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Possible substance use disorders among first responders during the COVID-19 era: a quasi-experimental study of personal and residential vulnerability

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ABSTRACT

Background: During the COVID-19 pandemic possible substance use disorders (SUD) were exacerbated from increased stress and isolation. Experiences of symptomology differ widely by occupations.

Objectives: The objectives were to determine if there is a temporal relationship between COVID-19 vulnerability and possible SUDs among first responders, and to examine the association with neighborhood vulnerability.

Methods: We conducted an analysis with two distinct cohorts dependent on time of entry: 1) First responders that began counseling prior to COVID-19 and 2) First responders that began counseling after the start of COVID-19. Data were collected at intake from first responders seeking mental health services between 2017 and 2021 at an organization in Dallas/Fort Worth, Texas. The study sample included 195 mostly male (75%) first responders (51% law enforcement officers; 49% emergency medical technicians/firefighters). Bivariate models tested unadjusted relationships between covariates and possible SUD. Adjusted models consisted of a two-level multivariable logistic regression models.

Results: Nearly 40% ($n = 77$) screened positive for a possible SUD. Those beginning counseling after COVID-19 did not have higher odds of SUDs. For every unit increase in neighborhood Severe COVID-19 Health Risk Index at a first responder's residential location there was an increase in the odds of a possible SUD (AOR = 3.14, 95% CI: 1.47, 6.75).

Conclusions: Our study highlights the degree to which personal and residential vulnerability to COVID-19 impacted first responders. The increased occupational stress of this population, and an established pattern of maladaptive coping, elucidates the need for preventative and clinical approaches to strengthen the resilience of this population.

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Introduction

The SARS-CoV-2 (COVID-19) pandemic has resulted in over two million deaths worldwide and more than half a million deaths within the United States (U.S.) (1). In order to control and reduce the spread of COVID-19, local and state governments implemented business lockdown procedures in mid-March 2020 that resulted in social isolation and loss or change in employment for millions of Americans. Social distancing and reduced socialization following the more stringent lockdown measures were encouraged to mitigate virus transmission. According to recent research, mental illness was exacerbated during this period due to fear of getting sick from COVID-19, feeling helpless in the effort to control the spread of the virus, stress and isolation due to quarantine and lack of socialization, or anger, anxiety, and confusion due to the novelty of the virus and pandemic (2–4).

Circumstantial predictors of mental illness outcomes can also differ widely by employment status (5–7). During large-scale crises, essential workers (*e.g.*, healthcare professionals, first responders) experienced increased pressure, workload, stress, and exhaustion (8,9). In the context of the COVID-19 pandemic, stressors can take the form of isolation due to augmented levels of interaction with the public and potentially infected individuals, therefore increased need to isolate from family and friends (10–13). Additionally, the civil unrest which followed the murder of George Floyd in May 2020 further stressed those in the occupation of policing in the U.S. This period sparked a significant

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exodus of officers from law enforcement and resulted in understaffing and increased demands (14). The assemblage of these period-specific stressors worked to create a work environment primed to strain officer mental health.

It is well established that mental illnesses and the potential for substance use disorders (SUD) among first responders are prevalent (15–17). Recent research has indicated that this may be worsened by the pandemic (18). First responders display a predisposition to maladaptive coping mechanisms, including alcohol misuse, to deal with occupational and life stressors (15,17,19–21). Several studies have described the recurrence of anxiety, depression and increased alcohol consumption during the pandemic among the general population and among first responders (4,11,18,22). Mental health providers have contextualized the threat of COVID-19 exposure (experienced regularly by first responders on the frontlines) as a traumatic experience with the potential for post-traumatic stress disorder (PTSD) symptomology (23).

