PERCEIVED STIGMA AND ITS IMPACT ON SUBSTANCE USE DISORDER AND MENTAL HEALTH

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ABSTRACT

Perceived stigma (the perception of public attitudes towards members of a marginalized group) toward people who use substances hinders treatment seeking, impacts the quality of care received, and affects treatment success. Despite its relevance to treatment, research on stigma's association with SUD-related outcomes is limited. This study aims to examine the associations between perceived stigma, types of substances used, mental health, and treatment type in a large sample across treatment sites. The present study involved survey completion upon treatment intake and early in treatment. Participants were individuals receiving treatment for substance use disorder (SUD; N=7591) in 75 treatment centers across the United States. Participants responded to the Perceived Stigma of Substance Abuse Scale (PSSAS). Participants' primary substances were collected. Participants completed mental health (anxiety, depression, stress), quality of life, and substance use-related surveys (craving and pursuit of abstinence). Finally, the treatment type received by each patient was reported. Reporting primarily using alcohol predicted lower PSSAS scores, while primarily using benzodiazepines, cocaine, heroin, methamphetamines, and opioids predicted higher PSSAS scores. Higher PSSAS scores also predicted higher levels of anxiety, depression, stress, and craving and lower levels of quality of life and pursuit of abstinence. Receiving intensive outpatient treatment predicted lower PSSAS scores. SUD patients report different levels of stigma depending on the substance they use and the type of treatment they receive. The differences in stigma levels predict distinctions in mental health outcomes. These findings highlight the need for tailored stigma-reduction interventions for those receiving SUD treatment[1].

***K*eywords** Stigma · Substance Use Disorder · Mental Health · Treatment

1 INTRODUCTION

Substance use disorders (SUDs) account for a high proportion of the total burden of illness across the globe and are the most stigmatized health conditions [1, 2, 3, 4, 5, 6]. There are different types of stigma that affect those with SUDs and mental health conditions, such as public stigma ("unfair beliefs, attitudes, or behaviors directed at individuals or groups"), experienced stigma ("stigma experienced by the individual, usually through discrimination"), self stigma

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("stigma that occurs when the stigmatized person agrees with and applies public stigma to themselves"), and perceived stigma ("beliefs that members of a stigmatized group have about the prevalence of stigmatizing attitudes and actions in society") [7, 8, 9]. Perceived stigma is especially prevalent in SUD populations, perhaps due to the widespread belief that people who use substances are dangerous [10, 11, 12] and entrenched cultural beliefs linking addiction to moral failure and a lack of willpower [13, 14, 15].

High levels of perceived stigma are associated with negative consequences at all stages of treatment, from inhibiting an individuals' help seeking behavior [16, 17, 6, 18] to the quality and approach of care they receive from health care providers [19]. It can even determine the success of their treatment [20, 21]; stigma differentially affects subpopulations of people receiving treatment for SUD. For example, high levels of stigma have been reported in participants receiving supervised withdrawal treatment such as detoxification [22] and in people who use heroin as compared to people who use marijuana [23]. Stigma has also been shown to predict higher levels of SUD outcomes such as craving [24]. Not only does it impact SUDs, but stigma is also related to mental health and well-being. Self stigma is related to more severe anxiety and perceived stigma is higher in those with severe depression [25, 26]. More generally, stigma is related to higher levels of stress [27, 28, 29] and lower quality of life [30, 31].

Despite the negative consequences of stigma in the context of SUDs and related mental health conditions, the existing literature surrounding the role of perceived stigma in SUD is conflicting and limited in several ways [6, 4]. Previous research is mixed when it comes to the relationship between stigma and treatment commitment and motivation [32]; some studies clearly suggest a positive correlation [33, 34], while others suggest that increased stigma made patients less motivated to continue treatment [35]. A 2018 review of the relationship between perceived stigma and SUDs points out the limitations of previous studies, noting small sample sizes (e.g., a maximum of 523 participants) and failure to explore the intricacies of perceived stigma that may be related to primary substance, mental health outcomes, or treatment type [6]. Although some of these relationships have been explored within the context of stigma related to SUD generally [22, 23, 24, 25, 27, 28, 29, 30, 31], it remains unclear whether the same holds true when it comes to perceived stigma specifically.

To address these gaps, in the present study, we analyzed the relationship between perceived stigma and multiple factors related to SUD treatment in a large sample (N = 7591). Our research had three research questions. First, as previous research had not established a relationship between primary substance use and stigma, we explored (**RQ1**) whether one's primary substance predicts different levels of perceived stigma. This question is exploratory and, therefore, we do not have a hypothesis. Second (**RQ2**), we explored mental health and SUD-related outcomes. Here, we hypothesized ($\mathbf{H}_{RQ2}$) that perceived stigma would negatively impact one's pursuit of abstinence and overall quality of life (QOL) and it would be associated with increased mental health symptoms and increased drug craving levels. Third (**RQ3**), we explored the relationship between stigma and treatment type, hypothesizing ($\mathbf{H}_{RQ3}$) that supervised withdrawal treatment would predict higher levels of perceived stigma relative to other types of treatment.

2 DATA

2.1 Data Collection

The survey was administered by Trac9, a third party treatment outcomes provider that partners with substance use treatment facilities in the United States to track patient symptoms and treatment outcomes. In total, there were 75 treatment sites, which were located across 12 U.S. states: Arkansas, California, Colorado, Florida, Illinois, Indiana, Maryland, Massachusetts, Oklahoma, Pennsylvania, Tennessee, and Texas. As the data collection was administered by a third-party, we did not have access to recruitment or sample details, besides those included below.

Participants all self-reported survey responses upon intake and throughout treatment via an electronic portal. Inclusion criteria was as follows: (1) self-reported stigma, (2) responded to all sociodemographics (age, gender, race, and employment), (3) self-reported all other clinical and mental health measures used in the study (see Section 2.2), and (4) were not enrolled in independent outpatient treatment. We excluded the participants enrolled in independent outpatient treatment due to the small sample size. Out of the total 7942 participants in the initial data set, N = 7591 met all inclusion criteria. See Figure 1 for inclusion criteria flow chart.

Previous studies utilizing Trac9's survey administration studied patient attitudes towards naloxone dosage [36] and the use of xylazine in SUD treatment [37], the role of age as a moderator of the role of optimism and treatment outcomes [38], demoralization and anhedonia of SUD patients receiving treatment [39], and craving in populations co-using opioids and stimulants [40]. Additionally, Trac9 survey data has been used to understand the role of sleep disruption and pain [41] and non-drug reinforcement [42] in SUD recovery.

