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Psychopathology and HIV Diagnosis among Older Adults in the United States: Disparities by Age, Sex, and Race/Ethnicity

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Abstract

In 2016, 17% of new HIV infections in the US were among adults aged 50 and older. Differences by age, sex, and race/ethnicity exist among older people living with HIV. Co-morbid mental health and substance use disorders (SUD) are also major challenges for this population. This study examined the association between generalized anxiety disorder (GAD), posttraumatic stress disorder (PTSD), SUD, depression, and HIV diagnosis among adults aged 50 and older, and the disparities by age, sex, and race/ethnicity. Data were obtained from Cerner Corporation's *Health Facts*[®] database. Multivariable logistic regression models were used to determine the associations between GAD, PTSD, SUD, and depression, and HIV diagnosis. Results were also stratified by age group, sex, and race/ethnicity. Overall, there were positive associations between SUD, depression, GAD, PTSD and HIV; and differences by age, sex and race/ethnicity existed in these associations. For example, after adjusting for age, race/ethnicity and marital status, men who were diagnosed with GAD were 10 times more likely (adjusted OR: 10.3; 95% CI: 8.75 – 12.1) to have an HIV diagnosis compared to men who were not diagnosed with GAD. Women who were diagnosed with GAD were five times more likely (adjusted OR: 5.01; 95% CI: 3.81 – 6.58) to have an HIV diagnosis compared to women who were not diagnosed with GAD. HIV prevention and intervention programs for older adults should address GAD, PTSD, SUD and depression and consider the age, sex and racial/ethnic disparities in the association between psychopathology and HIV.

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Keywords

depression; anxiety; posttraumatic stress disorder; substance abuse; HIV

Introduction

HIV among Older Adults

HIV continues to be a public health challenge among populations 50 and older in the US (Centers for Disease Control and Prevention, 2018). In 2016, 17% of new HIV diagnoses were among adults age 50 and older (Centers for Disease Control and Prevention, 2018). Majority of infections among older adults living with HIV (OALH) tend to be sexually acquired (Metcalfe, Schofield, Milosevic, & Peters, 2017). In addition, adults 60 and older tend to have lower CD4 count (glycoproteins on the surface of T or helper cells) and higher frequency of AIDS-defining illness (opportunistic infections resulting from HIV) compared to adults age 50–59 (Metcalfe et al., 2017). Among a New York City academic health center population, 21% of newly diagnosed patients were age 50 and older, with close to 70% being concurrently diagnosed with AIDS (Ellman, Sexton, Warshafsky, Sobieszczyk, & Morrison, 2014).

Health Disparities among Older Adults Living with HIV

Disparities by sex, race/ethnicity and marital status exist among OALH. Among adults aged 50 and older, approximately two-thirds of new infections were among men (64%) with approximately three out of four being due to male-to-male sexual contact (Centers for Disease Control and Prevention, 2018). Women and injection drug users accounted for 24% and 12% of new HIV infections, respectively (Centers for Disease Control and Prevention, 2018). Using data from 37 US states, among adults 50 and older, the HIV diagnosis rate among Black populations (49.2 per 100,000) was almost 13 times that of White populations (3.9). Latino adults (19.5) and those who identified as “Other” (6.4) had 5 times and twice the HIV diagnosis rate of White adults 50 and older, respectively (Linley, Prejean, An, Chen, & Hall, 2012). HIV diagnosis also tends to vary by marital status where single, never married, and women of other marital status have higher odds of reporting an HIV diagnosis compared to married women (Hakre et al., 2015). Due to these differences among OALH, from a primary prevention approach, it is important to determine the age, sex, and racial disparities that may exist in the association between modifiable risk factors, such as mental health and substance use disorders and HIV diagnosis among older populations.

Mental Health and Substance Use Disorders and HIV among Older Adults

The intersection between mental health and substance use disorders (SUDs) and HIV is an important area of concern for older adults. Psychopathology may be associated with HIV diagnosis via risky behaviors such as unprotected sex and injection drug use, which are established risk factors for HIV transmission. Previous studies have shown that older adults may be at risk for HIV due to lack of condom use (Amin, 2014; Gorbach et al., 2014), which may also be related to mental health and substance use disorders. Research has shown that depression has been linked to risky sexual behavior in varied populations including

adolescents (Braje, Eddy, & Hall, 2016), adults (Miller, Solomon, Bunn, Varni, & Hodge, 2015), and substance abuse treatment patients (Tull & Gratz, 2013). Prior research has examined age (Hall, Byers, Ling, & Espinoza, 2007), sex (Lesko et al., 2015) and racial/ethnic differences in HIV (Hall et al., 2007; Lesko et al., 2015; Linley et al., 2012).

