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## ORIGINAL CONTRIBUTION

# What Brings You in Today? Sex, Race, Substance Type, and Other Sociodemographic and Health-Related Characteristics Predict if Substance Use is the Main Reason for a Clinical Encounter

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**Background:** Substance-related diagnoses (SRDs) are a common healthcare presentation. This study identified sociodemographic and health-related characteristics associated with having an SRD as the primary reason for a clinical encounter compared to those with an SRD who are treated for other reasons. **Methods:** Electronic health record (EHR) data on patients with an SRD (n=12,358, ages 18-90) were used to assess if an SRD was the primary reason for a clinical encounter from January 1, 2012-January 1, 2018. Patients were matched on key demographic characteristics at a 1:1 ratio. Adjusting for covariates, odds ratios, and 95% confidence intervals were calculated. **Results:** In the matched cohort of 8,630, most reported male sex (65.8%), White race (70.0%), and single marital status (62.7%) with a mean age of 47.2 (SD=14.6). Patient reported female sex, Black race, age 70+, married status, and low-income (<\$50,000) were associated with a lower likelihood of presenting to care for an SRD as the primary reason for a clinical encounter. A nicotine-, alcohol-, opioid-, or stimulant-related diagnosis was associated with a higher likelihood of presenting to care for an SRD as the primary reason for the clinical visit. **Conclusion:** This is the first study to investigate whether sociodemographic and health-related characteristics were associated with having an SRD as the primary reason for a clinical encounter. Using rigorous methods, we investigated a unique clinical question adding new knowledge to predictors of patients seeking clinical care. Understanding these predictors can help us better align service provision with population needs and inform new approaches to tailoring care.

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Abbreviations: SUD, Substance use disorder; SRD, Substance-related diagnosis; ICD-10, International Classification of Diseases, 10th edition; EHR, electronic health record; HIPAA, Health Insurance Portability and Accountability Act; VRD, Virtual Research Desktop; SMI, serious mental illness diagnosis.

Keywords: substance-related diagnosis, substance use disorder, health service utilization, clinical visit

Author Contributions: NSC-K (ORCID: 0000-0002-9231-647X): Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data Curation, Writing, Review, and Editing, Visualization, Project administration. CBM (ORCID: 0000-0002-3909-3318): Conceptualization, Methodology, Validation, Resources, Writing, Review, and Editing, Supervision, Funding acquisition. WK (ORCID: 0000-0003-3182-6131): Writing, Review, and Editing.

## INTRODUCTION

The treatment gap between the number of people with a substance-related diagnosis (SRD) and the number treated represents a major public health challenge [1-3]. SRDs are a common presentation in healthcare settings [4-7]. The International Classification of Diseases, 10<sup>th</sup> edition (ICD-10) classifies SRDs into categories that include substance intoxication, withdrawal, use, substance use disorder (SUD), misuse, and dependence (F10.xx-F19.xx). SRDs can be the main reason for a clinical encounter, or one of several healthcare needs. Understanding who is receiving clinical care for an SRD as the main reason for the encounter allows healthcare providers to plan for the specific needs of these patients. In addition, providers can consider addressing those who are treated primarily for other healthcare needs, but also have an SRD.

Although there are no national rates for all SRDs, the 2020 National Survey on Drug Use and Health (NS-DUH) found that a past year SUD (defined by meeting Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria), which is a sub-group of SRD, was reported in 40.3 million people (14.5%) ages 12 or older in the United States [8]. In the same year, 41.1 million people (14.9%) aged 12 and older were in need of SUD treatment (defined by having a SUD or if they received treatment at a specialty facility in the past year). However, 97.5% of those who needed treatment but did not receive it in the past year, did not feel that they needed treatment. Research has shown that socioeconomic and health related characteristics, such as sex and race, may be associated with substance use treatment outcomes [9]. However, there is limited data on the specific sociodemographic and health-related characteristics of patients with SRDs being treated primarily for an SRD. Identifying predictors of those *not* presenting for an SRD can help further characterize those who may be in the “treatment gap.” Interventions can be designed to improve access to treatment for those who are less likely to be treated for an SRD as the primary reason for their healthcare encounter.

In the present study, electronic health record (EHR) data were used to identify factors associated with having an SRD as the primary reason for a clinical encounter compared to those with an SRD who are treated for a different primary reason. Identifying these factors can help us recognize the populations who are more or less likely to make use of the healthcare system for treatment of an SRD and predict populations less likely to be receiving care for SRDs, specifically looking at populations that are underserved in healthcare, including those with a higher burden of the sociodemographic and health-related characteristics. We hypothesized that patients in underserved population groups and with known health determinants

will have a greater health disparity in being treated primarily for a SRD.

## METHODS

### Sample and Data Source

With Institutional Review Board (IRB) approval, this retrospective observational study used deidentified EHR data on patients 18-90 years of age with any ICD-10 code for an SRD (eg, alcohol, nicotine, stimulants, opioids) from a large tertiary healthcare system in Southern California from January 1, 2012-January 1, 2018. Patients with ages <18 or >90 were excluded to reduce the risk of identification due to the small number of individuals with and without an SRD in these age ranges. This healthcare system is a referral center with a large urban hospital and a large suburban hospital with a county-wide network of primary care clinics in urban and suburban areas that also serve many rural residents. Clinical services include inpatient and outpatient visits for primary, mental health, addiction, and other medical specialty care. As such, this healthcare system provides a full range of primary and specialty care.

All of these data were collected from the health center’s biomedical informatics team through their standardized data request process. Data was provided in a secured Health Insurance Portability and Accountability Act (HIPAA) approved Virtual Research Desktop (VRD).

