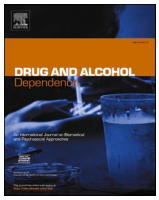
Drug and Alcohol Dependence 264 (2024) 112454

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep



Review

# Factors associated with medications for opioid use disorder (MOUD) treatment success during the pregnancy and postpartum periods: A scoping review

Maureen Mburu [a], Rita Masese [b], Elizabeth T. Knippler [c,d], Melissa H. Watt [e], Amnazo Muhirwa [c], Leila Ledbetter [f], Margaret Graton [f], Brandon A. Knettel [c,g,h,*]

[a] University of Pittsburgh, Department of Medicine, Pittsburgh, PA 15261, USA
[b] University of North Carolina at Chapel Hill, School of Medicine, Department of Social Medicine, Chapel Hill, NC 27599, USA
[c] Duke University School of Nursing, 307 Trent Drive, Durham, NC 27710
[d] Duke Center for AIDS Research, 200 Trent Dr, Durham, NC 27710
[e] University of Utah School of Medicine, Department of Population Health Sciences, 295 Chipeta Way, Salt Lake City, UT 84108, USA
[f] Duke University Medical Center Library, Seeley G. Mudd Bldg, 103, Durham, NC 27710, USA
[g] Duke Global Health Institute, 310 Trent Drive, Durham, NC 27710, USA
[h] Duke Center for Global Mental Health, 310 Trent Drive, Durham, NC 27710, USA

ARTICLE INFO

*Keywords:*
Medications for opioid use disorder
Opioid use disorder
Scoping review, pregnancy
Postpartum
Treatment success

ABSTRACT

*Background:* Medications for opioid use disorder (MOUD) are a crucial intervention for pregnant and postpartum individuals with opioid use disorder (OUD). However, there is paucity of data on the factors associated with MOUD treatment success in this population. This scoping review aimed to evaluate factors associated with MOUD success during the pregnancy and postpartum period.

*Methods:* We completed a structured search of MEDLINE, CINAHL, PsycINFO, Web of Science, and ProQuest databases. Eligible studies included a metric of success in outpatient treatment in the pregnancy and postpartum period and were conducted in the United States after the Food and Drug Administration's approval of buprenorphine in 2002. Reviewers independently screened studies for inclusion and extracted data. The primary outcome was treatment success (i.e., treatment adherence, abstinence from illicit opioids, or retention in care) during pregnancy and up to 12 months postpartum.

*Results:* Data from 15 studies were included. Medications included methadone, naltrexone and buprenorphine (mono or combination therapy). High daily dose of buprenorphine as mono or combination therapy, early initiation and longer duration of MOUD were associated with treatment success. Legal involvement, homelessness, and rural residency were negatively associated with treatment success. There were no differences in outcomes of individuals receiving telemedicine versus in-person care.

*Conclusion:* We identified several factors associated with MOUD treatment success among individuals with OUD during the pregnancy and postpartum periods. These factors may help guide future research and inform the development and adaptation of interventions tailored to better meet the needs of this key population.

## 1. Introduction

As of 2021, more than 7.6 million individuals in the United States were living with opioid use disorder (OUD), the majority of whom were not receiving treatment (Krawczyk et al., 2022). That same year, 80,411 people in the United States died of opioid related overdose, representing more than 400 % increase in overdose deaths from 2010 (NIDA, 2023). Effective treatments exist in the form of medications for opioid use disorder (MOUD) and have been proven to reduce overdose deaths and improve quality of life (SAMHSA, 2016). Unfortunately, an enormous treatment gap exists, as 86.6 % of individuals with OUD in the United States do not receive treatment (Krawczyk et al., 2022). Barriers to MOUD include the cost of treatment, long wait times, insufficient training among providers, and concerns regarding MOUD diversions

* Correspondence to: Duke University School of Nursing, 307 Trent Drive, Room 3080, Durham, NC 27710, USA.
*E-mail address:* Brandon.Knettel@duke.edu (B.A. Knettel).

https://doi.org/10.1016/j.drugalcdep.2024.112454
Received 27 March 2024; Received in revised form 11 September 2024; Accepted 21 September 2024
Available online 28 September 2024

(National Academies of Sciences, 2019).

Among people with OUD, pregnant and parenting individuals face unique barriers to accessing MOUD at the individual, family-social, healthcare system and policy level (Apsley et al., 2024; Choi et al., 2022; Frazer et al., 2019). Individual level barriers include feelings of guilt for their OUD, comorbid and postpartum mental health conditions, lack of transportation, financial constraints and lack of childcare (Apsley et al., 2024; Frazer et al., 2019). Only 5.5 % of treatment facilities provide childcare limiting the number of facilities individuals can use if they don't have childcare (Apsley et al., 2024). Family-social barriers include stigma from family and friends for their OUD in pregnancy, partner's substance use, and lack of emotional and financial support (Apsley et al., 2024; Choi et al., 2022; Frazer et al., 2019). Health care system barriers include exclusion from treatment facilities unable to provide services to pregnant and parenting people and inadequate healthcare provider training on MOUD (Choi et al., 2022; National Academies of Sciences, 2019). Policy level barriers include loss of eligibility from Medicaid after childbirth in certain states, laws that criminalize substance use in pregnancy in certain states, and fear of involvement of Child Protective Services and loss of child custody due to mandatory reporting requirements when they seek care (Apsley et al., 2024; Choi et al., 2022; Frazer et al., 2019).

Pregnancy provides a unique opportunity for engagement with care and can serve as a motivator for individuals with substance use disorders, such as OUD, to seek treatment (Cochran et al., 2018; Kendler et al., 2017). Optimal treatment for OUD during the pregnancy and postpartum period is multifactorial and requires a multidisciplinary team of healthcare providers and case managers (Krans et al., 2017). Several interventions, such as MOUD, harm reduction services, mental health counselling, and breastfeeding support have been shown to be vital in improving outcomes among pregnant individuals with OUD (American College of Obstetricians and Gynecologists' Committee on Obstetric Practice, 2017; Benningfield et al., 2012).

MOUD has been a key pillar in the management of individuals with OUD due to its effect on lowered rate of return to use and opioid-related mortality (Clark et al., 2015; Sordo et al., 2017). MOUD commonly used in the pregnancy and postpartum periods include methadone and buprenorphine, which are full and partial opioid agonists, respectively (Brogly et al., 2014; Link et al., 2020; Suarez et al., 2022). These medications relieve opioid cravings, decrease withdrawal symptoms, reduce the euphoric response to illicit opioid use, and thus promote abstinence and reduced opioid exposure to the fetus (Brogly et al., 2014; Link et al., 2020; SAMHSA, 2023). Compared to methadone, buprenorphine has been associated with better neonatal outcomes i.e. lower risk of preterm birth, greater birthweight and gestational age (Brogly et al., 2014; Noormohammadi et al., 2016; Suarez et al., 2022). Due to the full agonist nature of methadone and the partial agonist nature of buprenorphine, these MOUD may predispose infants to developing neonatal opioid withdrawal syndrome (NOWS) (Brogly et al., 2014; Link et al., 2020; Suarez et al., 2022). This underscores the importance of a multidisciplinary care team that can provide personalized care and carefully weigh the benefits and risks of MOUD during pregnancy (Krans et al., 2017).

Factors associated with MOUD retention and treatment success have been studied extensively in the non-pregnant population, and include adequate dosing of MOUD, stable housing, being female, older age, lack of criminal justice involvement and abstaining from other drug use during treatment (Biondi et al., 2022; Degenhardt et al., 2023; Timko et al., 2016; Viera et al., 2020). However, there is limited research on factors associated with treatment success among pregnant and postpartum individuals. This review aims to identify factors associated with MOUD success among pregnant and postpartum individuals with OUD. Our findings may help guide care providers towards optimal treatment strategies and promote maternal and fetal wellbeing. Our findings may also inform the development and adaptation of interventions tailored towards increasing MOUD initiation and retention in this population.

## 2. Materials and methods

We conducted a scoping review to examine factors associated with treatment success during the pregnancy and the postpartum periods.

### 2.1. Search strategy

The search strategy was designed and conducted by professional medical librarians in consultation with the research team. We conducted searches on the Medline (via PubMed), CINAHL (via EbscoHost), PsycINFO (via EbscoHost), Web of Science (via Clarivate), and ProQuest Dissertations & Theses Global databases. Searches were initially conducted in November 2020 and updated in July 2022. We used a mixture of database-specific subject headings and key words related to the constructs of: (1) opioid use disorder, (2) medication-assisted treatment, and (3) an adult population in the United States. The search was carefully constructed to allow us the flexibility to combine terms with adjacency, rather than having to come up with every possible phrase that could be used to capture this concept. While we did not use the term 'medication for opioid use disorder,' our search strategy allowed us the flexibility to combine terms with adjacency and enabled us to capture articles that used the term. A complete reproducible search strategy is detailed in Appendix A.

### 2.2. Eligibility criteria

Studies were eligible for inclusion if they had participants who were currently pregnant and/or within one year of giving birth at the time of data collection. Studies had to have been conducted in the United States among individuals engaged in treatment for OUD and reported patient-level outcomes on outpatient treatment success. The outcome of interest was treatment success during the pregnancy and/or postpartum (within one year of giving birth) period. Based on prior literature, the definitions of treatment success included MOUD adherence, negative urine toxicology screens, absence of return to use, absence of opioid misuse, absence of misuse of unprescribed substances and retention in clinical care (Hutchison et al., 2023). Retention in care was defined as attendance of scheduled study/program visits. Outcomes could be self-reported or observed by study or clinic staff, including clinic attendance, medical record review, or urine drug screens. Studies were not included if their outcomes were related to withdrawal symptoms, tapering off of MOUD or drug detoxification only, if outcomes were reported only for fetuses/infants (no maternal outcomes), or if a retention outcome referred to retention in the study/trial only (not retention in treatment). Studies with individuals on MOUD and individuals not on MOUD were included in the review if they reported disaggregated outcomes among individuals on MOUD; for these studies, only data from the individuals on MOUD were included in the extraction.

We limited the search to English-language studies with data collection beginning in 2002 or later, after the Food and Drug Administration (FDA) approval of buprenorphine, which marked the beginning of the modern era of MOUD provision (U.S. Food & Drug Administration (FDA), 2002). We included published research manuscripts, dissertations, theses, and conference abstracts. We excluded purely qualitative studies, case studies and other studies with a sample size of fewer than ten participants, systematic reviews or meta-analyses, commentaries, and letters to the editor. We also excluded studies with purely pharmacokinetic or genetic predictors of outcomes and those that focused on systems- or provider-level data with no patient-level outcomes. As part of our extraction, we did not include predictors mentioned without statistics to support the findings (e.g., a claim that something was "not significant" but with no statistics provided in the main article or in the supplemental data.

### 2.3. Study selection

Studies selected for this review were obtained from a broader, pooled MOUD systematic review data set that was created using all studies on OUD and MOUD. Six reviewers screened titles, abstracts, and full-text articles, using a standardized form. We identified 10,642 records (representing 10,577 studies) from the pooled database. After removing 3696 duplicates, 6881 studies were retained. Reviewers independently screened the titles and abstracts of the 6881 studies. Seven hundred ninety-eight studies were retained for full-text review. Of those 798 studies, 418 studies were retained in the final pooled database of MOUD studies of perinatal and non-perinatal populations.

For this study, the team reviewed the final MOUD database of 418 studies and included studies whose main population of interest was pregnant and/or postpartum individuals. These studies then went on to the data extraction stage. Disagreements that arose during the study selection stage were resolved through team discussions. We used Covidence review software to facilitate literature screening.

A total of 15 studies were included in our final review. In two instances, two studies used the same dataset and were therefore listed together in the study tables (Coker et al., 2018; Krans et al., 2021; Lo-Ciganic et al., 2019; Ray-Griffith et al., 2021). Findings from these pairs were reported together except when one of the studies reported a unique finding. See Fig. 1 for the PRISMA flow chart diagram for additional detail about the study selection process.

### 2.4. Data extraction

A standardized data extraction form was developed in Covidence, and data for each included study were extracted by the research team. Questions that arose during extraction were discussed among the team until consensus was reached. Extracted data included general information about the context of care (location, setting of treatment, medication studied), study design (type of study, aims, data collection dates), and participants (inclusion/exclusion criteria, participant demographics). We also extracted data on maternal or neonatal outcomes as descriptive information about the sample in relation to pregnancy (e.g., gestational age at time of MOUD initiation).

