

ORIGINAL RESEARCH

Intersection of PTSD, HIV, and Cardiometabolic Health Among Middle-Aged Men in the Multicenter AIDS Cohort Study

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Introduction

Cardiometabolic conditions such as hypertension, diabetes, and dyslipidemia disproportionately affect people living with HIV (PLWH). Rates of post-traumatic stress disorder (PTSD) are highly prevalent among gay and bisexual men, potentially compounded due to sexual-minority stress and trauma. This study investigates the relationship between PTSD and cardiometabolic outcomes in middle-aged and older gay and bisexual men, stratified by HIV status.

Methods

Data from 1,180 participants in the Multicenter AIDS Cohort Study (MACS) was analyzed. PTSD was assessed using the PTSD Checklist-Civilian Version, and hypertension, diabetes, and dyslipidemia were defined based on clinical criteria. Multivariate logistic regression models, adjusted for covariates, examined associations between PTSD and cardiometabolic outcomes, with stratification by HIV status.

Results

PTSD was significantly associated with 2.5 times higher odds of hypertension (OR: 2.49; 95% CI: 1.16–5.33). While PTSD showed no statistical significance with diabetes or dyslipidemia, the prevalence of dyslipidemia was higher in PLWH than PLWOH, with a greater (but not statistically significant) positive relationship observed in PLWH. Hypertension, diabetes, and dyslipidemia prevalence were elevated in the cohort, with BMI and age emerging as significant covariates. No interaction effects between PTSD and HIV status were observed.

Conclusion

There was a statistically significant positive risk associated with PTSD and hypertension risk, emphasizing its role in cardiovascular health among gay and bisexual men. These findings highlight the need for trauma-informed, integrated care addressing PTSD and metabolic health, particularly in PLWH. Future research should explore causal pathways and the impact of demographic and lifestyle factors on these relationships.

Introduction

Improvements in HIV treatment have promoted longer survival among people living with HIV (PLWH), but these advancements have led to a growing recognition of the complex interplay between HIV, mental health, and metabolic comorbidities.^{1,2} Furthermore, therapeutic interventions, including antiretroviral therapy (ART) and preexposure prophylaxis, are not devoid of adverse effects. There is a growing body of literature indicating that these therapies may contribute to cardiometabolic disorders such as dyslipidemia and insulin resistance.³ Additionally, psychiatric sequelae associated with long-term use of these medications have been reported.⁴ The potential adverse health outcomes may influence individuals' decisions regarding the initiation and continuation of these therapies, impacting HIV management strategies. One specific area of concern is the high prevalence of posttraumatic stress disorder (PTSD), chronic stress, and perceived stress among PLWH, which may significantly contribute to adverse health outcomes.⁵ PTSD is clinically defined as a psychiatric disorder that can occur in individuals who have experienced or witnessed a traumatic event, characterized by symptoms such as intrusive memories, avoidance behaviors, negative changes in mood and cognition, and heightened arousal and reactivity.⁶ Chronic stress is clinically defined as the physiological and psychological response to perceived threats that persist over an extended period, often leading to a range of health issues. Meanwhile, perceived stress refers to an individual's ability to deal with problems and difficulties that arise due to uncontrollable circumstances, reflecting their current subjective evaluation of stress in their life.⁷ Clinical signs of both forms of stress can manifest as psychological symptoms, such as anxiety and depression, as well as physical symptoms, such as headaches, fatigue, and sleep disturbances.

