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A scoping review of social determinants of health's impact on substance use disorders over the life course

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Abstract

Background: Substance use is a public crisis in the U.S. Substance use can be understood as a series of events in the life course, from initiation to mortality. Social Determinants of Health (SDoH) have increasingly been recognized as essential contributors to individuals' health. This scoping review aims to examine available evidence of SDoH impact on the life course of substance use disorder (SUD).

Methods: This study identified peer-reviewed articles that reported longitudinal studies with SDoH factors as independent variables and substance use and disorders as dependent variables from PubMed, Embase, and Web of Science. The reported associations between SDoH and substance use stages over the life course were narratively and graphically summarized.

Results: Among the 50 studies identified, ten revealed parental monitoring/support and early childhood education as protective factors, while negative peer influences and neighborhood instability were risk factors of substance use initiation. Nineteen articles reported factors associated with escalation in substance use, including unemployment, neighborhood vulnerability, negative peer influence, violence/trauma, and criminal justice system (CJS) involvement. Ten articles suggested that employment, social support, urban living, and low-barrier medication

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Declaration of competing interest

All authors declare no conflict of interest.

CRedit authorship contribution statement

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.josat.2024.209484>.

treatment facilitated treatment participation, while stigma and CJS involvement had negative impact on treatment trajectory. Social support and employment could foster progress in recovery and CJS involvement and unstable housing deterred recovery. Four studies suggested that unemployment, unstable housing, CJS involvement, and lack of social support were associated with overdose and mortality.

Conclusions: This review underscores the influence of social networks and early life experiences on the life course of SUD. Future SDoH research should investigate overdose and mortality and the impact of broader upstream SDoH on SUD. Interventions addressing these social factors are needed to mitigate their detrimental effects on the trajectories of SUD over the life course.

Keywords

Social Determinants of Health; Substance use disorder; Life course; Health disparity; United States

1. Introduction

The substance use epidemic in the United States has evolved into a major public health crisis over the past few decades. The opioid epidemic, in particular, has been at the forefront of national attention. There were 40.3 million people aged 12 or older (representing 16.5 % of the population) who had a substance use disorder (SUD) in 2020, among whom 94 % did not receive any treatment (Substance Abuse and Mental Health Services Administration [SAMHSA], 2021). The COVID-19 pandemic has exacerbated the overdose crisis. In 2021, deaths from synthetic opioids, heroin, and prescription opioids reached 80,000, a tenfold increase since 1999, while stimulant-related fatalities, mainly from cocaine and methamphetamine, surged to 32,537 (Hedegaard et al., 2021; National Institute on Drug Abuse, 2021).

The longitudinal patterns of SUD can be rather complicated, dynamic, and heterogeneous (Hser et al., 2007). The Drug Treatment Career Framework (Hser et al., 1997, 2007) offers a broadened framework for delineating and examining critical stages that occur during an individual's span of SUD, including initiation of substance use, escalation into frequent or high-risk use leading to SUD diagnosis, receiving treatment to mitigate progression of SUD, recurring cycles of cessation of use and relapse, overdose, and mortality. The framework underscores the connection between individuals' stages in SUD and the structural, cultural, and socioeconomic context in which these individuals lived (Elder & Giele, 2009), which is nowadays termed as social determinants of health (SDoH). SDoH are defined as "*conditions in the environments where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks*" (U.S. Department of Health and Human Services, 2020). The Kaiser Family Foundation (KFF) SDoH framework categorizes social risks into six domains: economic stability, neighborhood and physical environment, education, food insecurity, social context and community, and the healthcare, and each domain encompasses a detailed compilation of specific social factors (Artiga, 2018; KFF, 2021). This comprehensive framework was used

to guide the investigation of the impact of SDoH on various health conditions and disparities (Hagan et al., 2023; Wray et al., 2022).

Existing reviews on the impact of SDoH on substance use have typically focused on a single domain of SDoH, a particular substance use outcome, or a specific population (Alhammad et al., 2022; Faller et al., 2023; Shahram, 2016; Galea & Vlahov, 2002; Jackson et al., 2022). Additionally, a scoping review by Leza and colleagues revealed that adverse childhood experiences, such as violence, abuse, neglect, separation, and substance use/mental illness of family members, were positively associated with SUD in adolescents and adulthood (Leza et al., 2021). Given the profound implication of SDoH on health and the widened disparities that resulted from the COVID-19 pandemic, it is imperative to enhance understanding of ways in which SDoH intersect with SUD with rigorously designed longitudinal studies. This scoping review seeks to synthesize available evidence of SDoH's impacts on stages in the life course of SUD. The Drug Treatment Career Framework and the KFF SDoH Framework (Artiga, 2018; KFF, 2021) were selected as our guiding frameworks due to their comprehensive scope, detailed granularity, interconnectedness, and widespread recognition and application in public health research (Fig. 1). Longitudinal quantitative studies were emphasized due to their ability to track changes over time and provide a more comprehensive understanding of the long-term trajectory of substance use patterns and outcomes in relation to SDoH. The review focused on the U.S. because SDoH vary significantly across countries, shaped by different socioeconomic structures, healthcare systems, and cultural and political contexts. Additionally, the substance use epidemic in the U.S. has distinct patterns and influencing factors. We concentrated on substances such as opioids and stimulants that are currently the primary substance use types driving overdose in the U.S. This review should inform future directions for SDoH research and actionable insights for policymakers and practitioners to reduce the negative outcomes and disparities in the realm of SUD in the U.S.

2. Methods

2.1. Search strategy

The process of literature search, screening, selection, coding, and reporting was guided by Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al., 2021). The study team conducted comprehensive searches on PubMed, Embase, and Web of Science, using four major concepts in the search, including:

1. SUD (substance use, abuse, dependence, addiction, and specific types of substance of interest, such as opioids, stimulants, methamphetamine, etc.).
2. Stages of SUD, including initiation (e.g., first-time substance use, onset of substance use), escalation (i.e., change in substance use frequency, amount, type, transition to injection drug use, SUD diagnosis), treatment (including utilization, prescription, uptake, and retention in pharmacotherapy, behavioral treatment, and harm reduction), recovery (including remission, time to cessation, period of abstinence, time to relapse), overdose and mortality (including fatal- and non-fatal overdose, intoxication, and death).

3. SDoH, including general SDoH-related terms (e.g., social determinants, socioeconomic status, disparity) as well as specific factors under each domain of KFF SDoH framework (Artiga, 2018; KFF, 2021). For example, “Economic stability” domain includes employment, income, expense, and bill; “Neighborhood and physical environment” domain covers housing, transportation, safety, and geography; “Education” domain includes literacy, language, early childhood education, vocational training, higher education; “Food” domain consists of hunger and access to healthy options (this domain was later combined with “Economic stability” domain due to limited articles being identified); “Social context and community” domain encompasses social integration and support, community engagement, exposure to violence/trauma/discrimination/stress, criminal justice system (CJS), and policy; and “Healthcare” domain includes health coverage, access to care, provider availability, provider linguistic and cultural competency, and quality of care.
4. Study design (e.g., longitudinal study, repeated measures, follow-up).

With consultation with a health sciences librarian, our search used a combination of specific keywords and indexing terms (e.g., MeSH terms for PubMed, Emtree for Embase), with additional hand searches conducted on Google Scholar. The search was limited to the past 20 years (2003–2023), with the search ending on July 17, 2023. Identified records were imported into Mendeley Reference Manager (Mendeley Ltd., Elsevier) to identify and remove duplicates.

2.2. Screening criteria

A total of 1214 unique records were imported into Rayyan (Ouzzani et al., 2016) for preliminary screening. The criteria for inclusion were as follows: 1) peer-reviewed articles; 2) longitudinal studies; 3) studies with SDoH being independent variables and SUD stages being dependent variables; and 4) studies conducted in the U.S. Articles were excluded if 1) studies did not collect original data, such as review, letter, editorial, meta-analysis, protocol paper; 2) outcomes only focused on tobacco and alcohol; 3) data were solely collected from animals, laboratories, or simulations; 4) studies testing the efficacy of a medication, device, and/or behavioral therapy; and 5) studies only providing cross-sectional or qualitative data.

2.3. Data extraction and analysis

The abstract screening process resulted in 95 studies that potentially met the requirements for this review. The study team further reviewed the full articles of these studies using an Excel spreadsheet to summarize study design, location, setting, population, SDoH factors, SUD stages, and key findings. At least two coders cross-checked each article record to ensure the accuracy of the extracted data. During the coding process, an additional 45 articles were removed due to their lack of clarity in defining SDoH, SUD stages, and inconclusiveness of the relationship between SDoH and SUD stages (for example, SDoH were considered as mediators or moderators in the analyses). Fig. 2 reflects the article screening, review, and selection process. The final list includes 50 articles (Table 1), and their characteristics are presented in Table 2. We summarized the SDoH factors examined across the studies, irrespective of the significance levels of the findings, to

showcase the extent of research focus on the nexus between SDoH and SUDs (Table 3). We conducted a thematic analysis based on the Drug Treatment Career Framework to aggregate and elucidate the findings from various studies, highlighting how SDoH influenced the progression of SUDs, as reported in the included papers. A heatmap demonstrates the density of reported statistically significant associations between various SDoH factors and SUD stages.