To examine factors associated with MOUD success, we extracted information about the type of statistical analysis used, any sub-groups of participants, and the study's definition of treatment success (our outcome of interest). In studies where success was measured in multiple

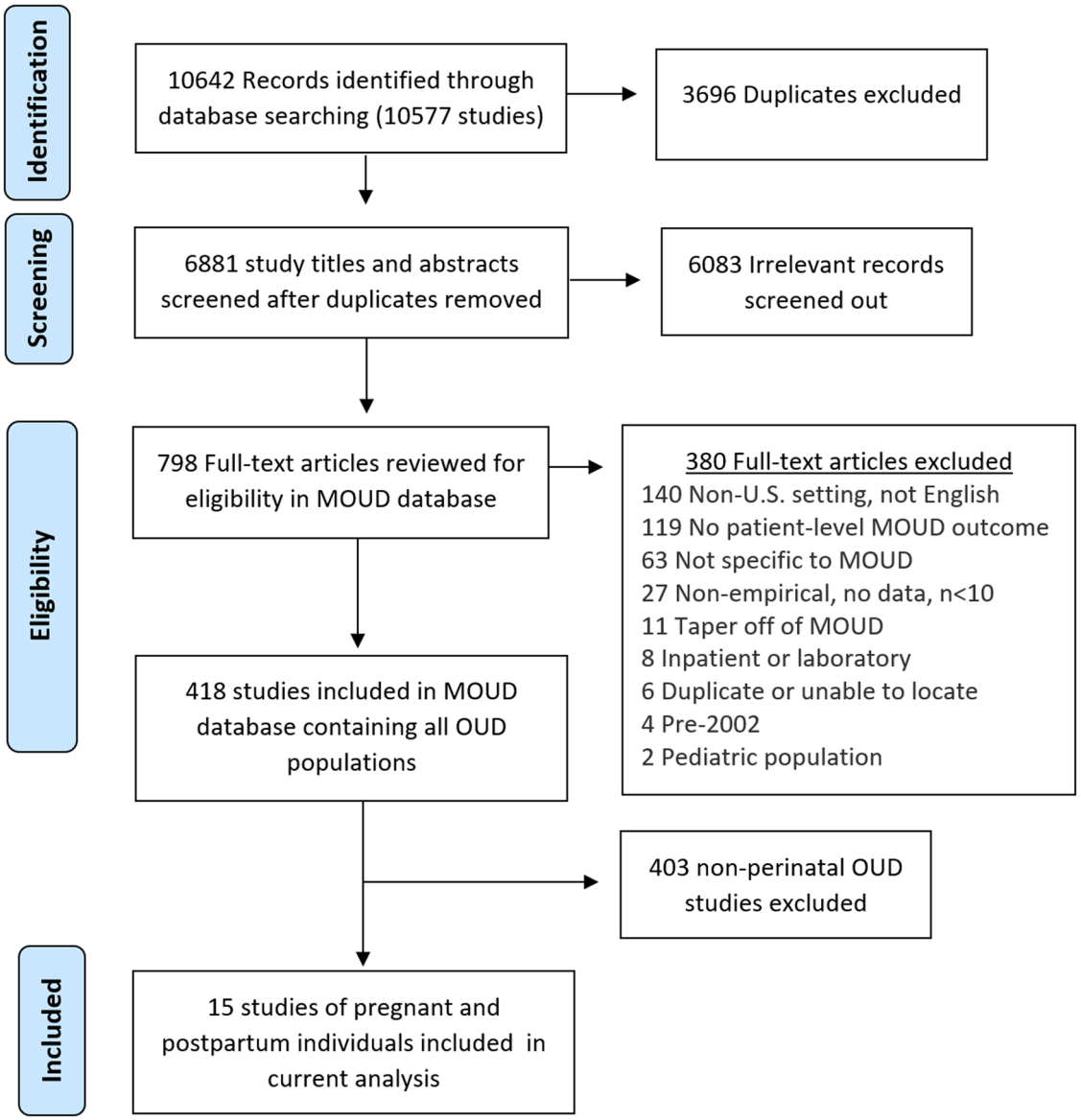



**Fig. 1. :** PRISMA flow chart diagram.

ways, we prioritized observed measures such as clinic documentation of treatment retention or drug screen data over self-reported outcomes such as self-reported drug use. We noted the sample size for each study, documenting any participants excluded from analysis by the authors and their rationale (e.g., incomplete data) and any participants excluded from extraction by our study team and rationale (e.g., exclusion of a trial group that was not enrolled in MOUD). Once a measure of treatment success was identified for each study, both significant ($p<.05$) and non-significant factors were recorded in the extraction form, including the assessed associations of the predictors with the identified outcome as reported in the study. Factors were only included if test statistics were provided (e.g., referring to an association as "significant" or "non-significant" was not adequate). We extracted data from multivariable assessments, however if a paper only had descriptive statistics such as t-tests, chi square, ANOVA etc., univariate or bivariate assessments, we considered those as well. For studies that had predictor variables at multiple levels, the variable was considered a significant predictor if any of the levels were significantly associated with treatment success.

## 3. Results

### 3.1. Summary of included studies

A total of 15 studies met the inclusion criteria for this review. With regard to study design, 13 were observational cohort studies, 1 was a nonrandomized control trial, and 1 was a randomized controlled trial of different group therapy modalities in the context of MOUD. The number of study participants ranged from 19 to 7754 (mean=975, median=144). The studies were conducted across nine different states, with data collection occurring between the years of 2006–2019. MOUD used included buprenorphine mono-product (n=13 studies)(Brogly et al., 2018; Cochran et al., 2018; Coker et al., 2018; Guille et al., 2020; Krans et al., 2018, 2021; Lander et al., 2015; Lo-Ciganic et al., 2019; Mullins et al., 2020; O'Connor et al., 2018; Ray-Griffith et al., 2021; Schiff et al., 2021; Wachman et al., 2019), combination product of buprenorphine and naloxone (n=4)(Lo-Ciganic et al., 2019; Mullins et al., 2020; O'Connor et al., 2018; Schiff et al., 2021), methadone (n=5) (Brogly et al., 2018; Ellis et al., 2019; Krans et al., 2021; Schiff et al., 2021; Wilder et al., 2017), and naltrexone (n= 1) (Wachman et al., 2019), with several studies having participants who were on more than one drug at different time points of treatment. Additional characteristics of the individual studies are described in Table 1.

Studies assessed treatment success during the antenatal period for individuals who had initiated MOUD prior to conception as well as those initiating MOUD during pregnancy. Treatment success definitions varied among the studies with some studies having more than one definition of treatment success. Definitions included treatment adherence (taking medication, absence in gaps of MOUD receipt), abstinence (negative urine toxicology screens, absence of return to use, absence of opioid misuse and absence of misuse of unprescribed substances), and retention in clinical care (attendance of medical/program appointments and absence of transfer to other facilities for care) (Table 2). Follow-up duration for assessment of treatment success ranged from measurement only during the prenatal period to 12 months postpartum. The mean age of participants ranged from 26 to 33 years old at the time of enrollment. Notably, nearly all the studies enrolled a very high percentage of non-Hispanic white participants, making up 80–98 % of the study samples. Additional information about the study designs and findings can be found in Table 2.

We summarize the factors associated with MOUD treatment success in 7 areas: medication characteristics, demographic and social characteristics, health and healthcare utilization, perinatal health and behavior, non-opioid substance use, mental health, and supportive intervention strategies.

### 3.2. Medication characteristics

Four studies compared treatment success between medication regimens (Fig. 2). Schiff et al. found a decreased likelihood of discontinuation among participants receiving 'any buprenorphine' (included those who had received buprenorphine and methadone on separate occasions) vs. those on methadone only (Schiff et al., 2021). Brogly et al. showed no differences in return to use or continued opioid use when comparing individuals in a buprenorphine group to those in a methadone group (Brogly et al., 2018). When compared to individuals receiving naltrexone (Wachman et al., 2019) or the combined product of buprenorphine and naloxone (Mullins et al., 2020), individuals receiving only buprenorphine had no significant differences in urine toxicology screens, or provider reports of misuse of an unprescribed substance.

Concerning MOUD dosage, higher buprenorphine daily dose as monotherapy or as combination therapy in the prenatal period and during pregnancy was largely associated with an increased likelihood of treatment retention and lower likelihood of poor adherence in three out of four studies analyzing buprenorphine dose as a predictor (Coker et al., 2018; Lo-Ciganic et al., 2019; Ray-Griffith et al., 2021); only O'Connor et al. found no significant association between buprenorphine dose at delivery and treatment retention at six and twelve months postpartum (O'Connor et al., 2018). Two studies explored the possible relationship of methadone dose with treatment success (Ellis et al., 2019; Wilder et al., 2017). Wilder et al. showed that individuals on $\geq$60 mg of methadone during pregnancy were associated with higher retention in treatment at delivery and sixty days postpartum compared to those who were on <60 mg of methadone (Wilder et al., 2017). Ellis et al., however, observed no significant association between methadone dose at delivery and retention in care or cases of opioid misuse (Ellis et al., 2019).

Six studies examined duration of MOUD as a factor associated with treatment success. Longer duration in treatment was associated with higher retention rates and treatment success, particularly during the postpartum period, in five out of six studies (Coker et al., 2018; Ellis et al., 2019; Krans et al., 2021; Schiff et al., 2021; Wilder et al., 2017). Ray-Griffith et al. however, reported no significant association between the duration of treatment at the time of delivery and retention in care (Ray-Griffith et al., 2021).

Regarding treatment initiation, O'Connor et al. demonstrated that early initiation of MOUD, either at conception or during the first trimester of pregnancy, was associated with increased retention in care (O'Connor et al., 2018). Ray-Griffith et al. however found no association between gestational age at enrollment and thirty-day postpartum rates of dicontinuing care among participants (Ray-Griffith et al., 2021). Lo-Ciganic et al. categorized a cohort of Medicaid enrollees on buprenorphine into six treatment trajectories based on time of initiation and levels of adherence or discontinuation. They found that prior use of buprenorphine or early initiation during pregnancy were associated with consistent adherence measured at twelve weeks postdelivery (Lo-Ciganic et al., 2019).

### 3.3. Demographic and social determinants of health

Factors such as age, race/ethnicity, employment, marital status, and level of education were reported in nine out of the fifteen studies. Studies also examined personal variables such as legal involvement, homelessness, rural residence, insurance status, social services involvement, and social support (Fig. 3)

Eight studies reported on mother's age (Cochran et al., 2018; Coker et al., 2018; Ellis et al., 2019; Lo-Ciganic et al., 2019; O'Connor et al., 2018; Ray-Griffith et al., 2021; Schiff et al., 2021; Wilder et al., 2017). Of these, three studies reported a significant association of older age with treatment success (Ellis et al., 2019; Lo-Ciganic et al., 2019; Schiff et al., 2021), while this was non-significant in five studies. Lo-Ciganic et al. reported that younger age was associated with late initiation and