Given the susceptibility of this occupational population to engage in maladaptive coping styles, and the added stress associated with responding as an essential worker during the COVID-19 pandemic, a multi-level assessment is warranted. Community relationships have been tested through the COVID-19 pandemic, emphasizing the importance of a neighborhoods impact on mental and physical health. Past research suggests that environmental factors and vulnerability can act to increase the risk of possible SUD among community members (24). Environmental characteristics such as access to substances, crime-level, vacant housing, perception of safety, and poverty may indicate vulnerability (25,26). These characteristics act on both the aggregate-level (*i.e.*, infrastructure, transportation, employment, and educational resources) and individual-level (*i.e.*, social networks) (27). One study used aggregated, neighborhood-level data to assess the impact of traumatic events on firefighter and emergency medical technician (EMT) alcohol use, showing that alcohol use significantly increased following traumatic events (28). However, despite the vulnerability of this population to turn to SUD for coping, there are minimal studies utilizing aggregate data in evaluating the relationship between trauma, the environmental pathway of vulnerability, and first responder substance use.

The objectives of this study are 1) determine the change of possible SUDs among a mental health treatment-seeking group of first responders in North Texas before and during the COVID-19 pandemic; and 2) examine the association of neighborhood-level COVID-19 vulnerability on possible first responder SUDs. We hypothesize that among those first responders beginning mental health treatment after the start of the COVID-19 pandemic, and those who live in areas with high vulnerability to COVID-19 severe outcomes, will score higher (*i.e.*, greater indication of substance use) on possible SUD screening taken at the intake visit compared to those entering mental healthcare prior to the COVID-19 pandemic. We also hypothesize that COVID-19 neighborhood vulnerability measures of first responder residential areas during the stay-at-home orders will be associated with higher scores of substance use.

Methods

Study design and population

Retrospective review was conducted using the self-reported data collected at intake from clients who sought voluntary counseling and therapy services between 2017 and 2021 at a nonprofit organization in the Dallas-Fort Worth, TX metroplex. The nonprofit serves military service members, first responders, frontline health-care workers, and their families. Upon the initial visit (*i.e.*, mental health-care treatment entry), clients complete paperwork, which includes sociodemographics, mental health symptomology, behavioral patterns, and history of traumatic experiences. This initial assessment determines the appropriate care pathways for services. This secondary analysis of program data was approved and a waiver of informed consent was granted by the University of Texas Health Science Center Institutional Review Board (HSC-SPH-20-1264).

The current study is a quasi-experimental analysis with two distinct cohorts within cross-sections dependent on time of mental healthcare treatment entry: 1) Clients that began mental healthcare treatment prior to COVID-19 (1 January 2017 to 12 March 2020) and 2) Clients that began mental healthcare treatment during COVID-19 (13 March 2020 to 1 March 2021). The distribution of client treatment entry over time is a product of an increase in first responder awareness of available services. There was a lower rate of client entry in the pre-COVID-19 period, therefore the longer period allowed for the groups to reach similar sizes. There were 85 (43.6%) clients in the group entering

treatment prior to COVID-19 and there were 110 (56.4%) clients in the group entering treatment after the start of COVID-19.

Measurements

Prevalence of *possible SUD*, the study outcome, was measured using the CAGE Adapted to Include Drugs (CAGE-AID) (29), which is an extended and validated adaptation of the CAGE alcohol assessment tool (30). The CAGE-AID is a 4-item measure intended to capture perceptions and behaviors surrounding substance use (*i.e.*, alcohol, illegal drugs, prescription drug use other than prescribed), with a possible response of yes/no to each of the questions (*e.g., "Have you ever felt that you ought to cut down on your drinking or drug use?"*). An answer of "yes" on any 2 or more questions indicates a possible SUD, requiring further clinical assessment for a formal diagnosis. This cutoff was used to dichotomize the outcome for indicated possible SUD or no indicated SUD (sensitivity = 70.9%; specificity = 75.7%; Chronbach's alpha = 0.87) (29).