Age and Sex Disparities in Mental Health and Substance Use Disorders

Depression (Liu et al., 2014), mood disorder and self-reported mood problems (Fazeli et al., 2014), and substance use (Mannes et al., 2018) are more common among OALH compared to younger adults living with HIV. Among OALH, close to four in ten reported major depression in a New York City population (39.1%) (Groves, Golub, Parsons, Brennan, & Karpiak, 2010). However, among OALH attending an outpatient HIV practice in San Francisco, 54% reported depressive symptoms. Substance use is also common among OALH (Mannes et al., 2016) and has been shown to be related to poor antiretroviral therapy adherence among older adults (Parsons, Starks, Millar, Boonrai, & Marcotte, 2014). PTSD and anxiety have been rarely assessed in the context of HIV, especially among older adults. However, one study found that among Black heterosexual men, posttraumatic stress symptoms and HIV risk behavior were fewer among older men compared to younger men (Bowleg et al., 2014).

Age and sex disparities exist in mental health and substance use disorders. Previous studies have shown a negative relationship between age and anxiety as a trait (Simming, Conwell, Fisher, Richardson, & van Wijngaarden, 2012; Weiss Wiesel et al., 2015) and also with the prevalence of GAD (Brenes et al., 2008). The prevalence of 30-day and 12-month depression tends to decrease while lifetime depression fluctuates with increasing age (Kessler et al., 2010). Younger age was found to be associated with SUD chronicity (Mackenzie, El-Gabalawy, Chou, & Sareen, 2014) and the prevalence of SUD decreases with increasing age among older adults (Kessler et al., 2005). Age differences have also been found in PTSD occurrence among adults aged 55 and older (Byers, Covinsky, Neylan, & Yaffe, 2014). The mean age for persistent PTSD was 60 years old while the mean age of adults reporting no PTSD was approximately 70 years old among a nationally representative sample in the US (Byers et al., 2014). Among U.S. older adults, there were sex differences seen in the prevalence of anxiety and mood disorders where a higher proportion of women reported mental health disorders than men among those aged 55 to 64 but no difference among individuals aged 85 and older (Reynolds, Pietrzak, El-Gabalawy, Mackenzie, & Sareen, 2015).

Racial/Ethnic Disparities and Mental Health and Substance Use Disorders

Research on the relationship between race/ethnicity and mental health outcomes has been mixed. Chou & Cheng did not find a statistically significant association between race and major depressive disorder among adults aged 65 or older from a nationally representative sample of the noninstitutionalized US population from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) (Chou & Cheung, 2013). However, Spence et al., found that older Black women had higher scores of depressive symptoms from the CES-D compared to older White women from a nationally representative sample of women from the National Longitudinal Survey of Mature Women (Spence, Adkins, & Dupre, 2011).

Among patients aged 18 and older at three urban mental health and community health centers in South California, Ghafoori et al. found no racial/ethnic differences in PTSD occurrence (Ghafoori, Barragan, Tohidian, & Palinkas, 2012). However, data from NESARC showed that among respondents who reported trauma, compared to White populations, Black and Asian respondents had a higher and lower risk of having PTSD, respectively (Roberts, Gilman, Breslau, Breslau, & Koenen, 2011).

Racial/ethnic differences have also been observed in the association between PTSD and HIV where Black and Latino with HIV were twice as likely as White men with HIV to have PTSD (Reisner, Falb, & Mimiaga, 2011). In addition, among older adults, non-Hispanic Whites were more likely to report mood and anxiety disorders and to have interactions between self-rated mental health and these disorders (Kim et al., 2011). However, among a nationally representative sample of men, when Black populations were differentiated into Caribbean Blacks and African Americans, Caribbean Blacks had the highest prevalence of anxiety or mood disorders 14.2% compared to African Americans (6.2%) and White populations (9.0%) (Johnson-Lawrence, Griffith, & Watkins, 2013).