Many studies have shown that PTSD rates, and their subsequent health outcomes, are notably worse in PLWH.^{8,9} Machtinger et al¹⁰ found that the rates of exposure to traumatic events and recent PTSD were 2- to 5-fold higher among women living with HIV than rates of exposure in their seronegative counterparts. The study defined recent PTSD as a diagnosis within the past 6 months, reflecting the acute phase of the disorder following exposure to a traumatic event.¹⁰ An epidemiological study by Ba et al¹¹ further found that PLWH had a significantly higher risk of developing mental health disorders, and stronger associations were observed among the subgroups consisting of men and individuals aged 18 to 34 years. The conclusions of Neigh et al⁵ regarding the high rates of these disorders underscored the need to address mental health concerns among PLWH, but they also pointed to the importance of studying cardiometabolic health, and other intersecting conditions, within this population. Specifically, PLWH have a significantly higher likelihood of developing chronic conditions such as overweight/obesity, diabetes, stroke, and ischemic heart disease.⁵ Roer et al¹² demonstrated that PTSD is associated with an increased risk of developing

various cardiometabolic conditions, including hypertension, diabetes, and obesity, in the general population. These associations persisted after adjusting for socioeconomic status and comorbid conditions, highlighting the independent impact of PTSD on cardiometabolic health.¹² Webel et al¹³ also demonstrated that the rate of atherosclerotic cardiovascular disease development was 1.5 to 2.0 times greater for PLWH compared with people living without HIV (PLWOH), and this risk was exacerbated by traditional risk factors such as hypertension, hyperlipidemia, and obesity.

Adverse cardiovascular outcomes among PLWH have also been associated with higher rates of stress and unhealthy coping behaviors.¹⁴ Through examining multiple stress indicators (chronic, perceived, and traumatic) in Hispanic/Latino adults, Gallo et al¹⁴ found that a higher stress burden was associated with a higher prevalence of coronary heart disease, stroke, diabetes, and hypertension. Perceived stress was also found to independently correlated with delayed verbal memory, poor executive functions, and increased antiretroviral nonadherence.¹⁵ Moreover, perceived stress and traumatic life events were found to be associated with elevated levels of inflammatory markers such as C-reactive protein and interleukin-6, which are known to contribute to the development and progression of cardiometabolic diseases.¹⁶

The mechanisms underlying the association among PTSD, stress, and cardiometabolic conditions are multifaceted. Proposed pathways include autonomic nervous system dysfunction, increased inflammation, alterations in brain circuits involved in emotion processing, and behavioral changes such as sleep disorders and substance use.¹⁷ Additionally, HIV infection itself may contribute to a state of chronic inflammation and immune activation, potentially exacerbating the effects of stress on metabolic health. Recent studies have also correlated perceived stress with increased systemic inflammation and heightened uptake of ¹⁸F-fluorodeoxyglucose, a radiologic marker used to assess metabolic activity in tissues.¹⁸ Although the exact mechanism for this association remains unclear, it suggests that psychological stress may activate inflammatory pathways and reduce resting metabolic activity.

By evaluating perceived stress and clinical definitions of dyslipidemia, hypertension, and diabetes using laboratory measurements to evaluate comorbidity outcomes, we hope to understand the role that perceived stress plays in health outcomes among people who are living with or without HIV. We hypothesize that there exists a positive relationship between PTSD and the prevalence of dyslipidemia, hypertension, and diabetes among middle-aged and aging men living with or without HIV, and that this relationship is greater in men living with HIV compared with men living without HIV. Understanding the complex relationships between PTSD, chronic stress, and cardiometabolic conditions in men living with HIV is crucial for developing targeted interventions and improving long-term health outcomes in this

population. To do this, our study used data from the Multicenter AIDS Cohort Study (MACS) substudy, Understanding Patterns of Healthy Aging Among Men Who Have Sex With Men, which consists of biannual surveys of PLWH and PLWOH.¹⁹