**Table 1**
Characteristics of included studies and participant demographics.

| Study | Location | Setting and type of treatment/care | Medications studied | Age mean (SD) | Race/Ethnicity n (%) |
|---|---|---|---|---|---|
| Brogly et al. (2018) | Boston, MA | Comprehensive outpatient treatment program offering MOUD, prenatal visits, labor/delivery services, and social services | Buprenorphine or Methadone | 28.3 (4.4) | Non-Hispanic white: 91 (80.5)<br>Non-Hispanic black: 11 (9.7)<br>Hispanic: 11 (9.7) |
| Cochran et al. (2018) | Pittsburgh, PA | Outpatient MOUD plus prenatal care, case management, and behavioral health referrals | Buprenorphine | 29.7 (5.7) | White: 20 (95.2) |
| Coker et al. (2018); Ray-Griffith et al. (2021) | Little Rock, AR | Outpatient MOUD with phased clinic visits including urine drug screen, psychiatric care, and group therapy (two studies covering different time periods with overlap) | Buprenorphine | Study 1:<br>28 (4) - "Adherent"<br>29 (5) - "Moderately adherent"<br>29 (6) - "Non-adherent"<br>Study 2:<br>28.1 (4.4) | Study 1:<br>White: 31 (76): "Adherent":<br>7 (88):"Moderately adherent"<br>13 (87): "Non-adherent"<br>Study 2:<br>White: 50 (78.1) |
| Ellis et al. (2019) | Detroit, MI | Outpatient urban, methadone treatment program | Methadone | Retained at 30 days<br>29.9 (5.1)<br>Discharged by 30 days<br>27.3 (4.2) | Retained at 30 days<br>White: 35 (68.6)<br>Non-white: 16 (31.4)<br>Discharged at 30 days<br>White: 13 (86.7)<br>Non-white: 2 (13.3) |
| Guille et al. (2020) | South Carolina | MOUD received via telemedicine or in-person at obstetrician's office | Buprenorphine | Telemedicine<br>30.2 (5.5)<br>In person<br>30.1 (4.9) | Telemedicine<br>White: 42 (91.3)<br>Black: 2 (4.3)<br>In person<br>White: 43 (76.8)<br>Black: 7 (12.5) |
| Krans et al. (2018) | Pittsburgh, PA | Comparison of two cohorts:<br>1. Women-centered services at maternity hospital (MOUD + women-centered medical and social services received at Pregnancy Recovery Center – *PRC)*<br>2. MOUD from buprenorphine programs that did not provide women-centered services (*Non-PRC)* | Buprenorphine | PRC<br>28.9 (4.5)<br>Non-PRC<br>28.7 (4.9) | PRC<br>Caucasian: 67 (95.7)<br>Non-PRC<br>Caucasian: 166 (96.5) |
| Lander et al. (2015) | Morgantown, WV | Outpatient MOUD plus group therapy (cognitive behavioral therapy, psychoeducation on disease model of addiction, return-to-use prevention, 12-step)<br>Comparison of treating pregnant women in pregnancy-only groups (included topics related to labor and delivery, parenting, etc.) or treatment as usual: mixed-gender therapy groups | Buprenorphine | **reported as n (%)*<br>Treatment as usual<br>≤ 18 years: 0<br>19–34 years: 17 (94)<br>≥35 years: 1 (6)<br>Pregnancy-only groups<br>≤18 years: 1 (4)<br>19–34 years: 25 (93)<br>≥35 years: 1 (4) | |
| Lo-Ciganic et al. (2019); Krans et al. (2021) | Pennsylvania | Statewide retrospective longitudinal analysis using Medicaid claims data (two studies with different sub-samples and time periods) | Study 1:<br>Buprenorphine or Buprenorphine/naloxone<br>Study 2:<br>Buprenorphine or Methadone | Study 1:<br>27.8 (4.6)<br>Study 2:<br>1–10 weeks MOUD<br>27.9 (4.5)<br>11–20 weeks MOUD<br>28.2 (4.6)<br>>20 weeks MOUD<br>29.0 (4.5) | Study 1:<br>White: 94.5 %<br>Non-white: 5.5 %<br>Study 2:<br>1–10 weeks MOUD<br>Hispanic white: 2466 (90.7)<br>Non-Hispanic black: 146 (5.4)<br>Hispanic: 58 (2.1)<br>Other: 48 (1.8)<br>11–20 weeks MOUD<br>Non-Hispanic white: 1300 (91.8)<br>Non-Hispanic black: 68 (4.8)<br>Hispanic: 33 (2.3)<br>Other: 15 (1.1)<br>>20 weeks MOUD<br>Non-Hispanic white: 3372 (93.2)<br>Non-Hispanic black: 130 (3.6)<br>Hispanic: 63 (1.7)<br>Other: 55 (1.5) |
| Mullins et al. (2020) | Western North Carolina | "Comprehensive, perinatal substance use disorders (PSUDs) program" at a community-based obstetrics and gynecology residency program | Buprenorphine or Buprenorphine/naloxone | Buprenorphine<br>27.5 (4.4)<br>Buprenorphine and naloxone<br>28.0 (4.6) | Buprenorphine<br>White: 95 (92.2)<br>Black: 1 (1.0)<br>Hispanic: 2 (1.9)<br>Native-American: 5 (4.9)<br>Buprenorphine and naloxone<br>White: 70 (88.6)<br>Black: 2 (2.5) |

(*continued on next page*)

**Table 1** (*continued*)

| Study | Location | Setting and type of treatment/care | Medications studied | Age mean (SD) | Race/Ethnicity n (%) |
|---|---|---|---|---|---|
| | | | | | Hispanic: 1 (1.3)<br>Native-American: 5 (6.3)<br>Unreported: 1 (1.3) |
| O'Connor et al. 2018 | Waterville, ME | Family residency program with rural and socioeconomically disadvantaged patient population. MOUD plus required integrated obstetric care, addiction medicine, and behavioral health treatment program | Buprenorphine or Buprenorphine/ naloxone | In treatment at six months<br>26.5 (0.34)<br>Not in treatment at six months<br>27.0 (0.57) | |
| Schiff et al. (2021) | Massachusetts | Retrospective longitude analysis of linked statewide datasets including records of individuals receiving methadone or buprenorphine | Buprenorphine or Buprenorphine/ naloxone | *reported as n (%)*<br>Continued treatment for 1 year postpartum<br>≤25 years: 367 (24.7)<br>26–34 years: 951 (64.1)<br>≥35 years: 166 (11.2)<br>Discontinued treatment during 1 year postpartum<br>≤25 years: 265 (32.1))<br>26–34 years: 480 (58.1)<br>≥35 years: 81 (9.8) | Continued treatment for 1 year postpartum<br>White non-Hispanic: 1368 (92.2)<br>Black non-Hispanic: 24 (1.6)<br>Hispanic: 73 (4.9)<br>Other: 19 (1.3)<br>Discontinued treatment during 1 year postpartum<br>White non-Hispanic: 717 (86.8)<br>Black non-Hispanic: 32 (3.9)<br>Hispanic: 57 (6.9)<br>Other: 20 (2.4) |
| Wachman et al. (2019) | Boston, MA | Outpatient MOUD and integrated addiction and prenatal care program | Buprenorphine or Naltrexone | Buprenorphine<br>30.5 (4.7)<br>Naltrexone<br>32.4 (4.0) | Buprenorphine<br>White: 11 (85)<br>Hispanic: 1 (8)<br>Other: 1 (8)<br>Naltrexone<br>White: 6 (100) |
| Wilder et al. (2017) | Cincinnati, OH | Outpatient MOUD with weekly individual counseling, biweekly physician appointments with dose adjustments, and coordination of care with prenatal care providers | Methadone | 27.5 (4.3) | Caucasian: 185 (97.9)<br>African American: 1 (0.5)<br>Hispanic: 4 (2.1)<br>Other: 3 (1.6) |

Note: White race was reported differently across the studies. It was interchangeably reported as White non-Hispanic, non-Hispanic white or Caucasian. Buprenorphine refers to monotherapy while buprenorphine and naloxone refers to the combination product. Age and race/ethnicity in some studies were reported as subgroups based on treatment groups, outcomes or medications

discontinuation of treatment (Lo-Ciganic et al., 2019). Similarly, bivariate analysis from Ellis et al. reported that younger intake age was associated with being out of care at thirty days postpartum. However, this significance did not hold in their multivariate analysis (Ellis et al., 2019). Schiff et al. found that younger mothers had a higher likelihood of having gaps of two consecutive months without receipt of MOUD during the pregnancy and postpartum periods (Schiff et al., 2021). After stratification by type of MOUD, however, younger age was significantly associated with a gap in care only in the buprenorphine group and not the methadone group (Schiff et al., 2021).

Amongst the six studies that looked at race/ethnicity, only two reported a significant association between race/ethnicity and MOUD success (Cochran et al., 2018; Coker et al., 2018; Ellis et al., 2019; Lo-Ciganic et al., 2019; Ray-Griffith et al., 2021; Schiff et al., 2021). In studies by Lo-Ciganic et al. and Schiff et al., white participants were associated with higher treatment adherence compared to participants from other racial or ethnic groups (Lo-Ciganic et al., 2019; Schiff et al., 2021).

Employment status, marital status and education level were not significantly associated with treatment success in any of the included studies (Cochran et al., 2018; Coker et al., 2018; Ray-Griffith et al., 2021; Schiff et al., 2021). Social services involvement and maternal social support were also not associated with treatment success (Cochran et al., 2018; Ray-Griffith et al., 2021).

Schiff et al. reported that homelessness and rural residency were both related with a higher likelihood of treatment discontinuation (Schiff et al., 2021). Lo-Ciganic et al. observed that participants outside of metropolitan counties were more likely to initiate MOUD late in pregnancy and to experience challenges with treatment adherence (Lo-Ciganic et al., 2019). Additionally, Schiff et al. and Brogly et al. showed that legal involvement (i.e., incarceration, being on parole, or having pending charges) was associated with lower retention in treatment (Brogly et al., 2018; Schiff et al., 2021).

Schiff et al. reported that women on Medicaid were associated with better retention in treatment as compared to individuals with other insurance or no insurance (Schiff et al., 2021). Coker et al. explored differences in adherence to treatment at delivery among those with Medicaid insurance, while Ray-Griffith et al. explored differences in postpartum retention among those with Medicaid insurance; no differences were reported between the "adherent" and "non-adherent" groups or those who discontinued vs. those retained in treatment 12 weeks postpartum respectively (Coker et al., 2018; Ray-Griffith et al., 2021).

### 3.4. Health and healthcare utilization

Lo-Ciganic et al. reported that frequent hospitalizations and fewer outpatient visits during pregnancy were associated with lower treatment adherence (Lo-Ciganic et al., 2019). In the study by Coker et al., participants were enrolled and scheduled to attend several visits during their pregnancy; lower attendance of visits was negatively associated with adherence to treatment (Coker et al., 2018). Schiff et al. reported higher discontinuation of treatment among the participants who had three or more visits to the emergency department and with those with less adequate prenatal care (measured by the Kotelchuck Index) (Schiff et al., 2021). Schiff et al. also found that those receiving an opioid prescription other than MOUD in the three months before delivery had increased likelihood of MOUD discontinuation (Schiff et al., 2021). After stratification by type of medication, this difference was only significant in the methadone group (Schiff et al., 2021).

Cochran et al. asked participants to indicate both their level of general health and pain on scales of 1–5; neither of these self-assessments were significantly associated with early discontinuation of