Racial/ethnic differences are also seen in the occurrence of substance use disorders (Evans, Grella, Washington, & Upchurch, 2017; Pacek, Malcolm, & Martins, 2012). Among a US nationally representative sample from the National Survey on Drug Use and Health, White and Hispanic populations had higher alcohol use disorder compared to Black populations (Pacek et al., 2012). However, marijuana use disorder was most prevalent among Black populations (Pacek et al., 2012). In addition, with regards to persistence of SUDs, another study found that Hispanic men and women were less likely to have persistent SUDs than White men and women, respectively (Evans et al., 2017). Black men with an alcohol or drug use disorder had a lower likelihood of having persistent SUDs compared to White men. However, Black men who had poly-substance use disorder had a higher likelihood of having persistent SUDs compared to Hispanic populations (Evans et al., 2017).

Marital Status and Mental Health Disorders

Another sociodemographic factor that may impact mental health outcomes is marital status. Marital status may be a correlate of post-traumatic stress where individuals who are separated, divorced or widowed have higher odds of post-traumatic stress syndrome compared to married individuals (Lamoureux-Lamarche, Vasiliadis, Preville, & Berbiche, 2015). Not being married was also shown to be associated with higher odds of having any affective disorder and any mental disorder (excluding cognitive impairment) over the past 12 months among individuals aged 65 to 85 years old (Sunderland, Anderson, Sachdev, Titov, & Andrews, 2015).

Study Rationale and Aims

As rates of HIV (Centers for Disease & Prevention, 2018; Hall et al., 2007) and mental health disorders (Kessler et al., 2010; Stein-Shvachman, Karpas, & Werner, 2013) vary among older and younger populations, the association between mental health and HIV diagnosis may differ among the two groups. Recent estimates show that the HIV incidence rate among older adults aged 50–54 was almost twice compared to those aged 15–19 (14.1

vs. 8.1 per 100,000) (Centers for Disease & Prevention, 2018). Another key difference is that HIV tends to be diagnosed at a later stage during the course of infection among adults 50 and older compared to adults 49 and younger in the US (45% vs. 28%, respectively) (Centers for Disease & Prevention, 2018). In addition, the prevalence of depression among older populations range from 1% among community-dwelling populations to 42% among older institutionalized populations (Djernes, 2006) with estimates averaging approximately 20% among adults aged 18–64 (Kessler et al., 2010). Treatment for anxiety disorders, including GAD and PTSD, has been shown to be less effective for older adults compared to younger populations (Wetherell et al., 2013). Indeed, comorbidity of major depression with GAD was 31% among US adults aged 50–64 and 18.6% among adults aged 18–34 (Kessler et al., 2010).

To date and to our knowledge, no study has examined the association between depression, GAD, PTSD, and SUD, and HIV diagnosis among older adults; and the age, sex, *and* racial/ethnic differences that may exist in these associations. Therefore, the aim of this study was to examine if older age, being female, or being from a racial/ethnic minority group would be linked to greater effect estimates in the association between GAD, PTSD, SUD and depression, and HIV diagnosis among adults age 50 and older. We hypothesized that GAD, PTSD, SUD and depression would be associated with HIV diagnosis and the effect estimates would be higher among the older age group, women, and racial/ethnic minority populations. The results of this study may inform health care providers and public health professionals of specific psychiatric and substance use disorders that may be risk factors for an HIV diagnosis among specific older populations.

Methods

Data Source and Study Population

Data were obtained from Cerner Corporation's *Health Facts*[®] database, which includes data from participating hospitals and outpatient clinics nationwide. The Cerner Health Facts database captures and stores deidentified electronic health record (EHR) patient data. These data are then aggregated and organized into datasets for analysis and reporting (Cerner Corporation, 2019). Cerner Corporation has established Health Insurance Portability and Accountability Act–compliant operating policies to ensure de-identification of the *Health Facts*[®] database. Data collected consisted of patient demographic characteristics (sex, age, and race/ethnicity), medical history and comorbidities as determined by the International Classification of Diseases, Ninth Revision (ICD-9) codes. We excluded patients who were less than 50 years of age. The study population included 37,936,891 patients from 459 inpatient and outpatient health care facilities between 2000 and 2013. For each patient, the most recent visit was considered the index visit. The Virginia Commonwealth University Institutional Review Board considered the study exempt.