Methods

Participant Characteristics

From 1984 to 2019, the MACS investigated the natural and treated history of HIV in more than 7000 sexual minority men living with and without HIV. It was conducted across 4 US sites: Baltimore, Maryland/Washington, DC; Chicago, Illinois; Los Angeles, California; and Pittsburgh, Pennsylvania/Columbus, Ohio. Participants attended semiannual MACS clinic visits that collected demographic information, medical history, behavioral data, and biospecimens through audio computer-assisted self-interviews and standardized clinical examinations. Further details on the MACS study design have been described elsewhere.²⁰ The Understanding Patterns of Healthy Aging Among Men Who Have Sex With Men substudy of the MACS sought to identify psychosocial factors contributing to healthy aging in middle-aged and older sexual minority men living with and without HIV.¹⁹ This substudy was administered across 6 MACS visits between April 2016 and March 2019. Eligibility criteria required participants to be at least 40 years old by April 2016, report at least 1 instance of sexual intercourse with another man since MACS enrollment, and complete 2 consecutive MACS visits before April 2016. A total of 1317 MACS participants enrolled in the substudy. The current cross-sectional analysis included 1180 PLWH and PLWOH who responded to questions related to PTSD between April 2018 and April 2019 (MACS visits 69 and 70). If a participant completed both visits, data from the most recent visit were used.

Measures

The outcome measures for this analysis were hypertension, diabetes, and dyslipidemia. Hypertension was defined as having a systolic blood pressure of 130 mm Hg or greater, diastolic blood pressure of 80 mm Hg or greater, or the use of antihypertensive medication. Diabetes was defined as having a fasting glucose level of 126 mg/dL or greater, hemoglobin A_{1c} level greater than 6.5%, or using diabetes medications. Dyslipidemia was defined as total cholesterol level of 200 mg/dL or greater, low-density lipoprotein cholesterol level of 130 mg/dL or greater, high-density lipoprotein cholesterol level less than 40 mg/dL, or triglycerides level of 150 mg/dL or greater.

Primary Predictor

PTSD symptoms were measured using the PTSD Checklist–Civilian Version and consisted of 17 items.²¹ Participants were given a list of problems and complaints that some may have in response to stressful life experiences and

included questions such as, “Feeling jumpy or easily startled?” and “Being super alert or watchful on guard?” The response choices were not at all, a little bit, moderately, quite a bit, and extremely. Participants were classified as having symptomatic PTSD if they responded with moderately or higher to at least 1 symptomatic response in items 1 through 5, at least 3 symptomatic responses in items 6 through 12, and at least 2 symptomatic responses in items 13 through 17.²¹

Covariates

Age was analyzed as a continuous variable in years. Self-identified race and ethnicity were categorized as Hispanic (including participants identifying as Black, White, or other races), non-Hispanic Black, non-Hispanic White, and other non-Hispanic. Education was categorized as less than high school, high school diploma, at least some college, and at least some graduate work. Current insurance coverage (private, Tricare, Medicare, or Medicaid) was dichotomized as yes or no. The number of health care professional visits was assessed at each visit. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared.

Statistical Analysis

Descriptive statistics were generated for the outcomes, PTSD, and covariates using frequencies and percentages for categorical variables and medians and IQRs for continuous variables. Separate multivariate logistic regression models were used to estimate the association between hypertension, diabetes, and dyslipidemia and PTSD, adjusting for age, race and ethnicity, education, insurance status, the number of health care visits, and BMI. Additionally, we tested the interaction effect between HIV status and symptomatic PTSD in each of the models. Odds ratios (ORs) and 95% confidence intervals (CIs) were reported. All analyses were performed using SAS version 9.4 (SAS Institute). Statistical procedures were conducted using the PROC LOGISTIC procedure for multivariate logistic regression, with plots of predicted probabilities and interaction effects generated using the EFFECTPLOT statement to visualize model estimates.

Results

Participant Characteristics

Our sample was evenly divided between PLWH (49.7%) and PLWOH (50.3%). The median age of participants was 62 years (IQR, 56-68), with 68.7% identifying as non-Hispanic White, and 86.9% having at least some college education. Most participants had insurance coverage (93.2%), with a median of 2 physician visits in the 6 months prior to their MACS visit. The median BMI was 26.1. The prevalences of hypertension, diabetes, and dyslipidemia were 70.8%, 15.0%, and 74.2%, respectively. PTSD was reported

in 8.7% of participants, with a higher prevalence among PLWH (10.6%) compared with PLWOH (6.9%). Further details stratified by HIV status are provided in Table 1.