The independent variables in this study included *mental healthcare treatment entry* date before COVID-19 vs. treatment entry date after start of COVID-19. *Depression* was measured using the Patient Health Questionnaire-9 (PHQ-9) (31). Responses range from 0 (not at all) to 3 (nearly every day) and scores are summed to a continuous score ranging from 0 to 27, higher scores represent the greater severity of depression. In the current study, the Cronbach's alpha of the scale was 0.89. *Generalized anxiety* was assessed using the Generalized Anxiety Disorder-7 (GAD-7) (32). Responses range from 0 (not at all) to 3 (nearly every day) and aggregated continuous scores range from 0 to 21; higher scores indicate the greater severity of generalized anxiety. In the current study, the Cronbach's alpha of the scale was 0.90. *Suicidal behavior* was measured using the Suicidal Behaviors Questionnaire-Revised (SBQ-R) (33). Each question probes different dimensions of suicidality: lifetime ideation and attempts, frequency of ideation in the past 12 months, threat of suicidal behaviors, and likelihood of suicidal behaviors. Scores are summed ranging from 3 to 18, with higher scores indicating a greater risk of suicide. In this sample, the Cronbach's alpha of the scale was 0.86. The measure of suicidality was dichotomized with a positive indication identified as those with a SBQ-R score ≥7 and no indication with a SBQ-R score <7.

Our client-level sociodemographic measures included occupation (law enforcement officer [LEO], EMT/Firefighter [occupations combined based on prior evidence of mental health outcome similarity] (34)), gender (male, female), age (years), race/ethnicity (non-Hispanic white, non-Hispanic other [black, Native American Indian, Asian, Hawaiian, Native/Pacific Islander, Mixed race/ethnicity], and Hispanic), education (high-school diploma or less, some college, college degree [including graduate degrees]), and length of service as a first responder (≤5 years, 6–10 years, 11–15 years, 16–20 years, more than 20 years).

The neighborhood-level indicators were controlled for using the *COVID-19 Health Risk Index* which was measured using the ZIP code in which the client lived. This is a composite index measurement created by Johns Hopkins University and PolicyMap (35). The index represents the relative risk for a high proportion of residents in a given area to develop serious health complications from COVID-19 because of underlying health conditions identified by the Centers for Disease Control and Prevention (CDC) as contributing to a person's risk of developing severe symptoms from the virus. These conditions include chronic obstructive pulmonary disease (COPD), heart disease, high blood pressure, diabetes, and obesity. The area scores were calculated using normalized values of the adult population. Because these values are normalized by adult population, they can be used to compare overall risk between areas with different populations. The risk categories were assigned based on the standard deviations of the area's z-score above or below the average risk, as classified by CDC risk factors. *Social vulnerability* was measured at the ZIP code level using a composite index measurement calculated by the CDC (Social Vulnerability Index [SVI]) to help public health officials and emergency response planners identify and map the communities that will most likely need support before, during, and after a hazardous event (*i.e.*, disease outbreak) (36). This index measurement is based on four summary themes of vulnerability. Only the "minority status and language" SVI theme was included in our models given the statistical relationship. ZIP code rankings were based on percentiles with values ranging from 0 to 1, with higher values indicating greater vulnerability. These percentile ranks were generated for individual variables, themes, and overall position.

Statistical analysis

Univariate (*i.e.*, tabulations, frequencies, means, standard deviations [SD]) and bivariate (*i.e.*, Chi-square test, *t*-test, Wilcoxon rank sum test, unadjusted odds