Data were deidentified. This study was reviewed and acknowledged as not human subjects research by the Johns Hopkins University Medicine Institutional Review Board.

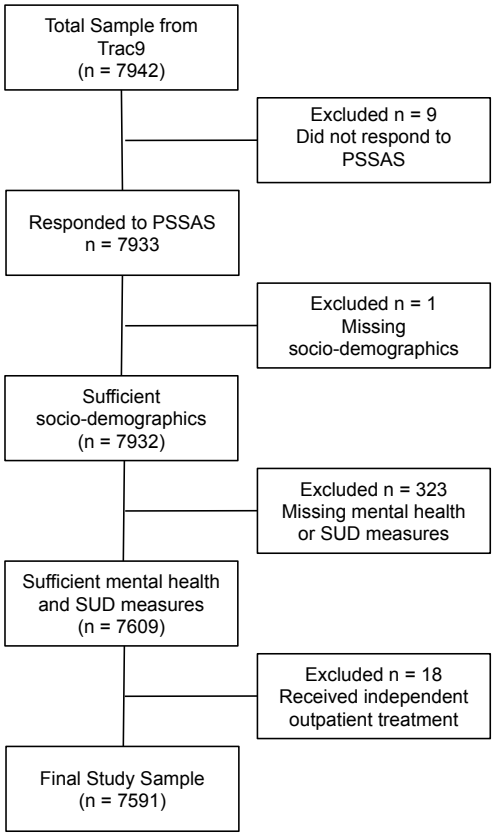

Figure 1: Inclusion criteria.

2.2 Measurements

2.2.1 Perceived Stigma of Substance Abuse Scale

Perceived stigma was measured using the Perceived Stigma of Substance Abuse Scale (PSSAS) at treatment intake [8]. Participants responded to eight stigma related items which asked them to evaluate perceptions towards people who use substances (e.g., "Most people would think less of a person who has been treated for a SUD") on a four-point Likert scale (from 1 = strongly disagree to 4 = strongly agree). Items in which a high score indicated low stigma were reverse scored.

2.2.2 Additional Outcomes

Perceived stigma was compared with multiple other mental health and substance use related outcomes from the surveys that were collected on intake and first in-treatment assessment.

Primary Substance Participants were asked to report their "drug of choice" as one of the following: alcohol, benzodiazepines, cocaine, heroin, marijuana, methamphetamines, opioids, or stimulants. As the term "drug of choice" is sometimes considered stigmatizing, we refer to this variable as "primary substance" in our analysis. Primary substance, a categorical variable, was converted into a series of binary variables, one for each substance type, where the reference group refers to all others in the sample (e.g., opioids = 1, all other substances categories = 0).

Mental Health and SUD-Related Outcomes Mental health factors included anxiety, depression, and stress, measured with the Penn State Worry Questionnaire [43], the Center for Epidemiologic Studies Depression Scale [44], and the Perceived Stress Scale [45] respectively. SUD-related outcomes included verbal craving and responses to the Commitment to Sobriety scale [46]. The verbal craving response refers to patients' reported urge to use substances [47]. Scales were unique to participants' primary substance. As ranges of scores on verbal craving scales varied for different substances, scores were standardized. We refer to responses to the Commitment to Sobriety scale as the "pursuit of

abstinence" to avoid using stigmatizing language. Finally, participants responded to two questions about their overall quality of life.

Treatment type Information was also collected from clinical records that denoted the type of treatment of each participant. Types of treatment included supervised withdrawal (i.e., detoxification), residential, and intensive outpatient. As noted above, due to the small sample size, we excluded the 18 participants who were enrolled in independent outpatient treatment. As with primary substance, treatment type was operationalized using a series of binary variables where the reference group referred to all others in the sample (e.g., outpatient = 1, all other treatment types = 0).

3 METHODS

This study was not preregistered and, thus, the analysis described below should be considered exploratory. This study followed the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines [48]. For all analyses, we use the statsmodels Python package [49] version 0.13.2.

3.1 Univariate Correlations

Before approaching our research questions and hypothesis, we began by correlating socio-demographic factors with stigma, in order to (1) get a baseline understanding of how stigma was related to our sample and (2) identify possible confounders which may have influenced the subsequent analyses. The socio-demographic factors used were age, gender, race, and employment status. For (continuous) age, we computed a product moment correlation between age and PSSAS. For all other variables, which were categorical, we converted each into a series of binary variables, where the reference group referred to all others in the sample (e.g., female = 1, all other gender categories = 0). We then computed point biserial correlations between PSSAS and each binary variable: six for race (African American, Asian, Native American, Native Hawaiian/Pacific Islander, White, other), three for gender (male, female, other), and one for employed (employed vs not employed). To correct for multiple comparisons, we performed a Benjamini-Hochberg False Discovery Rate (FDR) correction [50] and used a corrected significance level of $p < 0.05$.

3.2 Independent and Dependent Variables

While we do not claim any causality in our modeling (e.g., does increased stigma cause poor mental health or does poor mental health cause increased stigma), we set up the independent and dependent variables based on causal assumptions. First, we assume a person's primary substance was set before entering treatment, where the PSSAS was administered. Thus, for **RQ1** primary substance is the independent variable and PSSAS is the dependent variable (i.e., does one's primary substance predict stigma). Similarly, since treatment type was assigned before the PSSAS was administered, for **RQ3**, treatment type is the independent variable and stigma is the dependent variable. For **RQ2**, all measures were administered at the same time, and thus there is no preference as to which variables should be independent vs. dependent. However, prior literature suggests that stigma may cause worse mental health [26, 51]. Therefore, PSSAS is the independent variable and the mental health and substance use outcomes are the dependent variables.

3.3 Mixed Effects Models

To answer our three research questions, we used a mixed effects model. We included age, gender, race, and employment as fixed effects since, using the correlational analysis above, we saw that all factors are significantly related to stigma. Thus, by adding these variables to the model as covariates, we were able to control for these baseline relationships and see if our associations hold over and above socio-demographics. All continuous variables (age, PSSAS, and mental health and substance use outcomes) were mean centered and normalized by the standard deviation. We also included binary encoded variables for each primary substance and included these as fixed effects when predicting mental health and substance use outcomes (**RQ2**) and when predicting stigma from treatment type (**RQ3**).

Treatment sites were included as random effects, nesting patients within their respective treatment sites and allowing for each site to have its own intercept. This allowed every site to have their own mean estimates for each dependent variable, controlling for differences in variance between sites which may not be attributable to the fixed effects.