Adjusted Associations of PTSD and Metabolic Disorders

Participants with symptomatic PTSD had 2.5 times the odds of hypertension (OR, 2.49; 95% CI, 1.16-5.33) compared with those without PTSD, after adjusting for covariates (Table 2). We did not find statistically significant associations between PTSD and the other metabolic disorders. Regarding the covariates, identifying as Hispanic (OR, 0.54; 95% CI, 0.30-0.99), the number of physician visits (OR, 1.06; 95% CI, 1.01-1.12), and BMI (OR, 1.15; 95% CI, 1.10-1.20) were associated with hypertension. Age (OR, 1.05; 95% CI, 1.02-1.08), PLWH (OR, 1.74; 95% CI, 1.11-2.71), and identifying as non-Hispanic Black (OR, 1.96; 95% CI, 1.17-3.26), number of physician visits (OR, 1.05; 95% CI, 1.02-1.09), and BMI (OR, 1.14; 95% CI, 1.10-1.18) were associated with diabetes. Identifying as non-Hispanic Black (OR, 0.51; 95% CI, 0.32-0.81) and BMI (OR, 1.09; 95% CI, 1.05-1.14) were associated with dyslipidemia. We did not find a statistically significant interaction effect between HIV status and symptomatic PTSD in the hypertension ($\beta = -1.34$; SE, 1.16; $P = .23$), diabetes ($\beta = -0.33$; SE, 0.65; $P = .61$), and dyslipidemia ($\beta = 0.58$; SE, 0.56; $P = .29$) models and thus were excluded in the final reported models.

Discussion

The key findings of this study underscore the complex relationship between mental health and cardiometabolic conditions among middle-aged and older sexual minority men. The primary finding indicates a significant positive association between PTSD and hypertension, with participants reporting PTSD exhibiting over double the odds of hypertension compared with those without PTSD. This association persisted after adjusting for covariates such as age, BMI, race and ethnicity, and health care access, emphasizing that PTSD independently contributes to hypertension risk. Hypertension's increased prevalence across the cohort, affecting 70.8% of participants, underscores its critical importance as a public health issue within this population. Notably, we observed no significant associations between PTSD and diabetes, or PTSD and dyslipidemia, although the prevalence of both conditions was substantial across the cohort. While age was a significant covariate for diabetes, and BMI was a consistent determinant across all outcomes, no interaction between PTSD and HIV status was observed for the other metabolic conditions. Some studies previously showed that HIV infection itself may contribute to a state of chronic inflammation and immune activation,^{22,23} leading to our hypothesis that the relationship between PTSD and hypertension would be greater among PLWH than PLWOH, but we did not find that association in this study. It is possible that the metabolic impact of PTSD operates through biological pathways

