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Association of PTSD with COVID-19 testing and infection in the Veterans Health Administration

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ABSTRACT

Posttraumatic stress disorder (PTSD) is associated with coronavirus disease 2019 (COVID-19) risk factors, such as hypertension and obesity. Associations between PTSD and COVID-19 outcomes may affect Veterans Health Administration (VA) services, as PTSD occurs at higher rates among veterans than the general population. While previous research has identified the potential for increased PTSD prevalence resulting from COVID-19 as a public health concern, no known research examines the effect of pre-existing PTSD on COVID-19 test-seeking behavior or infection. This study aimed to evaluate pre-existing PTSD as a predictor of COVID-19 testing and test positivity. The sample consisted of 6,721,407 veterans who sought VA care between March 1, 2018 and February 29, 2020. Veterans with a previous PTSD clinical diagnosis were *more likely* to receive COVID-19 testing than veterans without PTSD. However, among those with available COVID-19 test results ($n = 168,032$), veterans with a previous PTSD clinical diagnosis were *less likely* to test positive than veterans without PTSD. Elevated COVID-19 testing rates among veterans with PTSD may reflect increased COVID-19 health concerns and/or hypervigilance. Lower rates of COVID-19 test positivity among veterans with PTSD may reflect increased social isolation, or overrepresentation in the tested population due to higher overall use of VA services. As the COVID-19 pandemic continues, the identification of patient-level psychiatric predictors of testing and test positivity can facilitate the targeted provision of medical and mental health services to individuals in need.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has precipitated a global mental health crisis. Internationally, the onset of COVID-19 has been linked to increased anxiety, depression, substance use, stress response, and suicidal ideation in the general population (Kim et al., 2020; Xiong et al., 2020; Czeisler et al., 2020). It appears that greater exposure to COVID-19 worsens psychological outcomes; people who report close contact with a loved one who is infected, live in COVID-19 affected areas, or are diagnosed with COVID-19 are at elevated risk for negative mental health outcomes (Boyras and Legros, 2020). Although quarantine is a necessary measure to decrease COVID-19 transmission (Nussbaumer-Streit et al., 2020), people in quarantine report higher depression and anxiety symptoms than people who are not in quarantine

(Tang et al., 2020). Pre-existing psychiatric illness may lead to greater psychological distress associated with COVID-19 (Van Rheenen et al., 2020; Asmundson et al., 2020). For example, people with a history of anxiety, depression, or bipolar disorder experience higher COVID-19 related distress than people with no mental disorders (Van Rheenen et al., 2020; Asmundson et al., 2020). Among public health experts, these negative impacts have spurred dialogue on how to mitigate the global mental health burden of COVID-19 (Pfefferbaum and North, 2020).

Since the early stages of the pandemic, public health experts noted the potential for increased posttraumatic stress disorder (PTSD) prevalence in the general population (Horeish and Brown, 2020). These concerns are supported by historical evidence of trauma symptoms following prior pandemics, such as the 2003 severe acute respiratory

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syndrome (SARS) outbreak (Mak et al., 2009). Early data from the COVID-19 pandemic suggest increased prevalence of PTSD and trauma symptoms in the general population since the onset of COVID-19 (Bo et al., 2020; Boyraz and Legros, 2020; Karatzias et al., 2020). PTSD prevalence is particularly high among people in self-isolation (Wu et al., 2020), demonstrating the adverse impacts of reduced social interaction. Other risk factors for COVID-19-related PTSD include higher COVID-19 exposure (i.e., through diagnosis or close contact with an infected individual), female gender, and prior history of PTSD symptoms (Hamam et al., 2020).

Although the psychological impacts of COVID-19 on the general population are evident, no known work examines whether *prior* PTSD diagnosis affects access to COVID-19 testing, or test positivity. PTSD is a predictor of putative COVID-19 risk factors, including hypertension and obesity (Farr et al., 2015). People with PTSD are known to seek medical and psychiatric services more often than people without PTSD (Gillock et al., 2005; Schnurr et al., 2000; Washington et al., 2013), potentially influencing care seeking behaviors in response to perceived COVID-19 symptoms. This issue is particularly pertinent to the Veterans Health Administration (VA), given that PTSD occurs at higher rates among veterans than the general population (Wolf et al., 2015). Given that past research has documented higher VA utilization among veterans with PTSD (Gillock et al., 2005; Schnurr et al., 2000; Washington et al., 2013), it is likely that many veterans with PTSD continue to use VA services despite barriers posed by the pandemic. Greater understanding of COVID-19 testing and infection among veterans with PTSD can support the effective allocation of VA resources to address their needs.