### Measures

The sociodemographic and health-related measures used in this study were selected based on what was available in the EHR. Data included patient self-reported characteristics such as sex (male, female), age (18-24, 25-39, 40-54, 55-69, 70+), race (Black, White, Other or Mixed (Asian/Pacific Islander, American Indian/Alaska Native, other or mixed race)), Latinx ethnicity, and marital status (single, married/living as married, divorced/separated/widowed). As a proxy for household income, median income was assessed by patient zip code estimates data from the US Census Bureau [10]. After assessing the distribution of the data, income was then categorized into < \$50,000, \$50,000-\$75,000, \$75,000-\$100,000, or \$100,000+. The Charlson Comorbidity Index was used to create a summary variable that captures medical health severity ( $\geq 1$  Charlson Comorbidity (yes/no); Appendix A: Table B in the supplemental material) [11,12]. A serious mental illness (SMI) diagnosis (yes/no) included any ICD-10 code for schizophrenia, schizotypal disorder, persistent delusional disorder, schizoaffective disorder, other psychotic disorder not due to a substance or known physiological condition, unspecified psychosis, manic episode, bipolar disorder, or major depressive

symptom severe (Table A in the supplemental material). A non-SMI included any ICD-10 code for brief psychotic disorders, major depressive disorder mild or moderate, persistent mood disorder, reaction to severe stress, and/or adjustment disorders (includes post-traumatic stress syndrome), obsessive compulsive disorder, phobic anxiety disorder, other anxiety disorder, eating disorder, specific personality disorder, and/or impulse disorder (Table A in the supplemental material).

For each clinical encounter, an ICD-10 code is assigned for the primary reason for the encounter (eg, F10.xx alcohol-related diagnosis). The primary reason for the encounter is decided by the provider at the time of the visit, is not dependent on the chief complaint, and is coded in this study as “primary reason for the encounter” (yes/no). Additional ICD-10 codes may be assigned as a second, third, etc. reason for the encounter. Because this study aimed to capture information from individuals presenting for any substance-related reason (eg, use, misuse, dependence), and not just those with a clinically diagnosed SUD, any patient with an ICD-10 code for a SRD—at any point during the study period—were included in the SRD group. Those without an SRD as the primary reason for the clinical encounter were included in the group with an SRD who present for another clinical reason. The ICD-10 codes used to construct the SRD cohort (F10.xx-F19.xx) are available in the supplemental material (Table A). The SRD type variables included any alcohol-, nicotine-, stimulant (ie, cocaine, other stimulants)-, opioids-, cannabis-, sedatives-, hallucinogen-, inhalant-, or other psychoactive SRD. Due to diagnostic uncertainty, those with an ICD-10 code for multiple drug use and use of other psychoactive substances (F19.xx; formerly known as “polysubstance abuse”) with no other code for an SRD (eg, alcohol, opioids) were not included in the analysis. This is because it is not possible to confirm that the patients with an F19.xx diagnosis should not be included in one of the other substance type categories (eg, alcohol, stimulants, nicotine, cannabis) used in the bivariate and multivariable regression models. Those with an ICD-10 code for F19.xx and a co-occurring SRD code for specific substances (eg, alcohol, opioids, etc.) remained in the analysis. Routine screening for SRD in the healthcare system was not implemented at the time of data collection. As such, SRDs were identified by the provider or patient-reported.

### Statistical Analysis

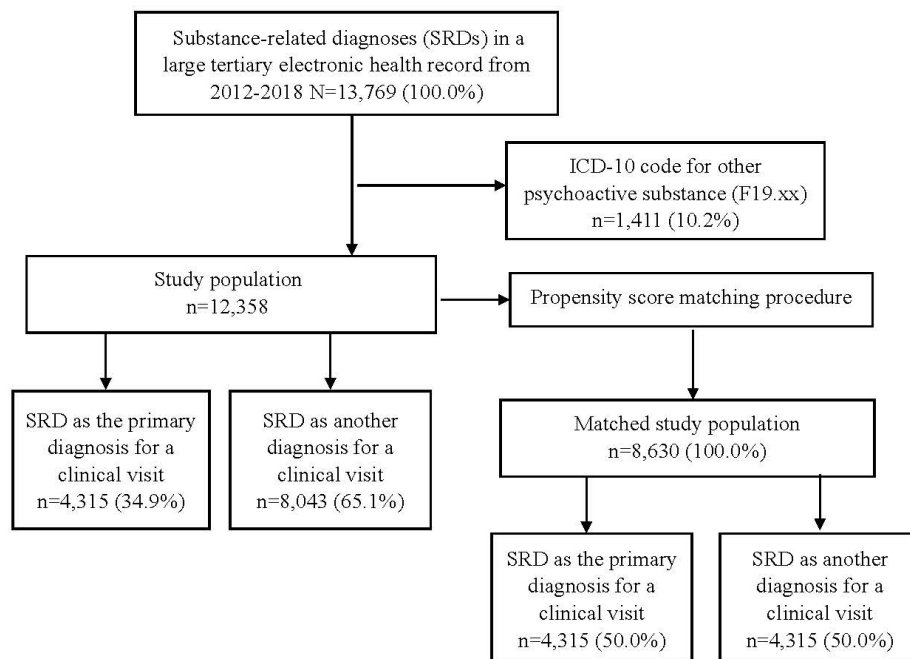
Descriptive statistics were used to describe the data in the unmatched cohort. Propensity score matching using the SAS PSMATCH procedure [13] was used to produce a 1:1 statistical model by matching on pre-existing health conditions, defined by  $\geq 1$  Charlson Comorbidi-

ty (yes/no) and SMI (yes/no), which are two predictors known to be associated with healthcare service utilization in this population [14-16]. This approach measures the imbalance in health-related characteristics by creating a matched 1:1 sample of those with an SRD as the primary reason for a clinical encounter compared to those who were treated for another reason [17,18]. The new generated 1:1 cohort allows for equal distribution of pre-existing health conditions and SMI in both of the SRD groups (ie, primary reason for a clinical encounter yes/no). To determine sociodemographic factors associated with having an SRD as the primary reason for a clinical encounter compared to those with an SRD who are primarily treated for other clinical reasons, bivariate analysis in the unmatched and matched cohort using Chi-squared ( $X^2$ ) tests of significance for categorical data were used. To determine the effect/magnitude of the associations, unadjusted odds ratios (ORs) were calculated and reported. Effect sizes such as Phi for dichotomous measures were used in addition to p-values and ORs to identify meaningful differences. However, OR confidence intervals that cross 1 (indicating that there was no significant difference), p-values  $\leq 0.05$ , and knowledge of any key predictor variables from the literature were used to determine whether a covariate would be included in the final multivariable regression. Multivariable logistic regression was then used to determine the measures that were associated with having an SRD as the primary reason for a clinical encounter compared to those with an SRD who are primarily treated for other clinical reasons. Standardized betas ( $\beta$ ), standard errors ( $SE(\beta)$ ), adjusted odds ratios (AOR) and the respective confidence intervals and p-values were reported. None of the interaction terms (eg, age\*sex, sex\*race) that were tested showed a large main effect. As such, interaction terms were not included in the multivariable regression analyses. Sensitivity analyses were also conducted by 1) including/excluding different covariates in the regression models, and 2) including/excluding different variables in the matching procedure to measure the robustness of the associations observed in the unmatched and matched regression models.