Measures

HIV diagnosis was operationalized by using ICD-9 code 042 (Centers for Medicare & Medicaid Services, 2015) and psychopathology was operationalized by generalized anxiety disorder (GAD) code 300.02, posttraumatic stress disorder (PTSD) code 309.81, and

depression codes 311.x (Centers for Medicare & Medicaid Services, 2015). The substance use disorders (SUD) group included Alcohol Dependence Syndrome coded as 303.x, drug dependence coded 304.x, and non-dependent abuse of drugs coded as 305.x. The SUD group includes opioid, sedative, cocaine, cannabis, amphetamine, hallucinogen, combinations of drugs, and unspecified drug dependence. ICD-9 codes were used in the current study as these were the codes available during the time of data collection.

Moderators and Confounders

As the current study included only people aged 50 and older, we examined the association between psychopathology and HIV diagnosis among adults aged 50–64, and 65 and older to differentiate between relatively “younger” older adults (50–64) and older populations (65 and older). This categorization was also used to determine if differences would exist for older adults who have been excluded from HIV testing recommendations (Centers for Disease Control and Prevention, 2019) and were eligible for Medicare (65+) vs. the younger group. This differentiation has also been used in previous studies (Dai & Meyer, 2019; Han, Sherman, & Palamar, 2019). We also examined the association among men and women, and among Blacks, Whites, Hispanic and Other racial/ethnic groups. Sociodemographic confounders were considered based on literature review *a priori* and were found to be associated with a diagnosis of a psychiatric or substance use disorder, and HIV diagnosis. Therefore, age, sex, race/ethnicity and marital status were considered confounders in the current study. The variable that was used as a moderator for a model was not considered as a confounder for that specific model. For example, if we were examining the association between depression and HIV diagnosis among different age groups, age was not included as a confounder in that model.

Analytic Approach

Descriptive statistics were used to determine the distribution of sociodemographic characteristics and diagnosis of GAD, PTSD, substance abuse and depression among the total sample population and among patients who were diagnosed with HIV and those who were not. *P* values were used to determine differences that were statistically significant ($\alpha < 0.05$). Logistic regression was used to obtain crude odds ratios (ORs) and 95% confidence intervals (CIs) depicting the association between GAD, PTSD, SUD, and depression, and HIV diagnosis. Multivariable logistic regression models adjusted for potential confounders. Results were also stratified by age group, sex, and by race/ethnicity.

Results

Descriptive Characteristics of the Study Sample

Overall, 0.10% of the study population had a diagnosis of HIV ($n=37,438$) (Table 1). Seventy percent (70%) of patients who had an HIV diagnosis were men, and 90% were between 50 and 64 years old. Among HIV-positive patients, approximately 59% were Black and 84% were divorced, separated or single. Majority of patients who were diagnosed with HIV did not have a mental health or substance use disorder diagnosis (GAD: 99.4%; PTSD: 99.5%; SUD: 84.0%; and Depression: 93.9%). However, 16.0% of patients who were HIV-positive were diagnosed with an SUD compared to 2.1% of patients who were not HIV-

positive. Approximately 6% of patients who were HIV-positive also had depression compared to 1% of patients who were not HIV-positive.

Table 2 shows the distribution of sociodemographic characteristics by GAD, PTSD, SUD, and depression. Approximately 71% of patients who were diagnosed with GAD were women compared to approximately 60% of patients who were not diagnosed with GAD. Approximately 84% of patients diagnosed with PTSD were between the ages of 50 and 64 compared to 48% who did not have a PTSD diagnosis. Twenty-one percent (21%) of patients diagnosed with an SUD were Black compared to 12% who were not diagnosed with an SUD.