To inform VA efforts to meet the medical and mental health needs of veterans with PTSD during the COVID-19 pandemic, the current study aimed to examine pre-existing PTSD diagnosis as a predictor of COVID-19 testing and test positivity in a national VA cohort.

2. Methods

Design and Sample. This study included a national cohort of all veterans who used VA services from 3/1/18 to 2/29/20, two years prior to initiation of VA COVID-19 testing. We used VA administrative data from 3/1/20 to 6/17/20 to assess receipt of COVID-19 testing, and test positivity.

2.1. Measures

PTSD diagnosis. We used administrative data from 3/1/18–2/29/20 to identify PTSD diagnosis (ICD-10 codes F43.10, F43.11, F3.12). We created a binary variable to indicate PTSD diagnosis (0 = No, 1 = Yes).

Demographic characteristics. We obtained demographic data from patient medical charts. Categorical variables for age, sex (male, female), race/ethnicity, and rurality were included as model covariates. A three-category variable for age (18–39, 40–64, 65+) was derived from chart data. Age was included as a model covariate based on evidence of higher COVID-19 illness severity among older people (Centers for Disease Control, 2020). Race categories included White, Black or African American, Hispanic, Asian, Multi-Racial, Native Hawaiian/Pacific Islander, American Indian/Alaska native, and Missing/Unknown. We included race/ethnicity based on evidence of higher test positivity rates among African Americans compared to Whites (Jordan and Adab, 2020). Rurality designation was based on the location of each patient's home VA medical facility, as indicated by primary care visits and/or outpatient visit frequency. Facilities were categorized as urban, rural, or insular (i.e., on an island) using data from the Veterans Support Services Center, which includes a database of VA facility characteristics. We included rurality based on early reports of lower test availability in rural areas, and increased infection rates in urban areas (Jordan and Adab, 2020; Souch and Cossman, 2020).

Medical comorbidities. We used administrative data from 3/1/18–2/29/20 to identify medical comorbidities. Comorbidities included

end-stage renal disease, hypertension, and severe obesity (Body Mass Index ≥ 40) based on early evidence of associations with test positivity (Jordan and Adab, 2020). Comorbidities were identified using ICD-10 Codes (Appendix 1). Separate binary variables were created for each comorbidity to indicate presence of each comorbidity (0 = No, 1 = Yes).

COVID-19 testing and test positivity. We created a binary response variable (0 = No, 1 = Yes) to indicate whether veterans received a VA COVID-19 test between 3/1/20 and 6/17/20. Among veterans who received a COVID-19 test and had available results, we analyzed COVID-19 test positivity (0 = COVID-19 Negative, 1 = COVID-19 Positive).

2.2. Statistical Analysis

To evaluate PTSD as a predictor of COVID-19 testing and test positivity, we ran separate logistic regression models with standard errors clustered by VA facility. Models for receipt of COVID-19 testing included all VA users; models for test positivity included veterans who underwent VA COVID-19 testing and had available test results. For both outcomes, we ran two nested regression analyses. The first model included PTSD alone; the second model added age, sex, race/ethnicity, and rurality. For analyses evaluating PTSD as a predictor of test positivity, medical comorbidities were also included in the second model. We conducted all statistical analyses using Stata version 15.1 (StataCorp, 2017). This project received a determination of non-research from the Institutional Review Board at VA Greater Los Angeles Healthcare System VA.

3. Results

The sample comprised a national VA cohort of 6,721,407 patients who used VA services between 3/1/18 and 2/29/20 (Table 1). Seventeen percent had a PTSD diagnosis. Veterans with PTSD were younger than veterans without PTSD. They were also more likely to be female, and non-White. Overall, 184,616 veterans (2.8%) received VA testing for COVID-19. Of 168,032 patients with available results, 14,364 (8.6%) tested positive for COVID-19.

In unadjusted (Model 1) and adjusted (Model 2) logistic regression models, veterans with PTSD were more likely to receive testing for COVID-19 than veterans without PTSD (Table 2). Among veterans with available COVID-19 test results, those with PTSD were less likely to receive a positive COVID-19 diagnosis in both unadjusted and adjusted models. In summary, we found that although veteran VA users with PTSD are *more likely* to be tested for COVID-19, they are *less likely* to test positive.