Table 1. Demographic Characteristics

Characteristics	Participants living with HIV (n=586)	Participants living without HIV (n=594)	Overall (n=1180)
Age at Visit, median (IQR)	59.0 (54.0, 65.0)	65.0 (59.0, 70.0)	62.0 (56.0, 68.0)
Race/Ethnicity, n (%)			
White, Non-Hispanic	333 (56.8%)	478 (80.5%)	811 (68.7%)
Black, Non-Hispanic	164 (28.0%)	74 (12.5%)	238 (20.2%)
Hispanic	77 (13.1%)	31 (5.2%)	108 (9.2%)
Other	12 (2.0%)	11 (1.9%)	23 (1.9%)
Education Attainment, n (%)			
Less than High School	20 (3.4%)	11 (1.9%)	31 (2.6%)
High School Diploma	72 (12.3%)	42 (7.1%)	114 (9.7%)
At least some college	299 (51.0%)	246 (41.4%)	545 (46.2%)
At least some graduate work	192 (32.8%)	288 (48.5%)	480 (40.7%)
Missing	3 (0.5%)	7 (1.2%)	10 (0.8%)
Currently Insured, n (%)			
No	19 (3.2%)	14 (2.4%)	33 (2.8%)
Yes	541 (92.3%)	559 (94.1%)	1100 (93.2%)
Missing	26 (4.4%)	21 (3.5%)	47 (4.0%)
Number of Doctor Visits, median (IQR)	3.0 (2.0, 5.0) (9.6%)	2.0 (1.0, 4.0) (15.8%)	2.0 (1.0, 5.0) (12.7%)
Body Mass Index, median (IQR)	25.8 (23.3, 29.6) (7.2%)	26.5 (23.8, 30.0) (5.9%)	26.1 (23.5, 29.7) (6.5%)
Hypertension, n (%)			
No	140 (23.9%)	116 (19.5%)	256 (21.7%)
Yes	397 (67.7%)	439 (73.9%)	836 (70.8%)
Missing	49 (8.4%)	39 (6.6%)	88 (7.5%)
Diabetes, n (%)			
No	448 (76.5%)	474 (79.8%)	922 (78.1%)
Yes	102 (17.4%)	75 (12.6%)	177 (15.0%)
Missing	36 (6.1%)	45 (7.6%)	81 (6.9%)
Dyslipidemia, n (%)			
No	119 (20.3%)	124 (20.9%)	243 (20.6%)
Yes	436 (74.4%)	440 (74.1%)	876 (74.2%)
Missing	31 (5.3%)	30 (5.1%)	61 (5.2%)
Perceived Stress Category, n (%)			
High Perceived Stress	18 (3.1%)	10 (1.7%)	28 (2.4%)
Moderate Stress	234 (39.9%)	204 (34.3%)	438 (37.1%)
Low Stress	235 (40.1%)	311 (52.4%)	546 (46.3%)
Missing	99 (16.9%)	69 (11.6%)	168 (14.2%)

Characteristics	Participants living with HIV (n=586)	Participants living without HIV (n=594)	Overall (n=1180)
PTSD, n (%)			
No	451 (77.0%)	510 (85.9%)	961 (81.4%)
Yes	62 (10.6%)	41 (6.9%)	103 (8.7%)
Missing	73 (12.5%)	43 (7.2%)	116 (9.8%)

common to both PLWH and PLWOH, such as sympathetic nervous system overactivity or hypothalamic-pituitary-adrenal axis dysregulation, thereby diminishing differential effects by HIV status. Furthermore, the overlapping influence of HIV-related inflammation, ART-induced metabolic dysregulation, and high levels of health care engagement in PLWH may obscure or dilute any additive interaction between HIV and PTSD on these outcomes. These findings highlight the need for longitudinal research to clarify potential moderating factors—such as HIV duration, ART regimen, and cumulative stress exposure—and to better understand PTSD’s role in broader metabolic health.

The relationship between PTSD and hypertension observed in this study aligns with a substantial body of research demonstrating an association between PTSD and elevated blood pressure. PTSD has been consistently linked to dysregulated autonomic nervous system activity, characterized by increased sympathetic tone and reduced parasympathetic modulation, which elevate blood pressure over time.¹⁷ Furthermore, chronic psychological stress associated with PTSD exacerbates inflammation, a critical mediator of hypertension, by upregulating proinflammatory cytokines such as interleukin-6 and C-reactive protein.¹⁶ Studies have shown that PTSD increases hypertension risk across diverse populations, with rates as high as 30% among individuals with chronic PTSD symptoms compared with 15% to 20% in the general population.¹² In contrast, the absence of significant associations between PTSD and diabetes or dyslipidemia in our study challenges findings from previous literature that identified PTSD as a contributor to broader metabolic syndrome. For instance, research by Zicari et al²³ highlighted that PTSD correlated with insulin resistance and dysregulated lipid metabolism, particularly among populations exposed to chronic stressors. Additionally, in the general population, PTSD has been associated with a 40% to 50% increased risk of type 2 diabetes, mediated by both physiological factors, such as hypothalamic-pituitary-adrenal axis dysregulation, and behavioral factors, such as physical inactivity and poor dietary patterns.²⁴ Dyslipidemia has also been linked to PTSD, with studies reporting an association between chronic stress and unfavorable lipid profiles, including elevated low-density lipoprotein and triglyceride levels, particularly in populations with concurrent obesity.²⁵