## RESULTS

### Sample Characteristics

There were 13,769 patients with any ICD-10 code for an SRD associated with their visit to the health system EHR from January 1, 2012-January 1, 2018 (Figure 1). A total of 1,411 (10.2%) had an ICD-10 code for other psychoactive substances (F19.xx) with no other code for an SRD (eg, alcohol, opioids). Because the type and number of substances could not be determined, these individuals were not included in the analysis resulting in a total of 12,358 with a specified SRD. The bivariate and



**Figure 1. Flow chart of the study population for substance-related diagnosis as the primary reason for a clinical encounter in a large healthcare system from January 1, 2012-January 1, 2018.**

multivariable analysis results from the unmatched cohort ( $n=12,358$ ) can be found in the supplemental material (Tables C-D). Briefly, an SRD as the primary reason for a clinical encounter was documented in 4,315 (34.9%) unmatched patients. Results from the multivariable analyses in the unmatched cohort ( $n=11,080$ ), showed that all of the variables assessed in this study were significantly associated with having an SRD as the primary reason for a clinical encounter except for those who identified as Black (AOR = 0.90, 95% CI = 0.78-1.03,  $p$ -value = 0.1288), other/mixed race (AOR = 0.94, 95% CI = 0.83-1.07,  $p$ -value = 0.3646, and Latinx ethnicity (AOR = 0.88, 95% CI = 0.77-1.01,  $p$ -value = 0.0698). Results from the sensitivity analyses did not change our understanding or approach. These results are available upon request.

The matched cohort ( $n=8,630$ ; Table 1) was mostly male (65.8%), identified as White (70.0%), identified as non-Latinx (83.0%), and single (62.7%) with a mean age of 47.2 (SD = 14.6, range 18-90), and in the \$50,000-\$75,000 income range (60.8%; mean = \$68,811.3, SD = 20,554.3). Due to matching on  $\geq 1$  Charlson Comorbidity Index and SMI in those with and without an SRD, a Charlson comorbidity condition was identified in 38.5% and SMI was identified in 21.1%. Non-SMI was identified in 44.1%. An SRD as the primary reason for a clinical encounter was documented in 4,315 (50.0%) patients. Of these, an SRD for alcohol (58.2%), nicotine (11.4%), stimulants (24.5%), opioids (20.9%), cannabis (7.5%), and sedatives (3.6%) were identified (Table 1).

#### *Correlates of SRD as the Primary Visit Diagnosis in the Matched Cohort*

In the matched adjusted regression analysis ( $n=8,015$ ; Table 2), those with an SRD as the primary reason for a clinical encounter were more likely to be male (AOR = 1.28, 95% CI = 1.16-1.41,  $p$ -value =  $<0.0001$ ), report younger age (age 18-24 AOR = 3.80, 95% CI = 2.89-5.03,  $p$ -value =  $<0.0001$ ; age 25-39 AOR = 2.89, 95% CI = 2.30-3.65,  $p$ -value =  $<0.0001$ ; age 40-54 AOR = 2.29, 95% CI = 1.85-2.86,  $p$ -value =  $<0.0001$ ; age 55-69 AOR = 1.78, 95% CI = 1.43-2.23,  $p$ -value =  $<0.0001$ ), report divorced/separated/widowed marital status (AOR = 1.29, 95% CI = 1.11-1.50,  $p$ -value = 0.0010), and report \$50,000-\$75,000 income (AOR = 1.20, 95% CI = 1.05-1.37,  $p$ -value = 0.0060). Patients who identified as Black with an SRD were less likely to be seen for an SRD as the primary reason for a clinical encounter compared to patients who identify as White (AOR = 0.71, 95% CI = 0.61-0.82,  $p$ -value =  $<0.0001$ ). Having an SRD as the primary reason for a clinical encounter was also significantly associated with having an alcohol- (AOR 2.63, 95% CI = 2.28-3.03,  $p$ -value =  $<0.0001$ ), nicotine- (AOR 1.32, 95% CI = 1.14-1.52,  $p$ -value =  $<0.0001$ ), opioid- (AOR 1.23, 95% CI = 1.14-1.52,  $p$ -value =  $<0.0001$ ), or stimulant-related diagnosis (AOR 1.22, 95% CI = 1.06-1.41,  $p$ -value =  $<0.0001$ ). Having an SRD as the primary reason for a clinical encounter was not significantly associated with a cannabis-related diagnosis (AOR 0.89, 95%



**Table 1. Matched unadjusted analysis of factors associated with having a substance-related diagnosis as the primary reason for a clinical encounter among patient records in a Southern California electronic medical record from January 1, 2012-January 1, 2018 (n= 8,630)**