**Table 2**
Definitions and Factors associated with Treatment Success.

| | Study Design | Data Collection | n included in extraction | Definition of Treatment Success | Significant Factors ($p<.05$) | Non-significant Factors ($p\geq.05$) |
|---|---|---|---|---|---|---|
| Brogly et al. (2018)[#] | Prospective Cohort study | 2015 | 103 (59 buprenorphine, 54 methadone) | Retention in clinical care or negative urine toxicology screens | No legal involvement<br>Lower mean ASI drug, family and legal scores | Type of medication |
| Cochran et al. (2018)[***] | Prospective Cohort study | 2015–2016 | 21 | Absence of return to use and lack of transfer of clinical care to another facility | Absence of depression at baseline | Age, education, employment status, white race, number of children, pain, general health, maternal social support, moderate nicotine dependence, anxiety, days in outpatient SUD treatment 28 days prior to consent, drug misuse severity score, lifetime heroin use, heroin use 30 days prior to enrollment and injection heroin use 30 days prior to enrollment |
| Coker et al. (2018)[#]; Ray-Griffith et al. (2021)[**] | Retrospective cohort study based on record review | Study 1<br>2014–2016<br>Study 2<br>2014–2017 | Study 1<br>64<br>Study 2<br>64 | Study 1<br>Adherence to treatment at delivery<br>Study 2<br>Attendance of appointment within 10–14 weeks postpartum | Study 1<br>Higher buprenorphine dose at last visit<br>Total time in treatment<br>More scheduled visits<br>Lower COWS score at last visit<br>Study 2<br>Higher dose of buprenorphine at delivery<br>Lack of Illicit benzodiazepine use<br>Higher breastfeeding rates | Study 1<br>Age, high school graduate, employment, white race, marriage, Medicaid insurance, SOWS score at last visit, previous MOUD treatment, major depressive disorder, posttraumatic stress disorder, bipolar disorder, parity, gravidity, and positive tobacco use<br>Study 2<br>Age, high school graduate, employment, white race, marriage, Medicaid insurance, the COWS and SOWS proximate to delivery, duration in treatment at delivery, social services involvement, major depressive disorder, beck depression inventory, posttraumatic stress disorder, substance use disorders, antidepressant prescription during pregnancy, positive UDT for cannabis during the third trimester, positive tobacco use at enrollment, gestational age at enrollment, gravidity, parity, vaginal delivery and NAS |
| Ellis et al. (2019) | Retrospective cohort study based on record review | 2010–2017 | 66 | Bivariate:<br>Retention 30 days postpartum or no opioid misuse at thirty days<br>Multivariate:<br>No opioid misuse at 30 days among those retained | Bivariate:<br>Older age<br>Longer days in treatment during pregnancy<br>Smaller proportion of opioid-positive toxicology screens before delivery<br>Nonopioid only discharge medication<br>Vaginal delivery<br>Multivariate:<br>Days in treatment during pregnancy<br>Vaginal delivery<br>No receipt of opioids at discharge | Bivariate:<br>Race<br>Methadone dose at delivery<br>History of injection use<br>Multivariate:<br>Intake age |
| Guille et al. (2020)[***] | Nonrandomized controlled trial | 2017–2018 | 89 (41 telemedicine, 48 in-person) | Retention 6–8 weeks postpartum | n/a | Treatment via telemedicine |
| Krans et al. (2018)[#] | Retrospective cohort study based on record review | 2014–2016 | 248 (177 intervention, 71 control) | Negative urine toxicology screen for illicit drug use at delivery (including opioids) | n/a | Pregnancy Recovery Program |
| Lander et al. (2015)[#] | Randomized controlled trial | n/a | 45 (27 intervention, 18 control) | Retention 4 weeks postpartum | n/a | Mixed-gender group therapy |
| Lo-Ciganic et al. (2019)[***]; Krans et al. (2021)[***] | Retrospective cohort study based on record review | Study 1<br>2008–2015<br>Study 2<br>2009–2017 | Study 1<br>2361<br>Study 2<br>7754 | Study 1<br>Early initiation to treatment and high adherence prenatally and up to 12 weeks | Study 1<br>Older age<br>White race<br>Metropolitan county residents | Study 1<br>Prior methadone<br>Mental health disorders<br>Study 2<br>n/a |

(*continued on next page*)

**Table 2** (*continued*)

| | Study Design | Data Collection | n included in extraction | Definition of Treatment Success | Significant Factors ($p<.05$) | Non-significant Factors ($p\geq.05$) |
|---|---|---|---|---|---|---|
| | | | | postpartum<br>Study 2<br>Rates of continuation of medication for OUD | Higher buprenorphine daily dose<br>Buprenorphine therapy prior to pregnancy<br>Presence of OUD coded diagnosis<br>Lower pregnancy hospitalizations<br>More outpatient visits<br>No history of SUD<br>Tobacco use<br>Less frequent diagnoses of comorbid alcohol use disorders<br>Study 2<br>Longer duration of use of medication during pregnancy | |
| Mullins et al. (2020)*** | Retrospective cohort study based on record review | 2014–2018 | 184 (105 buprenaloxone, 79 buprenorphine) | Prescribed medication urine drug screen at delivery | n/a | Type of medication |
| O'Connor et al. 2018# | Retrospective cohort study based on record review | 2007–2015 | 190 | Retention in treatment at 6 and 12 months postpartum | 6 months postpartum:<br>Antidepressant prescription during 3rd trimester<br>Absence of Illicit drug use (excluding marijuana)<br>12 months postpartum:<br>Treatment with buprenorphine at conception<br>Entry into treatment after first trimester<br>Absence of Illicit drug use (excluding marijuana)<br>Marijuana use during third trimester | Age at delivery<br>Buprenorphine dose at delivery Tobacco use |
| Schiff et al. (2021)*** | Retrospective cohort study based on record review | 2011–2014 | 2314 | No gaps of 2 consecutive months without receipt of MOUD one-year postpartum | Older age<br>White non-Hispanic race<br>Rural residence<br>Medicaid insurance<br>No incarceration<br>No homelessness<br>Buprenorphine<br>Longer duration of treatment prenatally<br>No anxiety diagnosis<br>Less than 3 ED visits<br>Higher perceived adequacy of prenatal care<br>No prenatal receipt of an opioid prescription other than MOUD<br>No cesarian section delivery<br>Absence of pre-term or low birth weight<br>Absence of infant NAS diagnosis | Maternal education<br>Marital status<br>Overdose event<br>Depression diagnosis<br>Breastfeeding at discharge<br>Multiple pregnancy |
| Wachman et al. (2019)* | Retrospective cohort study based on record review | 2017–2019 | 19 | Negative urine toxicology screen or no misuse of unprescribed substances as reported by provider | n/a | Type of medication |
| Wilder et al. (2017)+ | Retrospective cohort study based on record review | 2006–2013 | 189 (108 <60 mg/day, 81 ≥60 mg/day) | Retention in treatment at delivery and 60 days postpartum | Higher methadone dose<br>Longer length of time in treatment | Maternal age<br>Percent of negative UDS results for illicit substances |

Note: #Descriptive analysis; *Univariate Assessment; **Bivariate Assessment; ***Multivariate Assessment; +Generalized Linear Model (not specified if univariate or multivariate).
ASI= Addiction Severity Index; Bup-naloxone= Combination product of Buprenorphine and Naloxone; COWS= Clinical Opiate Withdrawal Scale; ED= Emergency Department; MOUD= Medications for Opioid Use Disorder; NAS= Neonatal Abstinence Syndrome; OUD= Opioid Use Disorder; SOWS= Subjective Opiate Withdrawal Scale; SUD= Substance Use Disorder; UDT= Urine Drug Toxicology; UDS= Urine Drug Screen

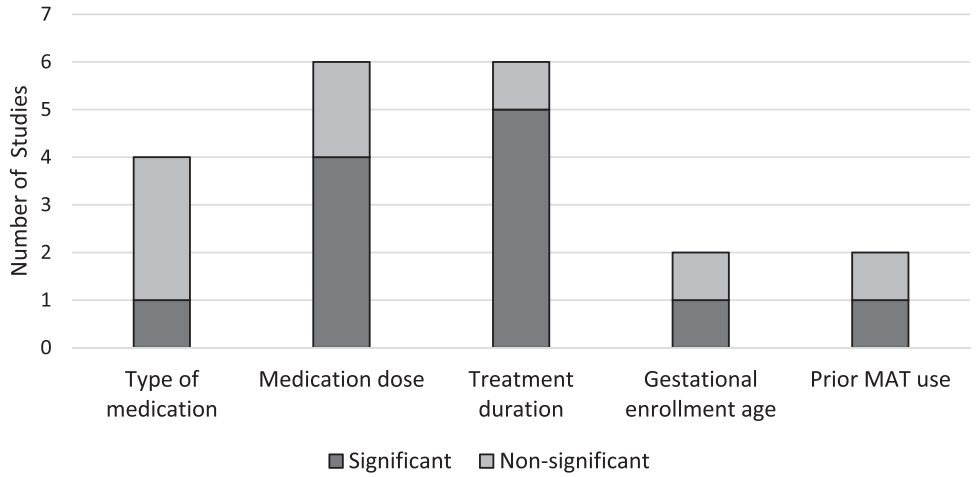



**Fig. 2. :** Medication related factors associated with treatment success.

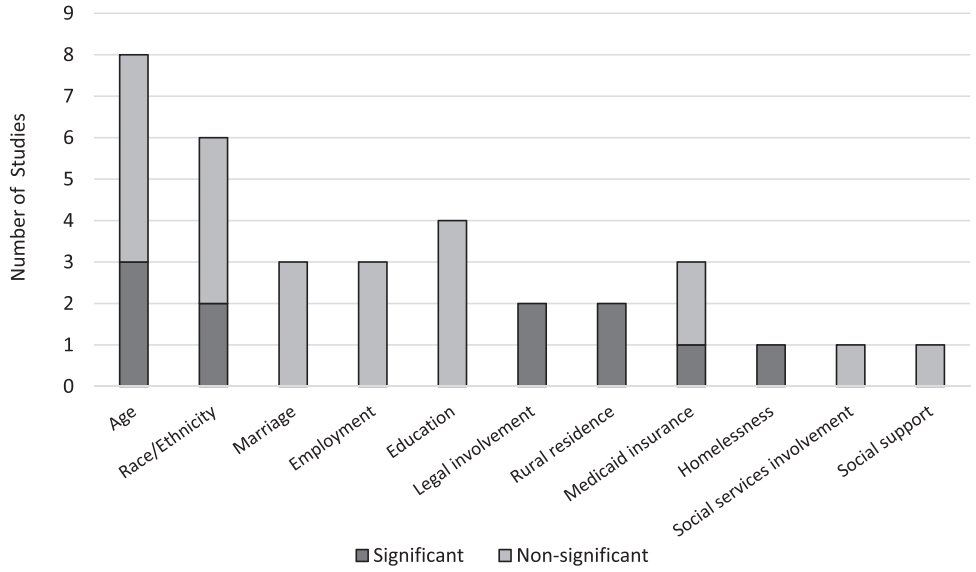



**Fig. 3. :** Sociodemographic factors associated with treatment success.

treatment (Cochran et al., 2018).

Lo-Ciganic et al. found that the presence of an ICD-9 code (304.0x, 304.7x and 305.5x) of OUD significantly increased the odds of early initiation to MOUD and subsequent adherence (Lo-Ciganic et al., 2019). In the Coker et al. and Ray-Griffith et al. studies, assessment of opioid withdrawal using the Clinical Opiate Withdrawal Scale (COWS) was undertaken at enrollment and in subsequent visits (Coker et al., 2018; Ray-Griffith et al., 2021). A higher COWS score on the last visit was reported in the "non-adherent" group compared to the "adherent" group in the Coker et al. study (Coker et al., 2018). In the Ray-Griffith et al. study, a higher COWS score proximate to delivery was not associated with treatment retention defined as 'attendance of appointment within 10–14 weeks postpartum (Ray-Griffith et al., 2021).

### 3.5. *Pregnancy and postpartum related factors*

Five studies explored pregnancy and postpartum related factors (Cochran et al., 2018; Coker et al., 2018; Ellis et al., 2019; Ray-Griffith et al., 2021; Schiff et al., 2021).

Coker et al. and Ray-Griffith et al. observed that parity and gravidity were not associated adherence to treatment, or attendance at treatment appointments respectively (Fig. 4) (Coker et al., 2018; Ray-Griffith et al., 2021). Cochran et. al reported no significant association between number of children between those retained vs. those discharged early from the pregnancy recovery program (Cochran et al., 2018). In those with multiple pregnancy, Schiff et. al reported no differences in retention in those who continued treatment one year postpartum vs. those who discontinued treatment (Schiff et al., 2021). Ellis et al. reported that delivery via cesarean section and subsequent receipt of a discharge opioid prescription were both independently associated with a higher

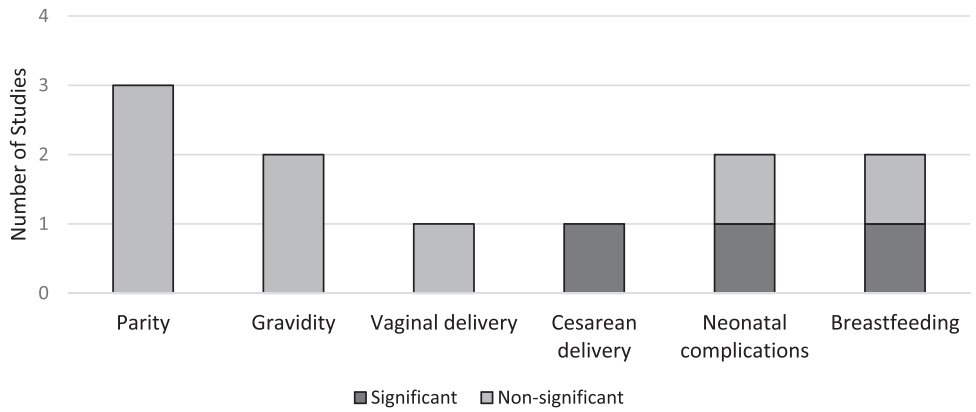



**Fig. 4. :** Perinatal related factors associated with treatment success.

likelihood of opioid misuse during the thirty-day postpartum period (Ellis et al., 2019). Ray-Griffith et al. observed no differences in postpartum treatment discontinuation among those who had a vaginal delivery (Ray-Griffith et al., 2021).