Table 2. Adjusted Models (Hypertension, Diabetes, and Dyslipidemia Outcomes) With PTSD as Primary Predictor

	Hypertension OR (95% CI)	Diabetes OR (95% CI)	Dyslipidemia OR (95% CI)
PTSD			
Yes	2.49 (95% CI: 1.16 - 5.33)	1.26 (95% CI: 0.67 - 2.39)	0.60 (95% CI: 0.34 - 1.04)
No (referent)	-	-	-
Age at Visit (per unit increase)	1.02 (95% CI: 0.99 - 1.04)	1.05 (95% CI: 1.02 - 1.08)	1.02 (95% CI: 0.99 - 1.04)
HIV Status			
Participants living with HIV	0.79 (95% CI: 0.54 - 1.14)	1.74 (95% CI: 1.11 - 2.71)	1.44 (95% CI: 0.99 - 2.10)
Participants living without HIV (referent)	-	-	-
Race/Ethnicity			
Black, Non-Hispanic	1.11 (95% CI: 0.67 - 1.85)	1.96 (95% CI: 1.17 - 3.26)	0.51 (95% CI: 0.32 - 0.81)
Hispanic	0.54 (95% CI: 0.30 - 0.99)	1.18 (95% CI: 0.55 - 2.53)	0.60 (95% CI: 0.32 - 1.11)
Other	2.08 (95% CI: 0.44 - 9.82)	1.75 (95% CI: 0.43 - 7.03)	0.58 (95% CI: 0.17 - 1.92)
White, Non-Hispanic (referent)	-	-	-
Education Attainment			
Less than High School	1.03 (95% CI: 0.54 - 1.98)	1.18 (95% CI: 0.55 - 2.56)	0.87 (95% CI: 0.46 - 1.66)
At least some college	0.89 (95% CI: 0.46 - 1.74)	1.08 (95% CI: 0.49 - 2.40)	0.97 (95% CI: 0.50 - 1.89)
At least some graduate work	0.41 (95% CI: 0.12 - 1.43)	0.84 (95% CI: 0.16 - 4.46)	2.88 (95% CI: 0.57 - 14.54)
High School Diploma (referent)	-	-	-
Currently Insured, n (%)			
No	0.64 (95% CI: 0.27 - 1.56)	1.65 (95% CI: 0.54 - 5.05)	0.67 (95% CI: 0.28 - 1.65)
Yes (referent)	-	-	-
Number of Doctor Visits (per unit increase)	1.06 (95% CI: 1.01 - 1.12)	1.05 (95% CI: 1.02 - 1.09)	1.02 (95% CI: 0.98 - 1.06)
BMI (per unit increase)	1.15 (95% CI: 1.10 - 1.20)	1.14 (95% CI: 1.10 - 1.18)	1.09 (95% CI: 1.05 - 1.14)

Rates of cardiometabolic conditions among PLWH in our cohort were higher compared with the general population. While hypertension prevalence in the general US population is approximately 45%, it reached 67.7% among PLWH in this study. Similarly, diabetes and dyslipidemia prevalence among PLWH in this study exceeded national averages, reflecting the combined metabolic burden of HIV, ART, and aging. These elevated rates highlight the multifactorial nature of metabolic risk in this population, where PTSD, while