3. Results

3.1. Study characteristics

Table 2 summarizes the characteristics of the included articles. Approximately two-thirds (62 %) of the articles were published between 2016 and 2023. The vast majority ($n = 42$; 84 %) utilized cohort design. Sixteen (32 %) of the studies were conducted in healthcare settings and others were conducted in schools ($n = 11$; 22 %) and communities ($n = 11$; 22 %). Approximately half followed up children and adolescents into their early adulthood ($n = 23$; 46 %). The studies covered the following SDoH domains: 1) economic stability ($n = 23$; 46 %; including one study covering food security); 2) neighborhood and physical environment ($n = 21$, 42 %); 3) education ($n = 18$; 36 %); 4) social context and community ($n = 35$; 70 %); and 5) healthcare ($n = 10$; 20 %). Detailed factors covered in the studies by SDoH domains are illustrated in Table 3.

3.2. Association between SDoH and SUD stages

Table 4 presents a heatmap illustrating the density of reported statistically significant associations between various SDoH factors and SUD stages. The heatmap unveils a concentration of evidence on social networks (e.g., having family members and/or friends engaged in substance use, as well as positive social support) across the spectrum of substance use initiation, escalation, and treatment. A moderate amount of evidence is observed in the relationships between early childhood family structural/relationship dynamics, neighborhood instability and vulnerability, trauma and victimization, and CJS involvement and substance use initiation/escalation. Conversely, evidence regarding the longitudinal relationships between SDoH, particularly within the education domain, and SUD recovery/relapse, as well as overdose and mortality are relatively lacking. These reported findings are discussed below by stages of SUD.

3.2.1. Substance use initiation—All eleven identified articles reporting substance use initiation were conducted among children and adolescents. SDoH factors that could potentially prevent substance use initiation included parental monitoring, family values, and early childhood education. On the other hand, negative social influence, racial/ethnic segregation in schools, stressful life events, unstable housing, and disadvantaged neighborhood environments were predictive of substance use initiation.

3.2.1.1. Family structure and functioning: A cohort study following Mexican-origin youth annually from 5th to 11th grade found that youth who grew up in families with more parental monitoring (odds ratio [OR] = 0.56; 95 % confidence interval [CI]: 0.47–0.66) and stronger familism values (i.e., an emphasis on family closeness and responsibility; OR =

0.75; 95 % CI: 0.62–0.90) were less likely to initiate substance use, while those who spend more time home alone were more likely to initiate substance use (OR = 1.30; 95 % CI: 1.82–2.33); adolescents with older siblings who engaged in antisocial or delinquent behaviors had 76 % higher odds (95 % CI: 1.35–2.30) initiating substance use (Atherton et al., 2016). Remaining marijuana-free until young adulthood was also negatively associated with being in families with a single parent (OR = 0.81, <0.05) (Wu et al., 2016). Humenskey et al. analyzed data from the National Longitudinal Study of Adolescent to Adult Health (Add Health), a representative sample of 7th to 12th grade students, and concluded that individuals with a college-educated parent had a 1.27 higher odds (95 % CI: 1.04–1.54) of marijuana use in early adulthood than those with a high-school educated parent; higher parent income was also associated with increased odds of marijuana and cocaine use in early adulthood (Humensky, 2010).

3.2.1.2. Peer influence.: Several studies reported the impact of peer influence on substance use. For example, a study of adolescents aged 12–19 revealed that one-year marijuana initiation was associated with a greater proportion of school friends binge drinking (OR = 1.77; 95 % CI: 1.25–2.49) and having only friends outside of the school (OR = 1.39; 95 % CI: 1.02–1.88) (Tucker et al., 2013). Another study following urban African Americans and Puerto Ricans from adolescence to adulthood reported that affiliation with deviance-prone or drug-using peers was associated with greater participant substance use in young adulthood ($z = 6.34, p < 0.001$) (Brook et al., 2013). The relationship between peer influence and substance use initiation was further supported by a longitudinal cohort of 1155 undergraduate college students, which evidenced that having peers who had alcohol use or legal problems was associated with greater odds of cannabis use (OR = 2.33, $p < 0.001$), while participation in community activities (OR = 0.87, $p = 0.002$) and church activities (OR = 0.83, $p < 0.001$) had a negative association with cannabis use (Thomas et al., 2021).

3.2.1.3. Early childhood education.: School environment plays a vital role in adolescents' substance use initiation. A secondary analysis of Add Health data involving 12,438 students in 7th to 12th grades found that racial/ethnic segregation in school, measured by every 5 % increase in White students at school, was associated with 1.08 times increase in the odds of substance use for African American students (Dudovitz et al., 2021). Conversely, culturally appropriate school programs could potentially reduce the risk of substance use initiation in adolescents. An intervention offering adolescents classroom sessions to learn skills to resist and counteract peer pressures to use drugs demonstrated less initiation of amphetamines between ages 11 and 28 among intervention participants ($b = -0.35, p < 0.05$) (Riggs et al., 2009). A group randomized trial of a multifaceted, theory-based, and culturally tailored educational program to prevent HIV among American Indian/Alaska Native 7th or 8th grade middle school students ($N = 635$) also showed a 17.3 % lower overall risk of marijuana initiation in the intervention than the control group ($b = -1.11, \text{standard error [SE]} = 0.40, p < 0.01$) (Asdigian et al., 2018).

3.2.1.4. Other factors.: A cohort following 521 6th and 8th graders attending public schools found that children who experienced a greater number of stressful life events, such as losses, transitions, and traumas, had a significantly higher risk of initiating illicit

substance use at an early age (OR = 1.12; 95 % CI: 1.00–1.26) (McCarty et al., 2012). Data from the Add Health study ($N = 12,288$) showed a synergistic effect of childhood abuse and unstable housing on the initiation of marijuana, cocaine, and methamphetamine use in early adulthood (Ararso et al., 2021). Another study analyzing Wave I to Wave IV of the Add Health study demonstrated that adolescents with childhood welfare participation had significantly lower probabilities of remaining substance-free until young adulthood (marijuana-free by 30 %, $p < 0.001$; and other illicit substances-free by 16 %, $p < 0.05$) (Wu et al., 2016). The same study also revealed that a marijuana-free status in early adulthood was associated with living in neighborhoods with a low level of drug use (OR = 0.79, $p < 0.01$). Tucker et al. (2013) reported that the unemployment rate in the neighborhood was predictive of marijuana use initiation in adolescents (OR = 1.03; 95 % CI: 1.01–1.06) (Tucker et al., 2013).

3.2.2. Substance use escalation and disorder—Eighteen articles examined substance use escalation, including increased substance use frequencies/types, escalation to injecting drug use, and SUD diagnosis. Factors associated with substance use escalation included deviant peer networks, discrimination, victimization, trauma, neighborhood instability, exposure to community violence and drug activities, CJS involvement, and unsuccessful treatment attempts. Conversely, a positive family environment, social support, and employment training emerged as protective factors against substance use escalation.

3.2.2.1. Social network and peer influence.: Similar to substance use initiation, fluctuation of substance use was also influenced by one's social network and peer influences. A longitudinal nationally representative study of children recruited at ages 9, 11, and 13 years reported that any non-heroin opioid use was associated with having peers exhibiting social deviance (such as disruptive or disrespectful behaviors, drink alcohol, steal) (OR = 2.38; 95 % CI: 1.47–3.86; $p < 0.001$), having friends mostly being older (OR = 1.88; 95 % CI: 1.06–3.34; $p < 0.05$), and parental legal involvement (OR = 1.91; 95 % CI: 1.18–3.08) (Shanahan et al., 2021). Among veterans with alcohol or drug dependence and major depression ($N = 201$), a higher percentage of peers regularly using drugs was significantly correlated with an increase in the proportion of days the veterans themselves used drugs ($b = 0.13$; SE = 0.06, $p < 0.05$) (Worley et al., 2014). Controlled environments, i.e., settings that limit access to alcohol/drugs, such as inpatient/residential treatment and jails, appear to lessen the influence of social networks on substance use (Worley et al., 2014). Positive influence and social support could potentially prevent substance use from escalating. A study following 248 adolescents for two years reported that a healthy peer network, characterized by minimal substance use among peers, helped early adolescents limit their substance use, but the effect is primarily limited to youth living in socioeconomically disadvantaged neighborhoods ($b = -0.32$, $p < 0.001$) (Mason et al., 2017). A study following 653 adult residents in permanent housing from 2014 to 2017 revealed that the increase in social support was strongly associated with a decline in substance use problems during follow-up ($b = -0.98$) (Tan et al., 2021).

3.2.2.2. Family functioning.: Family factors influence changes in substance use frequency and amount. A randomized controlled trial (RCT) evaluating integrated cognitive behavioral

therapy among 111 adolescents with co-occurring substance use and psychiatric disorder reported that parental baseline emotional dysregulation predicted a greater percentage of days using marijuana over the 6-month follow-up ($b = 0.003$; 95 % CI: 0.001–0.005; $p = 0.008$), regardless of treatment condition (Spirito et al., 2021). Conversely, in a cohort of 406 adult patients with co-occurring mental health and SUD, patients with higher family conflict had higher substance use severity across the 15-month follow-up period (Haverfield et al., 2019).

