Association of PTSD with Longitudinal COVID-19 Burden in a Mixed-Serostatus Cohort of Men and Women: Weathering the Storm

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Conflicts of interest

All authors have no conflicts of interest to report.

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Abstract

OBJECTIVES: This study of people with HIV (PWH) and those without HIV conducted during the COVID-19 pandemic in the U.S. in 2020 examines the impact of post-traumatic stress disorder (PTSD) on COVID-19 burden, defined as pandemic-related disruptions.

METHODS: Data consisted of survey responses on PTSD among participants ($N = 2434$) enrolled in the Multicenter AIDS Cohort Study (MACS) and the Women's Interagency HIV (WIHS) cohorts. Unadjusted and adjusted regression models were used to examine the association of PTSD with COVID-19 burden (overall and domain-specific burdens). Quasi-Poisson regression models were used to assess associations with the COVID-19 burden score and two domain-specific burdens: (1) changes in resources, and (2) interruptions in health care. Analyses adjusted for age, race/ethnicity, HIV serostatus, current smoking status, number of comorbidities, education, and study regions.

RESULTS: Study participants were a median age of 58 (IQR 52-65). In both bivariate and multivariable models, PTSD severity was associated with greater overall COVID-19 burden. PTSD severity was associated with the number of resource changes and number of interruptions in medical care. These findings were also consistent across cohorts (MACS/WIHS) and across HIV serostatus, suggesting a greater risk for COVID-19 burden with greater PTSD severity, which remained significant after controlling for covariates.

CONCLUSIONS: This study builds on emerging literature demonstrating the impact of mental health on the burden and disruption associated with the COVID-19 pandemic, providing context specific to PWH. The ongoing pandemic requires structural and social interventions to decrease disruption to resources and health resource needs among these vulnerable populations.

Keywords

COVID-19; post-traumatic stress disorder; HIV; MACS; WIHS

Introduction

As of March 2022, there have been over 81 million cases and about 1 million deaths attributed to infection with Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), the virus that causes COronaVIrus Disease (COVID-19).[1] Globally, COVID-19 -associated morbidity and mortality triggered the implementation of rigorous lifestyle changes to mitigate transmission. COVID-19 pandemic-related lifestyle restrictions disrupted daily life and negatively impacted mental health and wellbeing, specifically depression, anxiety, difficulties with sleeping or eating, substance use, poorer overall health, among 4 out of 10 adults in the US. [2–7]. In addition, the pandemic may have a greater impact on individuals with existing psychological disorders [8], such as people with HIV (PWH). PWH may also experience high levels of chronic comorbidities [9–11], which may place them at increased risk for severe COVID-19 [12,13].

Among PWH, the estimated prevalence and mortality rates are 0.774% and 8.814%, respectively, with an even higher rate among those with co-occurring chronic illness [14]. Studies have also suggested that 19% of PWH were unable to receive antiretroviral therapy (ART) refills during the peak of the pandemic [15]. These disruptions in care were further exacerbated by the conversion of resources (i.e., prevention and control centers) from HIV to COVID-19 [15]. These contemporary disruptions in care were compounded by the higher rates of psychiatric disorders among PWH. For example, PWH report more lifetime traumatic events than do individuals without HIV, [16,17] including verbal, emotional, physical, and sexual abuse experienced in childhood and adulthood.[18] Post-traumatic stress disorder (PTSD) is a psychological disorder arising from traumatic events, and is characterized by three distinct symptom clusters including re-experiencing the traumatic event, hyperarousal, and avoidance of memories of the traumatic event.[19] One-third (35%) of women with HIV meet the criteria for PTSD [17] in comparison to the 9.7% lifetime prevalence of PTSD in the general population.[20] These rates of PTSD are commensurate with the high rates of lifetime sexual abuse, 61%, and physical abuse, 72%, reported by women with HIV.[21] Men with HIV also report high rates of abuse; 53% report a history of sexual assault and 63% report having been physically abused as adults.[21]