Models were fit using all default parameters, except that models were fit using maximum likelihood. While our objective was not to maximize model fit, we report model fit statistics of AIC, BIC, and Log-likelihood. We controlled for multiple comparisons by using a Benjamini-Hochberg False Discovery Rate (FDR) corrected significance level of $p < 0.05$.

	Mean (SD) / No. (%)	PSSAS (mean, SD)
Age	39.03 (12.4)	
Race		
African American	817 (10.8)	20.70 (4.09)
Asian	46 (.60)	20.67 (5.01)
Native American	66 (.90)	20.86 (3.42)
Native Hawaiian/Pacific Islander	20 (.30)	19.05 (4.59)
White	6,136 (80.8)	20.40 (4.04)
Other	506 (6.7)	20.48 (4.20)
Gender		
Male	5,282 (69.6)	20.27 (4.03)
Female	2,290 (30.2)	20.83 (4.10)
Other	19 (.30)	20.05 (4.96)
Employed	3474 (45.8)	20.00 (4.00)

Table 1: Demographic characteristics of study sample (N = 7591).

4 RESULTS

4.1 Descriptive Characteristics

The sample included 7591 SUD patients who were receiving treatment (Mage= 39.0, SDage = 12.4) at 75 treatment sites across the U.S.. The sample included 5510 males (69.5%), 2404 females (30.3%), and 19 participants reporting other genders (.2%). The majority of participants were White (N = 6423, 81.0%) and not Hispanic (N = 7316,92.2%). Eight primary substances were reported (alcohol, 3877 [48.9%]; heroin, 1160 [14.6%]; opioid, 932 [11.7%]; methamphetamine, 795 [10.0%]; cocaine, 566 [7.1%]; marijuana, 260 [3.3%]; benzodiazepines, 240 [3.0%]; and stimulant, 103 [1.3%]). Three different types of treatments were reported (supervised withdrawal, 4109 [51.8%]; residential, 3208 [40.4%]; outpatient, 616 [8.1%]). Complete demographic information is included in Table 1.

Point biserial correlations between race and perceived stigma indicated a significant positive relationship between being Black and perceived stigma and a significant negative relationship between being White and perceived stigma. Gender also appeared to be related to perceived stigma, as correlations indicated a positive relationship between being female and perceived stigma and a negative relationship between being male and perceived stigma. Finally, being employed was significantly negatively correlated with perceived stigma. Full results are shown in Table 4.1. Since age, race, gender, and employment were all significantly associated with stigma, we included them as covariates in all subsequent models.

4.2 Primary Substance (RQ1)

Table 3 displays the results of the mixed effects model with primary substance predicting perceived stigma. Results show a significant negative main effect of alcohol ($\beta = -0.29$; i.e., participants who report alcohol as their primary substance report less stigma). There were significant positive main effects of benzodiazepines ($\beta = 0.18$), cocaine ($\beta = 0.18$), heroin ($\beta = 0.18$), methamphetamines ($\beta = 0.10$), and opioids ($\beta = 0.15$; i.e., participants who reported these as their primary substances reported higher stigma). Results were significant at a Benjamini-Hochberg corrected significance level of $p < .05$. Marijuana and stimulants were not significantly related to stigma. All models controlled for age, gender, race, and employment (as fixed effects) and treatment site (as random effects).

4.3 Mental Health and SUD-Related Outcomes (RQ2)

Table 4 outlines the results of the mixed effects models where perceived stigma predicts mental health and SUD-related outcomes. Perceived stigma predicted all six mental health and SUD-related outcomes. Higher levels of stigma were associated with higher levels of anxiety ($\beta = 0.18$), depression ($\beta = 0.23$), stress ($\beta = 0.23$), and craving ($\beta = 0.12$), and lower levels of quality of life ($\beta = -0.18$) and pursuit of abstinence ($\beta = -0.10$). All results were significant at a Benjamini-Hochberg corrected significance level of $p < .001$. All models controlled for age, gender, race, and employment (as fixed effects) and treatment site (as random effects), as well as primary substance (as fixed effects).

	Correlation
Age	-.05***
Race	
African American	.03*
Asian	.01
Native American	.01
Native Hawaiian/Pacific Islander	-.02
White	-.03*
Other	.01
Gender	
Male	-.06**
Female	.06**
Other	-.002
Employed	-.10**

Table 2: Point biserial correlations were performed between each demographic trait (aside from Age, for which a product moment correlation was performed) and perceived stigma scores. Categorical race and gender were recoded as binary variables, where reference groups referred to all others in the sample (e.g., for the variable African American, 1 = African American, 0 = participants who endorsed any other race category. ****p <.001, **p < .01, *p <.05*.

	Stigma							
Fixed Effects								
Alcohol	-0.29*** (0.02)	-	-	-	-	-	-	-
Benzodiazepine	-	0.18** (0.07)	-	-	-	-	-	-
Cocaine	-	-	0.18*** (0.04)	-	-	-	-	-
Heroin	-	-	-	0.18*** (0.03)	-	-	-	-
Marijuana	-	-	-	-	0.02 (0.06)	-	-	-
Methamphetamine	-	-	-	-	-	0.10* (0.04)	-	-
Opioids	-	-	-	-	-	-	0.15*** (0.04)	-
Stimulants	-	-	-	-	-	-	-	-0.02 (0.10)
Age	0.00 (0.01)	-0.04*** (0.01)	-0.04*** (0.01)	-0.03** (0.01)	-0.04*** (0.01)	-0.04*** (0.01)	-0.04** (0.01)	-0.04*** (0.01)
Gender	0.12*** (0.02)	0.11*** (0.02)	0.12*** (0.02)	0.12*** (0.02)	0.12*** (0.02)	0.12*** (0.02)	0.12*** (0.02)	0.12*** (0.02)
Race	-0.01 (0.04)	0.02 (0.04)	-0.01 (0.04)	0.03 (0.04)	0.02 (0.04)	0.02 (0.04)	0.02 (0.04)	0.02 (0.04)
Employed	-0.08*** (0.02)	-0.13*** (0.02)	-0.13*** (0.02)	-0.12*** (0.02)	-0.13*** (0.02)	-0.12*** (0.02)	-0.13*** (0.02)	-0.13*** (0.02)
Intercept	0.07* (0.03)	-0.07* (0.03)	-0.07* (0.03)	-0.09** (0.03)	-0.06 (0.03)	-0.08* (0.03)	-0.08* (0.03)	-0.06 (0.03)
Random Effects								
Treatment site | (Intercept)	0.03	0.04	0.04	0.03	0.04	0.04	0.04	0.04
Model Fit								
AIC	20818.68	20950.08	20942.50	20930.12	20957.82	20951.68	20939.95	20957.95
BIC	20874.15	21005.56	20997.98	20985.60	21013.30	21007.16	20995.43	21013.43
Log-likelihood	-10401.34	-10467.04	-10463.25	-10457.06	-10470.91	-10467.84	-10461.98	-10470.98
Observations								
People	7591	7591	7591	7591	7591	7591	7591	7591
Treatment sites	75	75	75	75	75	75	75	75