significant for hypertension, may act synergistically with other factors to influence metabolic outcomes. For instance, the interaction between PTSD-induced autonomic dysregulation and HIV-related immune activation could exacerbate metabolic conditions beyond hypertension, such as diabetes and dyslipidemia. Although our study did not find significant associations between PTSD and these other metabolic conditions, the high prevalence of these conditions suggests a complex interplay that merits further investigation. Behavioral mechanisms, including sleep disturbances, substance use, and nonadherence to medical therapies, are notably prevalent in aging populations with chronic health issues; their prevalence could amplify these risks but this remains underexplored in older male populations. Thus, while PTSD independently contributes to hypertension, its role in conjunction with other factors in broader metabolic health represents a critical area for future research, potentially aiding in the development of more comprehensive treatment and management strategies for these populations.

To our knowledge, few studies have examined the intersection of PTSD, HIV, and cardiometabolic outcomes stratified by HIV status, particularly among men. A notable exception is a study by Turkson et al,²⁶ which found that PTSD and HIV together amplified cardiovascular risk in Black women by altering fear response pathways and heightening inflammatory processes. This research suggests that sex, race, and sociodemographic factors play significant roles in modulating the interaction between PTSD and HIV, potentially influencing cardiometabolic outcomes differently across populations. The absence of significant interaction effects in our study could reflect sex-specific differences, as male hormonal profiles and metabolic responses to chronic stress differ from those of females. Additionally, differences in racial composition may contribute, as our predominantly White cohort differs from the racially diverse populations studied elsewhere. HIV-specific factors may also mask the effects of PTSD in this population. Chronic inflammation and immune activation induced by HIV infection, coupled with metabolic adverse effects of ART, are potent drivers of cardiometabolic risk independent of PTSD. ART regimens, particularly older formulations, have been linked to dyslipidemia, insulin resistance, and fat redistribution, which may overshadow or interact with PTSD-related pathways.²⁷ Moreover, high rates of health care utilization among PLWH in our cohort, as evidenced by a median of 3 physician visits per year, may mitigate some of the behavioral risks associated with PTSD, such as undiagnosed hypertension or unmanaged diabetes.

Conclusions

This study aimed to investigate the relationship between PTSD and cardiometabolic outcomes (hypertension, diabetes, and dyslipidemia) among gay and bisexual middle-aged men living with and without HIV. PTSD rates are disproportionately higher in this population due to factors associated

with sexual minority stress, such as stigma, discriminatory policies, and social isolation.²⁸ Moreover, this population faces compounded vulnerabilities due to systemic inequities and unique psychosocial challenges. Gay and bisexual men are at heightened risk for experiencing trauma, such as hate crimes, interpersonal and intimate partner violence, and rejection from family or social networks, all of which can increase PTSD risk.²⁹ Our findings revealed a significant association between PTSD and hypertension risk, suggesting that PTSD may serve as a contributor to cardiovascular risk in this population. While associations between PTSD with diabetes and with dyslipidemia were not statistically significant, the overall high prevalence of these metabolic conditions in this sample underscores the ongoing need for proactive metabolic monitoring in this population, given their heightened vulnerability to cardiovascular and metabolic comorbidities.^{12,13}

Directions for future research include conducting longitudinal analyses to explore the causal pathways between these outcomes and their interactions over time. Using data from the MACS, future analyses could also examine how psychosocial factors, ART regimens, and genetic predispositions influence cardiometabolic risk in this population. Additionally, such studies should include a more diverse and representative population to improve generalizability, as our cohort is primarily non-Hispanic White and urban. In particular, recruiting participants from rural areas and racial and ethnic minority groups could provide a broader understanding of PTSD's health impacts across sociodemographic groups. In summary, the interplay between PTSD and HIV warrants more comprehensive public health attention. An integrated model of care that incorporates trauma-informed care and routine metabolic assessments, such as the 5-Step Conceptual Framework, may be instrumental in reducing the health disparities faced by PLWH.³⁰ As the population of PLWH ages, such holistic approaches could help mitigate long-term health impacts and foster more resilient, healthy aging trajectories.

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