Among PWH, PTSD has been associated with suboptimal HIV-related health outcomes such as higher HIV viral load, lower CD4+ T cell count, and decreased treatment adherence.[22,23] PWH with PTSD are also at higher risk of unemployment and low socioeconomic status, compared with persons without HIV with PTSD, putting them at risk for psychosocial and structural vulnerabilities. High rates of PTSD and traumatic events among PWH [24,16,17,18,21] and the potential for re-traumatization and post-traumatic stress associated with COVID-19 makes those living with PTSD especially vulnerable. Fear, depression, social vulnerability, and food insecurity (including panic buying and hoarding) have been associated with an increased COVID-19 burden (symptoms, testing, hospitalization; changes to daily life due to COVID-19; changes or loss of resources; disruptions, interruptions or loss of healthcare) [21]. During the COVID-19 pandemic, PWH may experience substantial disruption in medical and psychological care as well as greater COVID-19 related isolation; this disruption may create chronic stress that erodes health, diminishes self-concept, and increases symptoms of poor mental health.[25] Using a cumulative burden framework, this study examined whether

the individual-level factor of PTSD severity among PWH and individuals without HIV is associated with greater COVID-19 related burden over time. It was hypothesized that those with greater PTSD severity would experience greater levels of COVID-19 burden, changes in resources, and medical care interruptions, as found in previous research in a smaller sample of PWH [26]. Identifying PWH with greater pandemic challenges could provide an opportunity to mobilize patient resilience to enhance their capacity to weather the COVID-19 storm.

Methods

MACS & WIHS and the MACS/WIHS Combined Cohort Study (MWCCS)

The MWCCS is a prospective observational study comprised of two long-standing cohorts, the Multicenter AIDS Cohort Study (MACS), which enrolled gay and bisexual men with and without HIV, and the Women's Interagency HIV Study (WIHS), which enrolled women with and without HIV [27]. Participants in the MACS and WIHS attended semi-annual research visits until 2019, during which both physiological and behavioral health assessments were conducted in-person. In early 2020, a COVID-19 interview was developed and administered by telephone/videoconference by trained interviewers at all the combined cohort sites of the MWCCS sites (Baltimore, MD/Washington, DC, Chicago, IL, Los Angeles, CA, and Pittsburgh, PA/Columbus, OH, Atlanta, GA, Birmingham, AL/Jackson, MS, Chapel Hill, NC, Chicago, IL, Los Angeles, CA, Miami, FL, New York, NY, San Francisco, CA, and Washington, DC). Prior to implementation of study procedures, all sites obtained approval from their respective institutional review boards.

Participants

Study participants included 2434 men and women, of whom 1549 were WIHS participants, and 882 MACS participants aged 40 years or older. Participants completed one or more waves of the MWCCS COVID-19 telephone interview from April 2020 – September 2020 and had previously completed a questionnaire module on PTSD and other analytic covariates during a semi-annual visit in their cohort (MACS or WIHS).

MACS participants with non-missing PTSD data were more likely to be older, HIV-negative, white race, and have higher income and education; they were less likely to come from LA site, compared to MACS participants with missing PTSD data. To have comparable age ranges for MACS and WIHS participants, WIHS participants aged <40 years were excluded. A flowchart of participant inclusion and exclusion is presented in Figure 1.

Waves and Measures

Three consecutive waves of COVID-19 telephone/videoconference surveys of participants were administered from April–September 2020. Participants were men and women, both PWH and those without HIV. Data collection instruments are available at https://statepi.jhsph.edu/mwccs/.

Primary Outcome.—The conceptualization of COVID-19 burden was influenced by previous research examining COVID-19 burden and mental health symptoms (e.g.,

depressive symptoms, sleep difficulties) [26]. Consistent with prior research, the primary outcome in this study, therefore, was COVID-19 burden across waves 1–3. COVID-19 burden was defined as the sum of the following 5 domains (range 0-14): 1) tested for COVID-19; 2) hospitalized for COVID-19; 3) making changes to daily life due to COVID-19 pandemic; 4) number of reported changes in resources (i.e., job loss, childcare loss, other financial support loss, housing loss, health insurance loss, difficulty paying for basic necessities, working outside, food loss); 5) number of interruptions in healthcare (i.e., unable to attend a healthcare appointment, unable to obtain medications, interruption in mental health care).

COVID-19 burden domains 1, 2, 4, and 5 were assessed based on participants' "ever report" of the outcome over the follow-up period. If a participant answered "Yes" to a given question at any wave, then the "ever report" indicator was coded as "Yes". Since domain 3 measures the absence of, "Making changes to daily life", the indicator was coded as "Yes" only when participant answered "No" to "Not making any changes to your daily life and routine" at all waves.