3.2.2.3. Discrimination, victimization, and trauma.: Experiences of discrimination, victimization, and trauma can increase the risk of substance use escalation. In a cohort of 417 African American adolescents, levels of perceived discrimination from teachers were associated with increases in adolescents' substance use ($b = 0.16$, $SE = 0.07$, $p = 0.013$) across the high school years (Fuller-Rowell et al., 2012). Davis et al. (2016) reported that victimization and traumatic experiences, such as physical, emotional, and sexual abuse, were associated with higher levels of cannabis use ($b = 0.38$, $p < 0.001$) in a study following 3052 early adolescents (Davis, Merrin, et al., 2016). An analysis of the Add Health data ($N = 12,288$) found a dose-response association between childhood trauma (e.g., neglect; emotional/physical/sexual abuse, violence) and adulthood prescription pain reliever misuse (AOR increase from 1.46 to 3.09 as the increase of trauma) (Quinn et al., 2016). A cohort of 1399 Hispanic adolescents also yielded similar findings that young adults exposed to more adverse childhood experiences had significantly a higher level of past 30-day marijuana use ($b = 0.07$, 95 % CI = 0.03–0.11) than young adults with fewer traumatic experiences (Rogers et al., 2021).

3.2.2.4. Neighborhood characteristics.: As part of a longitudinal, school-based prevention trial, 452 African American students were followed up from 9th to 12th grade and neighborhood disorder (AOR = 3.20, $p = 0.004$), drug activity and sales (AOR = 2.28, $p = 0.028$), and community violence exposure (AOR = 4.54; $p < 0.001$) were associated with adolescents' transitioning from no use to frequent/problematic marijuana use (Reboussin et al., 2014). A longitudinal study in Michigan following boys from ages 3–5 to 18–20 found that neighborhood instability, a composite score of residences' mobility and the percentage of vacant/rental households, were associated with a higher likelihood of developing marijuana use disorder (MUD) ($b = 0.41$, $SE = 0.07$, $p < 0.05$). Those who moved to more affluent neighborhoods during developmental age tended to develop fewer MUD symptoms ($b = -0.43$, $SE = 0.20$, $p < 0.05$) (Buu et al., 2009).

3.2.2.5. CJS involvement.: Grella et al. analyzed 30-year patterns of heroin and other substance use among patients undergoing methadone maintenance treatment in California and found that individuals who had early-age arrests were more likely to belong to the “no decrease” or “gradual decrease” heroin trajectory groups than the “moderate decrease” or “rapid decrease” groups (Grella & Lovinger, 2011). Hser and colleagues examined long-term trajectories of drug use among those who primarily use heroin ($n = 629$), cocaine ($n = 694$), and methamphetamine ($n = 474$), classifying them into five categories: High Use, Increasing Use, Decreasing Use, Moderate Use, and Low Use. Notably, the High Use group members were characterized by the earliest average age of first arrest (16.3 [SD = 5.3] years)

and the longest duration of incarceration (33.7 [SD = 29.4] months over 10 years) (Hser et al., 2008).

3.2.2.6. Other factors.: Education and access to care also play vital roles in substance use trajectories. In a 16-year cohort, adolescents in the job skills training group ($n = 317$) demonstrated a decline in past-year illicit drug use from 4.6 % in the initial year to -2.5 % by year 16; in contrast, the basic services group ($n = 264$) showed an increase from 1.8 % in the starting year to 5.2 % in year 16 (Oh et al., 2020). A national cohort of women with or at risk of HIV reported that current low and very low food security was significantly associated with 1.59 (95 % CI: 1.02–2.46; $p = 0.039$) and 2.48 (95 % CI: 1.52–4.04; $p < 0.001$) higher odds of any illicit substance use, compared to high food security. Lower food security was also significantly associated with higher odds of cannabis, stimulant, and opioid use (Whittle et al., 2019). Lofwall and Havens’s (2012) study demonstrated that limited access to buprenorphine treatment increased the risk of misusing or abusing diverted buprenorphine in a cohort study of individuals using prescription opioids, heroin, cocaine, and/or methamphetamine ($N = 471$), showing increased odds of polysubstance use during a 6-month follow-up period (AOR: 7.31, 95 % CI: 2.07–25.8) (Lofwall & Havens, 2012).

3.2.3. SUD treatment—Ten articles examined SUD treatment enrollment, uptake, and retention. Factors positively associated with treatment utilization included low-barrier access to medication treatment for opioid use disorder (MOUD), living in metropolitan areas, and social networks supportive of sobriety. Stigma towards substance use was significantly negatively associated with MOUD uptake. The relationship between housing status and treatment utilization was inconclusive in the included studies. One study reported a moderating effect of Affordable Care Act (ACA) enrollment mechanisms on the association between deductibles and the likelihood of seeking care.

3.2.3.1. Health insurance.: In a cohort study involving 710 individuals who had used substances in the previous month but were not in treatment, Cucciare et al. (2019) reported that individuals with health insurance were more likely (OR = 1.85, 95 % CI: 1.29–2.65) to have a visit for SUD treatment during the 3-year follow-up (Cucciare et al., 2019). Satre and colleagues analyzed electronic health records from 6957 adults with SUD aged 18–64 newly enrolled in Kaiser Permanente North California in 2014 and found complex associations among ACA enrollment mechanisms, deductibles, and treatment utilization. For patients enrolled through the ACA, high deductibles were associated with a decreased likelihood to seek primary care (OR = 0.64, 95 % CI = 0.54–0.77) and psychiatry (OR = 0.58, 95 % CI = 0.45–0.74). For those enrolled through non-ACA schemes, the odds were 0.83 (95 % CI = 0.74–0.92) for primary care and 0.85 (95 % CI = 0.73–0.98) for psychiatry. However, enrollees from non-ACA mechanisms with deductibles were more likely to seek specialty SUD treatment than those without (Satre et al., 2020).

3.2.3.2. Access to care.: Winograd and colleagues compared service data before and after the implementation of “Medication First” approach, a rapid, sustained, low-barrier access to MOUD in response to the opioid crisis, in Missouri. MOUD were prescribed significantly faster when “Medication First” approach was implemented (Mean (SD) = 4.93 (11.86) days)

relative to the pre-implementation period (Mean (SD) = 21.16 (36.37) days). Treatment retention was also significantly better during the “Medication First” period ($p < 0.001$ for 1-, 3-, and 6-month retention) (Winograd et al., 2020).

3.2.3.3. Geographic area.: A retrospective cohort study on 2361 Pennsylvania Medicaid enrollees who underwent buprenorphine therapy during pregnancy with live births between 2008 and 2015 revealed that women residing in non-metropolitan counties had 50 % to 59 % higher odds of being late initiators of buprenorphine (OR = 1.59; 95 % CI: 1.12–2.25) when compared to early initiators with moderate-or-high adherence group; and OR = 1.50 (95 % CI: 1.04–2.15) when compared to early initiators with low-to-moderate adherence group (Lo-Ciganic et al., 2019).

3.2.3.4. Social network and support.: A longitudinal study of young (aged 18–30) people who inject drugs in Chicago ($N = 135$) reported that a greater number of direct support network connections was significantly associated with a higher likelihood of MOUD uptake (AOR = 1.50, $p = 0.024$) (Williams et al., 2023). A cohort of 176 patients in drug use reduction programs revealed that, for both men (AOR = 1.4; 95 % CI: 1.1–1.9) and women (AOR = 1.3; 95 % CI: 1.0–1.8), added non-kin network members at follow-up was associated with increased odds of engagement in SUD treatment in the past six months (Falade-Nwulia et al., 2022). A retrospective cohort study of 400 adults with alcohol problems and HIV/AIDS observed a higher likelihood of receiving SUD treatment among those who had social supports that helped with sobriety (AOR = 1.92; 95 % CI: 1.28–2.87) (Orwat et al., 2011). Davis and colleagues followed up serious juvenile offenders ($N = 1354$) for seven years and found that peer network factors, such as involvement with delinquent friends (Hazard ratio [HR] = 1.31, 95 % CI: 1.12–1.54) and having a larger proportion of friends arrested (HR = 1.40, 95 % CI: 1.04–1.88), were associated with delay in SUD treatment entry (Davis, Dumas, et al., 2016).

3.2.3.5. Housing status.: Evidence of housing status and SUD treatment utilization is limited. Orwat’s study reported that those with unstable housing (AOR = 2.40; 95 % CI = 1.60–3.62) were more likely to receive any SUD treatment, possibly because individuals experiencing homelessness had more interactions with the social welfare system, which could facilitate their connection to healthcare service (Orwat et al., 2011). A clinical cohort study of 265 primary care patients with substance dependence observed no association between housing status and engagement in a primary care-based addiction treatment program over a 6-month follow-up period (Walley et al., 2015).

3.2.3.6. Other factors.: The abovementioned Williams’ 2023 study demonstrated that community-level normative stigma was significantly negatively associated with MOUD uptake (AOR = 0.20, $p = 0.019$) (Williams et al., 2023). Cucciare’s cohort study with individuals who use drugs found an association between greater employment problems and higher odds (OR = 3.02, 95 % CI: 1.45–6.26) of SUD treatment (Cucciare et al., 2019). Prendergast’s study drawing on longitudinal samples of adult males who use drugs from three studies demonstrated that individuals with high incarceration trajectories prior to treatment were more often referred to treatment via the CJS. Additionally, these individuals

frequently received their initial treatment while incarcerated and typically spent a longer duration in treatment (Prendergast et al., 2008).

3.2.4. Recovery and relapse—The included studies around SUD recovery ($n = 5$) and relapse ($n = 2$) highlighted that employment could potentially foster progress in recovery, as evidenced by less positive urine drug screening (UDS), cessation of injection, and longer abstinence; conversely, CJS involvement and unstable housing were associated with prolonged time to cessation of injection and/or shorter abstinence episodes. Recovery group affiliation, geographic accessibility, and social support were predictive of better engagement in recovery services or recovery outcomes.