ratio) statistics were used to assess the relationship between treatment entry point (independent variable), client-level sociodemographics (*e.g.*, first responder type, gender, and age), patient-level mental illness comorbidities (*e.g.*, depression, anxiety, and suicidality), neighborhood-level factors (*e.g.*, social vulnerability, and severe COVID-19 risk) across the main dependent variable (possible SUD). Sensitivity analysis was conducted to compare the characteristics of those first responders without available CAGE-AID scores to those in the study sample to ensure that using only those without missing outcome data did not introduce selection bias (*Appendix A*). Geographic clustering of the outcome was assessed using Moran's Index, determining there was not need for a spatial regression model. Multivariable models were built using the Hosmer & Lemeshow model building strategy which involves the purposeful selection of all potential covariates for inclusion/exclusion through a multi-step decision process based on both clinical and statistical significance (37). Through this approach, the final model excluded a number of variables, such as resilience, PTSD, avoidance, prevalence of heavy drinking in the neighborhood, and unused subcategories of the SVI. The adjusted models consisted of a two-level multivariable random-effects logistic regression model with random intercept. The first adjusted model included the main exposure of time of treatment entry with the first level consisting of client-level characteristics nested within the second level of residence ZIP code. A second adjusted model was fit to assess the relationship of severe COVID-19 risk among only the group entering treatment after COVID-19 started, utilizing the same multilevel structure. Issues of misspecification of the covariance structure for any spatially correlated data was addressed by standard error adjustment by ZIP code using a sandwich estimator. All analyses were performed using Stata 16.0 (38) and mapping was performed in ArcGIS Pro (39).

Results

Table 1 shows the characteristics of the study sample (N = 195), with a similar number of EMT/Firefighters (n = 96) and LEOs (n = 99). A possible SUD was indicated in 40% (n = 77) of the clients. The sample comprised of mostly male (75%), non-Hispanic white (79%), and college educated (47%). Average age was 37.4 years (SD = 10.3). The largest group of first responder tenure was those with 5 or less years of service (29%). The number of first responders per ZIP code ranges from 1 to 9, and had an average of 1.9 (data not shown). Of those clients who entered treatment after the start of the COVID-19 lockdown procedures, the residential ZIP code COVID-19 Health Risk Index fell below average (*i.e.*, the risk for residents to develop severe COVID-19 symptoms based on underlying health conditions is below the median risk for the area) for most clients (61%), with another 25% falling into the above average risk classification (n = 48). Among those who entered treatment post-COVID-19 there was a larger proportion of clients with severe depression (17%) and risk of suicide (27%), compared to those in the pre-COVID-19 group. The highest SVI score of minority status and language vulnerability was a score of 0.6 on a scale of 0–1 (SD = 0.2).

Table 2 shows the bivariate relationship of substance use with independent variables. The mental health symptomology of depression (PHQ-9), anxiety (GAD-7), and suicidal behavior (SBQ-R) differed significantly across those clients with and without indicated possible SUD at treatment intake. Each unit increase in PHQ-9, GAD-7, and SBQ-R corresponds to an increase in the odds of a possible SUD of 8%, 6%, and 12%, respectively (Odds Ratio [OR] = 1.08, 95% Confidence Interval [CI]: 1.03, 1.13; OR = 1.06, 95% CI: 1.01, 1.12; OR = 1.12, 95% CI: 1.02, 1.23). Clients who were male and older were both associated with increased odds of a possible SUD (OR = 2.31, 95% CI: 1.11, 4.81; OR = 1.03, 95% CI: 1.00, 1.06). Compared to those with a college degree or greater, those with only some college had 2.14 (95% CI: 1.09, 4.21) times the odds of a possible SUD versus no SUD. Compared to those with less than 5 years in their first responder occupation, those with 5 to 10 years and those with 20 or more years had greater odds of a possible SUD (OR = 2.61, 95% CI: 1.11, 6.13; OR = 2.67, 95% CI: 1.09, 6.54). In the bivariate models, neither the main exposure of the Severe COVID-19 Health Risk Index nor the SVI were significant predictors of possible SUD.

Table 3 displays the multivariable, multilevel odds of having a possible SUD. After adjusting for client depression, first responder type, length of service, and residential social vulnerability of minority status and language differences there was no significant difference in the odds of a possible SUD before and after COVID-19. Depression score was associated with an increased odds of having a possible SUD of 6% (AOR = 1.06, 95% CI: 1.01, 1.12), after adjusting for time of treatment entry, first responder type, length of service, and residential social vulnerability of minority status and language differences. Firefighters and EMTs compared to LEOs displayed 1.45 (95% CI: 1.02, 2.06) times the odds of possible SUDs, adjusted for the factors listed previously. Those with 6 to 10 years of first responder service, compared to those with 5 or less years of first responder service, showed 3 times

Table 1. Descriptive statistics of first responders seeking mental health treatment, stratified by date of treatment entry (N = 195).

