Individual, interpersonal, and neighborhood measures associated with opioid use stigma: Evidence from a nationally representative survey

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Abstract

Despite growing awareness of opioid use disorder (OUD), fatal overdoses and downstream health conditions (e. g., hepatitis C and HIV) continue to rise in some populations. Various interrelated structural forces, together with social and economic determinants, contribute to this ongoing crisis; among these, access to medications for opioid use disorder (MOUD) and stigma towards people with OUD remain understudied. We combined data on methadone, buprenorphine, and naltrexone providers from SAMHSA's 2019 directory, additional naltrexone providers from Vivitrol's location finder service, with a nationally representative survey called "The AmeriSpeak survey on stigma toward people with OUD." Integrating the social-ecological framework, we focus on individual characteristics, personal and family members' experience with OUD, and spatial access to MOUD at the community level. We use nationally representative survey data from 3008 respondents who completed their survey in 2020. Recognizing that stigma is a multifaceted construct, we also examine how the process varies for different types of stigma, specifically perceived dangerousness and untrustworthiness, as well as social distancing measures under different scenarios. We found a significant association between stigma and spatial access to MOUD — more resources are related to weaker stigma. Respondents had a stronger stigma towards people experiencing current OUD (versus past OUD), and they were more concerned about OUD if the person would marry into their family (versus being their coworkers).

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Additionally, respondents' age, sex, education, and personal experience with OUD were also associated with their stigma, and the association can vary depending on the specific type of stigma. Overall, stigma towards people with OUD was associated with both personal experiences and environmental measures.

Keywords

Stigma; Opioid use disorder; Spatial access to MOUD; Social-ecological model

1. Introduction

Despite growing awareness of opioid use disorder (OUD), the incidence of fatal overdose has rapidly increased in the United States, with downstream health conditions (e.g., hepatitis C and HIV) continuing to rise in some populations. Various interrelated structural forces, together with social and economic determinants, contribute to this ongoing health crisis (Galea and Vlahov, 2002; Kolak et al., 2020). Lack of access to medications for opioid use disorder (MOUD) remains one of the most important structural barriers (Haffajee et al., 2019; McLuckie et al., 2019) to address OUD. For example, in a cross-sectional study using US national data from 2015 to 2017, Haffajee et al. (2019) identified many counties in the East, North, Central, South Atlantic, or Mountain regions that had high rates of opioid overdose mortality and low capacity to deliver MOUD. With lower access to treatments and medications, rural areas also have higher risk of fatal overdose and downstream infections from injection drug use and opioid use disorder (Brown et al., 2018; Haffajee et al., 2019; Joudrey et al., 2020).

Importantly, research suggests that underlying the lack of access to MOUD is stigma towards both the disease of substance use disorder and the use of medications to treat substance use disorder (Calver and Saitz, 2017; Finlay et al., 2020; Hadland et al., 2018; Olsen and Sharfstein, 2014; Tsai et al., 2019; Wakeman and Rich, 2018). Despite the fact that drug dependency has been long acknowledged as a disease, the general public may still view drug use and substance use disorder as a moral failure linked to criminal offense and thus, resist public health or medical interventions. Even among people who acknowledge the need of interventions, stigma towards medical medications is still widely spread and deeply rooted, in spite of considerable evidence regarding the effectiveness of MOUDs in reducing opioid-related mortality (Kelty and Hulse, 2017; Larochelle et al., 2018; Lee et al., 2016; Mattick et al., 2004, 2009). Many patients, families, and even treatment providers perceive those medications should only be used as a last resort and would prefer counseling along with or instead of medications (Finlay et al., 2020; Hadland et al., 2018). Some post-acute care facilities are unwilling to accept patients using MOUD (Wakeman and Rich, 2017), and some psychosocial programs and mutual help organizations may reject people on methadone or buprenorphine (Wakeman, 2016; White, 2011). Furthermore, Stein et al. (2016) present evidence that most buprenorphine-prescribing physicians treat far fewer patients than they could. Lack of treatment for OUD within the criminal justice system further underlines the fact that drug use, in general, is highly criminalized and stigmatized (Wakeman and Rich, 2018). However, to the best of our knowledge, very few studies have examined potential

factors underlying people's stigma towards OUD. This is an important gap in the literature, for such research can inform future policy-making that reduces such stigma.

In this study, we explore how some individual, interpersonal, and neighborhood factors may be associated with people's stigma towards OUD. Integrating the social-ecological framework, we focus on individual characteristics at the individual level, personal and family members' experience with OUD at the interpersonal level, together with spatial access to MOUD at the community level (see Figure S1 in the supplementary material). We use nationally representative survey data from 3008 respondents who completed their survey in 2020. Additionally, we examine how the process varies for different types of stigma, specifically perceived dangerousness and untrustworthiness, as well as people's unwillingness to interact with others with OUD (which we refer to as "social distancing").

2. Background

2.1. Stigma in a social-ecological model

In order to understand how various factors are associated with people's stigma toward others with OUD, we lean on the social-ecological model that highlights factors across multiple levels, such as those at individual, relationship or interpersonal, community, and societal levels (Bronfenbrenner, 1994; Dahlberg and Krug, 2002). In particular, we focus on the collective effects on stigma from people's individual characteristics, personal history, social experience, and structural access to MOUD (see Figure S1 in the supplementary material). By emphasizing the complex interplay between factors across multiple levels, the social-ecological model provides a theoretical framework to examine risk factors that individuals may experience in life. The model also highlights the importance of considering interventions across multiple levels.

More importantly, the social-ecological model has been incorporated with other theoretical frameworks to emphasize the importance of examining the role of structural contexts in producing and reinforcing inequity in health outcomes. For example, by integrating the social-ecological model, Seng et al. (2012) examined intersectionality across structural, contextual, and interpersonal levels, and reported how factors at each level helped explain variance in posttraumatic stress symptoms and quality of life scores. Though not always explicitly named, the way of considering multiple levels in the social-ecological model, especially the contextual and structural level, has seen robust discussions in the intersectionality literature to explicitly account for the roles of power structures, social positions and processes that directly link to social-structural discrimination and inequality (Bauer, 2014; Bowleg, 2012; Phelan and Link, 2015).

Previous literature has defined stigma as negative views towards others because their behaviors or characteristics are regarded as inferior to widely accepted norms (Dudley, 2000; Goffman, 1963). Importantly, researchers have emphasized stigma as a social construct that includes the co-occurrence of labeling, stereotyping, and discrimination that span over both the individual and structural level (Hatzenbuehler et al., 2013; Link and Phelan, 2001). The importance of the multilevel social-ecological feature in stigma experience and construction has also been highlighted in recent studies of stigma towards OUD, especially at the

structural level. For example, through a critical content analysis, Webster et al. (2020) describes how media reporting constructs the opioid epidemic in a manner that criminalizes and stigmatizes people with OUD. Moreover, Tsai et al. (2019) propose how five types of stigma (i.e., structural, public, enacted, internalized, and anticipated stigma) reinforce each other, collectively hindering the response to the opioid epidemic. In particular, they illustrate that public and enacted stigma can become structural and lead people with OUD to internalize or anticipate stigma related to their illness. Other authors (Shachar et al., 2020) apply related lenses to compare the opioid epidemic to prior challenges, particularly the crack cocaine epidemic, to identify ways that individuals living with OUD may face less public stigma due to the perception that wrongful prescribing practices by pharmaceutical manufacturers played a prominent causal role.