Predictor.—The predictor variable of interest in this study was the severity of PTSD symptoms, which was measured pre-pandemic using the PTSD checklist, civilian version (PCL-CV) [28]. A total symptom severity score (range 17-85) was calculated by summing the scores for each of the 17 items in PCL-CV with response options ranging from "Not at all" (coded as 1) to "Extremely" (coded as 5). The total symptom severity score was considered as a continuous variable. Probable PTSD was defined as when an individual had a total symptom severity score 45 and met symptom criterion based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition: having 1 B item (questions 1-5), 3 C items (questions 6-12), and 2 D items (questions 13-17) on the PCL-CV.[29–31] PTSD was assessed within 3 years of the COVID questionnaire, though the exact time interval was not available.

Covariates.—Using pre-pandemic data, age, HIV status, cigarette smoking (no was defined as "Not currently smoking" or "Not currently smoking, based on last report/ visit"; smoking was defined as "Currently smoking", or "Currently smoking, based on last report/visit"), number of comorbidities (hypertension, diabetes, chronic kidney disease, asthma, COPD/emphysema, recent cancer treatment since 2017, self-reported congestive heart failure), race/ethnicity, education, and study regions were included as behavioral and clinical covariates. In addition, income, number of people living in the household and depressive symptoms (score 16 on the Center for Epidemiologic Studies Depression Scale [32]) were assessed as potential covariates but not included in final models, the latter due to high correlation with the primary exposure, PTSD. Results of the multivariable model additionally adjusting for depressive symptoms are presented as a sensitivity analysis.

Comorbidities were defined as 1) hypertension, including the use of hypertensive medications, or systolic blood pressure 130, or diastolic blood pressure 80, 2) ever having diabetes: if ever self-reported anti- diabetic medication or confirmation of (a) fasting glucose >= 126 or (b) HbA1C >= 6.5% or (c) self- reported diabetes; 3) obesity*: body mass index 30; 4) chronic kidney disease*: eGFR<60 (stage 3 – 5) using Modification of Diet

in Renal Disease [MDRD] Study equation; 5) ever having asthma (self-reported), 6) ever having COPD/emphysema(self-reported), 7) reporting recent cancer treatment since 2017 (self-reported), 8) ever having congestive heart failure (self-reported). Comorbidity data was abstracted from the core data 3 years prior to the first V100 COVID wave.

Statistical Analyses

Characteristics of participants were summarized using descriptive statistics. Distributions of participant characteristics and outcomes were compared by cohort of origin (MACS, WIHS) using χ^2 tests for categorical variables and Wilcoxon rank-sum tests for continuous variables.

Unadjusted and adjusted regression models were used to examine the association of PTSD with COVID-19 -related burdens (overall and domain-specific burdens). All analyses were first performed separately by cohort of origin and were combined only if the association between PTSD and COVID-19 -related burden were qualitatively similar. Quasi-Poisson regression models were used to assess associations with the overall COVID-19 -related burden score, and two domain-specific burdens: (1) the number of changes in resources, and (2) the number of interruptions in health care. Quasi-Poisson regression was selected to accommodate under-dispersion/overdispersion of these count data, which assumes variance of the data is proportional to the mean. Logistic regression models were constructed to model the remaining dichotomous (yes/no) outcomes of whether participants (1) were tested for COVID-19 infection, (2) were hospitalized for COVID-19 infection, and (3) made changes to daily life due to the COVID-19 pandemic. For all of the models, we adjusted for covariates hypothesized a priori to be potential confounders, including age, race/ethnicity (non-Hispanic white or other, non-Hispanic black, Hispanic any race), HIV serostatus, current smoking status, number of comorbidities (0, 1, 2, 3), education (at least some college education, completed high school, did not complete high school), and study regions (West, Northeast, Mid-Atlantic, South, Southeast, Midwest). Potential interactions of PTSD score with HIV serostatus, PTSD score and other covariates with cohort of origin were tested. Depressive symptoms were not included in multivariable models due to their high correlation with PTSD, but were included in a sensitivity analysis. A second sensitivity analysis evaluated a COVID-19 burden outcome that excluded the domains of testing and interruption to daily life (see supplemental material).

Analyses were conducted using Stata/IC 16.1 and R version 4.0.2 (RStudio Version 1.3.1093). Statistical significance was determined by a 2-sided P-value <0.05.

Results

Participant Characteristics by Cohort of Origin

Participants were women and men enrolled in the MACS and WIHS. For the analytic sample as a whole, the median age of participants was 58 years. On average, 46% were non-Hispanic Black, 40% had completed some college or completed college, and 47% reported low income. A probable PTSD diagnosis was present in 125 participants, 33% had at least two comorbidities, 27% had depressive symptoms that were above 16 on the Center

for Epidemiologic Studies Depression Scale, 49% had 1-2 people living with them, and 25% lived in the Midwest.