Parameter	Total n (%)	Primary Visit n (%)	Non-Primary Visit n (%)	Odds Ratio 95% (CI)	$\chi^2$	P
All	8,630 (100.0)	4,315 (50.0)	4,315 (50.0)			
Sex						
Male	5,678 (65.8)	3,002 (69.6)	2,676 (62.0)	<b>1.40 (1.29-1.54)</b>	55.48	<b>&lt; 0.0001</b>
Female (ref)	2,948 (34.2)	1,309 (30.6)	1,639 (38.0)	—		
Age*						
18-24	671 (7.8)	399 (9.3)	272 (6.3)	<b>3.00 (2.35-3.83)</b>	42.96	<b>&lt; 0.0001</b>
25-39	2,058 (23.9)	1,115 (25.8)	943 (21.9)	<b>2.42 (1.96-2.98)</b>	25.50	<b>&lt; 0.0001</b>
40-54	3,020 (35.0)	1,552 (36.0)	1,468 (34.0)	<b>2.16 (1.76-2.65)</b>	7.99	<b>0.0047</b>
55-69	2,397 (27.8)	1,090 (25.3)	1,307 (30.3)	<b>1.70 (1.39-2.09)</b>	8.34	<b>0.0039</b>
70+ (ref)	484 (5.6)	159 (3.7)	325 (7.5)	—		
Race						
Black	1,028 (12.2)	413 (9.8)	615 (14.6)	<b>1.59 (1.39-1.81)</b>	44.8	<b>&lt; 0.0001</b>
Other or mixed	1,505 (17.8)	769 (18.2)	736 (17.5)	1.02 (0.91-1.14)	0.10	0.7495
White (ref)	5,908 (70.0)	3,046 (72.0)	2,862 (67.9)	—		
Hispanic						
Yes	1,398 (17.0)	694 (16.7)	704 (17.4)	1.00 (0.85-1.07)	0.61	0.4333
No (ref)	6,814 (83.0)	3,461 (83.3)	3,353 (82.7)	—		
Marital status						
Single	5,342 (62.7)	2,770 (65.1)	2,572 (60.4)	<b>1.34 (1.20-1.49)</b>	18.9	<b>&lt; 0.0001</b>
Divorced/separated/ widowed	1,501 (17.6)	740 (17.4)	761 (17.9)	1.21 (1.05-1.39)	0.52	0.4728
Married/living as married (ref)	1,675 (19.7)	748 (17.6)	927 (21.8)	—		
Income						
< \$50,000 (ref)	1,310 (15.8)	597 (14.5)	713 (17.2)	—		
\$50,000-\$75,000	5,029 (60.8)	2,595 (62.9)	2,434 (58.7)	<b>1.27 (1.13-1.44)</b>	11.77	<b>0.0006</b>
\$75,000-\$100,000	1,240 (15.0)	589 (14.3)	651 (15.7)	1.19 (1.00-1.43)	0.66	0.4175
\$100,000+	698 (8.4)	348 (8.4)	350 (8.4)	1.08 (0.93-1.26)	0.85	0.3576
≥ 1 Charlson Comorbidity						
Yes	3,322 (38.5)	1,661 (38.5)	1,661 (38.5)	1.00 (0.92-1.09)	0.00	1.000
No (ref)	5,308 (61.5)	2,654 (61.5)	2,654 (61.5)	—		
Serious mental illness						
Yes	1,818 (21.1)	909 (21.1)	909 (21.1)	1.00 (0.90-1.11)	0.00	1.000
No (ref)	6,812 (78.9)	3,406 (78.9)	3,406 (78.9)	—		
Non-serious mental illness						
Yes	3,804 (44.1)	1,910 (44.3)	1,894 (43.8)	1.02 (0.93-1.11)	0.12	0.7287
No (ref)	4,826 (55.9)	2,405 (55.7)	2,421 (56.1)	—		
Sedative-related diagnosis						
Yes	314 (3.6)	161 (3.7)	153 (3.6)	1.05 (0.84-1.32)	0.21	0.6457
No (ref)	8,316 (93.4)	4,154 (96.3)	4,162 (96.5)	—		

Cannabis-related diagnosis						
Yes	644 (7.5)	285 (6.6)	359 (8.3)	<b>0.78 (0.66-0.92)</b>	9.15	<b>0.0025</b>
No (ref)	7,986 (92.5)	4,030 (93.4)	3,956 (91.7)	—		
Opioid-related diagnosis						
Yes	1,801 (20.9)	728 (16.9)	1,073 (24.9)	<b>0.61 (0.55-0.68)</b>	82.67	<b>&lt; 0.0001</b>
No (ref)	6,829 (79.1)	3,587 (83.1)	3,242 (75.1)	—		
Stimulant-related diagnosis						
Yes	3,033 (24.5)	997 (23.1)	2,036 (25.3)	<b>0.85 (0.77-0.93)</b>	11.17	<b>0.0008</b>
No (ref)	9,325 (75.5)	3,318 (76.9)	6,007 (74.7)	—		
Nicotine-related diagnosis						
Yes	981 (11.4)	537 (12.4)	444 (10.3)	<b>1.24 (1.08-1.42)</b>	9.92	<b>0.0016</b>
No (ref)	7,649 (88.6)	3,887 (87.6)	3,871 (89.7)	—		
Alcohol-related diagnosis						
Yes	5,026 (58.2)	2,919 (67.7)	2,107 (48.8)	<b>2.19 (2.01-2.39)</b>	309.78	<b>&lt; 0.0001</b>
No (ref)	3,604 (41.8)	1,396 (32.4)	2,208 (51.2)	—		

Age range = 18-90, mean = 47.2 (SD = 14.6). Other or mixed race includes American Indian/Alaskan Native (n=49), Asian/Pacific Islander (n=197), and other or mixed race (n=1,259). Income range = \$21,677.0-\$208,984.0, mean = \$68,811.3 (SD = 20,554.3). SD = Standard deviation, CI = confidence interval. P-values based on Chi-squared ( $\chi^2$ ) tests of significance for categorical data. Bolded adjusted odds ratios >1 with CIs that do not cross 1 and P-values indicate higher odds of having a primary SRD visit. Bolded adjusted odds ratios <1 with CIs that do not cross 1 and p-values indicate lower odds of having a primary SRD visit. Variable totals might not sum to column totals due to missing data.

CI = 0.73-1.08, p-value = 0.2309).

## DISCUSSION

To our knowledge, this is the first study to identify factors associated with having an SRD as the primary reason for a clinical encounter compared to those with an SRD who are treated for other clinical reasons. By using real-world clinical data in which the clinician identifies the primary reason for the clinical encounter, we can better understand real life clinical encounters.

Findings from this study suggest that among those treated for an SRD, patients who identified as female, reported Black race, and were age 70+, married, and low-income (<\$50,000) were less likely to present to care for an SRD as the primary reason for a clinical encounter. A nicotine-, alcohol-, opioid-, or stimulant-related diagnosis was associated with a higher likelihood of presenting to care for an SRD as the primary reason for the clinical encounter. A cannabis- and sedative-related diagnosis was not associated with having an SRD as the primary reason for a clinical encounter.