Discussions above highlight that stigma towards OUD is shaped, experienced, and reinforced through a complex process from personal, social experience through societal structure, and such stigma directly links to complex health inequalities via creating various barriers to seeking and accessing MOUD. In this case, we use the social-ecological model to highlight that stigma is closely associated with people's experience at different social-ecological levels, from individual, interpersonal, to community levels. More importantly, by highlighting the social structural factors, the social-ecological model guides us to carefully consider the community and structural level factors associated with stigma towards OUD.

2.2. The multidimensionality and contextual contingency of stigma

In line with Tsai et al. (2019), we focus on public and enacted stigma as they play a fundamental role in the complicated, multidimensional construct of stigma. *Public stigma* refers to negative attitudes toward people with OUD based on negative stereotypes of these individuals such as their perceived dangerousness and immorality (Tsai et al., 2019). *Enacted stigma* refers to "the behavioral manifestations of public stigma, including discrimination and social distancing" (Tsai et al., 2019). Collectively, public and enacted stigma turns structural once they are normalized in culture, laws, and institutional policies. The public stigma further links to opioid-related health outcomes via people's anticipation or internalization of such stigma attached to their illness. As such, studying public and enacted stigma provides critical insights into the holistic process of how stigma hinders the response to the opioid crisis. Particularly, we attend to (a) general stigma towards people with OUD driven by stereotypes as public stigma, and (b) social distancing or people's unwillingness to interact with people with OUD as enacted stigma (Link et al., 2004).

Unlike previous studies that combine such measures into one composite score (Adams et al., 2021; Kennedy-Hendricks et al., 2017), we study each stigma typology separately in this paper. By nature, such measures are highly correlated to each other. Thus, from a measurement perspective, aggregating these measures generates a more consistent and stable score. However, we argue that the potential variation among different stigma measures essentially reflects the built-in multidimensionality and contextual contingency of stigma. These variations shed light on how stigma, as a social construct, is shaped by multilevel factors, ranging from individual history to social structural forces, based on the social-ecological framework. More importantly, distinctions among different stigma measures

highlight the various contexts (e.g., workplace or family) under which people with OUD may experience different stigma, and such varying contexts may reflect experiences of different subpopulations (e.g., current or past OUD) as well. As such, studying different stigma measures also provides insights for policymakers in terms of how and where the interventions should be implemented. Some respondents may reject moralized views of OUD but still consider living with someone suffering from OUD as dangerous. Yet these same respondents may regard people with OUD as less trustworthy, or as less productive in the workplace.

2.3.   Stigma and spatial access to MOUD

The US Food and Drug Administration approved a few medications that can reduce opioid overdose deaths, including buprenorphine, methadone, and extended-release naltrexone (Mattick et al., 2004; Lee et al., 2016; Kelty and Hulse, 2017). These medications are not interchangeable: they are different in terms of pharmacology, delivery, as well as patient preference (Leshner and Mancher, 2019; Huhn et al., 2017; Randall-Kosich et al., 2020; Muthulingam et al., 2019). Specifically, Buprenorphine is a partial opioid agonist available within primary care settings (Leshner and Mancher, 2019; McCarty et al., 2018). Methadone is a full opioid agonist but can only be provided at federally certified opioid treatment programs (Leshner and Mancher, 2019; McCarty et al., 2018). Extended-release naltrexone is an opioid antagonist and is typically dispensed by a pharmacy and requires administration by a healthcare professional (Leshner and Mancher, 2019; McCarty et al., 2018). Thus, because of the diversity of settings and effects and in order to maximize retention, all three medications should be made available across diverse contexts (Leshner and Mancher, 2019).

As described in previous sections, many existing studies have highlighted stigma as a barrier to accessing these medications. Few of these studies have examined how spatial access to MOUD may be associated with local people's stigma as well. The social-ecological model highlights stigma as a social construct closely related to people's experience spanning across multiple levels, where spatial access to MOUD can play an important role at the structural level. For example, better access to MOUD in one's neighborhood, such as the presence of more clinics that provide these medications, may improve potential exposure to the medications, and thus, help improve one's awareness of the medications and normalize the medications and treatments in local culture. Lack of exposure, on the contrary, will prevent people from learning more about the medications and reinforce stigma. Better access to MOUD could also help destigmatize by providing better treatment for people with OUD and thus reducing overdose rates. However, it is also possible that more presence of MOUD contributes to stronger stigma towards OUD if residents hold a perspective that already criminalizes any opioid use. The potential impact of spatial access to MOUD on stigma could have substantial policy implications by providing insights on how to destigmatize MOUD as well as people with OUD.

3.   Methods

In this study, we used both individual-level survey data and community-level measures for spatial access to MOUD. Individual and community-level data were linked through

respondents' residential addresses. We chose the ZIP Code Tabulation Areas (ZCTAs) as our spatial scale to estimate spatial access to MOUD at a granular level. In total, we had 3008 respondents from 1832 ZCTAs in 48 states.

3.1. Data

3.1.1. Survey—A cross-sectional sample of participants was drawn from AmeriSpeak®, an on-going probability-based panel of 35,900 households designed to be representative of the U.S. household population (excluding those not found in households such as individuals currently incarcerated, institutionalized, and homeless). Randomly selected U.S. households are sampled using area probability and address-based sampling, with a known, nonzero probability of selection from an established national sample frame. These sampled households are then contacted by U.S. mail, telephone, and field interviewers (face-to-face) to capture harder-to-reach cases. The panel provides sample coverage of 97% of the U.S. household population (Dennis, 2019). AmeriSpeak panel's weighted household recruitment rate, which includes a second stage of recruitment for initial non-responders to capture harder-to-reach populations, is 37%, one of the highest for comparable national probability-based household panels (Bilgen et al., 2018; Montgomery et al., 2016). Created in 2014 by NORC at the University of Chicago, AmeriSpeak members take surveys on various topics of varying sensitivity levels such as current events, health outcomes, crime and justice issues, government programs, media usage, and political and social issues. By using a pre-screened, nationally representative pool of participants, AmeriSpeak provides researchers each month with the infrastructure for rapid data collection.

The analysis in this paper is based on 3008 respondents (weighted N = 3017.8), a sample aggregated from three nationally representative AmeriSpeak surveys on stigma towards people with OUD conducted in February, April, and June in 2020. We also weighted our data to national census benchmarks, taking into account selection probabilities (balanced by sex, age, education, race/ethnicity, and region) and non-responses (Dennis, 2019). A recent study shows that the AmeriSpeak sample only has very minor differences (under 1.5%) compared to the U. S. Census American Community Survey in terms of demographic and socioeconomic compositions (Bilgen et al., 2018; Montgomery et al., 2016; Adams et al., 2021).