Comparisons between WIHS and MACS participants are presented in Table 1; differences emerged in all demographics assessed. The MACS cohort was older (median age 65 versus 55 years; < .001) and had higher proportions of HIV (72% versus 62%; < .001) and of white participants (72% vs 9%; < .001). The MACS cohort was more likely to be college educated (3% WIHS versus 37% MACS; < .001), had lower proportions of low-income participants (60% WIHS versus 19 MACS% low income; < .001), lower mean PTSD scores (27 versus 23; < .001), lower proportions of probable PSTD (15% versus 6%; < .001), and lower proportions of multiple (3) comorbidities (36% versus 15%; < .001). The WIHS cohort had a higher proportion of current smokers (35% versus 13%; < .001), higher proportions of those living with others (23% versus 4%; < .001) and were more likely to live in the South (31% versus 0%; < .001). Further detail is presented in Table 1.

Distribution of Related Domains by HIV Serostatus among MACS and WIHS Participants

COVID-burden among participants ranged from 0 to 12. One-quarter of participants experienced more than or equal to 5 burdens overall, 40% were tested for COVID-19, 4% were hospitalized for COVID-19, the median number of interruptions in resources and healthcare was 1, and 67% reported making changes to daily life following the onset of the COVID-19 pandemic. These variables differed by both HIV status within the WIHS and MACS cohorts; further details of comparisons are listed in Table 2.

Bivariate and Multivariable Associations Between PTSD Severity Score (Per 10 Points) Scores) and COVID-19 burden and sub-Five Domains

In both bivariate and multivariable models, COVID-19 burden, number of resource changes, as well as number of interruptions in medical care were associated with PTSD severity, as presented in Table 3. Each 10-point increase in PTSD severity was associated with a 9% greater overall COVID-19 burden score, independent of other co-factors. These findings were also consistent across cohorts (MACS/WIHS) and across HIV serostatus (see Supplement Table 1). The magnitude of the associations did not change appreciably and remained statistically significant after adjusting for the covariates compared to the unadjusted models. In contrast, the odds of COVID-19 testing, hospitalization, or changes to daily life were not significantly associated with PTSD severity. The sensitivity analysis evaluating the association between PTSD severity and COVID-19 burden defined without COVID-19 testing or changes to daily life, found a similarly robust association within each cohort and overall.

Multivariable Associations Between Other Covariates and COVID-19 Burden

Table 4 presents the multivariable model for overall COVID-19 burden by cohort and overall. In addition to PTSD, independent of other covariates, participants in the WIHS cohort, current smokers, and those of younger age had greater COVID-19 burden. HIV serostatus and race were associated with COVID-19 burden, but these effects differed between MACS and the WIHS participants, such that PWH experienced lower COVID-19 burden than women without HIV in the WIHS but not in MACS. Black participants were

more likely to have lower COVID-19 burden than white participants in the WIHS, and higher COVID-19 burden in the MACS.

Depressive symptoms were not included in multivariable models due to their high correlation with PTSD, but in a sensitivity analysis including depressive symptoms as a covariate to the multivariable model in Table 4, the association between PTSD and overall COVID burden remained significant though slightly attenuated among all three samples (data not shown; see Supplemental Table 3).

Multivariable Associations Between PTSD Severity Score (Per 10 Points), Other Covariates, and Number of Interruptions in Medical Care

Adjusted associations between PTSD severity score and number of COVID-19 interruptions in medical care are presented in Table 5. PTSD severity score was associated with the number of COVID-19 interruptions in medical care across cohorts, suggesting a greater risk for number of COVID-19 interruptions in medical care with greater PTSD severity scores, after controlling for covariates.

Discussion

Using a cumulative burden framework, this study examined whether the individual-level factor of PTSD severity pre-COVID-19 would be associated with greater COVID-19 related burden over time. A series of comparisons were conducted between MACS and WIHS participants and by serostatus. All participants reported remarkable COVID-19 burden, resource disruption, and interruption to medical care. As hypothesized, those with greater PTSD severity had greater COVID-19 burden, changes in resources, and interruptions in medical care. The overall COVID-19 burden was greater among women, and among women, the COVID-19 burden was greater among those without HIV; among men, the COVID-19 burden was higher among PWH.