Significant attention has been placed on the impact of sociodemographic characteristics such as sex and race/ethnicity, on of substance use treatment services [19-21]. Results from this study show that those receiving care is consistent with national rates of substance use by sex and age. For example, studies have shown that compared to females, males are more likely to use substances and their use is more likely to lead to ED visits and overdose

deaths [22]. Further study to clarify if the reduced rate of females being treated primarily for substance use is commensurate with the reduced rates of substance-related health problems in females would be informative.

Our data also suggests that patients who identify as Black were less likely to have an SRD as the primary reason for a clinical encounter compared to patients who identify as White. Research has shown that patients who identify as Black are less likely to receive substance use services and are more likely to delay care [23-25]. For those who do access care, there is a disproportionate use of emergency psychiatric services, and they are more likely to be treated for reasons other than their substance-related diagnosis [26]. Studies have shown that certain minoritized populations (eg, Black/African Americans) are less likely to report and seek treatment for their substance use due to fear, perceived treatment need and efficacy, differences in recovery goals, and other barriers stemming from cultural factors [27,28]. In the current study, it is possible that patients who do not identify as White are less likely to present for care for an SRD as a primary reason due to culturally related barriers such as stigma. For example, a qualitative study found that individuals who identify as Black would initially avoid or delay mental health treatment due to concerns about stigma and once they began treatment, they faced stigmatizing reactions from friends and family [29]. Another study found that compared to individuals who identify as White, individuals who identify as Black with an opioid use disorder had lower odds of utilizing substance use treatment [30].

**Table 2. Matched adjusted analysis of factors associated with having a substance-related diagnosis as the primary reason for a clinical encounter among patient records in a Southern California electronic medical record from January 1, 2012-January 1, 2018 (n= 8,015)**

Parameter	B	SE ( $\beta$ )	Adjusted Odds Ratio (95% CI)	$\chi^2$	P
Male (ref = Female)	0.24	0.05	<b>1.28 (1.16-1.41)</b>	23.48	<b>&lt;0.0001</b>
Age (18-90)					
18-24	1.34	0.14	<b>3.80 (2.89-5.03)</b>	89.02	<b>&lt;0.0001</b>
25-39	1.06	0.12	<b>2.89 (2.30-3.65)</b>	81.42	<b>&lt;0.0001</b>
40-54	0.83	0.11	<b>2.29 (1.85-2.86)</b>	54.85	<b>&lt;0.0001</b>
55-69	0.58	0.12	<b>1.78 (1.43-2.23)</b>	26.18	<b>&lt;0.0001</b>
70+ (ref)			—		
Race					
Black	-0.35	0.07	<b>0.71 (0.61-0.82)</b>	22.03	<b>&lt;0.0001</b>
Other or mixed	-0.07	0.06	0.94 (0.83-1.06)	1.14	0.2850
White (ref)			—		
Marital status					
Single	0.11	0.06	1.12 (1.00-1.27)	3.02	0.0819
Divorced/separated/widowed	0.26	0.08	1.29 (1.11-1.50)	10.78	<b>0.0010</b>
Married/living as married			—		
Income					
< \$50,000 (ref)			—		
\$50,000-\$75,000	0.18	0.07	<b>1.20 (1.05-1.37)</b>	7.54	<b>0.0060</b>
\$75,000-\$100,000	0.17	0.10	1.18 (0.97-1.44)	2.62	0.1053
\$100,000+	0.06	0.09	1.06 (0.89-1.25)	0.43	0.5136
Cannabis-related diagnosis (ref = no)	-0.12	0.10	0.89 (0.73-1.08)	1.44	0.2309
Stimulant-related diagnosis (ref = no)	0.20	0.07	<b>1.22 (1.06-1.41)</b>	7.86	<b>0.0051</b>
Opioid-related diagnosis (ref = no)	0.20	0.08	<b>1.23 (1.05-1.43)</b>	6.77	<b>0.0093</b>
Nicotine-related diagnosis (ref = no)	0.28	0.07	<b>1.32 (1.14-1.52)</b>	14.27	<b>0.0002</b>
Alcohol-related diagnosis (ref = no)	0.97	0.07	<b>2.63 (2.28-3.03)</b>	173.40	<b>&lt;0.0001</b>

B = unstandardized beta,  $\beta$  = standardized beta, SE = standard error, CI = confidence interval, P-values based on logistic regression. P-values based on Chi-squared ( $\chi^2$ ) tests of significance for categorical data. Bolded adjusted odds ratios >1 with CIs that do not cross 1 and P-values indicate higher odds of having a primary SRD visit. Bolded adjusted odds ratios <1 with CIs that do not cross 1 and p-values indicate lower odds of having a primary SRD visit.

Our study adds to this body of evidence by showing that patients who identify as Black are significantly less likely to present for an SRD as their primary reason compared to patients who identify as White.

Those with an alcohol-related diagnosis had the highest odds of having a SRD as the primary reason for the clinical encounter, followed by a nicotine-, opioid-, and stimulant-related diagnoses. Alcohol-, nicotine-, opioid-, and stimulant-related diagnoses have been shown to have adverse impacts on morbidity that lead to higher rates of healthcare utilization [30-32]. Surprisingly, cannabis- and sedative-related diagnoses were not associated with having an SRD as the primary reason for a clinical encounter. Individuals with cannabis use disorder typical-

ly have high rates of comorbid substance use and mental health illnesses [33]. By matching on SMI, we were able to show that having a cannabis-related diagnosis alone is not associated with a primary SRD. Although studies suggest that benzodiazepine use is associated with increased ED use, our study found no association between sedative-related diagnosis and a primary SRD diagnosis [34]. Future studies should investigate how substance-specific groups are engaging with the healthcare system, determine rates of healthcare service utilization broadly and in what healthcare settings and contexts, and assess if there are differences by substance type among these vulnerable populations.