Association between Mental Health and Substance Use Disorders and HIV Diagnosis

Table 3 shows the overall association between GAD, PTSD, SUD, and depression using stratified multiple logistic regression models. After adjusting for age, race/ethnicity and marital status, men who were diagnosed with GAD were 10 times more likely (adjusted OR: 10.3; 95% CI: 8.75 – 12.1) to have an HIV diagnosis compared to men who were not diagnosed with GAD. However, after adjusting for age, race/ethnicity, and marital status, women who were diagnosed with GAD were five times more likely (adjusted OR: 5.01; 95% CI: 3.81 – 6.58) to have an HIV diagnosis compared to women who were not diagnosed with GAD. Compared to men who did not have a diagnosis of PTSD, men who did were almost three times more likely (adjusted OR: 2.86; 95% CI: 2.38 – 3.43) to have an HIV diagnosis. However, compared to women who were not diagnosed with PTSD, women with PTSD were four times more likely (adjusted OR: 4.01; 95% CI: 3.16 – 5.09) to have an HIV diagnosis. After adjusting for covariates, patients aged 50–64 years diagnosed with PTSD were three times more likely (adjusted OR: 3.29; 95% CI: 2.84 – 3.82) to have an HIV diagnosis compared to patients aged 50–64 without a PTSD diagnosis. However, among patients 65 years and older, those who were diagnosed with PTSD were approximately 10 times more likely (adjusted OR: 9.80; 95% CI: 5.24 – 18.3) to have an HIV diagnosis compared to patients 65 years and older without a diagnosis of PTSD. After adjusting for age, sex, and marital status, White, Black, Hispanic and Other patients diagnosed with GAD were eight times (adjusted OR: 7.85; 95% CI: 6.47 – 9.52), eight times (adjusted OR: 7.85; 95% CI: 6.33 – 9.72), seven times (adjusted OR: 6.82; 95% CI: 3.00 – 15.5) and 11 times (adjusted OR: 11.2; 95% CI: 6.29 – 19.9) more likely to be diagnosed with HIV compared to White, Black, Hispanic and Other patients without GAD, respectively.

Discussion

Overall Associations between Mental Health and Substance Use Disorders and HIV Diagnosis among Older Adults

The current study showed associations between GAD, PTSD, SUD, depression, and HIV diagnosis and that differences by age, sex, and race/ethnicity exist in these relationships. To our knowledge, this is the first study to examine age, sex, *and* racial/ethnic differences in the association between GAD, PTSD, SUD and depression, and HIV diagnosis among a sample of adults aged 50 and older.

Theoretically, mental and substance use disorders may be risk factors for HIV diagnosis as individuals may take part in risky sexual behavior and injection drug use as a coping mechanism or due to a lack of motivation to take care of themselves (Crepaz & Marks, 2001). Nevertheless, it is important to note the association between psychopathology and HIV may indeed be bidirectional as an HIV diagnosis may also be a risk factor for psychopathology. For example, prior research suggests that PTSD can also occur in response to an HIV infection (Kelly et al., 1998), or may interact with each other (Neigh, Rhodes, Valdez, & Jovanovic, 2016). Indeed, an HIV diagnosis can be a traumatic event for some patients and may result in PTSD symptoms. Significant relationships have also been found between PTSD resulting from an HIV diagnosis and PTSD due to other traumatic events (Kelly et al., 1998). HIV diagnosis may also be associated with depression and GAD, as depressed mood and anxiety may increase in response to being diagnosed with HIV. SUD may also occur in response to an HIV diagnosis as some individuals may abuse substances as a coping mechanism. In the current study, there were statistically significant associations between all mental health disorders and HIV diagnosis. Due to the cross-sectional nature of the study, it is also possible that these relationships are bi-directional.

Age Disparities in Mental Health and Substance Use Disorders and HIV Diagnosis among Older Adults

Research on the association between mental health (especially PTSD and GAD), SUD and an HIV diagnosis among older adults is lacking. However, prior research has shown that adults living with HIV who were 50 years old or older had higher levels of depression compared to younger adults age 18–49 (Liu et al., 2014). In the current study, we found that the association between GAD, PTSD, SUD, depression, and HIV existed for adults aged 50 to 64, and 65 and older. The relationship between GAD, PTSD, SUD and an HIV diagnosis may be stronger for adults 65 and older compared to adults 50 to 64. These findings show the importance of addressing mental health and substance use disorders and HIV diagnosis among different age groups even among older adults, who are sometimes neglected in HIV research (Brennan-Ing, 2017). Indeed, recommendations from the Centers for Disease Control and Prevention suggest HIV testing for adults age 18–64, and exclude those 65 and older (Centers for Disease Control and Prevention, 2019). For example, adults age 50 to 64 may struggle with cohort-specific challenges, such as being a part of the sandwiched generation (being a caregiver to parents and children) (Do, Cohen, & Brown, 2014). Having these multiple caregiving roles may moderate the association between mental health and HIV. On the other hand, adults 65 and older may have other challenges related to income uncertainties (for example, retirement), frailty, and additional comorbidities, which may also moderate or mediate the pathway between mental health relates and HIV diagnosis. Additional research is needed to identify these potential relationships and determine distinct focal points of intervention and prevention programs geared towards preventing HIV among older adults.