3.1.2. Medication for opioid use disorder providers—To estimate publicly available medication for opioid use providers, we extracted providers specifying methadone, extended-release naltrexone maintenance medication, or DATA 2000 waiver buprenorphine providers from Substance Abuse and Mental Health Services Administration (SAMHSA) Behavioral Health Treatment Service Locator (derived from the 2019 National Survey of Substance Abuse Treatment Service) (SAMHSA, 2020). We complemented the SAMHSA dataset by retrieving location data on all clinicians registered with pharmaceutical manufacturers as providing extended-release naltrexone from the "Find a treatment provider" website by Alkermes (2020) on August 29, 2020, as provided by a previous study (Joudrey et al., 2022). In total, we retrieved 51,191 buprenorphine providers, 1442 methadone providers, and 9103 naltrexone providers. Acknowledging the well-known limitation of SAMHSA data as not being inclusive and thus inaccurate (Cushing and

Erfanian, 2021), it remains the only comprehensive, publicly available data source for MOUD nationwide.

3.2.   Measures

3.2.1.   Stigma towards people with OUD—Based on the work of Kennedy-Hendricks et al. (2017), and Yang et al. (2019), respondents in each survey were asked to rate to what extent they agree or disagree with a series of statements that measure their stigma towards OUD, including general stigma towards people with OUD driven by stereotypes and social distancing measures. Specifically, for the general stigma, we considered perceived dangerousness and untrustworthiness of people with OUD. For the social distancing measures, we considered people's unwillingness to interact with people with OUD in different scenarios, such as potential differences related to relational proximity (i.e., differences between co-workers and family members) and history of opioid use (i.e., differences between current versus past OUD). We listed all the survey questions in Table 1, where the first four are social distancing measures (as enacted stigma) and the last two are measures for general stigma driven by perceived dangerousness and untrustworthiness (as public stigma). All the measures were coded in a way that higher values represent a higher level of stigma. We also created a composite score using the average of all six stigma measures in Table 1, which was previously assessed to have acceptable reliability (Cronbach's alpha = 0.7) (Adams et al., 2021). All these stigma measures then served as outcome variables in our study.

Although the outcome variables were measured in Likert-scale questions, both bipolar and unipolar response scales were used in surveys, meaning some respondents received the unipolar version while others received the bipolar version. Specifically, bipolar responses included scales: strongly disagree, somewhat disagree, neither disagree nor agree, somewhat agree, and strongly agree, while unipolar responses included scales: do not agree at all, slightly agree, somewhat agree, strongly agree, and completely agree. We standardized the scale item for those receiving the bipolar version using Z transformations and then converted them to the scale that is consistent with the unipolar version. As such, we generated a continuous standardized score for our outcome measures with a scale from 1 to 5, with 5 indicating the highest level of stigma.

3.2.2.   Personal experience, family and friends' experience with OUD, and demographic variables—To capture respondents' personal histories of opioid use, we asked: "Have you ever used opioids/prescription pain medication illicitly obtained or used in a way not prescribed by a doctor?" Respondents were also asked if they had any family members or close friends who had used opioids in their lifetime (see Appendix B for specific survey questions). We generated two binary variables based on respondents' answers to these two questions, with 1 indicating yes and 0 indicating no. We also included individual-level demographic variables in the analysis, specifically the respondent's age, biological sex, race and ethnicity, as well as educational level. Age was measured as a continuous variable; sex, race and ethnicity, and educational level were measured as a few binary variables. For sex, we used one binary variable, with 1 indicating male and 0 indicating female. For race and ethnicity, we had four binary variables: White, Asian, Black,

others, with Hispanic individuals as the reference group. For the educational level, we had three binary variables: high school graduate or equivalent, some college, and bachelor or above, with no high school diploma as the reference group.

3.2.3.   Spatial access to MOUD resources—We measured potential spatial access across Zip Code Tabulation Areas (United States Census Bureau, 2019a) to MOUD in two ways, separated by type of medication (i.e., Methadone, Buprenorphine, and Naltrexone): a) drive time in minutes along the street network from the population-weighted centroid to the nearest provider, and b) count of providers within 30 minutes' drive time from the ZCTA population-weighted centroid. We included these two measures as they capture different dimensions of spatial accessibility (Talen and Anselin, 1998). The drive time to the nearest provider focuses on the spatial accessibility of MOUD for individuals with OUD. The count of providers within a certain range, on the other hand, highlights the quantity along with spatial access, and it serves as a proxy measure of potential exposure to MOUD for all residents, including those without OUD.

To calculate these access metrics nationally, we generated an origin-destination matrix of travel times along the street network using Open Source Routing Machine (OSRM) for all ZCTAs in the continental US to ZCTAs within 100 km ("Open Source Routing Machine," 2021). Travel distances were computed between population-weighted ZCTA centroids. We employed the *spatial_access* Python package (GeoDa Center, 2021) to calculate all these access measures using our travel time matrix input. For origin ZCTAs that also contain the provider destination, the drive time was estimated as zero. Since the survey respondents were asked to provide their residential addresses' ZCTA information, we were able to link spatial access measures to each survey respondent.

3.2.4.   Other covariates—Because places with more population or larger neighborhoods may have better MOUD resources, we statistically adjusted the total population and area of the ZCTA by including them as covariates in our linear regression models. We pulled the total population data from the American Community Survey (ACS) 2019 5-year estimates (United States Census Bureau, 2019b) and the area was calculated (in square kilometers) using the *sf* package in R (Pebesma, 2018) based on the ACS 2019 cartographic boundary file by ZCTAs (United States Census Bureau, 2019a).

3.3.   Analysis

We started with descriptive analyses and compared different measures of stigma through one-way repeated measure ANOVA, paired sample *t*-test, and correlation analyses. For robustness check, we also reported results using the Friedman test, Wilcoxon signed-rank tests, and both Pearson and Spearman correlation analyses. We employed linear regression models with sampling weighting and robust standard errors to study how individual demographic background, personal experience with OUD, family and friends' experience with OUD, and spatial access to MOUD are associated with different measures of stigma towards people with OUD (see Equation (1)). Considering the collinearity between all the spatial access measures, we examined each spatial access measure separately. We used pairwise deletion to handle missing data. All statistical tests were 2-sided with a

significance level of p 0.05. We used Bonferroni correction for multiple comparisons between different stigma measures and correlation analyses of stigma and spatial access measures. In regression analyses, we reported the results of all pre-planned comparisons with p-values and standard errors. All statistical analyses were performed using the R software environment (version 4.0.2) and STATA (version 15.1).

$$Stigma_i = \beta_0 + \beta_1 Demographic_i + \beta_2 Personal\ use\ of\ opioid_i + \beta_3 Family\ or\ friends'\ use\ of\ opioid_i + \beta_4 Spatial\ access\ to\ MOUD_i + \beta_5 Covariates_i + \varepsilon_i \tag{1}$$

4. Results

In Tables 2 and 3, we report summary statistics of all variables in this study. Differences across different stigma measures were both large and statistically significant. (In one-way repeated-measure ANOVA, F [5, 14635] = 997.6, $p < 0.001$; as a robustness check, Friedman chi-square = 3457.4, df = 5, $p < 0.001$). Respondents showed the highest level of stigma when they were asked how willing they were to have someone with *current* OUD *marry* into their family (mean = 3.95, median = 4.00). Respondents showed the lowest level of stigma when they were asked how willing they were to *work* with someone with a *past* history of OUD (mean = 2.63, median = 2.60). With Bonferroni correction, all pairwise differences were statistically significant except the difference between "*Trust*" and "*Dangerous.*"