Having access to a large health record dataset allows



for an in-depth review of the prevalence and correlates of having an SRD as the primary reason for a clinical encounter. This study is strengthened by the large sample size over 6 years of EHR data. Utilizing EHR data allows for a unique perspective on the assessment of having an SRD as the primary reason for a clinical encounter among a large sample, which is focused on provider diagnoses and outcomes instead of patient self-report. Provider diagnoses are critical, as these reflect what the provider identified and is providing care for, which is of interest in addition to knowing the prevalence of true underlying disorders. However, some health-related diagnoses may be missing or not adequately assigned in the EHR. It is possible that patients may have not disclosed their substance use or providers did not know how to appropriately diagnose an SRD. Consequently, there are likely many more patients with SRDs who were not included in this study.

Our approach to conduct this study in a matched sample is supported by the fact that important variables that may be associated with having an SRD as the primary reason for a clinical encounter (eg, race, substance type) appear to not be significant in the unmatched multivariable regression. This is likely due to the large impact that pre-existing health conditions and SMI have on the model. Matching on these two strong predictors allows for equal distribution of pre-existing health conditions and SMI in both of the SRD groups. As a result, we see that race and substance type are in fact associated with having an SRD as the primary reason for the clinical encounter in the matched cohort.

This study is limited by the use of ICD-10 codes, which are designed to identify diagnoses and procedures for billing purposes. This limitation is clearly observed in the way many SRDs are identified in the EHR as “non-specified substance-related disorder,” which is sufficient for billing purposes, though specific identification of the involved substance is clinically and epidemiologically important. Further exploration of the factors (eg, unable to identify substance, multiple substances) contributing to a clinical provider’s decision to classify a patient with an SRD in this ambiguous category instead of a designated substance type would be helpful to improve code classification in the EHR. It would also be advantageous to clearly identify the severity of the SRD in the EHR, as is recommended in the DSM-5.

The group of patients who have an SRD on their record but it is not listed as the primary reason may fall into several groups: 1) those not receiving care for their SRD, 2) those who are receiving care for it during the clinical encounter but have a more pressing issue at that time, so SRD is not listed first, or 3) those who are receiving specialty treatment related to their SRD elsewhere. This data set does not allow us to determine which category a

patient falls into. However, we can reasonably say that if an SRD was listed as the primary visit diagnosis, then the SRD would have been discussed in the visit.

## CONCLUSION

We found that patient reported female sex, Black race, older age, married/living as married status, and low-income (<\$50,000) was associated with a lower likelihood of presenting to care for an SRD as the primary reason for a clinical encounter. A nicotine-, alcohol-, opioid-, or stimulant-related diagnosis was associated with a higher likelihood of presenting to care for an SRD as the primary reason for the clinical encounter. Cannabis- and sedative-related diagnoses were not associated with having an SRD as the primary reason for a clinical encounter.

Results from this study helps us characterize patients who receive care for SRDs using demographic patterns, which can be used to understand disparities in care. From a public health standpoint, socio-demographic variables are often used to identify particularly vulnerable populations. Similarly, policy makers utilize sociodemographic and health-related characteristics as well as social determinants of health to aid their decision-making when examining structural differences in care including disparities in health care. Considering the significant gaps in treatment for SRD care for minoritized individuals, demographically characterizing those with SRD would guide future research on social determinants of health aimed to identify structural barriers to accessing care and can also assist clinicians during clinical encounters.

Future studies should investigate how those with an SRD are engaging with the healthcare system, determine rates of healthcare service utilization across healthcare settings, and assess if there are differences by substance type among vulnerable populations as another step towards reducing health disparities.

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## Appendix A: Supplemental Material

Table A: International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10) codes for substance-related diagnoses, serious mental illness, and non-serious mental illness<sup>1</sup>

Condition/Diagnosis	Diagnosis (DX) or Procedure (PR)	ICD-10 Codes
<b>Substance-related diagnosis (SRD)</b>		
Alcohol-related diagnosis	DX	F10.xx
Opioid-related diagnosis	DX	F11.xx
Cannabis-related diagnosis	DX	F12.xx
Sedative, hypnotic, or anxiolytic- related diagnosis	DX	F13.xx
Cocaine-related diagnosis	DX	F14.xx
Other stimulant-related diagnosis	DX	F15.xx
Hallucinogen-related diagnosis	DX	F16.xx
Nicotine-related diagnosis	DX	F17.xx
Inhalant-related diagnosis	DX	F18.xx
Other psychoactive substance-related diagnosis	DX	F19.xx
<b>Serious mental illness (SMI)</b>		
Schizophrenia	DX	F20.xx
Schizotypal disorder	DX	F21.xx
Persistent delusional disorder	DX	F22.xx
Schizoaffective disorder	DX	F25.xx
Other psychotic disorder not due to a substance or known physiologic condition	DX	F28
Unspecified psychosis	DX	F29
Manic episode	DX	F30.xx
Bipolar disorder	DX	F31.xx
Major depressive symptom severe	DX	F32.2-F32.3, F33.2-F33.2
<b>Non-serious mental illness (Non-SMI)</b>		
Brief psychotic disorders	DX	F23
Major depressive disorder mild or moderate	DX	F32.0-F32.1, F32.4-F32.9, F33.0-F33.1, F33.4-F33.9
Persistent mood disorder	DX	F39
Reaction to severe stress, and adjustment disorders (includes post-traumatic stress syndrome (PTSD))	DX	F43.xx
Obsessive compulsive disorder	DX	F42.xx
Phobic anxiety disorder	DX	F40.xx
Other anxiety disorder	DX	F41.xx
Eating disorder	DX	F50.xx
Specific personality disorder	DX	F60.xx
Impulse disorder	DX	F63.xx

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Table B: Charlson Comorbidity Index International Classification of Diseases, 10<sup>th</sup> edition (ICD-10) codes<sup>1</sup>