Ray-Griffith et al. observed a significant association between breastfeeding and treatment retention at thirty days postpartum; Even though Schiff et al. found a higher number of those breastfeeding at discharge in those retained in postpartum treatment, these differences were not significant (Ray-Griffith et al., 2021; Schiff et al., 2021). Schiff et al. additionally reported that neonatal outcomes such as preterm or low birth weight, and neonatal abstinence syndrome (NAS) were associated with a higher rate of treatment discontinuation (Schiff et al., 2021). Ray-Griffith et al., however, did not find an association between a diagnosis of NAS and treatment retention (Ray-Griffith et al., 2021).

### 3.6. Substance Use Related Factors

Several studies investigated potential associations between non-opioid substance use during pregnancy and MOUD success (Fig. 5). Lo-Ciganic et al. reported association between non-opioid substance use disorders and declining adherence or early discontinuation of MOUD (Lo-Ciganic et al., 2019). Ray-Griffith et al., however, found no differences in treatment discontinuation among those who were experiencing other substance use disorders (Ray-Griffith et al., 2021). Negative toxicology screens for non-opioid illicit substances during pregnancy was associated with higher retention in MOUD in studies by Ellis et al. and O'Connor et al., but not by Wilder et al. (Ellis et al., 2019; O'Connor et al., 2018; Wilder et al., 2017).

Although Brogly et al. reported a higher addiction severity index at enrollment among those who were lost to follow-up, Cochran et al.'s assessment of severity of drug use showed no association with early discharge from clinical care (Brogly et al., 2018; Coker et al., 2018). Cochran et al. and Ellis et al. observed that a history of injection drug use, lifetime history of heroin use, or injection heroin use thirty days before enrollment were not associated retention in MOUD (Cochran et al., 2018; Ellis et al., 2019).

Lo-Ciganic et al. found less frequent diagnosis of comorbid alcohol use disorder among early initiators of MOUD with persistently high adherence (Lo-Ciganic et al., 2019). Tobacco use was not associated with treatment retention in the studies by Cochran et al., Coker et al., Ray-Griffith et al., or O'Connor et al.,(Cochran et al., 2018; Coker et al., 2018; O'Connor et al., 2018; Ray-Griffith et al., 2021) but Lo-Ciganic et al. found a significant association between tobacco use and increased adherence among early initiators of MOUD (Lo-Ciganic et al., 2019). Marijuana use during the third trimester was associated with increased treatment retention during postpartum in the O'Connor et al.

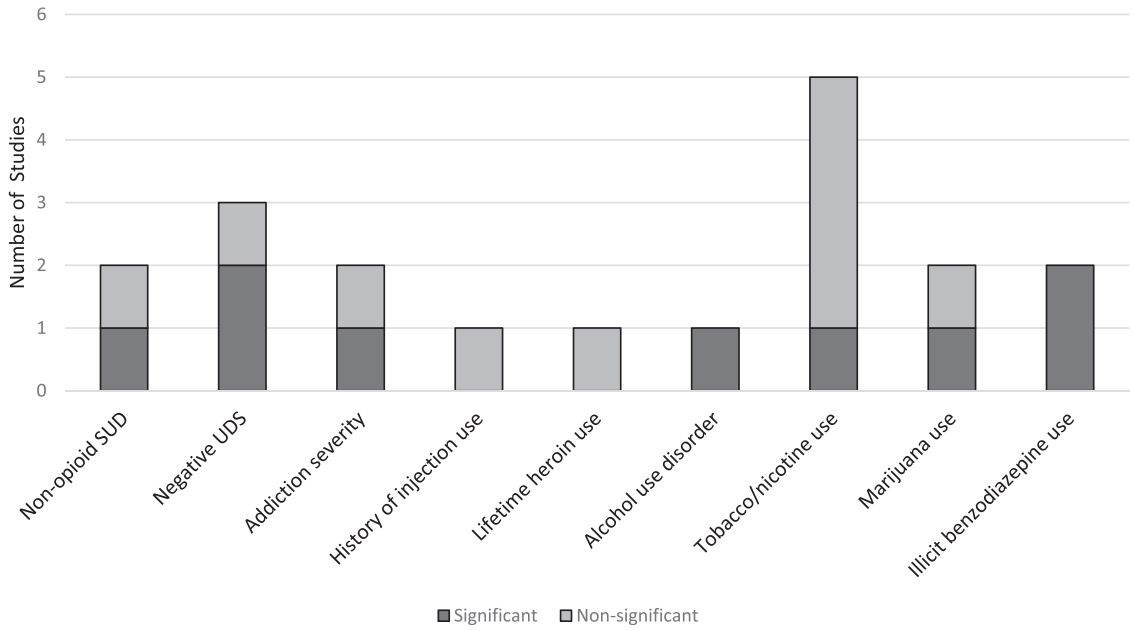



**Fig. 5. :** Substance use-related factors associated with treatment success.

but not in the Ray-Griffith et al. Study (O'Connor et al., 2018; Ray-Griffith et al., 2021). Both O'Connor et al. and Ray-Griffith et al. found increased likelihood of treatment discontinuation among participants who used illicit benzodiazepines (O'Connor et al., 2018; Ray-Griffith et al., 2021).

### 3.7. Mental health related factors

Six of the fifteen studies explored potential associations between psychiatric disorders and MOUD success (Fig. 6) (Cochran et al., 2018; Coker et al., 2018; Lo-Ciganic et al., 2019; O'Connor et al., 2018; Ray-Griffith et al., 2021; Schiff et al., 2021). Cochran et al. found that depression at baseline was associated with early discharge from their intervention program (Cochran et al., 2018). However, the diagnosis of depression was not significantly associated with treatment adherence in the studies by Coker et al., Ray-Griffith et al., and Schiff et al. (Coker et al., 2018; Ray-Griffith et al., 2021; Schiff et al., 2021). O'Connor et al. showed that receipt of an antidepressant prescription during the third trimester of pregnancy was associated with an increased likelihood of treatment retention at six months postpartum; Ray-Griffith et al. however, showed no differences in treatment discontinuation twelve weeks postpartum among those who had an antidepressant prescribed (O'Connor et al., 2018; Ray-Griffith et al., 2021).

Lo-Ciganic et al. found that individuals diagnosed with mental health disorders (defined by the study as major depression disorder, bipolar disorder, or schizophrenia) did not have significant differences in early initiation or adherence to MOUD (Lo-Ciganic et al., 2019). Bipolar disorder was also not associated with treatment discontinuation in the study by Coker et al. (Coker et al., 2018). Diagnosis of an anxiety disorder was significantly associated with treatment discontinuation in the study by Schiff et al. but not in the Cochran et al. study (Cochran et al., 2018; Schiff et al., 2021). Ray-Griffith et al. and Cochran et al. reported no association between posttraumatic stress disorder and treatment discontinuation (Cochran et al., 2018; Ray-Griffith et al., 2021).

### 3.8. Intervention strategies as predictors

Lander et al. conducted a randomized controlled trial to assess differences in treatment outcomes among patients receiving medication management group therapy in a mixed-gender group vs. a pregnancy-only group setting. They found no significant differences in treatment retention between the two groups (Lander et al., 2015). Krans et al. similarly examined differences in outcomes among mothers receiving women-centered services versus individuals receiving MOUD from programs without women-centered services; although participants in intervention group had higher buprenorphine doses, measures of treatment success i.e attendance of postpartum visits and illicit drug use were not different (Krans et al., 2018). Guille et al.'s comparison of outcomes among patients receiving OUD care via telemedicine vs. in-person found no differences in treatment retention between the groups (Guille et al., 2020).

## 4. Discussion

The pregnancy and postpartum period present unique challenges to individuals with OUD. Despite this, studies investigating factors influencing treatment success in this subpopulation remain nascent. Through a comprehensive review of the literature, we identified fifteen studies describing some of these factors. To our knowledge, this is the first review that explored factors associated with treatment success during both pregnancy and the postpartum period. This review is particularly relevant given the rising prevalence of OUD in pregnancy over the last decade (Crawford et al., 2022). This work not only contributes to the growing body of knowledge on the factors associated with treatment success among pregnant and postpartum individuals with OUD, but also provides insights that can enhance understanding of treatment response in MOUD, as well as guide future research directions.

Our review found that more intensive opioid treatment, characterized by higher therapeutic doses of medication, early initiation of MOUD, longer treatment duration and more frequent patient contact, were associated with better treatment outcomes. Pregnant and postpartum individuals who were prescribed higher therapeutic doses of MOUD, particularly buprenorphine, demonstrated an increased likelihood of treatment continuation (Coker et al., 2018; Lo-Ciganic et al., 2019; Ray-Griffith et al., 2021). Dosage adjustments during pregnancy are complex due to physiological changes such as increased blood volume and renal clearance, the need for induction and subsequent up-titration of doses, and the prevention of withdrawal symptoms in those who use opioid receptor agonists (William and Mozurkewich, 2014). Neonatal opioid withdrawal syndrome (NOWS), a factor negatively associated with postpartum treatment retention in one of the studies in this review, is also an important consideration when increasing dosing (Malhotra et al., 2019; Schiff et al., 2021; Velez et al., 2018). Health care providers should stay informed about the latest treatment safety data, including appropriate and effective MOUD dosing for pregnant individuals (Velez et al., 2018).

Regarding initiation of MOUD, early initiation before conception or early in pregnancy were salient factors associated with treatment success. Initiating treatment at the earliest contact for women of reproductive age with OUD is crucial (Kim et al., 2024). Pregnancy can serve as an important motivator for the cessation of substance misuse (Cochran et al., 2018). Pregnant people with OUD should be promptly engaged in prenatal and substance use-related care, including the receipt of MOUD (Cochran et al., 2018). Specialized programs tailored

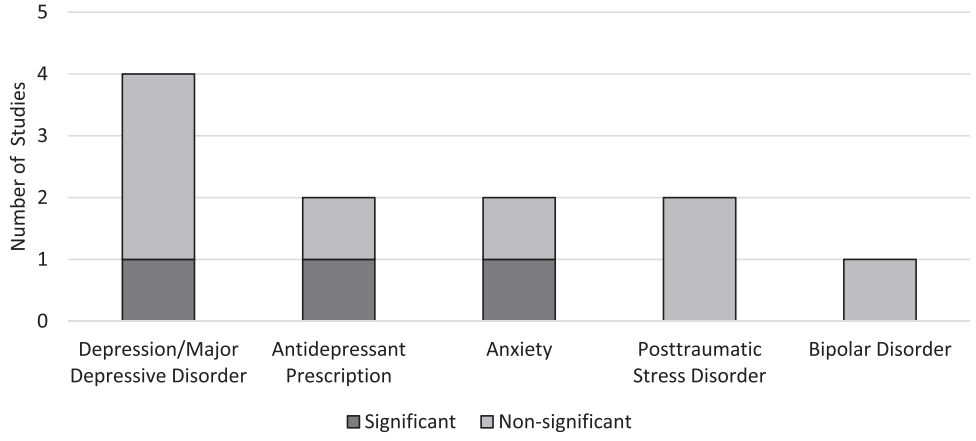



**Fig. 6. :** Mental health related factors associated with treatment success.

for pregnant and postpartum individuals is a factor that has been associated with longer treatment durations and favorable outcomes (Grella, 1999; Hser et al., 2011). However, group interventions specifically for pregnant individuals did not show improved treatment success compared to non-targeted treatments (Krans et al., 2018; Lander et al., 2015). Residential rehabilitation centers that offer education and skill training have proven effective in retaining non-pregnant individuals with substance use disorders and could be beneficial for pregnant and postpartum individuals (Hser et al., 2015; Treatment, 1997). Future research should explore the feasibility of such centers for this population.