Sex Disparities in Mental Health and Substance Use Disorders and HIV Diagnosis among Older Adults

Sex differences in the relationship between GAD, PTSD, and HIV diagnosis have been understudied, especially among older adults. Research has shown a higher prevalence of

anxiety disorders and a relationship between anxiety disorders and greater comorbidities among women compared to men (McLean, Asnaani, Litz, & Hofmann, 2011). However, the current study suggests that the associations between GAD and HIV diagnosis may be stronger in men compared to women, though still a relationship of concern for both sexes. The associations between PTSD and SUD and an HIV diagnosis were higher among women compared to men. Additional challenges including partner violence (Phillips et al., 2014) and relationship power (Altschuler & Rhee, 2015), which are more commonly reported by women and are related to mental health (Mitchell, Wight, Van Heerden, & RoCHAT, 2016) and HIV risk (Altschuler & Rhee, 2015; Mitchell et al., 2016), may help to explain the higher associations seen among women. Indeed, substance use was found to be a factor compounding the relationship between partner violence and HIV risk among women (Phillips et al., 2014).

Racial/Ethnic Disparities in Mental Health and Substance Use Disorders and HIV Diagnosis among Older Adults

Racial/ethnic differences also exist in the association between psychopathology and HIV diagnosis. The effect estimate depicting the association between GAD and HIV for each racial/ethnic group was large, but especially so for the “Other” category. The Other category consists of patients who did not identify as Black, White, or Hispanic. These findings suggest that the association between mental health diagnoses and HIV is an important public health issue despite race/ethnicity, but the association may be magnified for non-Black, non-White and non-Hispanic patients. As a result, racial/ethnic and cultural differences should be considered in HIV prevention programs geared towards treating mental health disorders among older adults.

Heckman et al. showed that White men with HIV were more likely to show elevated levels of anxiety compared to Black men living with HIV (Heckman et al., 2000). However, the relationship between GAD and HIV in the current study was similar for Black and White patients. Potential explanations for these disparate findings could have been due to the difference in study populations and the way in which anxiety was operationalized. Heckman et al., examined only men living with HIV recruited from AIDS service organizations in New York City and Milwaukee, Wisconsin; and used the self-report anxiety subscale of the Symptom Checklist-90-R. However, the current study examined race/ethnicity as a moderator in the association between GAD and HIV among women and men receiving inpatient and outpatient care throughout health care centers in the US, and used EHR data as indicated by ICD-9 codes. The estimates for the association between PTSD and HIV in the current study were about the same for White, Black and Other, but this relationship was not statistically significant for Hispanics. Previous research has found racial/ethnic differences in the association between PTSD and HIV infection where Black and Hispanic participants with PTSD were twice as likely to have an HIV infection compared to White men (Reisner et al., 2011). One potential explanation for this difference in findings could also be due to the differing study populations and the way PTSD was measured. Reisner et al., used a representative sample of the US noninstitutionalized population from the National Survey on Alcohol and Related Conditions and PTSD was operationalized using the Alcohol Use Disorder and Associated Disabilities Interview Schedule-IV to determine lifetime

Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition). However, the current study population was not representative of the US general population and used ICD-9 codes to operationalize PTSD. Even though the comparison and make-up of racial/ethnic groups differed between the current study and that of Reisner et al., both studies suggested that the racial/ethnic disparities exist in the association of PTSD and HIV.

Limitations and Strengths

The findings of this study should be considered with some limitations in mind. First, the study is cross-sectional, therefore, the temporal sequence is not clear. Psychopathology (GAD, PTSD, SUD, and depression) could have occurred before an HIV diagnosis. Nevertheless, the findings suggest that there is an association between psychopathology and HIV, and differences by sex, age, and race/ethnicity exist in this relationship. Second, the study population, even though large, represent people who receive health care and findings may not be generalizable to the general U.S. population. Third, the large sample size may result in overestimation of statistical significance. The prevalence estimates of mental health disorders were low (2%). For example, depression was lower in the current sample compared to the general population (Kessler et al., 2010). This finding suggests that mental health disorders may be lower among people who are receiving healthcare compared to the general population; and/or the use of diagnostic data may provide underestimates of the true prevalence of mental health disorders.