Condition/Diagnosis	Diagnosis (DX)	ICD-10 Codes
<b>Charlson Comorbidity Index</b>		
Myocardial infarction	DX	I21.x, I22.x, I25.2 I09.9, I11.0, I13.0, I13.2, I25.5, I42.0, I42.5 - I42.9, I43.x, I50.x, P29.0
Congestive heart failure	DX	
Peripheral vascular disease	DX	I70.x, I71.x, I73.1, I73.8, I73.9, I77.1, I79.0, I79.2, K55.1, K55.8, K55.9, Z95.8, Z95.9 G45.x, G46.x, H34.0, I60.x - I69.x
Cerebrovascular disease	DX	
Dementia	DX	F00.x - F03.x, F05.1, G30.x, G31.1
Chronic pulmonary disease	DX	I27.8, I27.9, J40.x - J47.x, J60.x - J67.x, J68.4, J70.1, J70.3
Rheumatic disease	DX	M05.x, M06.x, M31.5, M32.x - M34.x, M35.1, M35.3, M36.0
Peptic ulcer disease	DX	K25.x - K28.x
Mild liver disease	DX	B18.x, K70.0 - K70.3, K70.9, K71.3 - K71.5, K71.7, K73.x, K74.x, K76.0, K76.2 - K76.4, K76.8, K76.9, Z94.4
Diabetes without chronic complication	DX	E10.0, E10.1, E10.6, E10.8, E10.9, E11.0, E11.1, E11.6, E11.8, E11.9, E12.0, E12.1, E12.6, E12.8, E12.9, E13.0, E13.1, E13.6, E13.8, E13.9, E14.0, E14.1, E14.6, E14.8, E14.9
Diabetes with chronic complication	DX	E10.2 - E10.5, E10.7, E11.2 - E11.5, E11.7, E12.2 - E12.5, E12.7, E13.2 - E13.5, E13.7, E14.2 - E14.5, E14.7
Hemiplegia or paraplegia	DX	G04.1, G11.4, G80.1, G80.2, G81.x, G82.x, G83.0 - G83.4, G83.9
Renal disease	DX	I12.0, I13.1, N03.2 - N03.7, N05.2 - N05.7, N18.x, N19.x, N25.0, Z49.0 - Z49.2, Z94.0, Z99.2
Any malignancy, including lymphoma and leukemia, except malignant neoplasm of skin	DX	C00.x - C26.x, C30.x - C34.x, C37.x - C41.x, C43.x, C45.x - C58.x, C60.x - C76.x, C81.x - C85.x, C88.x, C90.x - C97.x
Moderate or severe liver disease	DX	I85.0, I85.9, I86.4, I98.2, K70.4, K71.1, K72.1, K72.9, K76.5, K76.6, K76.7
Metastatic solid tumor	DX	C77.x - C80.x
AIDS/HIV	DX	B20.x - B22.x, B24.x

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Table C. Unmatched unadjusted analysis of factors associated with having a substance related diagnosis as the primary reason for a clinical encounter among patient records in a Southern California electronic medical record from January 1<sup>st</sup>, 2012 through January 1<sup>st</sup>, 2018 (n= 12,358).

Parameter	Total n (%)	Primary n (%)	Non-Primary n (%)	Odds Ratio 95% (CI)	$\chi^2$	P
All	12,358 (100.0)	4,315 (34.9)	8,043 (65.1)			
Sex						
Male	8,174 (66.2)	3,002 (69.6)	5,172 (64.3)	1.27 (1.18-1.38)	35.56	<b>&lt; 0.0001</b>
Female (ref)	4,180 (33.8)	1,309 (30.4)	2,871 (35.7)	—		
Age						
18-24	1,033 (8.4)	399 (9.3)	634 (7.9)	2.28 (1.84-2.83)	20.12	<b>&lt; 0.0001</b>
25-39	3,067 (24.8)	1,115 (25.8)	1,952 (24.3)	2.07 (1.71-2.50)	15.64	<b>&lt; 0.0001</b>
40-54	4,207 (34.0)	1,552 (36.0)	2,655 (33.0)	2.12 (1.76-2.55)	24.62	<b>&lt; 0.0001</b>
55-69	3,316 (26.8)	1,090 (25.3)	1,090 (25.3)	1.77 (1.47-2.15)	0.00	0.9627
70+	735 (6.0)	159 (3.7)	576 (7.2)	—		
Race						
Black	1,301 (10.8)	413 (9.8)	888 (11.3)	1.59 (1.39-1.81)	44.8	<b>&lt; 0.0001</b>
Other or mixed	2,375 (19.7)	769 (18.2)	1,606 (20.5)	1.02 (0.91-1.14)	0.10	0.7495
White (ref)	8,402 (69.6)	3,046 (72.0)	5,356 (68.2)	—		
Latinx						
Yes	2,130 (18.0)	694 (16.7)	1,436 (18.7)	0.87 (0.79-0.96)	7.57	<b>0.0059</b>
No (ref)	9,687 (82.0)	3,461 (83.3)	6,226 (81.3)	—		
Marital status						
Single	7,515 (61.6)	2,770 (65.1)	4,745 (59.7)	1.36 (1.20-1.53)	29.76	<b>&lt; 0.0001</b>
Divorced/separated/widowed	2,091 (17.1)	740 (17.4)	1,351 (17.0)	1.45 (1.31-1.59)	5.34	<b>0.0171</b>
Married/living as married (ref)	2,599 (21.3)	748 (17.6)	1,851 (23.3)	—		
Income						
< \$50,000 (ref)	1,916 (16.2)	597 (14.5)	1,319 (17.1)	1.29 (1.16-1.43)	24.89	<b>&lt; 0.0001</b>
\$50,000-\$75,000	7,049 (59.5)	2,595 (62.8)	4,454 (57.7)	1.12 (0.96-1.32)	0.09	0.7628
\$75,000-\$100,000	1,846 (15.6)	589 (14.3)	1,257 (16.3)	1.04 (0.90-1.19)	2.36	0.1242
\$100,000+	1,032 (8.7)	348 (8.4)	684 (8.9)	—		
≥ 1 Charlson Comorbidity						
Yes	5,572 (45.1)	1,661 (38.5)	3,911 (48.6)	0.66 (0.61-0.71)	115.90	<b>&lt;0.0001</b>
No (ref)	6,786 (54.9)	2,654 (61.5)	4,132 (51.4)	—		
Serious mental illness						
Yes	2,389 (19.3)	909 (21.1)	1,480 (18.4)	1.18 (1.08-1.30)	12.78	<b>0.0004</b>
No (ref)	9,969 (80.7)	3,406 (78.9)	6,563 (81.6)	—		
Other mental illness						
Yes	5,430 (43.9)	1,910 (44.3)	3,520 (43.8)	1.02 (0.95-1.10)	0.28	0.5937
No (ref)	6,928 (56.1)	2,405 (55.7)	4,523 (56.2)	—		
Sedative-related diagnosis						
Yes	449 (3.6)	161 (3.7)	288 (3.6)	1.04 (0.86-1.27)	0.18	0.6683

