst								
No serious mental illness	Ref.	--	--	--	Ref.	--	--	--
Serious mental illness	-0.0474	0.0572	0.9537	0.4890	-0.0782	0.0521	0.9248	0.1334
Education								
Less than high school diploma	-1.4399	0.1258	0.2370	< 0.0001	-1.5989	0.1047	0.2021	< 0.0001
High school diploma or GED	-0.5535	0.0754	0.5749	< 0.0001	-0.6802	0.0685	0.5065	< 0.0001
Some college or technical degree	-0.2317	0.0535	0.7932	< 0.0001	-0.2768	0.0505	0.7582	< 0.0001
College or postgraduate education	Ref.	--	--	--	Ref.	--	--	--
Age (years)								
15-24	-0.4373	0.0613	0.6458	< 0.0001	-0.4803	0.0571	0.6186	< 0.0001
25-29	-0.0961	0.0739	0.9084	0.1935	-0.0858	0.0701	0.9178	0.2210
30-39	0.0445	0.0710	1.0455	0.5311	0.0633	0.0675	1.0653	0.3483
≥ 40	Ref.	--	--		Ref.	--	--	--
Race/Ethnicity								
White, non-Hispanic	Ref.	--	--	--	Ref.	--	--	--
Black, non-Hispanic	0.3009	0.1037	1.3511	0.0037	0.2383	0.0943	1.2691	0.0115
Hispanic or Latino	0.2604	0.0655	1.2974	< 0.0001	0.2719	0.0604	1.3125	< 0.0001
Multiracial/Other	0.1871	0.0883	1.2057	0.0340	0.1995	0.0824	1.2208	0.0115

Health Insurance Coverage								
Private	Ref.	--	--	--	--	--	--	--
Public	-0.1314	0.0724	0.8769	0.0695				
Other/multiple	-0.055	0.0823	0.9465	0.5036				
None	-0.3499	0.0822	0.7048	< 0.0001				
Illicit Substance Use								
No	Ref.	--	--	--	Ref.	--	--	--
Yes	0.2489	0.0479	1.2826	< 0.0001	0.2931	0.0448	1.3406	< 0.0001
Outness (sexual orientation)								
Has told someone	Ref.	--	--	--	--	--	--	--
Has never told someone	-0.654	0.1073	0.5200	< 0.0001				
Experience of Discrimination by Friends and/or Family								
No	Ref.	--	--	--	--	--	--	--
Yes	0.1086	0.0476	1.1147	0.0225				
Experience of Discrimination in Healthcare Setting								
No	Ref.	--	--	--	--	--	--	--
Yes	-0.1212	0.0505	0.8859	0.0164				

*participants were considered eligible to complete the American Men's Internet Survey (AMIS) self-administered survey if they were age 15 years or older, were male sex at birth, reported residence in the US, and had sex (oral or anal) with a man at any point in their lifetime

ŧthis measure was based on the use of the K6 Psychological Distress scale, with serious mental illness defined by a total score of ≥13