A significant barrier to early MOUD initiation before conception is the reduced accessibility of MOUD among marginalized populations influenced by disparities in age, race/ethnicity, geographical location, and in those with criminal justice involvement (Mauro et al., 2022; Pilarinos et al., 2022; Priest et al., 2020; Stein et al., 2018). This review noted suboptimal treatment outcomes for non-white participants, younger individuals, those in rural areas and those having legal involvement (Brogly et al., 2018; Ellis et al., 2019; Lo-Ciganic et al., 2019; Schiff et al., 2021). Predominantly white study participants reflect broader racial/ethnic disparities in MOUD access in the general population, underscoring the need to address systemic racism in substance use treatment (Barnett et al., 2023). Future studies should focus on recruiting diverse samples.

Geographical barriers can be mitigated through telemedicine, which has proven effective for non-pregnant populations with OUD, particularly those in rural areas, and shows promise for pregnant individuals as well (Chen et al., 2023; Guille et al., 2020; Korthuis et al., 2017; Silang et al., 2021; Young, 2012). High rates of unintended pregnancy among individuals using opioids pose another challenge to early and sustained MOUD treatment during pregnancy and postpartum (Heil et al., 2011; Schiff et al., 2022). Increasing MOUD accessibility could provide healthcare providers an opportunity to offer family planning and contraceptive counseling services, including long-acting reversible contraceptives (Krans et al., 2017). Overall, the field should pursue strategies to reduce sociodemographic barriers and support diverse, geographically dispersed populations during the pregnancy and postpartum period.

Even with accessibility to MOUD, legal involvement remains a significant barrier to extended treatment durations (Brogly et al., 2018; Schiff et al., 2021). The criminalization of opioid misuse during pregnancy and the postpartum period is a broader issue, with some states having enacted punitive laws viewing opioid misuse as child endangerment, potentially leading to child custody loss (Atkins and Durrance, 2020; Soelberg et al., 2017). This deters pregnant and postpartum individuals from seeking help due to fear of legal consequences (SAMHSA, 2024; Stone, 2015). These policies correlate with lower rates of OUD diagnosis, and increased NOWS incidence (Faherty et al., 2019; Gressler et al., 2019). Consequently, these punitive measures may discourage treatment seeking, therefore harming both parent and child (Patrick and Schiff, 2017; SAMHSA, 2024; Shah et al., 2023). Stigma further exacerbates reluctance to seek prenatal care, with individuals with OUD facing stigma from the public, child welfare, criminal justice systems, and healthcare providers (Kennedy-Hendricks et al., 2017; Klaman et al., 2019; Morton et al., 2023; National Academies of Sciences, 2019; Rich et al., 2005; Stringer and Baker, 2018). Addiction is a treatable, chronic medical disease involving complex interactions among brain circuits, genetics, environment, and life experiences (American Society of Addiction Medicine, 2019; Herlinger and Lingford-Hughes, 2022). Managing OUD like other chronic conditions, such as hypertension and diabetes, is complex and achieving remission is challenging (Shah et al., 2023). The criminalization of opioid misuse during pregnancy and the postpartum period reinforces stigma and misconceptions around OUD in this population.

Neonatal complications, mode of delivery and breastfeeding are potential perinatal factors influencing postpartum treatment success. Preterm birth and low birth weight were negatively associated with MOUD adherence (Schiff et al., 2021). Results were mixed when assessing NOWS as a predictor of adherence (Ray-Griffith et al., 2021; Schiff et al., 2021). Krans et al. showed that neonatal complications may decrease with early initiation and longer duration of treatment (Krans et al., 2021). We found mixed results regarding breastfeeding as a positive predictor of treatment success during the postpartum period (Ray-Griffith et al., 2021; Schiff et al., 2021). Although the additional benefit of reducing incidences of NOWS and its severity has been reported, individuals with OUD demonstrate low rates of breastfeeding (Bogen and Whalen, 2019; O'Connor et al., 2013; Welle-Strand et al., 2013). Mode of delivery is also critical as cesarean sections necessitate anesthesia and adequate pain management, which is challenging for those with OUD due to opioid tolerance (Ellis et al., 2019; Ray-Griffith et al., 2021). Pregnant individuals with OUD are at risk of inadequate pain management during delivery, which can lead to treatment discontinuation (Martin et al., 2019).

Mental health disorders and other substance use disorders show mixed associations with treatment success (Cochran et al., 2018; Coker et al., 2018; Ellis et al., 2019; Lo-Ciganic et al., 2019; O'Connor et al., 2018; Ray-Griffith et al., 2021; Schiff et al., 2021; Wilder et al., 2017). Addressing comorbidities such as mental health and benzodiazepine use has contributed to MOUD retention (Strang et al., 2020; Tsakiridis et al., 2021). Integrated treatment of substance use and psychiatric disorders is recommended for holistic health promotion (Kelly and Daley, 2013).

Considering the multifactorial nature of treatment success, it is crucial to involve multiple disciplines in the care of individuals with OUD during the perinatal period. Adopting perinatal substance use clinics could be a viable solution (Ganetsky et al., 2022; Townsel et al., 2023). These clinics can address the fragmented medical care that individuals with OUD often experience during pregnancy and postpartum (Allen et al., 2023). By integrating healthcare professionals such as an obstetrician, nurse, midwife, anesthetist, addiction specialist, psychiatrist, pediatrician, social worker and resource management officer among others, these clinics offer comprehensive and holistic care (Echols et al., 2023; Muzik et al., 2023). This integrated model can increase the patients' trust in providers, which is key to treatment adherence amongst peripartum individuals on MOUD (Guille et al., 2022). Additionally working with a multidisciplinary team can enhance provider confidence, as some healthcare providers have reported feeling unfit to handle the complexities of caring for pregnant OUD patients (Forray et al., 2022).

### 4.1. Limitations

Our review has several limitations. First, there was potential overlap of study participants in some studies; Lo-Ciganic et al. (Lo-Ciganic et al., 2019) and Krans et al. (Krans et al., 2021) used data from statewide Medicaid claims in Pennsylvania and Schiff et al. (Schiff et al., 2021) used a statewide dataset in Massachusetts. Participant data from these studies may have overlapped with smaller single-site studies conducted in the same state. Similarly, we identified two pairs of studies (Coker et al., 2018; Krans et al., 2021; Lo-Ciganic et al., 2019; Ray-Griffith et al., 2021) that used the same dataset; although we disaggregated the findings from these pairs and found some differences in their findings, the possibility of overlap warrants mentioning. Second, although terms such as 'opioid substitution treatment', 'opioid agonist/antagonist therapy', 'opioid reversal agents', 'medication assisted or 'medication treatment or pharmacotherapy' were used in our search (see appendix), the term "medication for opioid use disorder" was not included in our searches. While we did not use the term 'medication for opioid use disorder,' our search strategy allowed us the flexibility to combine terms with adjacency and enabled us to capture articles that used the term. Lastly, studies included in this review were only limited to the United States and therefore the results may not be generalizable to other regions.

## 5. Conclusions

There is limited literature on the barriers and contributors to treatment success among pregnant and postpartum individuals with OUD in the United States. This review found that early engagement, longer duration and higher appropriate doses of MOUD are positively associated with treatment success during and after pregnancy. Conversely, legal involvement, rural residence, and illicit benzodiazepine use negatively impacted treatment success. Additionally, Black and Hispanic individuals, younger individuals, and those with comorbidities such as other substance use disorders in addition to OUD, and psychiatric diagnoses are at higher risk for MOUD non-adherence. The field would benefit from research with more diverse study samples and studies that characterize barriers faced by these populations. Due to the heterogeneity of treatment success across studies in this review, future research should consider harmonizing these measures. Finally, future research should emphasize prevention, early treatment engagement for at-risk individuals, and explore novel strategies for improving care.

## Author disclosures

None

## Funding

This work was supported by a pilot grant from the Center for Nursing Research at the Duke University School of Nursing. We would like to acknowledge additional support from the Duke School of Medicine Opioid Collaboratory and the Duke Center for AIDS Research, an NIH-funded program (5P30 AI064518).

## CRediT authorship contribution statement

**Elizabeth T. Knippler:** Writing – original draft, Visualization, Validation, Data curation. **Melissa H. Watt:** Writing – review & editing. **Maureen Mburu:** Writing – review & editing, Writing – original draft, Visualization, Validation, Data curation. **Rita Masese:** Writing – review & editing, Writing – original draft, Visualization, Validation, Data curation. **Margaret Graton:** Resources. **Brandon A. Knettel:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Funding acquisition, Data curation, Conceptualization. **Amnazo Muhirwa:** Validation, Data curation. **Leila Ledbetter:** Resources.

## Declaration of Competing Interest

None

## Appendix A. Search Strategy

Searcher: Leila Ledbetter
Initial Search: November 3, 2020
Updated Search: July 7, 2022
Database 1: Medline

| Set # | | Results |
|---|---|---|
| 1 Opioid use disorder | exp Opioid-Related Disorders/dt OR exp Opioid-Related Disorders/rh OR exp Opioid-Related Disorders/th OR exp Opioid Epidemic/th | 15073 |
| 2 Opioid use disorder | (Opioid or opioids or opiod or opiods or opiate or opiates or narcotic or narcotics).ti,ab. | 137560 |
| 3 Opioid use disorder | exp Drug Overdose/ | 13761 |
| 4 Opioid use disorder | (disorder or disorders or dependence or dependent or Dependences or addiction or Addictions or abuse or abuses or addict or addicts or overdose or overdoses).ti,ab. | 3065145 |
| 5 Opioid use disorder | 3 OR 4 | 3069225 |
| 6 Opioid use disorder | (Opioid or opioids or opiod or opiods or opiate or opiates or narcotic or narcotics).ti,ab. adj3 (exp Drug Overdose/ or (disorder or disorders or dependence or dependent or Dependences or addiction or Addictions or abuse or abuses or addict or addicts or overdose or overdoses).ti,ab.) | 23157 |
| 7 Opioid use disorder | 1 or 6 | 30975 |
| 8 Specific opioids | exp Methadone/ or exp Buprenorphine/ or exp Naltrexone/ or exp Buprenorphine, Naloxone Drug Combination/ or exp Prescription Drugs/tu or exp Analgesics, Opioid/tu | 53859 |
| 9 Specific opioids | (methadone OR buprenorphine OR naltrexone OR Suboxone OR Biodone OR Dolophine OR Metadol OR Metasedin OR Symoron OR Methadose OR Methex OR Phenadone OR Physeptone OR Phymet OR Pinadone OR Amidone OR Buprenex OR Prefin OR Subutex OR Buprex OR Temgesic OR Temgesic OR "6029-M" OR "6029 M" OR 6029 M OR "RX−6029-M" OR "RX 6029 M" OR RX6029M OR Antaxone OR Trexan OR "EN−1639A" OR "EN 1639 A" OR EN1639A OR ReVia OR Nemexin OR Nalorex OR Celupan).ti,ab. | 27273 |
| 10 Specific opioids | 8 or 9 | 61326 |
| 11 MAT | exp Opiate Substitution Treatment/ or Narcotic Antagonists/ | 18467 |
| 12 MAT | (opioid substitution treatment or narcotic antagonist therapy or opioid agonist therapy or opioid antagonist therapy or opioid reversal agent or opioid reversal agents or opioid receptor antagonists or opioid receptor antagonist or medication assisted or medication-assisted or medication treatment or pharmacotherapy or Detoxification or Prescription Opioid Addiction Treatment Study or POATS).ti,ab. | 75095 |
| 13 MAT | (medication.ti,ab. Adj4 "addiction treatment".ti,ab.) | 61 |
| 14 MAT | 11 or 12 or 13 | 90054 |

(*continued on next page*)

(*continued*)

| Set # | | Results |
|---|---|---|
| 15<br>Use disorder + specific opioids + MAT | 7 and 10 and 14 | 6158 |
| 16<br>adults | 15 NOT ((exp Adolescent/ OR exp Child/ OR exp Infant/) NOT exp Adult/) | 5972 |
| 17<br>United States | 16 NOT (exp africa/ OR exp central america/ OR exp latin america/ OR exp south america/ OR exp caribbean region/ OR exp asia/ OR exp europe/ OR exp oceania/) | 5091 |
| 18<br>Not animals | 17 NOT (exp animals/ NOT exp humans/) | 4836 |
| 19 | 18 NOT (Editorial.pt. OR Letter.pt. OR Comment.pt.) | 4535 |
| 20 | Limit 19 to da=20201101–20221231 | 1155 |