No (ref)	11,909 (96.4)	4,154 (96.3)	7,755 (96.4)			
Cannabis-related diagnosis						
Yes	1,045 (8.5)	285 (6.6)	760 (9.5)	0.68 (0.59-0.78)	29.04	<b>&lt; 0.0001</b>
No (ref)	11,313 (91.5)	4,030 (93.4)	7,283 (90.6)	—		
Opioid-related diagnosis						
Yes	2,489 (20.1)	728 (16.9)	1,761 (21.9)	0.72 (0.66-0.80)	43.83	<b>&lt; 0.0001</b>
No (ref)	9,869 (79.9)	3,587 (83.1)	6,282 (78.1)	—		
Stimulant-related diagnosis						
Yes	3,033 (24.5)	997 (23.1)	2,036 (25.3)	0.89 (0.81-0.97)	7.39	<b>0.0066</b>
No (ref)	9,325 (75.5)	3,318 (76.9)	6,007 (74.7)	—		
Nicotine-related diagnosis						
Yes	1,372 (11.1)	537 (12.4)	835 (10.4)	1.23 (1.09- 1.38)	12.08	<b>0.0005</b>
No (ref)	10,986 (88.9)	3,778 (87.6)	7,208 (89.6)	—		
Alcohol-related diagnosis						
Yes	6,987 (56.5)	2,919 (67.7)	4,068 (50.6)	2.04 (1.89- 2.21)	327.85	<b>&lt; 0.0001</b>
No (ref)	5,371 (43.5)	1,396 (32.4)	3,975 (49.4)	—		

Age range = 18-90, mean = 46.8 (SD = 14.9). Other or mixed race includes American Indian/Alaskan Native (n=74), Asian/Pacific Islander (n=325), and other or mixed race (n=1,976). Income range = \$17,372.0-\$208,984.0, mean = \$68,883.5 (SD = 20,678.14). SD = Standard deviation, CI = confidence interval. P-values based on Chi-squared ( $\chi^2$ ) tests of significance for categorical data and analysis of variance (ANOVA) for continuous data. Variable totals might not sum to column totals due to missing data.

Table D: Unmatched adjusted analysis of factors associated with having a substance-related diagnosis as the primary reason for a clinical encounter among patient records in a Southern California electronic medical record from January 1<sup>st</sup>, 2012 through January 1<sup>st</sup>, 2018 (n= 11,080)

Parameter	<i>B</i>	SE ( $\beta$ )	Adjusted Odds Ratio (95% CI)	$\chi^2$	<i>P</i>
Male (ref = Female)	0.17	0.05	<b>1.84 (1.08-1.30)</b>	13.70	<b>0.0002</b>
Age (18-90)					
18-24	0.86	0.13	<b>2.37 (1.85-3.05)</b>	45.48	<b>&lt;0.0001</b>
25-39	0.70	0.11	<b>1.99 (1.61-2.47)</b>	38.96	<b>&lt;0.0001</b>
40-54	0.69	0.10	<b>2.00 (1.63-2.46)</b>	43.97	<b>&lt;0.0001</b>
55-69	0.11	0.11	<b>1.68 (1.37-2.07)</b>	24.55	<b>&lt;0.0001</b>
70+ (ref)			—		
Race					
Black	-0.11	0.07	0.90 (0.78-1.03)	2.31	0.1288
Other or mixed	-0.06	0.07	0.94 (0.83-1.07)	0.82	0.3646
White (ref)			—		
Latinx (ref = no)	-0.13	0.07	0.88 (0.77-1.01)	3.29	0.0698
Marital status					
Single	0.23	0.06	<b>1.26 (1.13-1.41)</b>	16.83	<b>&lt;0.0001</b>
Divorced/separated/widowed	0.32	0.07	<b>1.37 (1.20-1.57)</b>	21.14	<b>&lt;0.0001</b>
Married/living as married (ref)			—		
Income					
< \$50,000 (ref)			—		
\$50,000-\$75,000	0.17	0.06	<b>1.18 (1.05-1.33)</b>	7.79	<b>0.0052</b>
\$75,000-\$100,000	0.00	0.08	1.01 (0.87-1.17)	0.02	0.9004
\$100,000+	0.11	0.09	1.12 (0.93-1.33)	1.45	0.2287
≥ 1 Charlson Comorbidity (ref = no)	-0.36	0.05		66.16	<b>&lt;0.0001</b>
Serious mental illness (ref = no)	0.22	0.05		15.79	<b>&lt;0.0001</b>
Cannabis-related diagnosis (ref = no)	-0.20	0.09	<b>0.89 (0.73-1.08)</b>	5.10	<b>0.0240</b>
Stimulant-related diagnosis (ref = no)	0.29	0.07	<b>1.22 (1.06-1.41)</b>	19.14	<b>&lt;0.0001</b>
Opioid-related diagnosis (ref = no)	0.42	0.07	<b>1.23 (1.05-1.43)</b>	34.09	<b>&lt;0.0001</b>
Nicotine-related diagnosis (ref = no)	0.27	0.07	<b>1.32 (1.14-1.52)</b>	17.55	<b>&lt;0.0001</b>
Alcohol-related diagnosis (ref = no)	1.00	0.06	<b>2.63 (2.28-3.03)</b>	241.61	<b>&lt;0.0001</b>

*B* = unstandardized beta,  $\beta$  = standardized beta, SE = standard error, CI = confidence interval, P-values based on logistic regression. P-values based on Chi-squared ( $\chi^2$ ) tests of significance for categorical data. Bolded adjusted odds ratios >1 with CIs that do not cross 1 and P-values ≤ 0.5 indicate higher odds of having a primary SRD visit. Bolded adjusted odds ratios <1 with CIs that do not cross 1 and p-values ≤ 0.5 indicate lower odds of having a primary SRD visit.