Table 3: **RQ1** Summary of mixed effects models with primary substance predicting stigma (dependent variable). Reported standardized coefficients and standard errors (in parentheses), random effects reported as variance. Benjamini-Hochberg corrected significance levels: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$. Fixed effects are bolded (on the left) to indicate that these are the variables of interest, as opposed to general covariates.

	Mental Health			Substance Use		
	Anxiety	Depression	Stress	Craving	Quality of Life	Pursuit of Abstinence
Fixed Effects						
Stigma	0.18*** (0.01)	0.23*** (0.01)	0.23*** (0.01)	0.12*** (0.01)	-0.18*** (0.01)	-0.10*** (0.01)
Age	-0.11*** (0.01)	-0.12*** (0.01)	-0.10*** (0.01)	-0.13*** (0.01)	0.05*** (0.01)	0.10*** (0.01)
Gender	0.48*** (0.02)	0.29*** (0.02)	0.25*** (0.02)	0.06* (0.02)	0.01 (0.02)	0.12*** (0.02)
Race	-0.18*** (0.04)	-0.20*** (0.04)	-0.24*** (0.04)	-0.10** (0.04)	0.19*** (0.04)	0.06 (0.04)
Employed	0.00 (0.02)	-0.13*** (0.02)	-0.10*** (0.02)	-0.08*** (0.02)	0.13*** (0.02)	0.13*** (0.02)
Primary Substance						
Benzodiazepine	0.22** (0.07)	0.08 (0.06)	0.00 (0.07)	0.30*** (0.06)	0.06 (0.06)	0.11 (0.07)
Cocaine	-0.17*** (0.05)	0.07 (0.04)	0.00 (0.05)	-0.01 (0.04)	-0.02 (0.04)	0.06 (0.05)
Heroin	-0.24*** (0.04)	0.02 (0.04)	-0.11** (0.04)	0.54*** (0.03)	-0.05 (0.04)	-0.03 (0.04)
Marijuana	-0.12 (0.06)	-0.11 (0.06)	-0.05 (0.06)	0.79*** (0.06)	0.22*** (0.06)	-0.48*** (0.07)
Methamphetamine	-0.09* (0.04)	0.05 (0.04)	-0.08 (0.04)	0.01 (0.04)	0.00 (0.04)	0.05 (0.04)
Opioids	-0.14*** (0.04)	0.05 (0.04)	-0.07 (0.04)	0.59*** (0.04)	-0.01 (0.04)	-0.02 (0.04)
Stimulants	-0.11 (0.10)	0.07 (0.09)	-0.04 (0.10)	0.62*** (0.09)	-0.08 (0.09)	0.04 (0.10)
Intercept	-0.07** (0.03)	-0.15** (0.04)	-0.10* (0.04)	-0.28*** (0.03)	0.13** (0.05)	-0.11*** (0.03)
Random Effects						
Treatment site | (Intercept)	0.01	0.09	0.10	0.04	0.13	0.03
Model Fit						
AIC	20623.00	20459.61	20546.69	19933.57	20328.62	21216.57
BIC	20727.02	20563.63	20650.71	20037.60	20432.64	21320.59
Log-likelihood	-10296.50	-10214.80	-10258.35	-9951.79	-10149.31	-10593.28
Observations						
People	7591	7591	7591	7591	7591	7591
Treatment sites	75	75	75	75	75	75

Table 4: **RQ2** Summary of mixed effects models with stigma predicting mental health (dependent variables). Reported standardized coefficients and standard errors (in parentheses), random effects reported as variance. Benjamini-Hochberg corrected significance levels: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$. Fixed effects are bolded (on the left) to indicate that these are the variables of interest, as opposed to general covariates

4.4 Treatment Type (RQ3)

Table 3 displays the results of the mixed effects model applied where treatment type predicts perceived stigma. Within our sample, 3902 (51.4%) participants received supervised withdrawal treatment, 548 (7.2%) received intensive outpatient treatment, and 3141 (41.4%) received residential treatment. Of the treatment facilities in our sample, supervised withdrawal was offered at 42 locations (56%), intensive outpatient was offered at 42 locations (56%), and residential was offered at 45 locations (60%). 44 facilities offered more than one type of treatment, and 20 of them offered all three types. We are unable to provide a more detailed description of the treatment types offered at each location due to the third-party data collection and privacy concerns. Intensive outpatient treatment predicted significantly lower levels of perceived stigma ($\beta = -0.13$), while neither intensive outpatient nor supervised withdrawal treatment predicted stigma. All models controlled for age, gender, race, and employment (as fixed effects), primary substance (as fixed effects), and treatment site (as random effects).

5 DISCUSSION

The present study identified several factors associated with increased levels of perceived stigma. First, identifying benzodiazepines, cocaine, heroin, methamphetamines, or opioids as one's primary substance was associated with increased stigma, while individuals who reported using alcohol had lower levels (**RQ1**). Next, lower levels of stigma predicted positive SUD (lower craving and higher levels of pursuit of abstinence and quality of life) and mental health (lower levels of anxiety, depression, and stress) outcomes, confirming $\mathbf{H}_{RQ2}$. Finally, contrary to $\mathbf{H}_{RQ3}$, supervised withdrawal did not predict higher levels of perceived stigma. However, intensive outpatient predicted lower levels of perceived stigma compared to the other treatment modalities.