		Treatment Entry		
	All (N = 195) N (%)	Prior to COVID-19 (n = 85) N (%)	After COVID-19 (n = 110) N (%)	*p*-value*
Substance Use				.18
No Substance Use Disorder	118 (61)	56 (66)	62 (56)	
Possible Substance Use Disorder	77 (39)	29 (34)	48 (44)	
Mental Illnesses				
Depression, *Mean (SD)*	11 (7)	10 (7)	12 (7)	.36
Anxiety, *Mean (SD)*	12 (6)	11 (6)	12 (6)	.44
Suicidality, *Mean (SD)*	5 (3)	5 (3)	5 (3)	.43
Minimal Suicide Risk	145 (76)	65 (78)	80 (73)	
At-Risk of Suicide	47 (25)	18 (22)	29 (27)	
Client-level Indicators				
Occupation				**.01**
Emergency Technician/Firefighter	96 (49)	51 (60)	45 (41)	
Law Enforcement Officer	99 (51)	34 (40)	65 (59)	
Sex (male)	147 (75)	65 (77)	82 (75)	.84
Age (years), *Mean (SD)*	37 (10)	37 (12)	37 (9)	.92
Race/ethnicity				.64
NH White	153 (82)	67 (79)	86 (84)	
NH Other	11 (6)	5 (6)	6 (6)	
Hispanic	22 (12)	12 (14)	10 (10)	
Education				.36
≤HS Diploma	37 (19)	13 (16)	24 (23)	
Some College	58 (30)	29 (36)	29 (28)	
≥College Degree	91 (47)	39 (48)	52 (50)	
Length of Service				.55
≤5 years	57 (29)	28 (36)	29 (28)	
6–10 years	38 (20)	14 (18)	24 (24)	
11–15 years	37 (19)	15 (19)	22 (22)	
16–20 years	16 (8)	5 (6)	11 (11)	
>20 years	32 (16)	16 (21)	16 (16)	
Neighborhood-Level Indicators+				
Severe COVID-19 Health Risk Index	3.14 (0.65)	3.17 (0.64)	3.11 (0.66)	.57
Social Vulnerability Index				
Minority Status & Language	0.6 (0.2)	0.6 (0.2)	0.6 (0.2)	.78

SD = standard deviation; COVID-19 = coronavirus disease SARS-CoV-2; NH = non-Hispanic; HS = high school; depression = Patient Health Questionnaire-9; anxiety = Generalized Anxiety Disorder-7; suicidality = Suicide Behaviors Questionnaire Revised; * tests of independence using chi square, *t*-test, and Wilcoxon rank sum; + community of residence.

the adjusted odds of having a possible SUD (95% CI: 1.17, 7.72), and those with 20 or more years of service had 4.44 time the odds of a possible SUD (95% CI: 1.79, 11.04).

Among those entering treatment after COVID-19, adjusting for client first responder type, race/ethnicity, education, and length of service, every increase in the index measurement of Severe COVID-19 Health Risk at a client's residential location was associated with an increase in the odds of having a possible SUD of 97% (AOR = 1.97, 95% CI: 1.00, 3.87) (Table 4). Additionally, compared to LEO, firefighters and EMTs had 1.79 (95% CI: 1.09, 2.95) times the odds of possible SUDs versus no SUD, adjusting for race/ethnicity, education, length of service, and residential Severe COVID-19 Health Risk Index. Lastly, those with 20 or more years of service displayed 5.28 (95% CI: 1.60, 17.46) times the odds of possible SUDs when compared to those with 5 or less years of service.