The WIHS sample was predominantly Black and low income; the MACS sample was predominantly white and the majority was not low income. Additionally, about one third reported symptoms consistent with depression and one third reported at least two comorbid disorders, with one quarter reporting at least five COVID-19 disruptions. Previous research has found higher levels of social disruption to be associated with great likelihood of symptoms of depression and anxiety; in contrast, this study measured pre-pandemic depression, anxiety and PTSD and the effect of PTSD on COVID pandemic disruptions.[33] Results support that those with pre-existing mental health challenges may be especially burdened by disruptions associated with the COVID-19 pandemic. A bidirectional relationship may exist between social disruption and mental health, such that COVID-19 stressors such as fear and anxiety may also exacerbate mental health challenges, and those already living with mental illness may be especially vulnerable to disruptions [34]. Further, the current findings provide support for similar research in a smaller sample of PWH [26]. Specifically, this previous study identified an association between COVID-19 risk and burden and depressive symptoms as well as sleep difficulties. This study adds to the existing literature by showing that mental health symptoms cannot only be a potential outcome of COVID-19 disruptions but can also contribute to the accumulation of risk among those with

a history of PTSD. Expanding trauma-informed care efforts for HIV care providers may be beneficial for optimizing HIV care. For example, previous studies on trauma have identified group interventions as an important tool for helping women cope with HIV [35].

This study supports previous reports that suggest that women with HIV may be less impacted than lower income women at high risk for HIV by COVID-19 burden and have less interruptions to medical care than those without HIV, which may indicate more established medical support, as well as provide evidence of resilience among PWH who may be coping with their second pandemic (the first being HIV). [26,34,36,37] Time, social support, coping skills, and skill building to enhance resilience may be important elements of ameliorating the impact of the COVID-19 pandemic. This study also supports previous reports of sex differences in COVID-19 burden among both PWH [29] and those without HIV.

This study faces certain limitations, most notably the influence of the rapidly changing environment surrounding COVID-19 infection and vaccination, as well as time between PTSD assessments and the COVID-19 surveys given that the exact time interval between assessments was not available. However, while it is possible that some participants would have improved (or worsened) PTSD symptoms over that time period, participants with Cluster C symptoms (included as a probable PTSD diagnosis) are less likely to improve, and Cluster C symptoms were included a probable PTSD diagnosis.[38] Currently, though vaccine rollout is underway, significant numbers of the general population, including those with HIV, have expressed hesitancy regarding vaccination [37]. However, study results remain relevant as the emergence of new COVID-19 variants continues to increase transmission, including among those already vaccinated [39,40], creating the potential for renewed disruptions. Study findings may be limited by the conceptualization of COVID-19 burden, which is a novel conceptualization for understanding COVID-19 disruptions and effects among PWH [26]. Future studies may benefit from psychometric analyses to establish the construct validity of COVID-19 burden as a new way of conceptualizing COVID-19 disruptions.

Findings from this study may not generalize to the rest of the population; the MACS and WIHS cohorts are long-established cohorts with most participants linked to care and perhaps less vulnerable to medical care disruption. In addition, the current sample of PWH likely has more experience with obtaining medical care and living in a pandemic (i.e., the HIV pandemic). Furthermore, this study relied on a convenience sample and demographic differences between MACS and WIHS participants were significant. Specifically, WIHS participants are representative of the HIV epidemic among women in the US, which includes a high proportion of Black women from low socioeconomic backgrounds, many from Southern states (Alabama, Mississippi, Georgia, North Carolina, and Florida) in which Medicaid expansion has not been adopted [41]. Moreover, WIHS participants have fewer financial and medical resources than MACS participants, who were higher income, better educated, not residing in the South, and predominantly white (and thus, as a whole, less subject to issues of systemic racism). Some PWH may receive social services, including disability benefits, housing opportunities, health insurance, and prescription drug coverage, for which participants without HIV may not qualify. This difference may account for the higher rates of social disruption and consequent psychosocial disparities identified among women not living with HIV, who were the most socioeconomically disadvantaged

in this sample. In contrast, overall MACS participants PTSD severity scores, though not significantly different by serostatus, were slightly higher among male PWH which may have contributed to higher burden in the MACS PWH group. In addition, as men in this sample were significantly older than women, they were more likely to be survivors of the early years of the HIV pandemic and may have experienced a re-traumatization associated with fear of contagion, lack of treatment, and social isolation, which may be especially difficult among those who are older. These sample differences may further limit the generalizability of the findings.