In Fig. 1, we plotted the average levels of all six stigma measures from the highest to the lowest. First, respondents reported higher stigma level towards people with *current* OUD versus a *past* history of OUD: the "*Current Marry*" stigma variable was significantly higher than the "*History Marry*" stigma variable (0.94, $SE = 0.04$, $p < 0.001$); the "*Current Work*" stigma variable was also significantly higher than the "*History Work*" stigma variable (1.09, $SE = 0.04$, $p < 0.001$). Second, respondents were less willing to have people with OUD *marry* into their family versus *work* with people with OUD: the "*Current Marry*" stigma variable was significantly higher than the "*Current Work*" stigma variable (0.24, $SE = 0.04$, $p < 0.001$); the "*History Marry*" stigma variable is also significantly higher than the "*History Work*" stigma variable (0.39, $SE = 0.04$, $p < 0.001$). As a robustness check, all these comparisons were still statistically significant with $p < 0.001$ using the Wilcoxon signed-rank test.

To further quantify the potential variation among all six stigma measures, we examined the correlation matrix among these measures, using Pearson correlations and Bonferroni correction for multiple comparisons (see Fig. 2). As a robustness check, Spearman rank correlations showed a very similar pattern. Two social distancing measures that focused on people with a *history* of OUD had a strong positive correlation (r = 0.64, $p < 0.001$). Similarly, the two social distancing measures that focused on people with *current* OUD also positively correlated with each other (r = 0.62, $p < 0.001$). Additionally, there was a strong positive correlation between the stigma driven by perceived dangerousness and the one driven by perceived trustworthiness (r = 0.60, $p < 0.001$). However, the correlation plot also highlights substantial variation between certain types of stigma measures. First,

the correlations between the stereotype driven stigma ("*Dangerous*" and "*Trust*") and social distancing stigma measures ("*Current Work*", "*History Work*", "*History Marry*" and "*Current Marry*") were between 0.06 and 0.35, indicating that stereotype-driven stigma and social distancing based stigma captured two different dimensions of the stigma construct. Second, within the four social distancing measures, the correlation between "*Current Marry*" variable and "*History Work*" variable was 0.19, indicating that people's willingness to interact with people with OUD depended on particular contexts or relational proximity (i.e., difference between co-workers and family members and difference between current and past OUD). We also reported summary statistics for spatial access measures in Table 3 and Fig. 2. As shown in Table 3, among all three medications, Methadone had the fewest resources and furthest drive time spatial access (median count = 2; median drive time = 14) while Buprenorphine had the most resources and shortest drive time (median count = 62; median drive time = 0). This is consistent with the national trend reported in other literature (Joudrey et al., 2022). Additionally, as reflected in Fig. 2, the three count spatial measures for different medications were highly correlated with each other (between 0.92 and 0.96), while the count measures and drive time measures were only correlated at moderate levels, ranging from $- 0.18$ to $- 0.37$. In terms of correlations between spatial access measures and stigma measures, the correlations were in general low ($\sim - 0.1$), but the majority of count measures showed statistically significant correlations with stigma at a 0.05 level while none of the drive time measures showed statistically significant correlations.

With these patterns in mind, we now turn to the multivariate regression results. First, the number of providers within 30 minutes' drive time showed a significant association with stigma outcomes, while the drive time to the nearest provider was not associated with stigma outcomes. The count of providers within 30 minutes' drive (i.e., better access) was negatively associated with stigma (see Table 4 for the result of count access measure for Methadone, coefficients were between $- 0.004$ and $- 0.007$, standard errors were between 0.002 and 0.003); more MOUD resources in a neighborhood were associated with lower levels of stigma. This finding is consistent across all types of stigma as well as all three medications. We reported the regression results using the Methadone medication as an example (see Table 4 for the models using count access measure and Table 5 for the models using the drive time access measure). Buprenorphine and Naltrexone showed similar patterns (see Appendix A). In each column of Tables 4 and 5, we presented the result for one stigma outcome. Specifically, the first four columns in Table 4 included the results for social distancing stigma measures, followed by two columns presenting the results for two stereotype-driven stigma, and the last column presenting the result for a composite stigma score (i.e., the average across all stigma measures). Results for non-spatial access predictors were also very similar in Tables 4 and 5

As shown in Tables 4 and 5, older respondents showed higher stigma. Although the coefficient varied from 0.006 to 0.012 across different types of stigma, such positive association was statistically significant in all cases ($p < 0.001$). Male respondents reported slightly lower levels of stigma for "*Current Marry*" ($- 0.131$, $SE = 0.059$) and "*Trust*" ($- 0.178$, $SE = 0.055$). No statistically significant differences were identified between male and female respondents for other types of stigma measures. Additionally, Black/African

American respondents reported weaker stigma in general, especially the stigma driven by perceived dangerousness (– 0.497, *SE* = 0.119).

Unlike age, the associations between education attainment level and stigma showed entirely different results depending on specific type of stigma. People with a bachelor's degree or above reported lower stigma levels for "*History Work*" (– 0.438, *SE* = 0.139), while they also reported higher stigma for "*Current Marry*" (0.441, *SE* = 0.142). In other words, compared to respondents with no high school diploma, respondents with a bachelor's degree or above were less willing to have someone with a *current* OUD *marrying* into their family, although they were more willing to *work* with someone with a *past* history of OUD. When it comes to experience with OUD, the respondent's own experience with OUD was negatively associated with all four social distancing stigma variables: the coefficients slightly varied from – 0.384 to – 0.516 with standard errors around 0.111 to 0.120 for specific stigma.

We found different results when respondents reported lived experiences of a relative or friend's opioid use . If the respondent had some family members or friends who had used opioid, then their stigma towards people with a *history* of OUD tended to be lower, while their stigma towards people with *current* OUD tended to be higher. In particular, a respondent whose family members or friends had used opioid was likely to report a "*History Work*" stigma 0.258 lower than those whose family members or friends didn't have such experience (*SE* = 0.059); similarly, they were also likely to report a "*History Marry*" stigma 0.270 lower than others (*SE* = 0.065). However, they tended to show a stronger "*Current Work*" stigma (0.163, *SE* = 0.062).

5. Discussion

Using the social-ecological model, this study explored how individual, interpersonal, and community level factors were associated with people's stigma towards people with OUD. Our findings highlight that stigma was associated with many factors across different social-ecological levels. In particular, we contributed to the understanding of stigma in two major ways. First, we showed substantial variation among different dimensions of stigma, especially between the stereotype-driven public stigma and the enacted stigma through social distancing measures, highlighting the multidimensionality of the stigma construct. We also found that individuals' education attainment levels and their family or friends' experience of OUD were associated with different types of stigma in substantially different, even opposite ways. This distinct pattern was especially true for social distancing measures (enacted stigma), highlighting the important role of contexts or relational proximity when considering factors underlying such stigma measures. Second, we found that there was a positive association between all types of stigma and spatial access to MOUD when measured as the count of providers within a certain range. Such association has important policy implications for reducing stigma towards OUD and people who need MOUD. Below we discuss our findings from different levels of the social-ecological model, namely individual, interpersonal, and community levels.