Discussion

In this study of first responders seeking mental health treatment, we extend the literature to this currently susceptible population through our finding that comorbid mental health conditions and residential vulnerability to COVID-19 influenced the prevalence of possible SUDs in this sample. The results of our study echo previous research showing that exposure to disaster/emergency events increase alcohol use among first responder populations (17,40,41). While our study did find significant personal and environmental predictors of possible SUDs among an occupational group of first responders seeking mental healthcare during the COVID-19 pandemic, a comparative look at the pre-COVID-19/post-COVID-19 periods of treatment did not reveal a temporal impact of COVID-19 on having a possible SUD. Research has shown that first responders have higher PTSD, depression, anxiety, and suicidality than the general public, which are known to

Table 2. Bivariate relationship between mental health treatment entry point, covariates, and possible substance use disorders.

	No Substance Use Disorder (N = 118)	Possible Substance Use Disorder (N = 77)		
	N (%)	N (%)	p-value	OR (95% CI)
Treatment Entry			.18	
Prior to COVID-19	56 (47.5)	29 (37.7)		Ref
After COVID-19	62 (52.5)	48 (62.3)		1.49 (0.83, 2.69)
Mental Illnesses				
Depression	10.1 (6.6)	13.4 (6.7)	**<.01**	**1.08 (1.03, 1.13)**
Anxiety	10.8 (6.0)	12.9 (5.5)	**.05**	**1.06 (1.01, 1.12)**
Suicidality	4.4 (3.1)	5.5 (3.4)	**<.01**	**1.12 (1.02, 1.23)**
Client-Level Indicators				
Occupation			.07	
Emergency Technician/Firefighter	52 (44.1)	44 (57.1)		Ref
Law Enforcement Officer	66 (55.9)	33 (42.9)		0.59 (0.33, 1.05)
Male	82 (70.1)	65 (84.4)	**.02**	**2.31 (1.11, 4.81)**
Age in years, *Mean (SD)*	36.1 (10.5)	39.2 (9.9)	**.04**	**1.03 (1.00, 1.06)**
Race/ethnicity			.46	
NH White	92 (82.9)	61 (81.3)		Ref
NH Other	8 (7.2)	3 (4.0)		0.57 (0.14, 2.22)
Hispanic	11 (9.9)	11 (14.7)		1.51 (0.62, 3.70)
Education			.09	
≤HS Diploma	22 (19.5)	15 (20.6)		1.46 (0.66, 3.21)
Some College	29 (25.7)	29 (39.7)		**2.14 (1.09, 4.21)**
≥College Degree	62 (54.9)	29 (39.7)		Ref
Length of Service			.06	
≤5 years	40 (36.7)	17 (23.9)		Ref
6–10 years	18 (16.5)	20 (28.2)		**2.61 (1.11, 6.13)**
11–15 years	26 (23.9)	11 (15.5)		1.00 (0.40, 2.46)
16–20 years	10 (9.2)	6 (8.5)		1.41 (0.44, 4.50)
≥20 years	15 (13.8)	17 (23.9)		**2.67 (1.09, 6.54)**
Neighborhood-Level Indicators				
Severe COVID-19 Health Risk Index*	3.04 (0.62)	3.28 (0.67)	.06	1.79 (0.97, 3.30)
Social Vulnerability Index*				
Minority Status & Language	0.63 (0.20)	0.56 (0.24)	.15	0.23 (0.04, 1.37)

* Among those which entered treatment after COVID-19; Bold indicates p-value ≤ 0.05; p-value calculated using chi square, t-test, and Wilcoxon rank sum tests of independence.