Our study's key findings have multiple potential explanations and implications. First, related to **RQ1**, differences in perceived stigma based on one's primary substance used could be related to the legal status of the substance, as alcohol, a legal substance in the United States, was associated with lower levels of stigma relative to other primary substances, whereas heroin, which is an illegal Schedule I substance, was associated with the highest levels of perceived stigma [52]. In fact, all of the substances with significantly higher levels of stigma are illegal in the United States [52]. This suggests that perhaps the increased stigma associated with these substances is related to its illegality. Additionally, media representation could be at play, as consumption of alcohol is normalized in mass media, even media geared

	Stigma		
Fixed Effects			
Supervised Withdrawal	0.02 (0.03)	-	-
Intensive Outpatient	-	-0.13* (0.05)	-
Residential	-	-	0.01 (0.03)
Age	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)
Gender	0.12*** (0.02)	0.12*** (0.02)	0.12*** (0.02)
Race	-0.01 (0.04)	-0.01 (0.04)	-0.01 (0.04)
Employed	-0.09*** (0.02)	-0.08*** (0.02)	-0.08*** (0.02)
Primary Substance			
Benzodiazepine	0.35*** (0.07)	0.35*** (0.07)	0.35*** (0.07)
Cocaine	0.31*** (0.05)	0.31*** (0.05)	0.30*** (0.05)
Heroin	0.33*** (0.04)	0.33*** (0.04)	0.33*** (0.04)
Marijuana	0.20** (0.06)	0.21** (0.06)	0.19** (0.06)
Methamphetamine	0.27*** (0.04)	0.26*** (0.04)	0.26*** (0.04)
Opioids	0.29*** (0.04)	0.29*** (0.04)	0.29*** (0.04)
Stimulants	0.15 (0.10)	0.15 (0.10)	0.15 (0.10)
Intercept	-0.23*** (0.03)	-0.20*** (0.03)	-0.23*** (0.03)
Random Effects			
Treatment site | (Intercept)	0.03	0.03	0.03
Model Fit			
AIC	20823.99	20818.29	20824.58
BIC	20928.01	20922.31	20928.60
Log-likelihood	-10396.99	-10394.15	-10397.29
Observations			
People	7591	7591	7591
Treatment sites	75	75	75

Table 5: **RQ3** Summary of mixed effects models with treatment type predicting stigma (dependent variable). Reported standardized coefficients and standard errors (in parentheses), random effects reported as variance. Benjamini-Hochberg corrected significance levels: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$. Fixed effects are bolded (on the left) to indicate that these are the variables of interest, as opposed to general covariates

toward and used by young audiences [53, 54, 55]. On the other hand, the injection of substances that are illegal, especially heroin and cocaine, tends to be depicted in the media more negatively and in criminal contexts [56, 57, 58].

Second, related to **RQ2**, the relationship between perceived stigma, mental health, and SUD demonstrates that stigma can be harmful to one's mental health and overall quality of life. Specifically, these harms included increased anxiety, stress, depression, and craving, as well as decreased pursuit of abstinence and quality of life. Interestingly, despite mixed results in previous studies, [32], we found a strong negative relationship between perceived stigma and the pursuit of abstinence. As stigma can be motivating when someone has a supportive environment [32], the negative relationship in our study could be attributed to decreased help-seeking behaviors that are known to be related to increased stigma [16, 17, 6, 18, 36].

Third, related to **RQ3**, there were differences in perceived stigma among individuals in outpatient treatment compared to the two other treatment types included in our sample. Interestingly, both supervised withdrawal as well as traditional residential treatment are types of inpatient treatment. Although stigmatizing views towards inpatient versus outpatient SUD treatment has not been previously explored, previous literature has compared stigma related to inpatient versus outpatient mental healthcare [59]. As the measure for perceived stigma was given within the first week of treatment, a potential explanation of the differences in stigma by treatment type could be related to preconceived perceptions of mental healthcare in general, which can be largely attributed to the stigmatizing depiction of inpatient mental healthcare in the media [60, 61]. More generally, our results suggest that a "one size fits all" approach is not adequate nor effective for treating SUDs. By directing resources to groups most prone to high levels of perceived stigma on intake, SUD interventions could reduce these levels of stigma, in turn improving mental health and SUD-related outcomes.

Taken together, practical implications of our findings relate to the way treatment is delivered. There have been many instances of individuals in SUD and mental health treatment facilities who have reported perceived stigma from healthcare providers [62, 21, 63]. Perhaps our findings can inform stigma-reduction training and/or guidelines for SUD

treatment facilities, some of which have been successful preliminarily within the contexts of mental health conditions [64, 65]. Additionally, healthcare providers should be aware that certain drugs carry greater levels of stigma in people seeking treatment, and stigma reduction should be incorporated into their treatment plans accordingly. By identifying groups of individuals who are likely to perceive higher levels of stigma, intervention strategies can be tailored to reduce this stigma. It is likely that this reduction of stigma would encourage mental health improvements as it has been shown to in previous studies [66].

Our findings suggest that factors such as reporting the use of an illicit substance are associated with higher levels of perceived stigma while receiving intensive outpatient treatment predicts lower levels of stigma. However, the mechanism of this relationship remains unclear. Reference biases [67] are potentially at play, as the PSSAS measure refers to the perception of stigma towards people who use drugs generally, rather than towards the participant as a member of the stigmatized group. More detailed information about the mechanisms behind the relationships observed and other types of stigma (such as self or experienced stigma) would be useful in adjusting legislature, treatment techniques, and even everyday language to reduce perceived stigma in SUD populations.

5.1 Limitations

The present study should be considered in the context of its limitations. First, the participants only included those actively participating in treatment in the 75 treatment sites and results do not generalize to all individuals with SUDs who live in other countries, receive treatment in other sites, or are not currently participating in treatment. However, respondents included individuals in treatment centers located in different parts of the country, suggesting that this relationship is not specific to a single geographic region or cultural trait. Additionally, our sample was significantly larger than previous work about perceived stigma of SUD. Second, although the sample included a majority of White participants and people who used alcohol, many of the groups of people of other races and who used other substances were still larger compared to previous work in the field. While the 2021 Treatment Episode Data Set revealed that the majority of SUD treatment admissions were White (66.5%) [68], future work should over-sample groups other than White people who use alcohol. Additionally, the role of intersectional stigma (the combination of multiple types of stigma due to membership in more than one stigmatized population) may be at play and could be better observed in more diverse populations [69, 70]. Third, as it pertains to a patient's primary substance, participants only had the option to report one substance, which does not account for polysubstance use. While this variable is representative of the substance participants used the most, the role of polysubstance use should be further investigated, as polysubstance use is increasing and contributing to the fourth wave of the opioid epidemic [71]. Finally, as we have established, different substances are related to different levels of stigma, so perhaps this affected the way individuals reported their primary substance. For example, if a participant was experiencing both alcohol use disorder and heroin use disorder, our results suggest that they could be more likely to report alcohol due to increased perceived stigma related to heroin. Once again, future research should explore the role of polysubstance use in levels of perceived stigma.