This study builds on emerging literature demonstrating the impact of mental and physical health on the burden and disruption associated with the COVID-19 pandemic [26], providing context specific to PWH. Continued research is needed on the impact of the COVID-19 pandemic, with particular attention to the cumulative impact of protracted disruption on those living with mental illness, such as depression, anxiety, and PTSD. In addition, longitudinal trajectories of pre-pandemic mental health and COVID-19 disruptions over time should be examined to establish temporal effects with associated psychological and physical health outcomes. High rates of PTSD and traumatic events among PWH [24,16,17,18,21] and the potential for re-traumatization and post-traumatic stress associated with COVID-19 makes those living with PTSD especially vulnerable. Further research and exploration of trajectories of mental and physical health impacting COVID-19 burden can identify both mental and physical health factors that can be strengthened, such as resilience based coping and social support, that can mitigate those patterns of burden. PWH have faced pandemic stress and weathered the storm. Overall, the ongoing pandemic highlights the need for structural and social interventions to decrease disruption to resources and health resource needs among vulnerable populations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgment:

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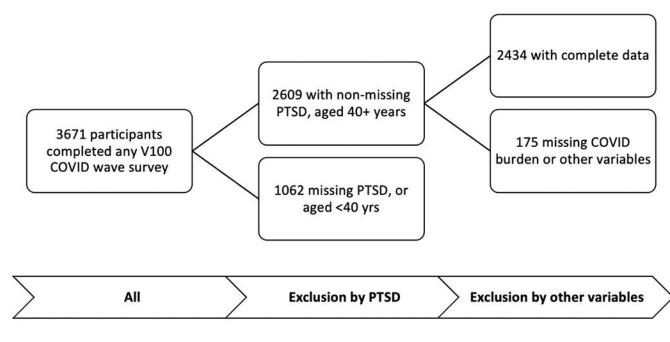41. Foundation KF. Status of state action on the Medicaid expansion decision. Kff org. 2016.

Figure 1:
Study participants exclusion flowchart

Table 1.

Participant characteristics by cohort of origin

Median (IQR), N (col %)	Overall (N=2434)	WIHS (N=1552)	MACS (N=882)	p-value
Age	58 (52, 65)	55 (49, 61)	65 (59, 70)	<0.001
HIV seropositive	1517 (62.3%)	1109 (71.5%)	408 (46.3%)	<0.001
Race/ethnicity				<0.001
Black NH	1107 (45.5%)	967 (62.3%)	140 (15.9%)	
Hispanic	274 (11.3%)	199 (12.8%)	75 (8.5%)	
White NH	774 (31.8%)	137 (8.8%)	637 (72.2%)	
Other	279 (11.5%)	249 (16.0%)	30 (3.4%)	
Education				<0.001
Did not complete high school	518 (21.3%)	494 (31.8%)	24 (2.7%)	
Completed high school	573 (23.5%)	483 (31.1%)	90 (10.2%)	
Some college or completed college	973 (40.0%)	531 (34.2%)	442 (50.1%)	
Attended/complete graduate school	370 (15.2%)	44 (2.8%)	326 (37.0%)	
Low income [*]	1035 (46.7%)	896 (59.8%)	139 (19.4%)	<0.001
PTSD severity score, range 17-85	25 (20, 36)	27 (20, 39)	23 (19, 31)	<0.001
Probable PTSD (cut-off ≥45)	288 (11.8%)	232 (14.9%)	56 (6.3%)	<0.001
Comorbidities, range 0-8	2 (1, 3)	2 (1, 3)	1 (1, 2)	<0.001
Comorbidities				<0.001
0	281 (11.5%)	118 (7.6%)	163 (18.5%)	
1	673 (27.6%)	359 (23.1%)	314 (35.6%)	
2	794 (32.6%)	518 (33.4%)	276 (31.3%)	
≥3	686 (28.2%)	557 (35.9%)	129 (14.6%)	
CES-D ≥16	631 (25.9%)	435 (28.0%)	196 (22.2%)	0.002
Currently smoking cigarettes	649 (26.7%)	538 (34.7%)	111 (12.6%)	<0.001
Number of people live with you				<0.001
0	781 (34.1%)	436 (29.5%)	345 (42.5%)	
1-2	1129 (49.3%)	698 (47.2%)	431 (53.1%)	
≥3	380 (16.6%)	344 (23.3%)	36 (4.4%)	
Region				<0.001
West (CA)	416 (17.1%)	177 (11.4%)	239 (27.1%)	
Northeast (NY)	474 (19.5%)	474 (30.5%)	0 (0.0%)	
Mid-Atlantic (Washington DC, MD)	466 (19.1%)	219 (14.1%)	247 (28.0%)	
South (AL, FL, GA, MS, NC)	480 (19.7%)	480 (30.9%)	0 (0.0%)	
Midwest (IL, OH, PA)	598 (24.6%)	202 (13.0%)	396 (44.9%)	