3.2.4.1. Employment. As part of a larger RCT, unemployed adult patients in Baltimore methadone programs who used cocaine ($N = 111$) were invited to work in a workplace with vouchers and job skill training provided. The study reported that the percentage of time attending the workplace was associated with a higher likelihood of having a negative UDS for cocaine in the intervention period ($b = 0.556$, $t(107) = 3.67$, $p < 0.001$) (Donlin et al., 2008). A study that followed individuals who injected drugs in Baltimore from 1988 to 2000 reported that employment at baseline was associated with a shorter time to the first cessation of injection (Time ratio [TR] = 0.84; 95 % CI: 0.72–0.99) (Shah et al., 2006). In a study of 471 males with heroin dependence enrolled in the California Civil Addict Program from 1962 onward, Nosyk et al. (2013) found that employment prior to abstinence was associated with longer abstinence durations (HR = 0.65, 95 % CI: 0.53–0.79) (Nosyk et al., 2013).

3.2.4.2. Access to care vs. CJS involvement. Nosyk et al. (2013) also revealed that abstinence initiated after drug treatment (for at least six months) was longer (HR = 0.50, 95 % CI: 0.33–0.74) than those initiated without treatment, and abstinence episodes post-incarceration were shorter (HR = 1.70, 95 % CI: 1.37–2.13) compared to other initiation points in the longitudinal California Civil Addict Program study (Nosyk et al., 2013).

3.2.4.3. Unstable housing. The cohort study of individuals who inject drugs in Baltimore also demonstrated the negative impact of unstable housing on relapse, among the participants who reported a cessation of injection, the time to relapse to injection was nearly 50 % faster (TR = 0.54) for those reporting unstable housing relative to those who were stably housed (Shah et al., 2006).

3.2.4.4. Other factors. Kelly et al. followed up with 275 individuals starting community recovery for three months and found greater engagement in recovery (indicated by the number of days they visited the community recovery center in the last three months) among participants who could commute to the community treatment center within 15 min (AOR = 1.67; 95 % CI: 1.11–2.52; $p = 0.016$). Recovery engagement was negatively associated with transportation by walking (AOR = 0.58; 95 % CI: 0.38–0.89; $p = 0.0015$) and perceived social support (AOR = 0.53; 95 % CI: 0.33–0.83; $p = 0.007$) (Kelly et al., 2021). Valeri's study showed that, among women with SUD under recovery group therapy, those who experienced the highest level of group affiliation, as measured by the frequency of using supportive, positive, or empathic comments among members, reduced substance use by

about 1.75 days more than women who experienced the lowest level of affiliation at the end of the 3-month treatment phase (Valeri et al., 2018).

3.2.5. Overdose (fatal/non-fatal) and mortality—The review identified one study investigating non-fatal overdoses, another focusing on fatal overdoses, and four studies examining all-cause mortality among patients who use substances. These studies highlighted a range of factors potentially contributing to overdose and mortality, including unemployment, CJS involvement, unstable housing, and lack of social support system. Additionally, one ecological study indicated that county-level factors, such as immigration within a county, were correlated with a declining overdose death trend at that county level.

3.2.5.1. Employment.: Aram and colleagues examined the National Longitudinal Mortality Study and found 157 overdose deaths among 438,739 noninstitutionalized U.S. adults aged 25 and above over a 6-year follow-up. After adjusting for age, race/ethnicity, education, and marital status, a higher hazard rate ratio (HR) of overdose death was observed among adults who were disabled (HR = 6.96; 95 % CI = 6.81–7.12), unemployed (HR = 4.20; 95 % CI = 4.09–4.32), or retired (HR = 2.94; 95 % CI = 2.87–3.00), compared to those who were employed (Aram et al., 2020). Adults working in service, construction/extraction, management, business and financial, and installation, maintenance, and repair occupations had relatively higher risks of overdose death (Aram et al., 2020).

3.2.5.2. CJS involvement.: A longitudinal study with assessment at baseline, 3-, 6-, and 12-month follow-up with individuals with alcohol and/or drug dependence ($N = 553$) found that incarceration in the past three months was significantly associated with overdose requiring ED/medical attention (AOR = 2.09, 95 % CI: 1.05–4.16) (Redmond et al., 2014).

3.2.5.3. Neighborhood characteristics.: Feldmeyer and colleagues conducted county-level analyses examining the longitudinal relationship between immigration and overdose mortality (2000–2015). They discovered that increases in county-level immigration (measured as the percentage of foreign-born residents) were associated with significant declines in total overdose death ($b = -0.045$, $p < 0.001$), as well as heroin ($b = -0.012$, $p < 0.05$) and cocaine-specific fatal overdose ($b = -0.013$, $p < 0.05$) (Feldmeyer et al., 2022).

3.2.5.4. Other factors.: Li and colleagues analyzed electronic medical records from 2015 to 2018 of patients ($N = 182$) admitted to the Boston Veterans Health Administration for medically supervised opioid withdrawal in 2015. Of these patients, 34 had passed away, with 21 deaths being opioid-related. It was observed that 47.1 % ($n = 16$) of the deceased had been homeless at the point of their initial admission, compared to 26.5 % ($n = 9$) of those who were still alive ($b = 4.33$, $SE = 2.60$, $p = 0.09$). In terms of partnered support, only 11.8 % ($n = 4$) of the surviving patients had the support of a partner at the time of their initial admission, while 23.5 % ($n = 8$) of the deceased did ($b = -5.89$, $SE = 3.26$, $p = 0.07$) (Li et al., 2019). Ibragimov et al. performed multilevel difference-in-difference model and found no evidence that state Medicaid expansion under the Affordable Care Act (2008–2018) resulted in a reduction in opioid overdose-related deaths among low-education adults (Ibragimov et al., 2022).

4. Discussion

This scoping review provides a comprehensive overview of the available literature concerning the influence of SDoH on the life course of SUD. It highlights the multifaceted association between SDoH and SUD, underscoring relationships with robust and moderate evidence bases. Moreover, the review identifies notable gaps in the literature concerning the longitudinal effects of SDoH on various stages of SUD.

This review underscores the pivotal role that social networks play at various stages of SUD. Specifically, negative social influences, such as family members and friends engaged in substance use or involved with the CJS, are associated with increased initiation and severity of an individual's substance use, and these associations are especially pronounced among adolescents (Atherton et al., 2016; Brook et al., 2013; Davis, Merrin, et al., 2016). Conversely, the presence of a supportive family environment and positive social connections can be protective of the initiation and escalation of substance use; in addition, such positive social support facilitates access to and engagement with treatment (McCarty et al., 2012; Orwat et al., 2011; Tan et al., 2021). Future studies should recognize the dual-edged nature of social influences and design interventions focusing on reducing detrimental social connections and promoting beneficial social and family support (Fadus et al., 2019; Hogue et al., 2022). Additionally, it is imperative to address the specific need to foster positive social networks for certain vulnerable populations, such as those facing unstable housing and associated social isolation, to mitigate risks and promote healthy behavioral changes (Tan et al., 2021).

This review also highlights the evidence indicating that early life experiences and environmental factors play a vital role in substance use initiation among youth. Such influences manifest at various levels. Primarily, a lack of family structure and parental monitoring heightened the risk of substance use initiation or escalation (Atherton et al., 2016; Shanahan et al., 2021; Spirito et al., 2021; Wu et al., 2016). School environment also wields considerable influence. The review presented evidence of how racial/ethnic segregation and discrimination elevate substance use initiation or exacerbation risks (Dudovitz et al., 2021; Fuller-Rowell et al., 2012; Grella & Lovinger, 2011; McCarty et al., 2012). Conversely, school-based interventions have shown promise in curtailing the initiation of substance use (Asdigian et al., 2018). Additionally, the impact of neighborhood environment, e.g., community instability and exposure to violence, on adolescents' long-term choices regarding substance use cannot be ignored (Buu et al., 2009; Reboussin et al., 2014; Tucker et al., 2013). These findings emphasize the need for interventions to mitigate the effects of early life adversity at multiple levels, with school-based education programs involving both parents and students being potentially viable approaches in this direction (Marsiglia et al., 2019; Nair et al., 2022).

The relationships between occupational training/employment status and substance use escalation and recovery underscore the importance of incorporating employment support into SUD treatment and recovery programs (Donlin et al., 2008; Hser et al., 2008; Nosyk et al., 2013). CJS involvement can certainly complicate one's employment and SUD trajectory (Nosyk et al., 2013; Prendergast et al., 2008; Redmond et al., 2014). A drug arrest or

charge, even without a conviction, can lead to reduced employment opportunities and subsequently impact individuals' health insurance coverage, food, and housing (Bushway et al., 2022; Cohen et al., 2022). The interplay between SUD and the CJS frequently creates a detrimental cycle hindering individuals with a history of incarceration from receiving the essential treatment care. It is imperative to revisit the discriminative criminal background checks in employment applications and devise efficient strategies to facilitate post-incarceration integration into society and enable individuals to secure jobs and access necessary healthcare.