6 Conclusions

Perceived stigma is highly related to several SUD and mental health outcomes and factors. A better understanding of the causes of these relationships could lead to improved treatment techniques and longer treatment retention. Focusing stigma reduction techniques on highly stigmatizing substances and treatments could contribute to more positive outcomes for individuals with SUDs. Overall, improved and targeted approaches based on the substance used as well as the treatment being received could improve one's chance of recovery and overall mental health.

Author contributions

Isman: Conceptualization, Methodology, Formal Analysis, Writing Original Draft, Writing Review & Editing. **Giorgi**: Conceptualization, Methodology, Validation, Formal Analysis, Data Curation, Writing Original Draft, Writing Review & Editing. **Ellis**: Conceptualization, Data Curation, Writing Review & Editing. **Huhn**: Conceptualization, Data Curation, Writing: Review & Editing, Funding Acquisition. **Liu**: Conceptualization, Writing: Review & Editing. **Curtis**: Conceptualization, Methodology, Validation, Data Curation, Writing Original Draft, Writing Review & Editing, Supervision, Funding acquisition.

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Conflict of interest

The authors declare no potential conflict of interests.

Data Availability

Due to the proprietary nature of data (i.e., collected through a third-party vendor), data is unable to be shared.

References

[1] Robin Room, Jürgen Rehm, Robert T Trotter II, Angela Paglia, and T Bedirhan Üstün. Cross-cultural views on stigma, valuation, parity, and societal values towards disability. 2001.

[2] Abigail W Batchelder, Jacklyn D Foley, Megan R Wirtz, Kenneth Mayer, and Conall OCleirigh. Substance use stigma, avoidance coping, and missed hiv appointments among msm who use substances. *AIDS and Behavior*, 25:1454–1463, 2021.

[3] Sarah Clement, Oliver Schauman, Tanya Graham, Francesca Maggioni, Sara Evans-Lacko, Nikita Bezborodovs, Craig Morgan, Nicolas Rüsch, June SL Brown, and Graham Thornicroft. What is the impact of mental health-related stigma on help-seeking? a systematic review of quantitative and qualitative studies. *Psychological medicine*, 45(1):11–27, 2015.

[4] Rebecca Hammarlund, Kathleen A Crapanzano, Lauren Luce, Lauren Mulligan, and Kathleen M Ward. Review of the effects of self-stigma and perceived social stigma on the treatment-seeking decisions of individuals with drug-and alcohol-use disorders. *Substance abuse and rehabilitation*, pages 115–136, 2018.

[5] Suneerat Yangyuen, Manop Kanato, Chatchada Mahaweerawat, and Udomsak Mahaweerawat. The perceived stigma of addiction and treatment utilization among cannabis addicts in thailand. *Indian Journal of Community Medicine*, 45(4):492–496, 2020.

[6] Kathleen A Crapanzano, Rebecca Hammarlund, Bilal Ahmad, Natalie Hunsinger, and Rumneet Kullar. The association between perceived stigma and substance use disorder treatment outcomes: a review. *Substance abuse and rehabilitation*, pages 1–12, 2018.

[7] Bruce G Link. Understanding labeling effects in the area of mental disorders: An assessment of the effects of expectations of rejection. *American sociological review*, pages 96–112, 1987.

[8] Jason B Luoma, Alyssa K O'Hair, Barbara S Kohlenberg, Steven C Hayes, and Lindsay Fletcher. The development and psychometric properties of a new measure of perceived stigma toward substance users. *Substance use & misuse*, 45(1-2):47–57, 2010.

[9] Jason B Luoma, Michael P Twohig, Thomas Waltz, Steven C Hayes, Nancy Roget, Michelle Padilla, and Gary Fisher. An investigation of stigma in individuals receiving treatment for substance abuse. *Addictive behaviors*, 32(7):1331–1346, 2007.

[10] Patrick W Corrigan, Sachiko A Kuwabara, and John O'shaughnessy. The public stigma of mental illness and drug addiction: Findings from a stratified random sample. *Journal of Social Work*, 9(2):139–147, 2009.

[11] Charlie Lloyd. The stigmatization of problem drug users: A narrative literature review. *Drugs: education, prevention and policy*, 20(2):85–95, 2013.

[12] Michael Shiner and Adam Winstock. Drug use and social control: The negotiation of moral ambivalence. *Social science & medicine*, 138:248–256, 2015.

[13] VADM Jerome M Adams and Nora D Volkow. Ethical imperatives to overcome stigma against people with substance use disorders. *AMA Journal of Ethics*, 22(8):702–708, 2020.

[14] Nicole L Henderson and William W Dressler. Medical disease or moral defect? stigma attribution and cultural models of addiction causality in a university population. *Culture, Medicine, and Psychiatry*, 41:480–498, 2017.

[15] Jenny Mincin. Addiction and stigmas: overcoming labels, empowering people. *New directions in treatment, education, and outreach for mental health and addiction*, pages 125–131, 2018.

[16] Madeline B Benz, Kathleen Palm Reed, and Lia S Bishop. Stigma and help-seeking: The interplay of substance use and gender and sexual minority identity. *Addictive Behaviors*, 97:63–69, 2019.

[17] Patrick W Corrigan, Benjamin G Druss, and Deborah A Perlick. The impact of mental illness stigma on seeking and participating in mental health care. *Psychological Science in the Public Interest*, 15(2):37–70, 2014.

[18] Yu Yu, Samantha L Matlin, Cindy A Crusto, Bronwyn Hunter, and Jacob Kraemer Tebes. Double stigma and help-seeking barriers among blacks with a behavioral health disorder. *Psychiatric Rehabilitation Journal*, 45(2):183, 2022.

[19] Robert D Ashford, Austin M Brown, Jessica McDaniel, and Brenda Curtis. Biased labels: An experimental study of language and stigma among individuals in recovery and health professionals. *Substance use & misuse*, 54(8):1376–1384, 2019.

[20] Robert D Ashford, Austin M Brown, Arielle Ashford, and Brenda Curtis. Recovery dialects: A pilot study of stigmatizing and nonstigmatizing label use by individuals in recovery from substance use disorders. *Experimental and clinical psychopharmacology*, 27(6):530, 2019.

[21] Rachel Simon, Rachel Snow, and Sarah Wakeman. Understanding why patients with substance use disorders leave the hospital against medical advice: a qualitative study. *Substance abuse*, 41(4):519–525, 2020.