Our study showed stigma towards OUD was associated with demographic, racial/ethnic, and educational characteristics of the respondent. Older survey respondents tended to have

stronger stigma, and Black or African American respondents tended to exhibit less stigma. Weaker stigma towards other with OUD could be a potential protective factor in the sense that people with weaker stigma are more likely to treat OUD as a disease and seek medical interventions when needed. However, there are many other barriers to treatments and medications as well that could outweigh this protective factor. Recent studies have shown evidence for disproportionately low treatment initiation and retention among people of color (Andraka-Christou, 2021; Kilaru et al., 2020; Manhapra et al., 2016; O'Connor et al., 2020; Stein et al., 2018). Compared to those who identify as White, additional barriers for racial and ethnic minority groups to accessing and retaining medications include fewer providers accepting Medicaid in their communities, more people experiencing unstable employment and housing, racial discrimination in treatments, among other factors underlying structural disparity (Andraka-Christou, 2021; Mays et al., 2017; Cummings et al., 2014; Knudsen and Roman, 2009; Jones, 2016; Marsh et al., 2009; Stein et al., 2018). Our finding of African American respondents reporting lower levels of stigma suggests that more research is needed to determine the underlying mechanisms driving this process.

Additionally, male respondents reported lower levels of stigma than female respondents for certain types of stigma measures. This is different from previous research which shows that female participants rated lower discrimination towards opioid users than male participants (Wood and Elliott, 2020). One possible explanation for such discrepancy could be that different dimensions of stigma were studied but more research is needed to explore how biological sex intersects with other factors in forming people's experience regarding OUD. Additionally, recent research has provided evidence that male opioid users may experience stronger stigma than female opioid users (Goodyear et al., 2018; Weeks and Stenstrom, 2020). Future research is needed to understand whether and how such an experience may relate to stigma towards other opioid users.

Meanwhile, the association between education and stigma varies for different types of stigma. Since education is often a proxy for socioeconomic status (SES), our results suggest that individuals with higher SES are wary of a potential association of OUD with their families, though they are comfortable working with someone with OUD. Research has shown education attainment level is inversely associated with stigma among *patients* with OUD (Yang et al., 2019); however, how education attainment impacts the general public's stigma towards *other* people with OUD is under-researched. Interestingly, literature on mental health stigma has recorded evidence for a negative association between education and stigma, meaning more educated people show less stigma towards others with mental health issues (Girma et al., 2013; Zieger et al., 2016). Future research is needed to further disentangle the role of educational attainment in shaping stigma, especially towards people with OUD, and moreover, how this mechanism varies for different types of diseases.

We also demonstrated that stigma was associated with multiple factors related to personal or social connections. First, people stigmatized others with *current* OUD more than people in recovery. Survey respondents were also more comfortable *working* with someone with OUD, than they were having such a person *marrying* into their family. This finding lends support for the contextual contingency of stigma, especially those social distancing measures. The conceptualization of stigma by Link and Phelan (2001) is

helpful to understand how the contextual contingency of stigma works. In particular, they described stigma as co-occurrence of interrelated components including the identification of differentness (labelling), the construction of stereotypes, the separation of labeled persons into distinct categories from "us", and the full implementation of exclusion and discrimination in a power dynamic, where the stigmatizer has more access to social, economic and political power (Link and Phelan, 2001). The contextual contingency we identified in this paper implies that the context (such as family versus workplace) where these components of stigma occur could potentially impact the process and consequences of stigma. For example, respondents may view the distinction between the stigmatized (here, people with OUD) and "us" as more critical in a family context versus a workplace. Or people may regard the distinction between "us" and people with current OUD as more substantial versus people with a history of OUD. Such difference during the labelling stage could also directly link to different levels of exclusion and discrimination. It is also possible that different contexts are related to different levels of power differences between the stigmatized and the stigmatizer, shaping different amounts of stigma that people with OUD may experience under certain contexts.

Some other findings in our paper also speak to how interpersonal-level factors may be associated with the labeling process (Link and Phelan, 2001). In most scenarios, if respondents themselves or their family members or friends had used opioids, they tended to show lower stigma towards people with OUD. Potential explanation for such association could be that the direct or indirect experience of opioid use may cultivate understanding and empathy. This is consistent with the literature in mental health, where interpersonal contact with people experiencing mental health issues is used as one major way to reduce the general public's stigma towards mental health via cultivating understanding and empathy (Corrigan et al., 2012). However, our results also showed that if people had family or friends who used opioids, they were likely to report *stronger* stigma with people experiencing *current* OUD. This could be explained as they are concerned that people still in the process of recovery may not succeed doing so based on their family or friends' experience. Individuals with family or friends who have used opioids may have also witnessed or experienced negative consequences of such use. More research is required to understand these associations.

Stigma was associated with community-level spatial access to MOUD. Improved spatial access to MOUD, specifically more providers in the neighborhood, was associated with weaker stigma towards people with OUD even after accounting for population. One possible explanation is that more providers in the neighborhood destigmatize OUD by improving the awareness of the medications and normalizing the treatments, or by helping people with OUD better manage their treatment, better perform in workplace and family roles, and reduce their overdose risk. Meanwhile, areas with lower OUD stigma may be more accepting of MOUD facilities, thereby improving treatment access. However, it is also possible that the association we identified reflects a mismatch between the need and supply of OUD – places with very few people experiencing OUD may have many providers of medications. Another alternative explanation is higher prevalence of OUD triggers stronger stigma, which further leads to zoning restrictions on clinics providing MOUD. Our study has shed light on the significant association between stigma towards OUD and spatial access

to MOUD. Future research should further refine spatial access metrics (as we discuss more below), investigate with more detailed longitudinal measures if this is a causal relationship, and examine the causal mechanisms linking spatial access to MOUD, stigma towards OUD, and opioid-related health outcomes.

Importantly, spatial access to MOUD provides a proxy measure for structural stigma. The association we identified between individual's stigma and structural stigma provides statistical evidence for the interplay between different stigma types and how they reinforce each other: once structural, stigma could be internalized and anticipated by individuals, which in turn, further strengthens the structural stigma (Tsai et al., 2019). Additionally, spatial access to MOUD is also a measure of stigma at the policy or healthcare system level for which interventions could be implemented. If future research confirms the causal effect of more medication providers on reducing stigma, then expanding access to MOUD will reduce opioid risk (overdose and downstream infections) in both indirect and direct ways. Indirectly, improved geographic access to MOUD reduces stigma and thus removes barriers to seeking treatment. Directly, improved access provides effective treatment for OUD.

Finally, our study showed that individual characteristics, social experience, and spatial access to MOUD were all associated with stigma towards OUD. Many of these factors could be tied to social identities, positions, and structural contexts that directly link to the underlying power structures. Recent literature has seen intersectionality (Crenshaw, 1989) as a promising approach to understand how multifaceted power structure (re)produce inequity in health outcomes (Agénor, 2020; Bauer, 2014; Hankivsky et al., 2017; Kapilashrami and Hankivsky, 2018; Larson et al., 2016). Thus, future research could apply the intersectionality framework to further examine how these different factors across social-ecological levels intersect to generate and reinforce inequity in opioid-related outcomes by impacting stigma towards OUD.