Notes: p-value by chi-square test for categorical variables and Wilcoxon rank-sum for continuous variables. IQR = interquartile range. NH = Non-Hispanic

*
MACS: Individual gross income/year <$20,000; WIHS: average household income/year income <=$18,000.

Table 2.

Distribution of COVID-19 burden and sub-domains by HIV serostatus among MACS and WIHS participants

Median (IQR), N (col %)	WIHS			MACS		
	HIV-negative (N=443)	HIV-positive (N=1109)	p-value	HIV-negative (N=474)	HIV-positive (N=408)	p-value
COVID-19 burden overall, range 0-14	3 (2, 5)	3 (2, 4)	<0.001	2 (2, 3)	3 (2, 4)	<0.001
COVID-19 burden overall			0.007			<0.001
0-1	58 (13.1%)	194 (17.5%)		106 (22.4%)	67 (16.4%)	
2	84 (19.0%)	235 (21.2%)		152 (32.1%)	106 (26.0%)	
3	94 (21.2%)	273 (24.6%)		105 (22.2%)	90 (22.1%)	
4	87 (19.6%)	174 (15.7%)		75 (15.8%)	77 (18.9%)	
5+	120 (27.1%)	233 (21.0%)		36 (7.6%)	68 (16.7%)	
Tested for COVID-19	179 (40.4%)	429 (38.7%)	0.53	161 (34.0%)	177 (43.4%)	0.004
Hospitalized for COVID-19	16 (3.6%)	31 (2.8%)	0.40	5 (1.1%)	13 (3.2%)	0.03
Experiencing changes in resources, range 0-8	1 (0, 2)	1 (0, 2)	<0.001	1 (0, 1)	1 (0, 2)	<0.001
Experiencing interruption in health care, range 0-3	1 (0, 2)	1 (0, 1)	0.09	0 (0, 1)	1 (0, 1)	0.03
Making changes to daily life	297 (67.0%)	754 (68.0%)	0.72	403 (85.0%)	326 (79.9%)	0.05

Notes: p-value by chi-square test for categorical variables and Wilcoxon rank-sum for continuous variables. IQR = interquartile range.

Table 3.

Bivariate and multivariable associations between PTSD severity score (per 10 points) and COVID-19 burden and five sub-domains by study and overall

	MACS: Unadjusted	MACS: Adjusted	WIHS: Unadjusted	WIHS: Adjusted	Overall: Unadjusted	Overall: Adjusted
Count Ratio, 95% CI						
COVID-19 burden	**1.10 (1.07, 1.13)**	**1.08 (1.05, 1.12)**	**1.08 (1.06, 1.10)**	**1.06 (1.04, 1.08)**	**1.09 (1.08, 1.11)**	**1.07 (1.05, 1.09)**
Sub-domains						
Count Ratio, 95% CI						
Number of resources changes	**1.11 (1.04, 1.19)**	**1.08 (1.02, 1.15)**	**1.07 (1.03, 1.10)**	**1.05 (1.02, 1.09)**	**1.10 (1.07, 1.13)**	**1.06 (1.03, 1.09)**
Number of interruptions in medical care	**1.21 (1.14, 1.29)**	**1.20 (1.13, 1.28)**	**1.18 (1.15, 1.21)**	**1.15 (1.12, 1.19)**	**1.20 (1.17, 1.23)**	**1.16 (1.13, 1.19)**
Odds Ratio, 95% CI						
COVID-19 testing	1.07 (0.94, 1.22)	1.05 (0.92, 1.20)	1.04 (0.97, 1.11)	1.03 (0.95, 1.10)	1.04 (0.98, 1.11)	1.03 (0.97, 1.10)
COVID-19 hospitalization	1.19 (0.81, 1.75)	1.16 (0.79, 1.68)	1.10 (0.92, 1.32)	1.02 (0.84, 1.25)	1.14 (0.97, 1.34)	1.05 (0.89, 1.25)
Making changes to life consistently	1.12 (0.93, 1.33)	1.07 (0.88, 1.31)	1.00 (0.93, 1.07)	1.01 (0.93, 1.10)	0.97 (0.91, 1.04)	1.02 (0.94, 1.09)
N	882	882	1552	1552	2434	2434

Table 4.