[22] Nikki Bozinoff, Bradley J Anderson, Genie L Bailey, and Michael D Stein. Correlates of stigma severity among persons seeking opioid detoxification. *Journal of addiction medicine*, 12(1):19–23, 2018.

[23] Seth A Brown. Stigma towards marijuana users and heroin users. *Journal of psychoactive drugs*, 47(3):213–220, 2015.

[24] Madeline E Crozier, Mehdi Farokhnia, Susan Persky, Lorenzo Leggio, and Brenda Curtis. Relationship between self-stigma about alcohol dependence and severity of alcohol drinking and craving. *BMJ Ment Health*, 26(1), 2023.

[25] J Busby Grant, CP Bruce, and Philip J Batterham. Predictors of personal, perceived and self-stigma towards anxiety and depression. *Epidemiology and psychiatric sciences*, 25(3):247–254, 2016.

[26] Bruce G Link, Elmer L Struening, Michael Rahav, Jo C Phelan, and Larry Nuttbrock. On stigma and its consequences: evidence from a longitudinal study of men with dual diagnoses of mental illness and substance abuse. *Journal of health and social behavior*, pages 177–190, 1997.

[27] Christine Baxter. Investigating stigma as stress in social interactions of parents. *Journal of Intellectual Disability Research*, 33(6):455–466, 1989.

[28] David M Frost. Social stigma and its consequences for the socially stigmatized. *Social and Personality Psychology Compass*, 5(11):824–839, 2011.

[29] Julia V Schibalski, Mario Mueller, Vladeta Ajdacic-Gross, Stefan Vetter, Stephanie Rodgers, Nathalie Oexle, Patrick W Corrigan, Wulf Roessler, and Nicolas Ruesch. Stigma-related stress, shame and avoidant coping reactions among members of the general population with elevated symptom levels. *Comprehensive psychiatry*, 74:224–230, 2017.

[30] Selim El-Badri and Graham Mellsop. Stigma and quality of life as experienced by people with mental illness. *Australasian Psychiatry*, 15(3):195–200, 2007.

[31] Amy Degnan, Katherine Berry, Charlotte Humphrey, and Sandra Bucci. The relationship between stigma and subjective quality of life in psychosis: A systematic review and meta-analysis. *Clinical Psychology Review*, 85:102003, 2021.

[32] Steve Matthews. Self-stigma and addiction. In *The stigma of addiction: An essential guide*, pages 5–32. Springer, 2019.

[33] Emine Merve Akdağ, Vahap Ozan Kotan, Samet Kose, Baise Tıkır, Makbule Çiğdem Aydemir, İhsan Tuncer Okay, Erol Göka, and Güven Özkaya. The relationship between internalized stigma and treatment motivation, perceived social support, depression and anxiety levels in opioid use disorder. *Psychiatry and Clinical Psychopharmacology*, 28(4):394–401, 2018.

[34] Neslihan Bozdağ and Döndü Çuhadar. Internalized stigma, self-efficacy and treatment motivation in patients with substance use disorders. *Journal of Substance Use*, 27(2):174–180, 2022.

[35] Stacey L McCallum, Antonina A Mikocka-Walus, Matthew D Gaughwin, Jane M Andrews, and Deborah A Turnbull. i'm a sick person, not a bad person: patient experiences of treatments for alcohol use disorders. *Health expectations*, 19(4):828–841, 2016.

[36] Justin C Strickland, Katherine R Marks, Kirsten E Smith, Jennifer D Ellis, J Gregory Hobelmann, and Andrew S Huhn. Patient perceptions of higher-dose naloxone nasal spray for opioid overdose. *International Journal of Drug Policy*, 106:103751, 2022.

[37] Martin Hochheimer, Justin C Strickland, Jill A Rabinowitz, Jennifer D Ellis, Kelly E Dunn, and Andrew S Huhn. Knowledge, preference, and adverse effects of xylazine among adults in substance use treatment. *JAMA Network Open*, 7(2):e240572–e240572, 2024.

[38] Martin Hochheimer, Justin C Strickland, Jennifer D Ellis, Jill A Rabinowitz, J Gregory Hobelmann, Maggie Ford, and Andrew S Huhn. Age moderates the association of optimism on craving during substance use disorder treatment. *Journal of Substance Use and Addiction Treatment*, 160:209297, 2024.

[39] Jill A Rabinowitz, Jennifer D Ellis, Justin C Strickland, Martin Hochheimer, Yijun Zhou, Andrea S Young, Brenda Curtis, and Andrew S Huhn. Patterns of demoralization and anhedonia during early substance use disorder treatment and associations with treatment attrition. *Journal of Affective Disorders*, 335:248–255, 2023.

[40] Martin Hochheimer, Justin C Strickland, Jill A Rabinowitz, Jennifer D Ellis, Cecilia L Bergeria, J Gregory Hobelmann, and Andrew S Huhn. The impact of opioid-stimulant co-use on tonic and cue-induced craving. *Journal of Psychiatric Research*, 164:15–22, 2023.

[41] Jennifer D Ellis, Jill A Rabinowitz, Justin C Strickland, Neha Skandan, J Gregory Hobelmann, Patrick H Finan, and Andrew S Huhn. Latent patterns of sleep disturbance, pain impact, and depressive symptoms in residential substance use treatment. *Drug and alcohol dependence*, 248:109903, 2023.

[42] Samuel F Acuff, Jennifer D Ellis, Jill A Rabinowitz, Martin Hochheimer, J Gregory Hobelmann, Andrew S Huhn, and Justin C Strickland. A brief measure of non-drug reinforcement: Association with treatment outcomes during initial substance use recovery. *Drug and alcohol dependence*, 256:111092, 2024.

[43] Thomas J Meyer, Mark L Miller, Richard L Metzger, and Thomas D Borkovec. Development and validation of the penn state worry questionnaire. *Behaviour research and therapy*, 28(6):487–495, 1990.

[44] Lenore Sawyer Radloff. A self-report depression scale for research in the general population. *Applied psychol Measurements*, 1:385–401, 1977.

[45] Sheldon Cohen, Tom Kamarck, and Robin Mermelstein. A global measure of perceived stress. *Journal of health and social behavior*, pages 385–396, 1983.

[46] John F Kelly and M Claire Greene. Beyond motivation: Initial validation of the commitment to sobriety scale. *Journal of Substance Abuse Treatment*, 46(2):257–263, 2014.