6. Limitation and future research

Our findings are subject to limitations. First, this is a cross-sectional study and thus associations should be interpreted with caution, and we cannot infer any causal inferences. Future studies should consider longitudinal or other quasi-experimental designs to identify causal effects, especially those between spatial access to MOUD, stigma towards OUD, and opioid-related health outcomes. Second, we used two different metrics to capture different dimensions of spatial access to MOUD in this paper: count of providers within 30 minutes' drive and drive time to the nearest provider. These measures are subject to a few limitations and need refinement in future research. Our measures do not account for the capacity of the treatment location, and the 30 minutes threshold could be adjusted for specific medication and urbanity as it may underestimate the transportation barriers in some places. Also, because drive time was estimated as zero if ZCTA contains a provider, we likely underestimate drive time for urban areas. Additionally, we used ZCTA in this analysis as they are the most granular spatial level available for our study. However, we acknowledge that ZCTA is not very effective in capturing social, cultural, or political boundaries and thus, may relate to ecological fallacy (Openshaw, 1984). Third, the survey only samples adults (18 years and older) and those who live in households. Individuals not found in households are

excluded from the sample, such as those currently incarcerated, institutionalized, homeless, and those in military quarters or college dormitories. Additionally, though the stigma measures used in this paper drew on existing literature and extensive consultation with an expert panel, future methodological research is needed to fully evaluate the psychometric properties of such measures, especially for measures focusing on one specific type of stigma. Fourth, the measure of biological sex we included is based on respondents' original birth certificate and may not accurately capture the social identity of gender. Future analyses should consider how gender intersects with other factors in shaping unique individual experiences regarding stigma towards OUD. Finally, our study looks at how individual-level factors may be associated with the labeling process in shaping stigma. Another critical factor could be the social identity (i.e., age, race and ethnicity, gender) of the individual with OUD, the person who experiences stigma. For example, people may have stronger stigma towards opioid users from a particular racial or ethnic background. Future studies should explore how such identities play a role in people's conceptualization of people with OUD. Such analysis would be beneficial as it further highlights groups who are marginalized and experience inequity in the opioid epidemic.

7. Conclusion

Through the social-ecological framework, we contribute new information about how people's stigma towards OUD is associated with various factors at different social-ecological levels. Demographic, racial/ethnic, educational characteristics at the individual level, personal and social experience related to OUD at the interpersonal level, and spatial access to MOUD at the community level are all associated with respondents' stigma. Importantly, some of these associations vary substantially for different types of stigma, highlighting heterogeneous processes in terms of how different factors are associated with various types of stigma in different contexts. This is also the first study we are aware of that connects spatial access to MOUD and stigma towards OUD. Collectively, these associations deepen our understanding of opioid-related stigma that directly relates to overdose and other downstream infections, suggesting the importance of further studies that examine power and social-context structures underlying individuals' stigma towards OUD, and potential policy interventions that combine efforts on both public education and expanding access to MOUD to lessen OUD stigma.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgement

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Fig. 1.

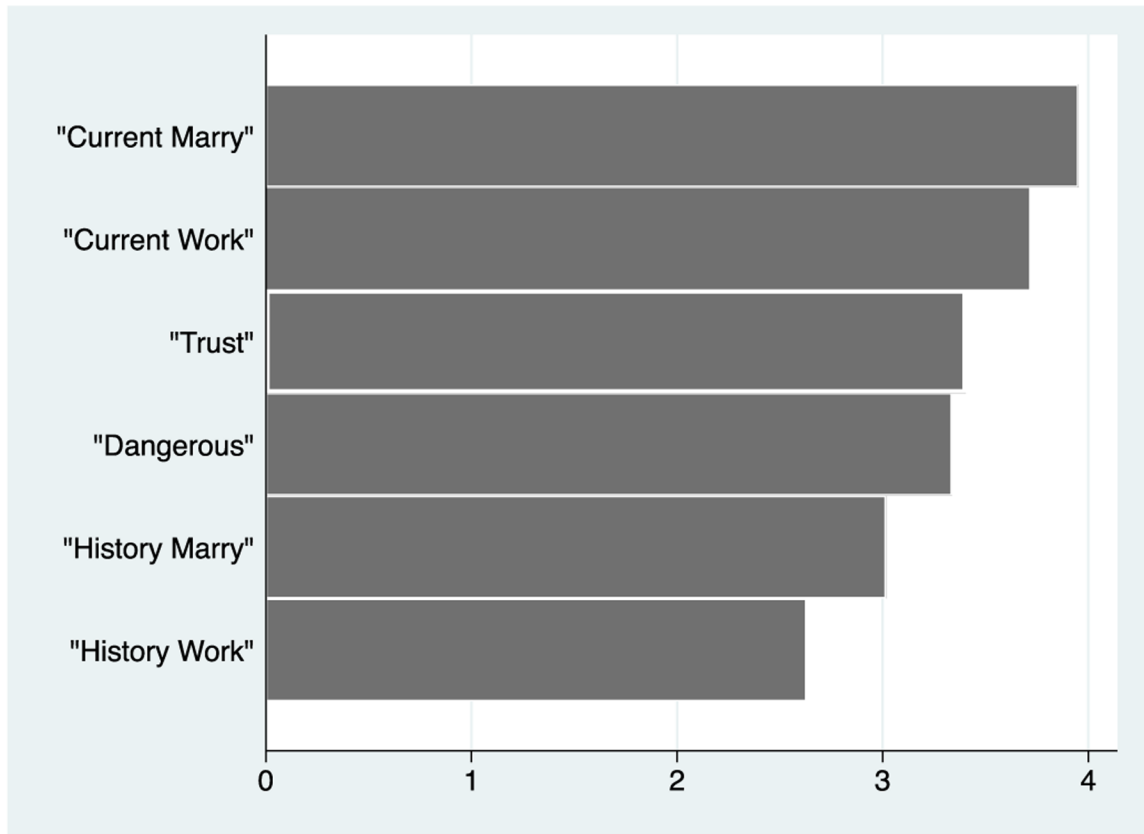Average Levels of Different Stigma Measures