Nevertheless, the study also had some strengths. To our knowledge, this is the first study to examine the age, sex, and racial/ethnic differences in the association between GAD, PTSD, SUD and depression, and HIV among adults aged 50 and older. The large sample size allowed for the examination of age, sex, and racial/ethnic differences of HIV diagnosis, which is estimated to have an incidence of rate of 6.19 per 100,000 among adults 50 and older (Centers for Disease Control and Prevention, 2018; United States Census, 2011). In addition, we were able to examine the association between psychopathology and HIV by multiple sociodemographic characteristics. Data were also based on health records and are not self-reported by patients.

Conclusions

The findings from the study suggest that HIV prevention, intervention and treatment programs for older adults should address GAD, PTSD, SUD and depression. Health care providers should also screen for these disorders among older adults living with HIV as an HIV diagnosis may also result in mental health or substance use disorders. A multipronged approach addressing various facets of psychopathology may be helpful in HIV prevention among older adults. In addition, considering the varying mental health disorders that may occur as a result of an HIV diagnosis will have important implications in the design of these programs. Intervention and prevention programs and health care providers should also consider the differences by sex, age, and race/ethnicity observed in the associations between GAD, PTSD, SUD, depression and HIV. Future research should include longitudinal analyses to determine the temporal sequence between mental health and substance use disorders, and HIV among older adults. By determining temporality, we will be able to

determine the extent to which mental health and substance use disorders predict HIV diagnosis or an HIV diagnosis predicts mental health and substance use disorders among older adults. In addition, future studies should also examine multilevel moderation to determine the interaction between age and race/ethnicity, age and sex, race/ethnicity and sex to determine specific target groups that would benefit from mental health and substance use prevention and intervention programs to prevent HIV, and reduce HIV incidence and prevalence rates.

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Table 1.

Overall and Distribution of Sociodemographic Characteristics by HIV Status

	Overall % N=37,704,936	HIV Positive N = 37,438	Not HIV Positive N = 37,667,498
Sex			
Female	59.2	30.0	59.2
Male	40.8	70.0	41.1
Age			
50–64	48.0	90.4	48.6
65	52.0	9.7	52.6
Race/Ethnicity			
Asian/Pacific Islander	1.5	0.5	1.5
Black	11.8	59.2	11.8
Hispanic	1.9	3.1	1.9
Other	3.9	3.2	3.9
White	81.0	34.1	81.0
Marital Status			
Married/Life Partner	57.8	15.6	57.8
Divorced/Separated/Single	42.1	84.4	42.1
GAD			
Yes	0.1	0.6	0.1
No	99.9	99.4	99.9
PTSD			
Yes	0.1	0.5	0.1
No	99.9	99.5	99.9
SUD			
Yes	2.1	16.0	2.1
No	97.9	84.0	97.9
Depression			
Yes	1.0	6.1	1.0
No	99.0	93.9	99.0

Note: Chi-square p-values were all <0.0001 comparing HIV-positive and not HIV-positive populations

GAD: Generalized Anxiety Disorder; PTSD: Posttraumatic stress disorder; SUD: Substance use disorder

Table 2. Distribution of Sociodemographic Characteristics by Psychiatric and Substance Abuse Disorders

	GAD N=21,221		PTSD N=21,528		SUD N=786,832		Depression N=395,741	
	Yes	No	Yes	No	Yes	No	Yes	No
Sex								
Female	70.8	59.2	54.2	59.2	44.3	59.5	67.2	59.1
Male	29.2	40.9	45.8	40.8	55.7	40.5	32.8	40.9
Age								
50-64	57.1	48.1	84.2	48.1	71.5	47.6	53.7	48.0
65	42.9	51.9	15.8	51.9	28.5	52.4	46.3	52.0
Race/Ethnicity								
Asian/Pacific Islander	0.8	1.5	0.3	1.5	0.5	1.5	0.5	1.5
Black	8.8	11.8	13.4	11.8	21.0	11.6	11.2	11.8
Hispanic	1.9	1.5	2.2	1.9	1.3	1.9	1.4	1.9
Other	3.9	2.9	3.0	3.9	2.3	3.9	2.7	3.9
White	80.9	86.0	81.1	80.9	74.9	81.1	84.3	80.9
Marital Status								
Married/Life Partner	57.8	46.7	35.9	57.8	41.9	58.2	44.4	58.0
Divorced/Separated/Single	42.2	53.3	64.1	42.2	58.1	41.8	55.6	42.0

GAD: Generalized Anxiety Disorder; PTSD: Posttraumatic stress disorder; SUD: Substance use disorder

Table 3.