This review spotlighted several gaps in the SDoH research in SUD. First, there was a paucity of studies that examined the longitudinal relationship between SDoH and overdose and mortality, which suggests a dire need for more research on these crucial outcomes, particularly as overdose deaths continue to rise in the country. The ecological studies examining the role of Medicaid expansion and county-level immigration patterns in overdose deaths were intriguing (Feldmeyer et al., 2022; Ibragimov et al., 2022), and we advocate for more studies of this nature to understand how the evolution of broader social structures and policies shapes the life course of SUD at the population level. Additionally, there was a significant gap in research exploring the impact of housing status on SUD escalation and treatment engagement. Future studies should investigate the efficacy of housing-first strategies (i.e., offering housing for those unhoused without requirements for sobriety or absence of criminal history) in preventing substance use escalation and treatment engagement (Cherner et al., 2017). Secondly, while the KFF SDoH framework (KFF, 2021) includes provider linguistic and cultural competency as a crucial component of the "Healthcare System Domain," our search yielded no studies on this topic. Future research should explore if and how provider-patient concordance in language and cultural background would influence patients with SUD's treatment outcome and recovery to inform provider cultural competency training and care coordination plans. Lastly, there was a notable shortage of interventional studies identified through this review (Asdigian et al., 2018; Donlin et al., 2008). Even among the few studies that employed RCT/quasi-experimental designs, SDoH were often treated as covariates or moderators rather than being the primary focus of intervention (Spirito et al., 2021; Valeri et al., 2018; Worley et al., 2014). This literature gap underscores the importance of conceptualizing and implementing SDoH-informed intervention studies to understand how modifications in SDoH might influence SUD outcomes.

This scoping review possesses several limitations. First, the review may be subject to publication bias as studies with non-significant findings and/or results in the opposite direction are less likely to be published. In addition, the literature search ended in July 2023. Although the field increasingly recognizes Internet connectivity and digital literacy as "super determinants" of health that shape people's access to healthcare information, treatment and care, and outcomes (SAMHSA, 2023), our review did not capture studies around the longitudinal relationships between digital access/literacy and SUD treatment. These pertinent studies may be undergoing but remain unpublished at the time of the review. Second, due to the breadth of SDoH and the life course of SUD, as well as the evolution of research terminologies, our review strategy might inadvertently omit search terms pertinent to certain SDoH factors, leading to the exclusion of relevant studies. Third, the diverse

methodologies employed, as well as SDoH and SUD outcomes of interest across studies, limited our ability to directly compare or consolidate findings. Fourth, since not all studies included in the review were prospectively designed or RCT, the association reported in the review could not be interpreted as causation. Finally, the relationship between SDoH and SUD is indeed complex and bidirectional, with SUD also impacting SDoH. As a limitation of this review, we focused exclusively on how SDoH affects SUD stages, recognizing that this approach did not capture their mutual influence. Future research or a separate review could be dedicated to unraveling how SUD impacts SDoH to provide a more comprehensive understanding of their interplay.

In conclusion, this scoping review illuminated several SDoH factors demonstrating longitudinal relationships with SUD stages across the life course, particularly social networks, early life experiences, employment, CJS involvement, and neighborhood stability. The review also unveiled several research gaps, including the scarcity of studies investigating overdose and drug-related mortality, as well as ecological studies investigating upstream SDoH's influence on SUD. There is a pressing need to devise and evaluate intervention approaches tackling SDoH to prevent and mitigate the negative outcomes of SUD.

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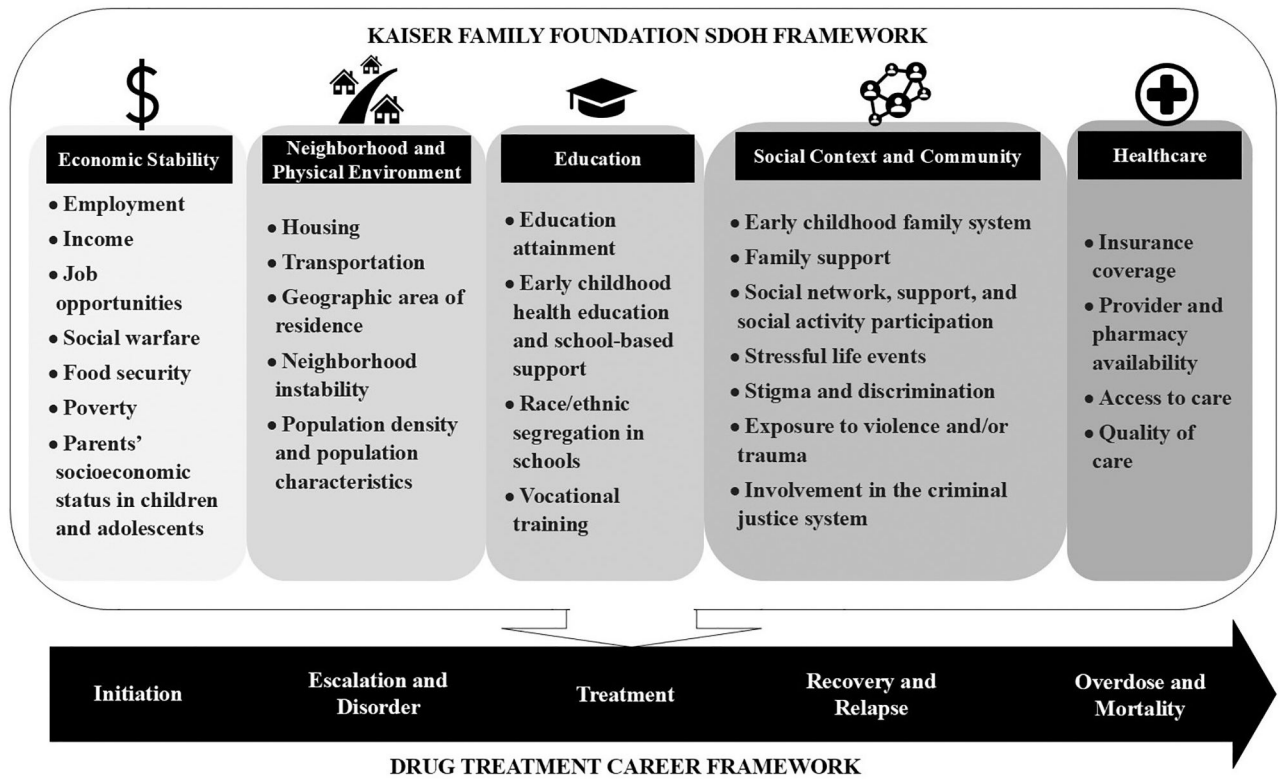


Fig. 1.
Theoretical frameworks guiding the scoping review.

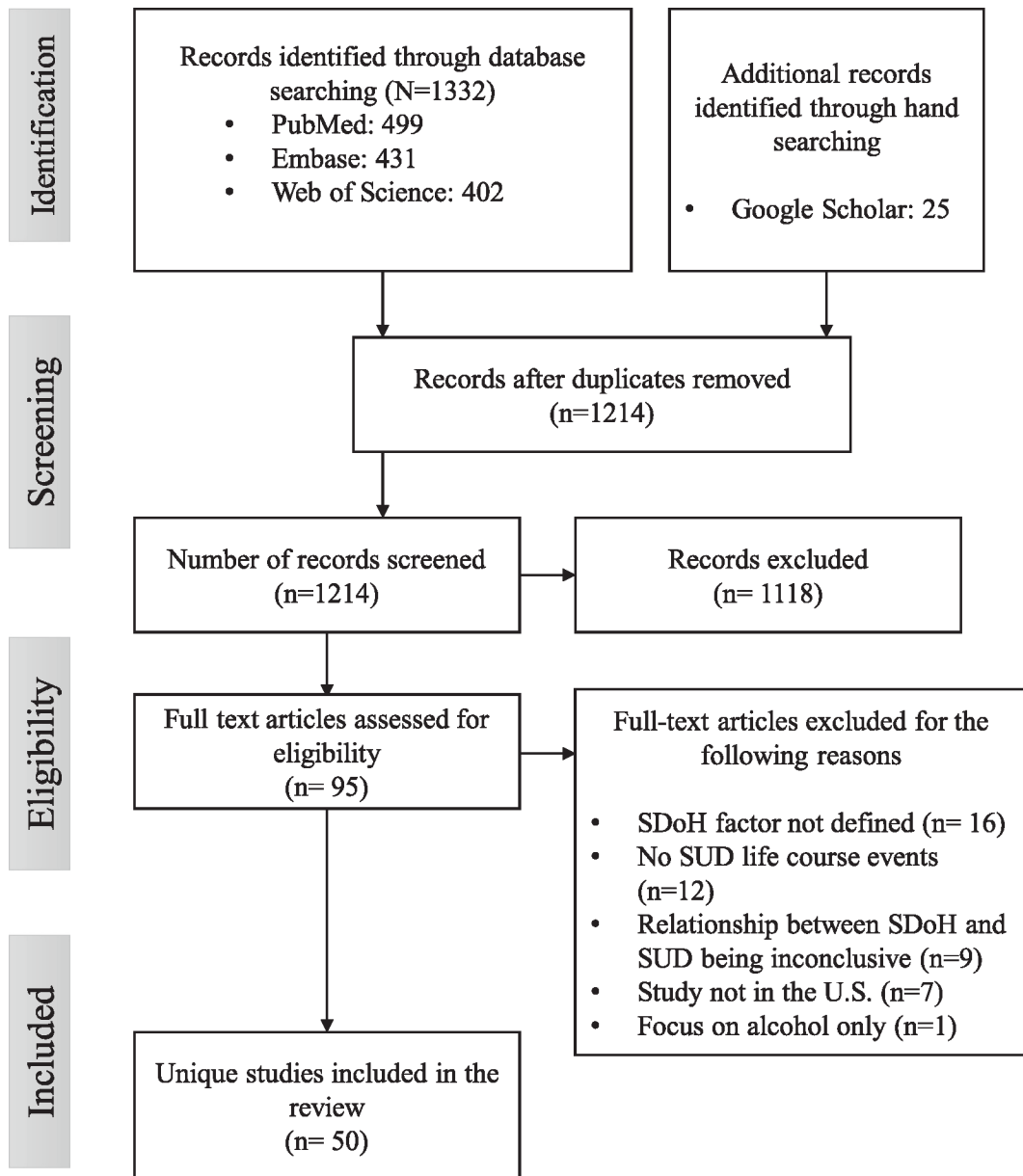


Fig. 2. Flowchart of selection of the studies.