Database 2: CINAHL Plus with Full Text (via EbscoHost)

| Set # | | Results |
|---|---|---|
| 1 | (MH "Opioid Epidemic") | 519 |
| 2 | (MH "Overdose") OR TI(disorder OR disorders OR dependence OR dependent OR Dependences OR addiction OR Addictions OR abuse OR abuses OR addict OR addicts OR overdose OR overdoses) OR AB(disorder OR disorders OR dependence OR dependent OR Dependences OR addiction OR Addictions OR abuse OR abuses OR addict OR addicts OR overdose OR overdoses) | 506,688 |
| 3 | TI(Opioid OR opioids OR opiod OR opiods OR opiate OR opiates OR narcotic OR narcotics) OR AB(Opioid OR opioids OR opiod OR opiods OR opiate OR opiates OR narcotic OR narcotics) | 47,661 |
| 4 | S2 AND S3 | 19,131 |
| 5 | S1 OR S4 | 19,378 |
| 6<br>Specific opioids | (MH "Buprenorphine") OR (MH "Methadone") OR<br>(MH "Naltrexone") OR (MH "Analgesics, Opioid/TU") OR (MH "Drugs, Prescription+/TU") OR TI(methadone OR buprenorphine OR naltrexone OR Suboxone OR Biodone OR Dolophine OR Metadol OR Metasedin OR Symoron OR Methadose OR Methex OR Phenadone OR Physeptone OR Phymet OR Pinadone OR Amidone OR Buprenex OR Prefin OR Subutex OR Buprex OR Temgesic OR Temgesic OR "6029-M" OR "6029 M" OR 6029 M OR "RX−6029-M" OR "RX 6029 M" OR RX6029M OR Antaxone OR Trexan OR "EN−1639A" OR "EN 1639 A" OR EN1639A OR ReVia OR Nemexin OR Nalorex OR Celupan) OR AB(methadone OR buprenorphine OR naltrexone OR Suboxone OR Biodone OR Dolophine OR Metadol OR Metasedin OR Symoron OR Methadose OR Methex OR Phenadone OR Physeptone OR Phymet OR Pinadone OR Amidone OR Buprenex OR Prefin OR Subutex OR Buprex OR Temgesic OR Temgesic OR "6029-M" OR "6029 M" OR 6029 M OR "RX−6029-M" OR "RX 6029 M" OR RX6029M OR Antaxone OR Trexan OR "EN−1639A" OR "EN 1639 A" OR EN1639A OR ReVia OR Nemexin OR Nalorex OR Celupan) | 21,990 |
| 7<br>MAT | (MH "Narcotic Antagonists+") OR TI("Opiate Substitution Treatment" OR "Narcotic Antagonists" OR "opioid substitution treatments" OR "narcotic antagonist therapy" OR "opioid agonist therapy" OR "opioid antagonist therapy" OR "medication assisted" OR "medication-assisted" OR "medication treatment" OR pharmacotherapy OR Detoxification OR "Prescription Opioid Addiction Treatment Study" OR POATS OR (medication AND "addiction treatment")) OR AB("Opiate Substitution Treatment" OR "Narcotic Antagonists" OR "opioid substitution treatments" OR "narcotic antagonist therapy" OR "opioid agonist therapy" OR "opioid antagonist therapy" OR "medication assisted" OR "medication-assisted" OR "medication treatment" OR pharmacotherapy OR Detoxification OR "Prescription Opioid Addiction Treatment Study" OR POATS OR (medication AND "addiction treatment")) | 24,635 |
| 8 | S5 AND S6 AND S7 | 3506 |
| 9 | (MH "Africa+") OR (MH "Central America+") OR (MH "Canada+") OR (MH "Greenland") OR (MH "Mexico") OR (MH "South America+") OR (MH "West Indies+") OR (MH "Asia+") OR (MH "Australia+") OR (MH "Europe+") OR (MH "New Zealand") OR (MH "Melanesia+") OR (MH "Micronesia+") | 1394,971 |
| 10 | S8 NOT S9 | 3116 |
| 11 | S10 NOT ((MH "Adolescence+" OR MH "Infant+" OR MH "Child+") NOT (MH "Adult+")) | 2979 |
| 12 | S11 NOT (((MH "Animals+") OR (MH "Animal Studies") OR (TI "animal model*")) NOT (MH "human")) | 2887 |
| 13 | S12 NOT PT (Book Review OR Commentary OR Editorial OR Letter OR Pamphlet OR Pamphlet Chapter OR Poetry) | 2674 |
| 14 | Limiters - Published Date: 20201101–20221231 | 567 |

Database 3: PsycINFO (via EbscoHost)

| Set # | | Results |
|---|---|---|
| 1 | DE "Opioid Use Disorder" OR DE "Heroin Addiction" OR DE "Morphine Dependence" | 5317 |
| 2 | (DE "Drug Overdoses") OR TI(disorder OR disorders OR dependence OR dependent OR Dependences OR addiction OR Addictions OR abuse OR abuses OR addict OR addicts OR overdose OR overdoses) OR AB(disorder OR disorders OR dependence OR dependent OR Dependences OR addiction OR Addictions OR abuse OR abuses OR addict OR addicts OR overdose OR overdoses) | 827,515 |
| 3 | TI(Opioid OR opioids OR opiod OR opiods OR opiate OR opiates OR narcotic OR narcotics) OR AB(Opioid OR opioids OR opiod OR opiods OR opiate OR opiates OR narcotic OR narcotics) | 37,345 |
| 4 | S2 AND S3 | 21,352 |
| 5 | S1 OR S4 | 23,912 |
| 6<br>Specific opioids | (DE "Buprenorphine") OR (DE "Methadone") OR<br>(DE "Naltrexone") OR TI(methadone OR buprenorphine OR naltrexone OR Suboxone OR Biodone OR Dolophine OR Metadol OR Metasedin OR Symoron OR Methadose OR Methex OR Phenadone OR Physeptone OR Phymet OR Pinadone OR Amidone OR Buprenex OR Prefin OR Subutex OR Buprex OR Temgesic OR Temgesic OR "6029-M" OR "6029 M" OR 6029 M OR "RX−6029-M" OR "RX 6029 M" OR RX6029M OR Antaxone OR Trexan OR "EN−1639A" OR "EN 1639 A" OR EN1639A OR ReVia OR Nemexin OR Nalorex OR Celupan) OR AB(methadone OR buprenorphine OR naltrexone OR Suboxone OR Biodone OR Dolophine OR Metadol OR Metasedin OR Symoron OR Methadose OR Methex OR Phenadone OR Physeptone OR Phymet OR Pinadone OR Amidone OR Buprenex OR Prefin OR Subutex OR Buprex OR Temgesic OR Temgesic OR "6029-M" OR "6029 M" OR 6029 M OR "RX−6029-M" OR "RX 6029 M" OR RX6029M OR Antaxone OR Trexan OR "EN−1639A" OR "EN 1639 A" OR EN1639A OR ReVia OR Nemexin OR Nalorex OR Celupan) | 14,379 |

(*continued on next page*)

(*continued*)

| Set # | | Results |
|---|---|---|
| 7 MAT | (DE "Medication-Assisted Treatment") OR (DE "Narcotic Antagonists") OR TI("Opiate Substitution Treatment" OR "Narcotic Antagonists" OR "opioid substitution treatments" OR "narcotic antagonist therapy" OR "opioid agonist therapy" OR "opioid antagonist therapy" OR "medication assisted" OR "medication-assisted" OR "medication treatment" OR pharmacotherapy OR Detoxification OR "Prescription Opioid Addiction Treatment Study" OR POATS OR (medication AND "addiction treatment")) OR AB("Opiate Substitution Treatment" OR "Narcotic Antagonists" OR "opioid substitution treatments" OR "narcotic antagonist therapy" OR "opioid agonist therapy" OR "opioid antagonist therapy" OR "medication assisted" OR "medication-assisted" OR "medication treatment" OR pharmacotherapy OR Detoxification OR "Prescription Opioid Addiction Treatment Study" OR POATS OR (medication AND "addiction treatment")) | 25,005 |
| 8 | S5 AND S6 AND S7 | 2623 |
| 9 | S8 Narrow by Subject Age: - adulthood (18 yrs & older) | 1330 |
| 10 | Limiters - Published Date: 20201101–20221231 | 148 |

Database 4: Web of Science (via Clarivate)
Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years

| Set # | | Results |
|---|---|---|
| 1 | TS=("Opioid-Related Disorders" OR "Opioid Epidemic") | 3308 |
| 2 | TS=(Opioid or opioids or opiod or opiods or opiate or opiates or narcotic or narcotics) | 154,914 |
| 3 | TS=("drug overdose" OR disorder or disorders or dependence or dependent or Dependences or addiction or Addictions or abuse or abuses or addict or addicts or overdose or overdoses) | 5059,265 |
| 4 | #2 AND #3 | 57,035 |
| 5 | #1 OR #4 | 58,037 |
| 6 Specific opioids | TS=(methadone OR buprenorphine OR naltrexone OR Suboxone OR Biodone OR Dolophine OR Metadol OR Metasedin OR Symoron OR Methadose OR Methex OR Phenadone OR Physeptone OR Phymet OR Pinadone OR Amidone OR Buprenex OR Prefin OR Subutex OR Buprex OR Temgesic OR Temgesic OR "6029-M" OR "6029 M" OR 6029 M OR "RX−6029-M" OR "RX 6029 M" OR RX6029M OR Antaxone OR Trexan OR "EN−1639A" OR "EN 1639 A" OR EN1639A OR ReVia OR Nemexin OR Nalorex OR Celupan) | 35,766 |
| 7 MAT | TS=("Opiate Substitution Treatment" OR "Narcotic Antagonists" OR "opioid substitution treatments" OR "narcotic antagonist therapy" OR "opioid agonist therapy" OR "opioid antagonist therapy" OR "medication assisted" OR "medication-assisted" OR "medication treatment" OR pharmacotherapy OR Detoxification OR "Prescription Opioid Addiction Treatment Study" OR POATS OR (medication AND "addiction treatment")) | 90,688 |
| 8 | #5 AND #6 AND #7 | 3153 |
| 9 | Refined by: [excluding] DOCUMENT TYPES: (LETTER OR EDITORIAL MATERIAL) | 3044 |
| 10 | Refined by: [excluding] RESEARCH AREAS: (PEDIATRICS) | 2989 |
| 11 | Refined by: COUNTRIES/REGIONS: (USA) | 1980 |
| 12 | Timespan: 2020–11–01–2022–12–31 (Publication Date) | 371 |

Database 5: ProQuest Dissertations & Theses Global

| Set # | | Results |
|---|---|---|
| 1 | noft("Opioid-Related Disorders" OR "Opioid Epidemic") | 338 |
| 2 | noft(Opioid or opioids or opiod or opiods or opiate or opiates or narcotic or narcotics) | 7830 |
| 3 | noft("drug overdose" OR disorder or disorders or dependence or dependent or Dependences or addiction or Addictions or abuse or abuses or addict or addicts or overdose or overdoses) | 445,517 |
| 4 | S2 AND S3 | 3748 |
| 5 | S1 OR S4 | 3837 |
| 6 Specific opioids | noft(methadone OR buprenorphine OR naltrexone OR Suboxone OR Biodone OR Dolophine OR Metadol OR Metasedin OR Symoron OR Methadose OR Methex OR Phenadone OR Physeptone OR Phymet OR Pinadone OR Amidone OR Buprenex OR Prefin OR Subutex OR Buprex OR Temgesic OR Temgesic OR "6029-M" OR "6029 M" OR 6029 M OR "RX−6029-M" OR "RX 6029 M" OR RX6029M OR Antaxone OR Trexan OR "EN−1639A" OR "EN 1639 A" OR EN1639A OR ReVia OR Nemexin OR Nalorex OR Celupan) | 1462 |
| 7 MAT | noft("Opiate Substitution Treatment" OR "Narcotic Antagonists" OR "opioid substitution treatments" OR "narcotic antagonist therapy" OR "opioid agonist therapy" OR "opioid antagonist therapy" OR "medication assisted" OR "medication-assisted" OR "medication treatment" OR pharmacotherapy OR Detoxification OR "Prescription Opioid Addiction Treatment Study" OR POATS OR (medication AND "addiction treatment")) | 4641 |
| 8 | S5 AND S6 AND S7 | 129 |
| 9 | NOT (England AND India AND Canada AND Spain AND Austria AND Sweden AND Wales) | 129 |
| 10 | Applied filters: 2020–11–01–2022–12–31 | 26 |

## References


Allen, A., Bueno, Y., Mallahan, S., MacPherson, A.H., Armin, J., 2023. Opportunities to expand postpartum support for those in recovery from opioid use disorder: results from a qualitative study. Drug Alcohol Depend. Rep. *7*, 100170. https://doi.org/10.1016/j.dadr.2023.100170.