Overall Association between Psychopathology and HIV Diagnosis by Gender, Age Group, and Race/Ethnicity, Marital Status

	GAD			PTSD			SUD			Depression		
	Crude OR 95% CI	Adjusted OR 95% CI	Crude OR 95% CI	Adjusted OR 95% CI	Crude OR 95% CI	Adjusted OR 95% CI	Crude OR 95% CI	Adjusted OR 95% CI	Crude OR 95% CI	Adjusted OR 95% CI	Crude OR 95% CI	
Overall	11.2 (9.79 – 12.7)	8.16 (7.11 – 9.36)	9.40 (8.17 – 10.8)	3.16 (2.73 – 3.66)	9.09 (8.84 – 9.34)	2.22 (2.16 – 2.29)	6.22 (5.96 – 6.49)	3.49 (3.33 – 3.66)				
Male	17.1 (14.7 – 19.9)	10.3 (8.75 – 12.1)	7.63 (6.40 – 9.10)	2.86 (2.38 – 3.43)	6.76 (6.54 – 6.99)	1.90 (1.84 – 1.97)	6.90 (6.54 – 7.28)	3.31 (3.12 – 3.50)				
Female	7.39 (5.67 – 9.63)	5.01 (3.81 – 6.58)	12.3 (9.74 – 15.6)	4.01 (3.16 – 5.09)	11.4 (10.8 – 12.0)	3.62 (3.43 – 3.83)	6.85 (6.39 – 7.35)	3.88 (3.59 – 4.18)				
Age 50–64	9.70 (8.46 – 11.1)	8.29 (7.19 – 9.57)	5.64 (4.88 – 6.52)	3.29 (2.84 – 3.82)	6.41 (6.23 – 6.60)	2.34 (2.27 – 2.41)	5.90 (5.65 – 6.17)	3.75 (3.58 – 3.93)				
Age 65	9.67 (5.92 – 15.8)	11.2 (6.81 – 18.3)	16.2 (8.70 – 30.1)	9.80 (5.24 – 18.3)	8.45 (7.54 – 9.48)	3.64 (3.23 – 4.10)	3.35 (2.77 – 4.05)	2.98 (2.44 – 3.64)				
White	13.5 (11.2 – 16.3)	7.85 (6.47 – 9.52)	11.4 (9.24 – 14.0)	3.31 (2.67 – 4.10)	7.47 (7.10 – 7.85)	2.23 (2.11 – 2.35)	6.47 (6.04 – 6.92)	3.64 (3.39 – 3.92)				
Black	10.0 (8.17 – 12.3)	7.85 (6.33 – 9.72)	6.32 (5.15 – 7.75)	3.11 (2.52 – 3.83)	4.89 (4.72 – 5.07)	2.11 (2.03 – 2.19)	4.89 (4.60 – 5.21)	3.12 (2.93 – 3.33)				
Hispanic	11.3 (5.05 – 25.4)	6.82 (3.00 – 15.5)	4.85 (1.81 – 13.0)	1.43 (0.53 – 3.87)	19.7 (17.2 – 22.7)	5.89 (5.06 – 6.86)	14.4 (11.9 – 17.4)	6.87 (5.63 – 8.38)				
Other	26.4 (15.8 – 44.2)	11.2 (6.29 – 19.9)	13.2 (6.26 – 27.8)	3.34 (1.56 – 7.15)	12.2 (10.4 – 14.3)	3.45 (2.91 – 4.10)	11.1 (9.03 – 13.7)	5.10 (4.11 – 6.33)				

Bolded estimates represent statistically significant associations at $p < 0.05$

GAD: Generalized Anxiety Disorder; PTSD: Posttraumatic stress disorder; SUD: Substance use disorder