Table 1

Summary of included studies.

Authors	Study design	Location of the study	Setting	Population	SDoH domain ^d	SUD stages	Key findings
1 Ararso et al., 2021	Cohort	Nationwide	Unspecified	Adolescent to Adult Health data (N = 12,288)	Env; Soc	Initiation	Exposure to childhood abuse alone, homelessness alone, and both were significant correlates of most substance use indicators in emerging adulthood.
2 Asdigian et al., 2018	Group randomized trial	Colorado	School	Middle school students (N = 635)	Edu	Initiation, Escalation	School-based group randomized trial showed that American Indian youths aged 12–14 who received the ‘Circle of Life’ (COL) intervention, a culturally tailored HIV prevention program, had a 17.3 % lower overall risk of marijuana initiation than those in the Control group. Intervention outcome on frequency of use was not significant.
3 Aram et al., 2020	Cohort	National	Community	Adults (N = 438,739)	Eco	Overdose mortality	In a large national cohort followed adults for up to 6 years, those who were disabled, unemployed, and retired are associated with higher risks of overdose deaths, with other factors controlled.
4 Atherton et al., 2016	Cohort	California	School	Mexican-origin youth aged 10–16 (N = 674)	Eco; Env; Soc	Initiation	Sibling and peer influences are associated with initiation of substance use in Mexican-origin youth. Stronger familism values and parent monitoring are protective factors for substance use initiation in youth.
5 Brook et al., 2013	Cohort	New York	From school to community	African American or Puerto Ricans from adolescence to adulthood (N = 816)	Soc	Initiation	Peer deviance and drug use in African American or Puerto Rican adolescents were associated with substance use in adulthood
6 Buu et al., 2009	Cohort	Michigan	Community	Males from 3 to 5 years to 18–20-year-old (N = 220)	Eco; Env; Soc	SUD	Parental marijuana use disorder (MUD) and baseline neighborhood instability were associated with children MUD. Children moving to more affluent neighborhood environments tended to have less MUD
7 Cucciare et al., 2019	Cohort	Arkansas, Kentucky, and Ohio	Community	Individuals who had used substances in the past month and not in treatment (N = 710)	Eco; Env; Soc, Hlt	Treatment	Among a cohort of individuals who use drugs, having medical insurance and higher employment problems was associated with a greater likelihood of a SUD treatment visit during the three-year follow-up.
8 Davis, Merrin, et al., 2016	Cohort	Nationwide	Substance use treatment clinics	Individuals in early adulthood (18–25 yrs; N = 3052)	Eco; Soc	Escalation	Early adults who experienced higher levels of victimization between baseline and 12 months tended to show comparatively higher levels of cannabis use than their less victimized peers. Exposure to social risk over time was also associated with greater cannabis use.
9 Davis, Dumas, et al., 2016	Cohort	Arizona and Pennsylvania	Criminal justice system and community	Serious juvenile offenders (N = 1354)	Env; Soc	Treatment	Associating with more deviant peers and having more of your peers arrested was associated with longer time to enter SUD treatment.

Authors	Study design	Location of the study	Setting	Population	SDoH domain ^d	SUD stages	Key findings
10 Donlin et al., 2008	RCT	Maryland	Methadone programs	Unemployed methadone patients who used cocaine (N = 111)	Eco	Recovery	The percentage of minutes that participants attended the workplace was associated with the percentage of cocaine-negative urine samples in the intervention period.
11 Dudovitz et al., 2021	Cohort	National	School	Adolescents to adults (N = 12,438)	Edu	Initiation	For Black students, greater racial segregation within schools was associated with increased odds of substance use at follow up surveys.
12 Falade-Nwulia et al., 2022	Cohort	Maryland	Community	Patients with HIV in drug use reduction programs (N = 176)	Eco; Env; Soc; Hlt	Treatment	For both men and women with HIV in substance use treatment, higher turnover into non-kin networks at follow-up was associated with one-year retention.
13 Feldmeyer et al., 2022	Ecological study	Nationwide	County-level analysis	N/A	Soc	Mortality	Increases in county-level immigration were associated with significantly lower overall overdose death rates and specific substance types
14 Fuller-Rowell et al., 2012	Cohort	Maryland	School	African American adolescents (N = 417)	Soc	Escalation	From African American adolescents, levels of discrimination were associated with increases in substance use across the high school years.
15 Grella & Lovinger, 2011	Cohort	California	Methadone maintenance programs	Patients of methadone maintenance program (N = 343)	Eco; Edu; Soc; Hlt	Escalation	More school problems and earlier age arrest were associated with more persistent heroin use among patients in methadone maintenance programs.
16 Harvey et al., 2016	Cohort	Nationwide	Residents of Oxford Houses	Individuals recovering from OUD (N = 268)	Eco	Relapse	Employment variables did not significantly predict relapse risk for individuals recovering from OUD.
17 Haverfield et al., 2019	Cohort	Michigan	Inpatient psychiatry treatment program	Patients with co-occurring mental health and SUD (N = 406)	Soc	Escalation	Individuals in the higher family conflict group had a higher drug use severity at baseline, a larger decrease in drug use severity from baseline to 9-month, and, subsequently, slightly less of an increase in severity from the 9-month to the 15-month follow-up
18 Hser et al., 2008	Cohort	California	Treatment and non-treatment settings (emergency rooms, STI clinics, and jails)	Primary heroin users (n = 629), primary cocaine users (n = 694), and primary methamphetamine users (n = 474)	Eco; Soc	Escalation	Among individuals who use drugs, those in the high-use group had earlier onsets of crime, longer incarceration durations, and were the least employed.
19 Humensky, 2010	Cohort	National	School	Secondary school students (N = 20,673)	Eco	Initiation	Among secondary school students, higher parental education is associated with higher rates of marijuana and cocaine use in early adulthood. Higher parental income is associated with higher rates of marijuana use.
20 Ibragimov et al., 2022	Quasi-experimental	National	County-level analysis	Socioeconomically disadvantaged populations (sample size not reported)	Env; Hlt	Mortality	In the 1-year lagged multivariable model that controlled for policy and sociodemographic covariates, the association between state Medicaid Expansion and county-level opioid overdose-related deaths was statistically insignificant.

Authors	Study design	Location of the study	Setting	Population	SDoH domain ^d	SUD stages	Key findings
21 Kelly et al., 2021	Cohort	Northeast	Recovery community centers	Individuals starting at recovering community centers (N = 275)	Eco; Edu; Soc	Recovery	Better engagement in community recovery was participants who could get to the recovery services in non-walking mode, with commute time within 15 min, and with lower initial social support.
22 Li et al., 2019	Cohort	Boston	Veteran's Health Admin, inpatient psychiatric units	Patients who were admitted for medically supervised opioid withdrawal (N = 182)	Eco; Edu; Soc	Mortality	This study suggested a potential association between unstable housing and an increased risk of death among veteran patients who were admitted for medically supervised opioid withdrawal. Conversely, being married or cohabiting appeared to be protective against death.
23 Lo-Cigamic et al., 2019	Cohort	Pennsylvania	Medicaid administrative claims data	Pregnant women who were Medicaid enrollees aged 15 to 46 (N = 2361)	Env; Hlt	Treatment	Among pregnant women who were Medicaid enrollees, factors significantly associated with late initiation of buprenorphine during pregnancy included residents of rural counties.
24 Lofwall & Havens, 2012	Cohort	Kentucky	Community	Participants who used opioids, heroin, cocaine and/or methamphetamine in the last 30 days (N = 471)	Eco; Edu; Soc; Hlt	Escalation	Predictors of increased risk of use of diverted buprenorphine during the 6-month follow-up included inability to access buprenorphine treatment (AOR: 7.31, 95 % CI: 2.07, 25.8)
25 Mason et al., 2017	Cohort	Virginia	Urban adolescent medicine primary care clinic and outpatient hospital	Adolescents aged 13–14 (N = 248)	Env; Soc	Escalation	Peer network health is most strongly associated with lower baseline substance use for young adolescents residing in more disordered neighborhoods.
26 McCarty et al., 2012	Cohort	Washington	School	Youth 6 th to 8 th grade (N = 521)	Soc	Initiation	Children with higher levels of perceived teacher support had a significantly lower risk of alcohol initiation during early follow-up periods. Recent stressful life events in Grade 6 were associated with a significantly greater risk of initiating an illicit substance by Grade 8.
27 Nosyk et al., 2013	Cohort	California	California Civil Addict Program	Individuals with heroin dependence (N = 471)	Eco; Edu; Soc; Hlt	Recovery	Heroin abstinence episodes initiated immediately following incarceration were shorter on average than episodes initiated at other time points. In contrast, episodes initiated following drug treatment tended to be longer than those initiated in the absence of treatment. Employment in the month prior to heroin abstinence episode initiation was predictive of longer durations of abstinence.
28 Oh et al., 2020	Cohort	National	Unspecified	Youths receiving job skills training (n = 317) and basic services (n = 264).	Edu	Escalation	Youth in the job skills training group reported decreased past-year illicit drug use over time from 4.6 % in year 0 to 2.5 % in year 16, sharply contrasting with the increasing trajectory among the basic services group from 1.8 % in year 0 to 5.2 % in year 16.
29 Orwat et al., 2011	Cohort	Massachusetts	Hospital	Adults with HIV infection and alcohol problems (N = 400)	Eco; Edu; Soc	Treatment	Among adults with alcohol problems and HIV/AIDS, those who experienced physical or sexual