Note. We report the average level of each stigma measure based on weighted data.
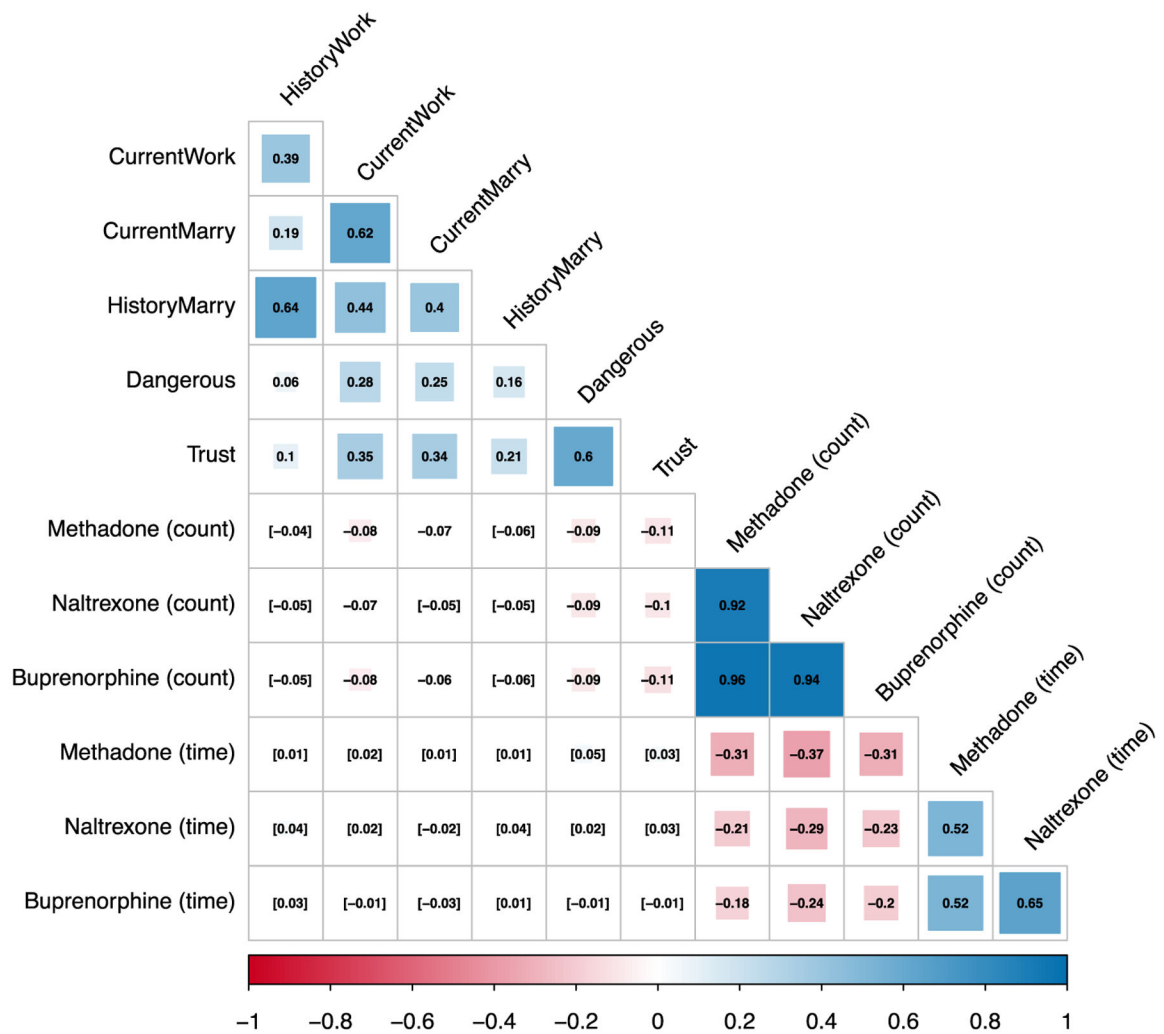
Fig. 2.
Correlation Matrix for Stigma Measures and Spatial Access Measures
Note. We report Pearson correlations based on weighted data. Coefficients are within brackets if not statistically significant at 0.05 level, with Bonferroni correction for multiple comparisons.

Table 1

Survey instruments to measure stigma towards people with OUD.

	Do you disagree or agree with the following statement?	Variable
Social distancing measures	I would be willing to have a person with a past history of opioid use disorder start working closely with me on a job.	History Work
	I would be willing to have a person with a current opioid use disorder start working closely with me on a job.	Current Work
	I would be comfortable having a person with a current opioid use disorder marry into my family.	Current Marry
	I am comfortable having a person with a past history of opioid use disorder marry into my family.	History Marry
General stigma driven by stereotypes	People with a current opioid use disorder are more dangerous than the general population.	Dangerous
	A person who currently has an opioid use disorder cannot be trusted.	Trust

Table 2

Summary statistics of stigma outcome variables in this study.

Variable	N (weighted N)	Mean	Median (IQR)
I would be comfortable having a person with a current opioid use disorder marry into my family. (CurrentMarry)	2966 (2968.0)	3.95	4.00 (3.00, 5.00)
I would be willing to have a person with a current opioid use disorder start working closely with me on a job. (CurrentWork)	2971 (2981.7)	3.72	4.00 (3.00, 5.00)
A person who currently has an opioid use disorder cannot be trusted. (Trust)	2959 (2965.8)	3.40	3.00 (3.00, 4.00)
People with a current opioid use disorder are more dangerous than the general population. (Dangerous)	2954 (2955.2)	3.34	3.00 (2.81, 4.00)
I am comfortable having a person with a past history of opioid use disorder marry into my family. (HistoryMarry)	2976 (2983.8)	3.02	3.00 (2.00, 4.00)
I would be willing to have a person with a past history of opioid use disorder start working closely with me on a job. (HistoryWork)	2969 (2980.1)	2.63	2.60 (2.00, 3.00)

Note. Mean and Median (IQR) are based on weighted data.

Table 3

Summary statistics of predictors in this study (weighted).

Variable	N (weighted N)	Median (IQR); n (%)
Age	3003 (3012.1)	47.00 (32.00, 62.00)
Sex	3008 (3017.8)	
Male		1462.3 (48.5%)
Female		1555.5 (51.5%)
Race and ethnicity	3008 (3017.8)	
Asian, non-Hispanic		120 (4%)
Black, non-Hispanic		361.5 (12%)
Hispanic		492.8 (16%)
Other, non-Hispanic		137 (5%)
White, non-Hispanic		1906.5 (63%)
Education	3008 (3017.8)	
BA or above		1020.9 (34%)
HS graduate or equivalent		855.8 (28%)
No HS diploma		300.4 (10%)
Some college		840.7 (28%)
Family Friend Use OUD (Yes = 1)	2773 (2742.4)	987.2 (36%)
Personal Use OUD (Yes = 1)	2983 (2991.7)	299 (10%)
Spatial access to Naltrexone provider (count)	3008 (3017.8)	12 (3, 33)
Spatial access to Methadone provider (count)	3008 (3017.8)	2 (0, 5)
Spatial access to Buprenorphine provider (count)	3008 (3017.8)	62 (17, 203)
Spatial access to Naltrexone provider (drive time)	3006 (3015.6)	6 (0, 15)
Spatial access to Methadone provider (drive time)	2890 (2931.6)	14 (7, 29)
Spatial access to Buprenorphine provider (drive time)	3008 (3017.8)	0 (0, 6)
Area (km^2)	3008 (3017.8)	79.5 (23.5, 210.2)
Total Population	3008 (3017.8)	27,875 (14,332, 40820)

Note. Median (IQR) and n (%) are based on weighted data.

Table 4

Multiple linear regression models predicting stigma towards people with OUD (spatial access measured as the number of Methadone providers within 30 minutes' drive time).