COVID-19 = coronavirus disease SARS-CoV-2; OR = adjusted odds ratio; CI = confidence interval; SD = standard deviation; Ref = reference; depression = Patient Health Questionnaire-9; anxiety = Generalized Anxiety Disorder-7; suicidality = Suicide Behaviors Questionnaire Revised; NH = non-Hispanic; HS = high school.

increase SUDs (42). Recent scholarship on the impact of COVID-19 stressors show that binge drinking and changes in alcohol consumption are of concern during the pandemic (43). Two stressors that are most applicable to first responders are the impact on their job status and depressive symptoms (18). Results of a national study revealed that adults who had a previous diagnosis with current symptoms were more likely to have an increase in alcohol consumption during the COVID-19 pandemic (18). Additionally, those persons that did not leave their homes for work show lower odds of binge drinking during the pandemic when compared to the essential worker population (18).

Table 3. Multivariable multilevel odds of a possible substance use disorder among a sample of first responders seeking mental health treatment.

	AOR (95% CI)
COVID-19	
Treatment Entry Prior	Ref
Treatment Entry After	1.26 (0.65, 2.46)
Mental Health Measures	
Depression	**1.06 (1.01, 1.12)**
Occupation	
Law Enforcement Officer	Ref
Emergency Technician/Firefighter	**1.45 (1.02, 2.06)**
Length of Service	
≤5 years	Ref
6–10 years	**3.00 (1.17, 7.72)**
11–15 years	1.30 (0.47, 3.59)
16–20 years	1.75 (0.46, 6.64)
≥20 years	**4.44 (1.79, 11.04)**
Social Vulnerability Index	
Minority Status & Language	0.37 (0.10, 1.43)

Model: substance problem use among all first responders in treatment adjusting for geographic social vulnerability and sociodemographics.

COVID-19 = coronavirus disease SARS-CoV-2; AOR = adjusted odds ratio; CI = confidence interval; HS = high school; NH = Non-Hispanic; Bold indicates p-value ≤ 0.05

The disease vulnerability of a first responder's home neighborhood was also linked to an increase of possible SUDs. While it has been suggested that frontline first responders may be among the most vulnerable populations regarding risk of COVID-19 related disruptions to stress and mood (23), no other study has yet shown evidence of this relationship at both a personal-level and community-level. First responders with higher sensitivity to mental health symptomology and those subject to health inequalities (*e.g.*, racial/ethnic minorities, those residing in communities of severe COVID-19 outcome risk) may be more likely to perceive the pandemic-related stress as uncontrollable and resort to behaviors, which are known to dampen

Table 4. Multivariable multilevel odds of a possible substance use disorder among a sample of first responders seeking mental health treatment *during COVID-19*.

	AOR (95% CI)
Occupation	
Law Enforcement Officer	Ref
Emergency Technician/Firefighter	**1.79 (1.09, 2.95)**
Race/ethnicity	
NH White	Ref
NH Other	0.51 (0.09, 2.81)
Hispanic	2.94 (0.51, 17.00)
Education	
≤HS Diploma	1.01 (0.26, 3.98)
Some College	1.45 (0.55, 3.81)
≥College Degree	Ref
Length of Service	
≤5 years	Ref
6–10 years	3.37 (0.81, 14.07)
11–15 years	3.12 (0.78, 12.49)
16–20 years	1.87 (0.38, 9.29)
≥20 years	**5.28 (1.60, 17.46)**
Severe COVID-19 Health Risk Index	**1.97 (1.00, 3.87)**

Model: substance problem use among those entering treatment after covid adjusting for geographic disease risk and sociodemographics.
COVID-19 = coronavirus disease SARS-CoV-2; AOR = adjusted odds ratio; CI = confidence interval; HS = high school; NH = Non-Hispanic.

these stress symptoms (*i.e.*, alcohol and substance use) (23,44). In turn, resilience in the face of these COVID-19 stressors may also act as a buffer against these stress symptoms. Community social capital is known to be a protective factor to manage disaster-related changes to community norms (22). This approach may result in mitigating the effects of COVID-19 related social isolation and exacerbation the need for coping with biopsychosocial health conditions in vulnerable populations (22).