Authors	Study design	Location of the study	Setting	Population	SDoH domain ^a	SUD stages	Key findings
30 Prendergast et al., 2008	Cohort	California	Treatment and no treatment settings (emergency rooms, sexually transmitted disease clinics, and jails)	Adult male who used drugs (N= 792)	Soc	Treatment	abuse and unstable housing were more likely to receive substance use treatment. Those with social support promoting sobriety were also more likely to receive treatment. Individuals who use drugs' treatment referral source, modality, and duration varies by pretreatment incarceration trajectories
31 Quinn et al., 2016	Cohort	National	Unspecified	Adolescent to Adult Health data (N = 12,288)	Eco; Edu; Soc	Escalation	The study found a dose-response association between childhood trauma and adulthood misuse of prescription pain relievers. Those who experienced four traumas had an approximately seven times higher odds of injecting drug use in adulthood
32 Reboussin et al., 2014	Cohort	Baltimore	School	African American students (N = 452)	Env; Soc; Edu	Escalation	Community violence exposure was associated with an increased likelihood of transitioning from no marijuana use to infrequent use. Higher perceived neighborhood disorder, drug activity and sales in the neighborhood, and community violence exposure were associated with an increased risk of transitioning from no use to frequent/problematic marijuana use.
33 Redmond et al., 2014	Cohort	Massachusetts	Detoxification programs/Community	Individuals with alcohol and/or drug dependence (N = 553)	Env	Overdose	Recent incarceration was associated with higher odds of overdose requiring emergency department (ED)/medical attention among individuals with alcohol and/or drug dependence.
34 Riggs et al., 2009	Cohort	Missouri	School	Adolescents (N = 1002)	Edu; Soc	Initiation	A multi-component community-based program delivered in early adolescence with a primary emphasis on skills to resist peer influence of substance use showed delayed amphetamine use initiation.
35 Rogers et al., 2021	Cohort	California	School	Hispanic adolescents (n = 1399)	Soc	Escalation	Every additional adverse childhood experience (ACE) was associated with significantly higher past 30-day marijuana use. Across all models, cross-level interactions between ACE and time indicated that young adults exposed to more ACE experience significantly steeper inclining trajectories of 30-day marijuana use.
36 Satre et al., 2020	Cohort	California	Hospital	Patients with SUD aged 18–64 years who were newly enrolled in Kaiser Permanente Northern California in 2014 (n = 6957)	Hlt	Treatment	High deductibles were associated with a decreased likelihood of seeking primary care and psychiatric services. However, enrollees from non-ACA mechanisms with deductibles were more likely to seek specialty SUD treatment than those without however, among patients who enrolled via non-ACA mechanisms, patients with deductibles were more

Authors	Study design	Location of the study	Setting	Population	SDoH domain ^d	SUD stages	Key findings
37 Shah et al., 2006	Cohort	Maryland	Community	Individuals who inject drugs (N = 1327)	Eco; Env; Edu; Soc	Recovery	likely than those without deductibles to utilize specialty SUD treatment. Among a cohort of individuals who injected drugs, the time to cessation for those reporting homelessness was 44 % longer than for those who reported stable housing. The time to relapse to injection was nearly 50 % faster for those reporting homelessness relative to those who did not.
38 Shanahan et al., 2021	Cohort	North Carolina	Community	American Indian, opioid-naïve children aged 9 to 13 years who were followed to age 13 to 30 (N = 1252)	Eco; Edu; Soc	Escalation	By age 30 years, approximately one-quarter of participants had used opioids, and the findings revealed that family instability and school or peer risk were associated with progression to heroin use. Few or no associations emerged between opioid use and childhood sociodemographic status, maltreatment, or family dysfunction.
39 Spirito et al., 2021	RCT	California	Community mental health clinic	Adolescents with co-occurring substance use and psychiatric disorders (N = 111)	Soc	Escalation	For adolescents with co-occurring substance use and mental disorders marijuana use during follow-up was negatively associated with parental monitoring and parental emotional dysregulation at baseline, regardless of intervention condition
40 Tan et al., 2021	Cohort	Texas	Permanent supportive housing	Residents of permanent supportive housing (N = 653)	Soc	Escalation	At baseline, individuals with greater social support tended to have less substance use problems. Individuals with a faster increase in social support tended to have steeper rates of reduction in substance use problems during follow-up.
41 Thomas et al., 2021	Cohort	Georgia	School	Undergraduate college students (N = 1155)	Soc	Initiation	Peer deviance among college students was associated with a higher probability of cannabis use, while engagement with community and church activities had a negative association with cannabis use.
42 Tucker et al., 2013	Cohort	Nationwide	School	Adolescents aged 12–19 years (N = 6516)	Env; Soc	Initiation	Marijuana Initiation, which occurred for 12.9 % of adolescents during one-year follow-up, was more likely among adolescents who had school friends engaged in binge drinking and friends mostly from outside of the school, as well as those who lived in neighborhoods with a higher unemployment rate.
43 Valeri et al., 2018	RCT	Massachusetts	Community outpatient treatment centers	Adult women with substance dependence (N = 100)	Hlt	Recovery	Among women in SUD treatment, those who experienced the highest level of treatment group affiliation were found to reduce substance use by about 1.75 days more than women who experienced the lowest level of affiliation at the end of the treatment phase (3 months).
44 Walley et al., 2015	Cohort	Massachusetts	Primary care clinics	Individuals with substance dependence with or at risk of HIV (N = 215)	Env; Edu	Treatment; relapse	Among a clinic cohort of individuals with substance dependence with or at risk of HIV, there was no observed association between education/housing status with treatment engagement/persistent substance dependence.

Authors	Study design	Location of the study	Setting	Population	SDoH domain ^a	SUD stages	Key findings
45 Whittle et al., 2019	Cohort	Nationwide	Clinic and community outreach	Women with or at risk for HIV (N = 2553)	Eco	Escalation	Women with or at risk of HIV with persistent very low food security had higher odds of any illicit substance use, cannabis use, and stimulant use compared to women who had high FS.
46 Williams et al., 2023	Cohort	Illinois	Community	Young (aged 18–30) people who injected drugs (N = 135)	Eco; Env; Edu; Soc	Treatment	Among young patients who injected drugs, MOUD uptake was positively associated with a greater number of direct support network connections and negatively associated with community-level normative stigma
47 Winograd et al., 2020	Pre and post	Missouri	SUD treatment agencies	Individuals receiving services at SUD treatment agencies (N = 3800)	Hlt	Treatment	Findings suggest Medication First implementation through STR was successful in shortening the time lag to MOUD prescription and improving treatment retention at various timeframes.
48 Worley et al., 2014	RCT	California	Veterans Affairs San Diego Healthcare System	Veterans with alcohol or drug dependence and major depression (N = 201)	Env; Edu; Soc	Escalation	The percentage of veterans' peer network regularly using drugs was significantly correlated with their percentage of days using drugs. More structured environmental settings appear to alleviate the risk associated with social network substance use.
49 Wu et al., 2016	Cohort	Nationwide	Community	Adolescents followed from grades 7–12 to adulthood (Wave I, 1995, N = 20,745; Wave IV, 2008–09, N = 15,701)	Eco; Env; Edu; Soc	Initiation	Adolescents who participated in welfare before the age of 18 years had a significantly lower probability of remaining substance-free until young adulthood. Remaining marijuana-free until young adulthood was also affected by other family and community factors, such as family structure, parental education, and community drug problems.
50 Xerxa et al., 2023	Cohort	North Carolina	Community	Children initially aged 9, 11, and 13 years (N = 1334)	Eco; Env; Soc	SUD	There was no evidence for an association of childhood loneliness with adult SUD.

^aEco = Economic stability; Env = Neighborhood and physical environment; Edu = Education; Soc = Social and community; Hlt = Healthcare.

Table 2Characteristics of Included Studies ($N = 50$).

	Number	Percentage
<i>Study characteristics</i>		
Publication year		
2010 and before	7	14 %
2011–2015	12	24 %
2016–2020	18	36 %
2021 and after	13	26 %
Study design		
Cohort	42	84 %
Randomized controlled trial (including group randomized trial)	5	10 %
Other designs	3	6 %
Setting		
School	11	22 %
Community	11	22 %
Substance use specialty setting	8	16 %
Primary care setting	8	16 %
Multiple setting	6	12 %
Other or unspecified	6	12 %
Population (at first assessment)		
Children, adolescents, young adults	23	46 %
Adults	25	50 %
Other	2	4 %
<i>SDoH factors and stages of SUD examined</i>		
SDoH domain		
Economic stability	23	46 %
Neighborhood and physical environment	21	42 %
Education	18	36 %
Social context and community	35	70 %
Healthcare	10	20 %
SUD stages		
Initiation	11	22 %
Escalation	19	38 %
Treatment	10	20 %
Recovery and relapse	7	14 %
Overdose and mortality	5	10 %

Table 3

Summary of SDoH factors examined in the included studies (N = 50).