4. Discussion

Among veterans receiving care in the VA, those with clinically diagnosed PTSD were more likely to receive VA COVID-19 testing than veterans without a PTSD clinical diagnosis; however, they were less likely to test positive for COVID-19. Higher testing rates among veterans with PTSD may reflect greater perceived risk for COVID-19, perhaps associated with hypervigilance, a diagnostic symptom of PTSD (American Psychiatric Association, 2013) or due to anxiety-related physical symptoms, such as shortness of breath or chest tightness, which are also symptoms of COVID-19. Perceived risk of COVID-19 infection predicts health behaviors such as handwashing and social distancing (Bruin and Bennett, 2020), as well as reassurance seeking (a recognized vulnerability factor for COVID-related distress; Taylor et al., 2020). These findings regarding associations between perceived risk and COVID-19 health behaviors may generalize to COVID-19 testing, which can be conceptualized as a health behavior intended to reduce spread and/or facilitate treatment for COVID-19. Future research should examine associations between perceived COVID-19 risk and COVID-19 testing, particularly among people with PTSD.

Although demographic and medical COVID-19 infection risk factors have been identified in prior research, research on mental health risk

Table 1
Patient characteristics by PTSD diagnosis.

	Total	No PTSD Diagnosis	PTSD Diagnosis
	6,721,407	5,556,051 (82.7)	1,165,356 (17.3)
Age Group, No. (%)			
18-39	929,737 (13.8)	633,678 (11.4)	296,059 (25.4)
40-64	2,190,881 (32.6)	1,743,236 (31.4)	447,645 (38.4)
65+	3,600,652 (53.6)	3,179,020 (57.2)	421,632 (36.2)
Missing	137 (0.0)	117(0.0)	20 (0.0)
Sex, No. (%)			
Women	589,031 (8.8)	437,593 (7.9)	151,438 (13.0)
Men	6,132,240 (91.2)	5,118,342 (92.1)	1,013,898 (87.0)
Missing	136 (0.0)	116 (0.0)	20 (0.0)
Race, No (%)			
White	4,492,888 (66.8)	3,787,592 (68.2)	705,296 (60.5)
Black or African American	1,120,722 (16.7)	864,157 (15.6)	256,565 (22.0)
Hispanic	443,350 (6.6)	334,449 (6.0)	108,901 (9.3)
Asian	74,993 (1.1)	61,085 (1.1)	13,908 (1.2)
Multi-Racial	53,725 (0.8)	40,656 (0.7)	13,069 (1.1)
Native Hawaiian/Pacific Islander	48,500 (0.7)	37,787 (0.7)	10,713 (0.9)
American Indian/Alaska Native	45,148 (0.7)	33,502 (0.6)	11,646 (1.0)
Missing/Unknown	442,081 (6.6)	396,823 (7.1)	45,258 (3.9)
Rurality, No. (%)			
Urban	6,220,294 (92.5)	5,137,099 (92.5)	1,083,195 (92.9)
Rural	406,278 (6.0)	338,939 (6.1)	67,339 (5.8)
Insular	6033 (0.1)	4584 (0.1)	1449 (0.1)
Missing	88,802 (1.3)	75,429 (1.4)	13,373 (1.2)
Comorbidity, No. (%)			
End-stage Renal Disease	55,971 (0.8)	48,654 (0.9)	7317 (0.6)
Hypertension	3,510,975 (52.2)	2,939,029 (52.9)	571,946 (49.1)
Severe Obesity	373,443 (5.6)	290,465 (5.2)	82,978 (7.1)
Received Covid-19 Test^a			
Yes	184, 616 (2.8)	136,469 (2.5)	48,147 (4.1)
No	6,536,791 (97.3)	5,419,582 (97.5)	1,117,209 (95.9)
Covid-19 Positive^b (Test results available n = 168,032)			
Yes	14,364 (8.6)	10,950 (8.8)	3414 (7.8)
No	153,668 (91.5)	113,266 (91.2)	40,402 (92.2)

Note. Chi-squared analyses showed that all No PTSD Diagnosis vs. PTSD Diagnosis patient characteristic comparisons were significant at $p < .001$. Patients in any racial group who reported Hispanic ethnicity were designated as Hispanic.

^a Patients with pending Covid-19 test results (n = 16,584) were included in Received Covid-19 Test cross-tabulation.