Variables	HistoryWork	CurrentWork	CurrentMarry	HistoryMarry	Dangerous	Trust	Composite
Age	0.006**	0.007***	0.010***	0.011***	0.011***	0.012***	0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Sex (Male = 1)	0.035	-0.064	-0.131*	0.080	0.062	-0.178**	-0.031
	(0.059)	(0.060)	(0.059)	(0.062)	(0.056)	(0.055)	(0.040)
White	-0.209*	0.078	0.200	-0.098	-0.078	0.011	-0.018
	(0.095)	(0.101)	(0.104)	(0.104)	(0.092)	(0.097)	(0.068)
Black	0.095	-0.280*	-0.291*	-0.030	-0.497***	-0.272*	-0.206*
	(0.122)	(0.126)	(0.136)	(0.132)	(0.119)	(0.121)	(0.087)
Asian	0.225	0.033	0.204	0.410*	-0.408*	-0.235	0.047
	(0.182)	(0.232)	(0.186)	(0.178)	(0.177)	(0.178)	(0.149)
Other non-Hispanic	-0.103	0.089	0.270*	-0.119	-0.185	-0.230	-0.064
	(0.158)	(0.157)	(0.137)	(0.157)	(0.135)	(0.137)	(0.096)
Family Friends Use of Opioid	-0.258***	0.163**	0.116	-0.270***	0.015	0.138*	-0.022
	(0.059)	(0.062)	(0.065)	(0.065)	(0.058)	(0.059)	(0.042)
Personal Use of Opioid	-0.384***	-0.412***	-0.466***	-0.516***	-0.062	-0.038	-0.302***
	(0.115)	(0.120)	(0.119)	(0.111)	(0.099)	(0.094)	(0.076)
HS graduate or equivalent	-0.032	-0.015	0.195	-0.003	0.138	0.246	0.124
	(0.146)	(0.151)	(0.153)	(0.150)	(0.133)	(0.134)	(0.103)
Some college	-0.149	0.139	0.369**	-0.175	0.163	0.173	0.124
	(0.141)	(0.143)	(0.141)	(0.144)	(0.124)	(0.127)	(0.099)
BA or above	-0.438**	0.109	0.441**	-0.252	0.176	0.148	0.067
	(0.139)	(0.144)	(0.142)	(0.142)	(0.123)	(0.126)	(0.098)
Methadone (count)	-0.007*	-0.004	-0.004	-0.006*	-0.005*	-0.007**	-0.005*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Area (km²)	3.55e-05	2.20e-05	2.60e-06	6.14e-06	0.0001	1.65e-05	3.70e-05

Variables	HistoryWork	CurrentWork	CurrentMarry	HistoryMarry	Dangerous	Trust	Composite
	(8.16e–05)	(0.0001)	(9.86e–05)	(9.76e–05)	(8.05e–05)	(8.34e–05)	(5.83e–05)
Total population	3.85e–08	–3.82e–07	8.28e–07	–4.97e–07	–2.30e–07	–2.37e–08	1.26e–07
	(1.46e–06)	(1.63e–06)	(1.55e–06)	(1.57e–06)	(1.44e–06)	(1.42e–06)	(1.10e–06)
Constant	2.817***	3.356***	3.141***	2.834***	2.802***	2.808***	2.931***
	(0.181)	(0.196)	(0.183)	(0.190)	(0.151)	(0.155)	(0.127)
Observations	2733	2735	2731	2739	2720	2725	2698
R-squared	0.069	0.047	0.099	0.077	0.071	0.079	0.087

Robust standard errors in parentheses.

***
$p < 0.001$,

**
$p < 0.01$,

*
$p < 0.05$.

Table 5

Multiple linear regression models predicting stigma towards people with OUD (spatial access measured as drive time to the nearest Methadone provider).

Variables	HistoryWork	CurrentWork	CurrentMarry	HistoryMarry	Dangerous	Trust	Composite
Age	0.006**	0.007***	0.010***	0.011***	0.011***	0.012***	0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Sex (Male = 1)	0.037	−0.061	−0.127*	0.085	0.051	−0.189***	−0.031
	(0.060)	(0.062)	(0.061)	(0.063)	(0.057)	(0.057)	(0.041)
White	−0.170	0.079	0.190	−0.064	−0.074	0.036	−0.002
	(0.096)	(0.102)	(0.105)	(0.105)	(0.092)	(0.097)	(0.067)
Black	0.104	−0.302*	−0.322*	−0.028	−0.516***	−0.277*	−0.217*
	(0.127)	(0.128)	(0.139)	(0.137)	(0.123)	(0.125)	(0.091)
Asian	0.231	0.011	0.174	0.412*	−0.394*	−0.233	0.042
	(0.187)	(0.237)	(0.191)	(0.183)	(0.180)	(0.180)	(0.154)
Other non-Hispanic	−0.096	0.053	0.216	−0.091	−0.218	−0.255	−0.084
	(0.159)	(0.158)	(0.140)	(0.157)	(0.134)	(0.145)	(0.093)
Family Friends Use of Opioid	−0.256***	0.155*	0.116	−0.259***	0.014	0.143*	−0.020
	(0.060)	(0.064)	(0.067)	(0.067)	(0.059)	(0.060)	(0.043)
Personal Use of Opioid	−0.389***	−0.410***	−0.474***	−0.525***	−0.062	−0.032	−0.303***
	(0.117)	(0.123)	(0.122)	(0.112)	(0.102)	(0.096)	(0.077)
HS graduate or equivalent	−0.040	−0.009	0.182	−0.009	0.154	0.250	0.126
	(0.150)	(0.155)	(0.156)	(0.155)	(0.137)	(0.138)	(0.106)
Some college	−0.157	0.159	0.382**	−0.181	0.194	0.203	0.138
	(0.145)	(0.146)	(0.144)	(0.147)	(0.128)	(0.131)	(0.101)
BA or above	−0.450**	0.124	0.442**	−0.262	0.199	0.157	0.073
	(0.143)	(0.147)	(0.146)	(0.146)	(0.127)	(0.131)	(0.102)
Methadone (drive time)	−0.000	−0.002	−0.002	−0.001	−0.001	−0.001	−0.001
	(0.002)	(0.002)	(0.002)	(0.0018)	(0.001)	(0.002)	(0.001)
Area (km²)	7.77e−05	8.66e−05	5.82e−05	6.83e−05	0.0002*	7.64e−05	0.0001
	(9.67e−05)	(0.0001)	(0.0001)	(0.0001)	(9.89e−05)	(0.0001)	(7.52e−05)
Total population	−9.93e−07	−1.75e−06	−6.62e−07	−1.74e−06	−1.20e−06	−1.26e−06	−1.17e−06

Variables	HistoryWork	CurrentWork	CurrentMarry	HistoryMarry	Dangerous	Trust	Composite
	(1.62e−06)	(1.71e−06)	(1.76e−06)	(1.77e−06)	(1.62e−06)	(1.64e−06)	(1.30e−06)
Constant	2.782 ***	3.380 ***	3.197 ***	2.829 ***	2.765 ***	2.767 ***	2.930 ***
	(0.186)	(0.191)	(0.193)	(0.199)	(0.166)	(0.172)	(0.131)
Observations	2619	2621	2617	2625	2607	2613	2586
R-squared	0.066	0.046	0.096	0.073	0.069	0.076	0.081

Robust standard errors in parentheses.

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p < 0.001,

**
p < 0.01,

*
p < 0.05.