SDoH measures	Description	Studies
<i>Economic stability</i>		
Employment	Employment status, duration, and occupation	(Aram et al., 2020; Davis, Merrin, et al., 2016; Falade-Nwulia et al., 2022; Hser et al., 2008; Kelly et al., 2021; Lofwall & Havens, 2012; Nosyk et al., 2013; Oh et al., 2020; Orwat et al., 2011; Prendergast et al., 2008; Shah et al., 2006; Williams et al., 2023; Wu et al., 2016)
Income	Days paid work, employment income, total household income	(Aram et al., 2020; Cucciare et al., 2019; Harvey et al., 2016; Kelly et al., 2021; Oh et al., 2020; Valeri et al., 2018; Whittle et al., 2019; Wu et al., 2016)
Job opportunities	Employment training and paid workplace attendance for patients in methadone programs	(Donlin et al., 2008; Oh et al., 2020)
Social welfare	Social welfare eligibility category, childhood welfare participation,	(Lo-Ciganic et al., 2019; Orwat et al., 2011; Wu et al., 2016)
Poverty	Concern about paying bills	(Quinn et al., 2016)
Parental socioeconomic status	Parental education and income	(Atherton et al., 2016; Buu et al., 2009; Davis, Dumas, et al., 2016; Humensky, 2010; McCarty et al., 2012; Shanahan et al., 2021; Tucker et al., 2013; Wu et al., 2016; Xerxa et al., 2023)
Food	Food security	(Whittle et al., 2019)
<i>Neighborhood and physical environment</i>		
Housing	Unstable housing, home ownership cohabitant status	(Ararso et al., 2021; Falade-Nwulia et al., 2022; Li et al., 2019; Orwat et al., 2011; Redmond et al., 2014; Rogers et al., 2021; Shah et al., 2006; Walley et al., 2015)
Transportation	Modes of transportation and time to get to community services	(Kelly et al., 2021)
Geographic area of residence	State of residence, metropolitan vs. nonmetropolitan	(Cucciare et al., 2019; Lo-Ciganic et al., 2019; Xerxa et al., 2023)
Neighborhood characteristics	Such as neighborhood unemployment and poverty rate, percentage of vacant households, educational level of residents, and change of neighborhood environment in childhood, and average distance to treatment facilities	(Atherton et al., 2016; Buu et al., 2009; Davis, Dumas, et al., 2016; Mason et al., 2017; Tucker et al., 2013; Williams et al., 2023)
	Neighborhood violence, crime, drug activities/sales	(Reboussin et al., 2014; Williams et al., 2023; Wu et al., 2016)
County-level characteristics	Including population density, percentage of the county population that is foreign-born or race/ethnic minority; employment rate, opioid prescription rate, health insurance coverage, prison population, and police per capita	(Feldmeyer et al., 2022; Ibragimov et al., 2022)
<i>Education</i>		
Education attainment	The highest grade/degree completed; years of education	(Cucciare et al., 2019; Kelly et al., 2021; Li et al., 2019; Lofwall & Havens, 2012; Nosyk et al., 2013; Orwat et al., 2011; Quinn et al., 2016; Redmond et al., 2014; Shah et al., 2006; Valeri et al., 2018; Walley et al., 2015; Williams et al., 2023; Wu et al., 2016)
Early childhood health education	Such as theory-based and culturally tailored education to reduce HIV risks in middle schools and school-based family resources center to support parenting	(Asdigian et al., 2018; Riggs et al., 2009)
	Race/ethnic segregation in schools	(Dudovitz et al., 2021)
	Perceived school safety, perceived teacher's interest in students, and theft experience at school	(Oh et al., 2020)

SDoH measures	Description	Studies
	Receipt of free or reduced-price lunch at school	(Reboussin et al., 2014; Rogers et al., 2021)
Vocational training	Basic skill training and job opportunities	(Oh et al., 2020)
<i>Social context and community</i>		
Early childhood family system	Family structure	(Atherton et al., 2016; Humensky, 2010; Shanahan et al., 2021; Tucker et al., 2013; Xerxa et al., 2023)
	Children's relationship with parents	(Brook et al., 2013; Grella & Lovinger, 2011)
	Parent supervision and monitoring	(Atherton et al., 2016; Shanahan et al., 2021; Spirito et al., 2021; Tucker et al., 2013)
	Family history of mental health, substance use, and legal involvement, drugs/alcohol available at home	(Mason et al., 2017; Shanahan et al., 2021; Spirito et al., 2021; Tucker et al., 2013; Xerxa et al., 2023)
Marital status	Being married or cohabiting, partnered support	(Aram et al., 2020; Cucciare et al., 2019; Davis, Merrin, et al., 2016; Kelly et al., 2021; Li et al., 2019; Lofwall & Havens, 2012; Nosyk et al., 2013; Orwat et al., 2011; Valeri et al., 2018)
Household	Household size, child dependence in the household	(Whittle et al., 2019; Wu et al., 2016)
Family relationship and support	Relationships with spouse/partners	(Atherton et al., 2016; Brook et al., 2013; Falade-Nwulia et al., 2022)
Social network	Having peers with deviant behaviors or substance use, gang involvement, numbers of persons in drug/sex/support network	(Brook et al., 2013; Davis, Dumas, et al., 2016; Grella & Lovinger, 2011; Lofwall & Havens, 2012; Mason et al., 2017; Oh et al., 2020; Shanahan et al., 2021; Thomas et al., 2021; Tucker et al., 2013; Williams et al., 2023)
Social activity participation	Participation in club sports, school, community, and church activities	(Davis, Dumas, et al., 2016; Thomas et al., 2021)
Social support	Having family, friends, neighbors, and community members available for psychological, physical, and financial support;	(Cucciare et al., 2019; Falade-Nwulia et al., 2022; Haverfield et al., 2019; Kelly et al., 2021; McCarty et al., 2012; Orwat et al., 2011; Tan et al., 2021; Williams et al., 2023)
Stressful life events	Such as losses, transitions, and traumas, in children and adolescents	(McCarty et al., 2012; Rogers et al., 2021)
Exposure to violence and/or trauma	Lifetime physical, emotional, and sexual victimization	(Davis, Dumas, et al., 2016)
	Trauma exposure in childhood, including bully, physical/sexual abuse	(Ararso et al., 2021; Quinn et al., 2016; Rogers et al., 2021; Shanahan et al., 2021)
Stigma	Stigma and discrimination, including racism	(Brook et al., 2013; Fuller-Rowell et al., 2012; Williams et al., 2023)
Immigration status		(Atherton et al., 2016; Orwat et al., 2011; Rogers et al., 2021)
Involvement in CJS	Age at first arrest, prior criminal charges, experience of incarceration	(Davis, Dumas, et al., 2016; Davis, Merrin, et al., 2016; Feldmeyer et al., 2022; Grella & Lovinger, 2011; Harvey et al., 2016; Hser et al., 2008; Nosyk et al., 2013; Oh et al., 2020; Orwat et al., 2011; Prendergast et al., 2008; Redmond et al., 2014; Shah et al., 2006; Williams et al., 2023)
<i>Healthcare</i>		
Insurance coverage	Including Medicaid expansion and Affordable Care Act and deductible	(Falade-Nwulia et al., 2022; Ibragimov et al., 2022; Lo-Ciganic et al., 2019; Redmond et al., 2014; Satre et al., 2020; Whittle et al., 2019)
Access to care	Rapid and low-barrier access to MOUD	(Winograd et al., 2020)
	Failed attempt to access buprenorphine	(Lofwall & Havens, 2012)
	Treatment or recovery referral source	(Kelly et al., 2021; Prendergast et al., 2008)
Quality of care	Sense of affiliation with treatment group	(Valeri et al., 2018)

Table 4

Number of studies reported significant association between SDoH factors and SUD stages.

SDoH DOMAINS	Initiation	Escalation & SUD	Treatment	Recovery & reoccurrence	Overdose & Mortality
Economic stability	Employment	18	7	27, 37	3
	Occupational opportunity			10	
	Food security	45			
	Social welfare	49			
Physical Environment	Parental SES for children	19, 49			
	Housing	1	29	37	22
	Transportation			21	
	Rural/urban		23		
	Neighborhood instability and vulnerability	42, 49	6, 32		
County-level immigration					13
Education	Education attainment	49			
	Early childhood health education	2, 34, 11	15		
	Vocational training		28		
Community, safety, and social context	Parent monitoring	4,34	39		22
	Family structure and relationship	49	17, 38		
	Deviant and substance use social (family & friend) network	4,5, 34,41, 42,49	6,8, 25, 38, 48	9	
	Social support and social activity participation	26	40, 41	12, 29, 46	21
	Stressful life events	26	35		
	Stigma, discrimination, racism		14	46	
	Violence, trauma, victimization	1	8, 31	29	
	Criminal justice system involvement		15, 18	30	27
33					
Health care	Insurance coverage		7,36		
	Low barrier access to MOUD		24	47	
	Recovery group affiliation				43

Note: Numbers in the cells represent study # in Table 1.

1 study 2 studies 3 or more studies

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