[47] Chung Jung Mun, Patrick H Finan, David H Epstein, William J Kowalczyk, Daniel Agage, Janelle E Letzen, Karran A Phillips, and Kenzie L Preston. Craving mediates the association between momentary pain and illicit opioid use during treatment for opioid-use disorder: An ecological momentary assessment study. *Addiction*, 116(7):1794–1804, 2021.

[48] Erik Von Elm, Douglas G Altman, Matthias Egger, Stuart J Pocock, Peter C Gøtzsche, and Jan P Vandenbroucke. The strengthening the reporting of observational studies in epidemiology (strobe) statement: guidelines for reporting observational studies. *The lancet*, 370(9596):1453–1457, 2007.

[49] Skipper Seabold and Josef Perktold. statsmodels: Econometric and statistical modeling with python. In *9th Python in Science Conference*, 2010.

[50] Yoav Benjamini and Yosef Hochberg. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the Royal statistical society: series B (Methodological)*, 57(1):289–300, 1995.

[51] Jennifer Ahern, Jennifer Stuber, and Sandro Galea. Stigma, discrimination and the health of illicit drug users. *Drug and alcohol dependence*, 88(2-3):188–196, 2007.

[52] National Institute on Drug Abuse. nida.nih.gov. `https://nida.nih.gov/sites/default/files/cadchart.pdf`, 2012. [Accessed 22-04-2024].

[53] Brenda L Curtis, Samantha J Lookatch, Danielle E Ramo, James R McKay, Richard S Feinn, and Henry R Kranzler. Meta-analysis of the association of alcohol-related social media use with alcohol consumption and alcohol-related problems in adolescents and young adults. *Alcoholism: Clinical and Experimental Research*, 42(6):978–986, 2018.

[54] Sonya Dal Cin, Keilah A Worth, Madeline A Dalton, and James D Sargent. Youth exposure to alcohol use and brand appearances in popular contemporary movies. *Addiction*, 103(12):1925–1932, 2008.

[55] Richard Griffiths and Sally Casswell. Intoxigenic digital spaces? youth, social networking sites and alcohol marketing. *Drug and alcohol review*, 29(5):525–530, 2010.

[56] Quincy Hodges. A comparative content analysis of how print media framed the heroin epidemic and the opioid crisis. 2022.

[57] Carmel Shachar, Tess Wise, Gali Katznelson, and Andrea Louise Campbell. Criminal justice or public health: A comparison of the representation of the crack cocaine and opioid epidemics in the media. *Journal of Health Politics, Policy and Law*, 45(2):211–239, 2020.

[58] Dea L Biancarelli, Katie B Biello, Ellen Childs, M Drainoni, Peter Salhaney, Alberto Edeza, Matthew J Mimiaga, Richard Saitz, and Angela R Bazzi. Strategies used by people who inject drugs to avoid stigma in healthcare settings. *Drug and alcohol dependence*, 198:80–86, 2019.

[59] Lily A Mathison, Andrew J Seidman, Rachel E Brenner, Nathaniel G Wade, Patrick J Heath, and David L Vogel. A heavier burden of stigma? comparing outpatient and inpatient help-seeking stigma. *Stigma and Health*, 2021.

[60] Matthias C Angermeyer and Beate Schulze. Reinforcing stereotypes: How the focus on forensic cases in news reporting may influence public attitudes towards the mentally ill. *International Journal of law and Psychiatry*, 24(4-5):469–486, 2001.

[61] Steven E Hyler, Glen O Gabbard, and Irving Schneider. Homicidal maniacs and narcissisfic parasites: stigmatization of mentally ill persons in the movies. *Psychiatric Services*, 42(10):1044–1048, 1991.

[62] Ethan Forsgren, Athreya Steiger, Yesenia Perez, David Salazar, Maureen McCollough, and Breena R Taira. Patient perspectives on emergency department initiation of medication for alcohol use disorder. *Academic Emergency Medicine*, 2023.

[63] Jane Tyerman, Autumn-Lee Patovirta, and Ann Celestini. How stigma and discrimination influences nursing care of persons diagnosed with mental illness: a systematic review. *Issues in mental health nursing*, 42(2):153–163, 2021.

[64] Akwatu Khenti, Sireesha J Bobbili, and Jaime C Sapag. Evaluation of a pilot intervention to reduce mental health and addiction stigma in primary care settings. *Journal of Community Health*, 44(6):1204–1213, 2019.

[65] Brandon A Kohrt, Elizabeth L Turner, Sauharda Rai, Anvita Bhardwaj, Kathleen J Sikkema, Adesewa Adelekun, Manoj Dhakal, Nagendra P Luitel, Crick Lund, Vikram Patel, et al. Reducing mental illness stigma in healthcare settings: proof of concept for a social contact intervention to address what matters most for primary care providers. *Social Science & Medicine*, 250:112852, 2020.

[66] Shazana Shahwan, Jue Hua Lau, Chong Min Janrius Goh, Wei Jie Ong, Gregory Tee Hng Tan, Kian Woon Kwok, Ellaisha Samari, Ying Ying Lee, Wen Lin Teh, Vanessa Seet, et al. The potential impact of an anti-stigma intervention on mental health help-seeking attitudes among university students. *BMC psychiatry*, 20:1–14, 2020.

[67] Benjamin Lira, Joseph M OBrien, Pablo A Peña, Brian M Galla, Sidney DMello, David S Yeager, Amy Defnet, Tim Kautz, Kate Munkacsy, and Angela L Duckworth. Large studies reveal how reference bias limits policy applications of self-report measures. *Scientific reports*, 12(1):19189, 2022.

[68] Substance Abuse and Mental Health Services Administration. Treatment episode data set 2021: Admissions to and discharges from substance use treatment services reported by single state agencies, 2021.

[69] Lisa Bowleg. The problem with the phrase women and minorities: intersectionalityan important theoretical framework for public health. *American journal of public health*, 102(7):1267–1273, 2012.

[70] Ali J Talan, Ore Shalhav, Aria Tilove, Carly Wolfer, Devin English, Viraj Patel, and H Jonathon Rendina. Capturing daily experiences of intersectional stigma among young sexual minority men in hiv prevention research. *American journal of public health*, 112(S4):S398–S400, 2022.

[71] Joseph Friedman and Chelsea L Shover. Charting the fourth wave: Geographic, temporal, race/ethnicity and demographic trends in polysubstance fentanyl overdose deaths in the united states, 2010–2021. *Addiction*, 118(12):2477–2485, 2023.