^b Patients with pending Covid-19 test results (n = 16,584) were excluded from Covid-19 positive cross-tabulation.

factors remains sparse. The present study found that veteran VA users with PTSD were less likely to test positive for COVID-19. Veterans with PTSD show higher overall VA healthcare utilization (Gillock et al., 2005; Schnurr et al., 2000; Washington et al., 2013), and consequently may be more familiar with VA services than veterans without PTSD. Assuming a similar underlying infection rate for veterans with and without PTSD, lower test positivity may reflect overrepresentation in the tested population due to higher VA utilization. Furthermore, veterans with PTSD may demonstrate higher levels of social isolation at baseline (American Psychiatric Association, 2013; Ozer et al., 2003), and therefore experience lower risk exposure. Although social isolation is associated with adverse effects during the COVID-19 pandemic (Tang et al., 2020; Wu

Table 2
Associations between PTSD diagnosis and Covid-19 outcomes.

Received Covid-19 Testing: All VA users (n = 6,721,407)	OR	95%CI
Model 1. Unadjusted	1.7*	1.6, 1.8
Model 2. Adjusted for Age, Sex, Race/Ethnicity, and Rurality	1.6*	1.5, 1.6
Tested positive for Covid-19: Covid-19 Tested Sample (n = 168,032)	OR	95%CI
Model 1. Unadjusted	0.9*	0.8, 0.9
Model 2. Adjusted for Age, Sex, Race/Ethnicity, Rurality and Comorbidity	0.9*	0.8, 0.9

Note. CI=Confidence Interval. OR=Odds Ratio. Estimates were obtained from logistic regression models with standard errors clustered by VA facility. Model covariates included age (18–39; 40–65, 65+), sex, race/ethnicity (White, Black or African American, Hispanic, Asian, Multi-Racial, Native Hawaiian/Pacific Islander, American Indian/Alaska native, and Missing/Unknown), VA facility rurality (urban, rural, or insular), and medical comorbidities (end-stage disease renal disease, hypertension, severe obesity). * $p < .01$.

et al., 2020), past research also notes that veterans may benefit from pre-existing coping skills gained from their prior military experience (Marini et al., 2020). Future efforts to address veterans' mental health care needs should attempt to mitigate the negative psychological impacts of social distancing, while leveraging their resilience and promoting alternative options for seeking human contact (e.g., video calling; Marini et al., 2020).

A strength of this study is that we used data from a national cohort of veteran VA users, allowing us to construct a sample representative of the VA treatment seeking population. Because of our large sample size (6.7 million), we had adequate power to detect significant differences between veterans with and without PTSD, and control for key covariates. A limitation of this study is that we relied on VA administrative data to establish PTSD diagnosis, which may have lower sensitivity than more rigorous methods such as diagnostic interviews (Lang et al., 2003). In addition, our findings may not generalize to veterans who are not VA users, or to the non-veteran population. Future research should attempt to replicate our findings in other populations.

Conclusions. Although past research has identified potential predictors of COVID-19 severe illness/mortality (Centers for Disease Control, 2020), research on patient-level predictors of testing, including pre-existing mental health conditions, remains sparse. Our findings suggest heightened health concerns among veterans with PTSD in response to the COVID-19 pandemic, providing preliminary support for the allocation of VA resources to address their medical and mental health needs. Some VA facilities report that most treatment seeking veterans with PTSD have shifted to telehealth (Sciarrino et al., 2020), which offers a safe and convenient modality for veterans to remain connected to care.

The association between the onset of COVID-19 and psychological distress in the global population is increasingly clear (Tang et al., 2020; Xiong et al., 2020), and mounting evidence suggests that COVID-19 has increased the prevalence of trauma symptoms across geographically diverse populations (Bo et al., 2020; Boyraz and Legros, 2020; Karatzias et al., 2020). Yet, the influence of pre-existing mental illness on COVID-19 testing behavior and positivity remains an area in need of more research. As the COVID-19 pandemic continues, increased understanding of potential mental health predictors of COVID-19 testing and positivity such as PTSD can facilitate the identification of at-risk individuals who may benefit from medical and/or psychosocial interventions.

CRedit authorship contribution statement

Taona P. Haderlein: Conceptualization, Writing - original draft, Writing - review & editing, Methodology, Formal analysis. **Michelle S. Wong:** Data curation, Writing - review & editing. **Anita Yuan:** Data curation, Writing - review & editing. **Maria D. Llorente:** Conceptualization, Writing - review & editing. **Donna L. Washington:** Supervision, Conceptualization, Methodology, Writing - review & editing, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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