Another important finding in our study was that before and after the pandemic EMT/firefighters had a significantly increased odds of having a possible SUD. EMT/firefighters that have become more isolative since the onset of the pandemic, experienced over four times the odds of a possible SUD compared to LEOs, which is an alarming. SUDs have been shown to impact suicidal thoughts and PTSD among this population (45,46). Systematic review for modifiable risk factors predicting adaptive mental health outcomes revealed five important areas: personality, coping, cognitions, social support, and physical inactivity (47). Additionally, they also investigated five intervention themes or types: physical, psychological, stress management, self-regulation, and debriefing after a potentially traumatic event (47). They found that physical, psychological, and stress management were found to be effective, but still recommended targeting modifiable risk factors. Currently, there is evidence for the efficacy of online mindfulness-based resilience training program among Australian firefighters and an internet-delivered resilience program for EMTs (48,49).

In our sample, we found that age may have an important relationship with possible SUDs among this population, which is consistent with previous research (15,20). According to a 2011 study among female LEOs, age was significantly associated with AUDIT scores, indicating that the younger you are, the more likely you are to have harmful or hazardous drinking (15,20). In our sample, those early in their career (6–10 years) and at the end of their career (20 years or greater), were at the greatest odds of having a possible SUD. We hypothesize that those in the middle of their career practice more adaptive coping skills that may not hinder their progression up the rank hierarchy.

The results of this study should be interpreted with caution for several reasons. First, this study utilized a cross-sectional measure of clients at intake, rather than repeated measures of clients over time. While this limits our ability to assert temporal ordering, this study still adds to the literature regarding this hard-to-reach population utilizing the natural progression of time across both the pre- and post-COVID-19 pandemic periods. It should be noted that the pre-COVID-19 group had a longer period to engage in treatment compared to the post-COVID-19 group. While there is the potential for this to introduce selection bias, a difference in the homogeneity of the treatment seeking population has not been observed over time (with the exception of the influence of COVID-19). Additionally, the circumstances surrounding the murder of George Floyd in the period following the start of the COVID-19 pandemic should be considered as an additional stressor which may have influenced LEO mental health and use of mental health services. Our study was unable to parse out the specific influence of this event and it should be noted that the additional stress of this event may have exacerbated the effects seen in this stressful post-COVID-19 period. Future research should look to quantitatively and qualitatively assess the degree to which these events influenced the stress on law enforcement, and how this relates to uptake or exacerbation of substance use. Next, the study population consists of only those first responders who have chosen to seek mental health services. This sample is not representative of larger populations of first responders whom are not in active mental health treatment. Not all those in this study entered treatment with concerns of substance or alcohol use, our primary outcome, and analyses attempted to control for client demographics to provide an accurate representation of this treatment seeking population. Lastly, this study did not have access to geographic units smaller than the residential ZIP code of clients. This concern stems largely from the modifiable areal unit problem of erroneous aggregation effects. While ZIP code geographic units do not provide the

robust aggregate spatial measure, they do retain a modest degree of utility (50). Additionally, the analysis chosen for this study does not make use of contiguity or boundary measures for calculation of the results (one of the more common errors made when utilizing ZIP codes as a spatial unit of study) (50). Care and planning have been taken in the statistical methodology used in the calculation of the two ZIP code-level variables utilized in this study by investigators to create measures which are representative of the underlying populations within each ZIP code (35,36). Furthermore, this study did not make use of aggregated demographic or socioeconomic data at the ZIP code level, but rather was able to incorporate these variables at the client-level of observation.

This study highlights the degree to which personal and residential vulnerability to COVID-19 disease outcomes impact behavior such as disordered substance and alcohol use in this essential worker population. Recent concerns of occupational stress among first responders has received much attention. This study highlights the impact of the stressful life changes incurred by COVID-19 among a specific group of frontline workers under mental healthcare. The increased occupational stress incurred by this population, in conjunction with an established pattern on maladaptive coping within this group, elucidates the need for proactive approaches which can strengthen the resilience of this population from progression to SUDs

Data availability statement

The data that support the findings of this study are available on request from the corresponding author, AB. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

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