Multivariable associations between PTSD severity score (per 10 points), other covariates, and COVID-19 burden by study and overall

Estimates, 95% CI	MACS (N=882)	WIHS (N=1552)	Overall (N=2434)
PTSD severity score (per 10 points)	**1.08 (1.05, 1.12)**	**1.06 (1.04, 1.08)**	**1.07 (1.05, 1.09)**
MACS vs WIHS	-	-	**0.82 (0.74, 0.90)**
Age (per 10 years)	**0.87 (0.84, 0.92)**	**0.87 (0.84, 0.90)**	**0.87 (0.84, 0.89)**
HIV-positive	1.06 (0.98, 1.13)	**0.91 (0.86, 0.97)**	**0.91 (0.86, 0.97)**
Interaction: HIV * MACS	-	-	**1.17 (1.06, 1.29)**
NH Black vs NH White or other	**1.11 (1.01, 1.23)**	**0.91 (0.86, 0.98)**	**0.92 (0.87, 0.98)**
Interaction: NH Black * MACS	-	-	**1.18 (1.05, 1.32)**
Hispanic vs NH White or other	1.03 (0.91, 1.17)	0.92 (0.83, 1.02)	0.95 (0.88, 1.03)
Currently smoking cigarettes	0.96 (0.87, 1.07)	**1.09 (1.02, 1.15)**	**1.06 (1.01, 1.12)**
Comorbidities: 1 vs 0	0.92 (0.84, 1.02)	0.98 (0.88, 1.11)	0.96 (0.89, 1.03)
Comorbidities: 2 vs 0	0.98 (0.89, 1.08)	0.99 (0.89, 1.11)	0.99 (0.91, 1.06)
Comorbidities: 3 vs 0	0.98 (0.87, 1.11)	1.06 (0.94, 1.18)	1.03 (0.95, 1.12)
Completed high school vs at least some college	**1.12 (1.01, 1.25)**	0.97 (0.91, 1.04)	1.00 (0.95, 1.06)
Did not complete high school vs at least some college	1.03 (0.85, 1.25)	0.97 (0.90, 1.04)	0.98 (0.92, 1.05)

Table 5.

Multivariable associations between PTSD severity score (per 10 points) and number of interruptions in medical care by study

Estimates, 95% CI	MACS (N=882)	WIHS (N=1552)	Overall (N=2434)
PTSD severity score (per 10 points)	**1.20 (1.13, 1.28)**	**1.15 (1.12, 1.19)**	**1.16 (1.13, 1.19)**
MACS vs WIHS	-	-	**0.77 (0.66, 0.89)**
Age (per 10 years)	0.92 (0.83, 1.02)	0.95 (0.89, 1.02)	**0.94 (0.89, 0.99)**
HIV-positive	1.05 (0.89, 1.23)	0.94 (0.85, 1.04)	0.98 (0.90, 1.07)
NH Black vs NH White or other	1.08 (0.88, 1.34)	**0.83 (0.74, 0.93)**	**0.85 (0.77, 0.95)**
Interaction: NH Black * MACS	-	-	**1.27 (1.02, 1.58)**
Hispanic vs NH White or other	0.96 (0.72, 1.28)	0.86 (0.73, 1.03)	0.92 (0.79, 1.07)
Currently smoking cigarettes	1.04 (0.83, 1.30)	**1.26 (1.14, 1.39)**	**1.21 (1.11, 1.33)**
Comorbidities: 1 vs 0	0.89 (0.72, 1.10)	1.02 (0.82, 1.27)	0.93 (0.80, 1.08)
Comorbidities: 2 vs 0	0.94 (0.76, 1.18)	1.14 (0.92, 1.40)	1.03 (0.89, 1.19)
Comorbidities: 3 vs 0	1.13 (0.88, 1.45)	**1.27 (1.04, 1.57)**	**1.18 (1.02, 1.37)**
Completed high school vs at least some college	**1.32 (1.05, 1.65)**	0.92 (0.82, 1.04)	0.93 (0.82, 1.05)
Interaction: completed high school * MACS	-	-	**1.39 (1.09, 1.77)**
Did not complete high school vs at least some college	1.26 (0.85, 1.88)	1.09 (0.97, 1.23)	1.11 (1.00, 1.25)