American College of Obstetricians and Gynecologists' Committee on Obstetric Practice, 2017. Committee opinion no. 711: opioid use and opioid use disorder in pregnancy. Obstet. Gynecol. *130* (2), e81. https://doi.org/10.1097/AOG.0000000000002235.

American Society of Addiction Medicine. (2019, September 15). What is the Definition of Addiction? Default. https://www.asam.org/quality-care/definition-of-addiction

Apsley, H.B., Brant, K., Brothers, S., Harrison, E., Skogseth, E., Schwartz, R.P., Jones, A. A., 2024. Pregnancy- and parenting-related barriers to receiving medication for opioid use disorder: A multi-paneled qualitative study of women in treatment, women who terminated treatment, and the professionals who serve them, 17455057231224181 Women'S. Health *20*. https://doi.org/10.1177/17455057231224181.

Atkins, D.N., Durrance, C.P., 2020. State policies that treat prenatal substance use as child abuse or neglect fail to achieve their intended goals. Health Aff. *39* (5), 756–763. https://doi.org/10.1377/hlthaff.2019.00785.

Barnett, M.L., Meara, E., Lewinson, T., Hardy, B., Chyn, D., Onsando, M., Huskamp, H.A., Mehrotra, A., Morden, N.E., 2023. Racial Inequality in Receipt of Medications for Opioid Use Disorder. N. Engl. J. Med. *388* (19), 1779–1789. https://doi.org/10.1056/NEJMsa2212412.

Benningfield, M.M., Dietrich, M.S., Jones, H.E., Kaltenbach, K., Heil, S.H., Stine, S.M., Coyle, M.G., Arria, A.M., O'Grady, K.E., Fischer, G., Martin, P.R., 2012. Opioid dependence during pregnancy: relationships of anxiety and depression symptoms to treatment outcomes. Addiction *107* (0 1), 74–82. https://doi.org/10.1111/j.1360-0443.2012.04041.x.

Biondi, B.E., Vander Wyk, B., Schlossberg, E.F., Shaw, A., Springer, S.A., 2022. Factors associated with retention on medications for opioid use disorder among a cohort of adults seeking treatment in the community. Addict. Sci. Clin. Pract. *17* (1), 15. https://doi.org/10.1186/s13722-022-00299-1.

Bogen, D.L., Whalen, B.L., 2019. Breastmilk feeding for mothers and infants with opioid exposure: what is best? Semin. Fetal Neonatal Med. *24* (2), 95–104. https://doi.org/10.1016/j.siny.2019.01.001.

Brogly, S.B., Saia, K.A., Walley, A.Y., Du, H.M., Sebastiani, P., 2014. Prenatal buprenorphine versus methadone exposure and neonatal outcomes: systematic review and meta-analysis. Am. J. Epidemiol. *180* (7), 673–686. https://doi.org/10.1093/aje/kwu190.

Brogly, S.B., Saia, K.E., Werler, M.M., Regan, E., Hernández-Díaz, S., 2018. Prenatal treatment and outcomes of women with opioid use disorder. Obstet. Gynecol. *132* (4), 916–922. https://doi.org/10.1097/AOG.0000000000002881.

Chen, H., Knettel, B.A., Harrison, L.M., Marais, A.D., Nelli, A., Campbell, H.A., Muhirwa, A., McKellar, M.S., Gulur, P., Guthrie, S., 2023. Leveraging policy changes made in response to covid-19 to advance telehealth and novel treatment approaches for people who use opioids: qualitative perspectives from two rural north carolina counties. North Carol. Med. J. *84* (5). https://doi.org/10.18043/001c.83930.

Choi, S., Rosenbloom, D., Stein, M.D., Raifman, J., Clark, J.A., 2022. Differential gateways, facilitators, and barriers to substance use disorder treatment for pregnant women and mothers: a scoping systematic review. J. Addict. Med. *16* (3), e185. https://doi.org/10.1097/ADM.0000000000000909.

Clark, R.E., Baxter, J.D., Aweh, G., O'Connell, E., Fisher, W.H., Barton, B.A., 2015. Risk factors for relapse and higher costs among medicaid members with opioid dependence or abuse: opioid agonists, comorbidities, and treatment history. J. Subst. Abus. Treat. *57*, 75–80. https://doi.org/10.1016/j.jsat.2015.05.001.

Cochran, G.T., Hruschak, V., Abdullah, W., Krans, E., Douaihy, A.B., Bobby, S., Fusco, R., Tarter, R., 2018. Optimizing pregnancy treatment interventions for moms (OPTI-Mom): a pilot study. J. Addict. Med. *12* (1), 72. https://doi.org/10.1097/ADM.0000000000000370.

Coker, J.L., Catlin, D., Ray-Griffith, S., Knight, B., Stowe, Z.N., 2018. Buprenorphine medication-assisted treatment during pregnancy: an exploratory factor analysis associated with adherence. Drug Alcohol Depend. *192*, 146–149. https://doi.org/10.1016/j.drugalcdep.2018.07.042.

Crawford, A.D., McGlothen-Bell, K., Recto, P., McGrath, J.M., Scott, L., Brownell, E.A., Cleveland, L.M., 2022. Stigmatization of pregnant individuals with opioid use disorder. *Women's*. Health Rep. *3* (1), 172–179. https://doi.org/10.1089/whr.2021.0112.

Degenhardt, L., Clark, B., Macpherson, G., Leppan, O., Nielsen, S., Zahra, E., Larance, B., Kimber, J., Martino-Burke, D., Hickman, M., Farrell, M., 2023. Buprenorphine versus methadone for the treatment of opioid dependence: a systematic review and meta-analysis of randomised and observational studies. Lancet Psychiatry *10* (6), 386–402. https://doi.org/10.1016/S2215-0366(23)00095-0.

Echols, A., Collins, S., Akbarali, S., Dronamraju, R., Uesugi, K., 2023. Public health approaches to perinatal substance use: an overview of strategic directions. Matern. Child Health J. *27* (Suppl 1), 1–4. https://doi.org/10.1007/s10995-023-03792-4.

Ellis, J.D., Cairncross, M., Struble, C.A., Carr, M.M., Ledgerwood, D.M., Lundahl, L.H., 2019. Correlates of Treatment Retention and Opioid Misuse Among Postpartum Women in Methadone Treatment. J. Addict. Med. *13* (2), 153. https://doi.org/10.1097/ADM.0000000000000467.

Faherty, L.J., Kranz, A.M., Russell-Fritch, J., Patrick, S.W., Cantor, J., Stein, B.D., 2019. Association of punitive and reporting state policies related to substance use in pregnancy with rates of neonatal abstinence syndrome. JAMA Netw. Open *2* (11), e1914078. https://doi.org/10.1001/jamanetworkopen.2019.14078.

Forray, A., Mele, A., Byatt, N., Tobon, A.L., Gilstad-Hayden, K., Hunkle, K., Hong, S., Lipkind, H., Fiellin, D.A., Callaghan, K., Yonkers, K.A., 2022. Support Models for Addiction Related Treatment (SMART) for pregnant women: Study protocol of a cluster randomized trial of two treatment models for opioid use disorder in prenatal clinics. PLOS ONE *17* (1), e0261751. https://doi.org/10.1371/journal.pone.0261751.

Frazer, Z., McConnell, K., Jansson, L.M., 2019. Treatment for substance use disorders in pregnant women: motivators and barriers. Drug Alcohol Depend. *205*, 107652. https://doi.org/10.1016/j.drugalcdep.2019.107652.

Ganetsky, V.S., Heil, J., Yates, B., Jones, I., Hunter, K., Rivera, B., Wilson, L., Salzman, M., Baston, K.E., 2022. A low-threshold comprehensive shared medical appointment program for perinatal substance use in an underserved population. J. Addict. Med. *16* (3), e203. https://doi.org/10.1097/ADM.0000000000000912.

Grella, C.E., 1999. Women in residential drug treatment: differences by program type and pregnancy. J. Health Care Poor Under *10* (2), 216–229.

Gressler, L.E., Shah, S., Shaya, F.T., 2019. Association of criminal statutes for opioid use disorder with prevalence and treatment among pregnant women with commercial insurance in the United States. JAMA Netw. Open *2* (3), e190338. https://doi.org/10.1001/jamanetworkopen.2019.0338.

Guille, C., Simpson, A.N., Douglas, E., Boyars, L., Cristaldi, K., McElligott, J., Johnson, D., Brady, K., 2020. Treatment of opioid use disorder in pregnant women via telemedicine: a nonrandomized Controlled Trial. JAMA Netw. Open *3* (1), e1920177. https://doi.org/10.1001/jamanetworkopen.2019.20177.

Guille, C., Hall, C., King, C., Sujan, A., Brady, K., Newman, R., 2022. Listening to women and pregnant and postpartum people: Qualitative research to inform opioid use disorder treatment for pregnant and postpartum people. Drug Alcohol Depend. Rep. *3*, 100064. https://doi.org/10.1016/j.dadr.2022.100064.

Heil, S.H., Jones, H.E., Arria, A., Kaltenbach, K., Coyle, M., Fischer, G., Stine, S., Selby, P., Martin, P.R., 2011. Unintended pregnancy in opioid-abusing women. J. Subst. Abus. Treat. *40* (2), 199–202. https://doi.org/10.1016/j.jsat.2010.08.011.

Herlinger, K., Lingford-Hughes, A., 2022. Opioid use disorder and the brain: A clinical perspective. Addiction *117* (2), 495–505. https://doi.org/10.1111/add.15636.

Hser, Y.-I., Evans, E., Huang, D., Messina, N., 2011. Long-term outcomes among drug dependent mothers treated in women-only versus mixed-gender programs. J. Subst. Abus. Treat. *41* (2), 115–123. https://doi.org/10.1016/j.jsat.2011.02.004.

Hser, Y.-I., Evans, E., Grella, C., Ling, W., Anglin, D., 2015. Long-Term Course of Opioid Addiction. Harv. Rev. Psychiatry *23* (2), 76. https://doi.org/10.1097/HRP.0000000000000052.

Hutchison, M., Russell, B.S., Leander, A., Rickles, N., Aguiar, D., Cong, X.S., Harel, O., Hernandez, A.V., 2023. Trends and barriers of medication treatment for opioid use disorders: a systematic review and meta-analysis. J. Drug Issues, 00220426231204841. https://doi.org/10.1177/00220426231204841.

Kelly, T.M., Daley, D.C., 2013. Integrated treatment of substance use and psychiatric disorders. Soc. Work Public Health *28* (0), 388–406. https://doi.org/10.1080/19371918.2013.774673.

Kendler, K.S., Ohlsson, H., Svikis, D.S., Sundquist, K., Sundquist, J., 2017. The protective effect of pregnancy on risk for drug abuse: a population, co-relative, co-spouse, and within-individual analysis. Am. J. Psychiatry *174* (10), 954–962. https://doi.org/10.1176/appi.ajp.2017.16091006.

Kennedy-Hendricks, A., Barry, C.L., Gollust, S.E., Ensminger, M.E., Chisolm, M.S., McGinty, E.E., 2017. Social stigma toward persons with prescription opioid use disorder: associations with public support for punitive and public health–oriented policies. Psychiatr. Serv. *68* (5), 462–469. https://doi.org/10.1176/appi.ps.201600056.

Kim, K., Liu, G., Dick, A.W., Choi, S.W., Agbese, E., Corr, T.E., Hsuan, C., Wright, M.S., Park, S., Velott, D., Leslie, D.L., 2024. Timing of treatment for opioid use disorder among birthing people. J. Subst. Use Addict. Treat. *161*, 209289. https://doi.org/10.1016/j.josat.2024.209289.

Klaman, S.L., Andringa, K., Horton, E., Jones, H.E., 2019. Concurrent Opioid and Alcohol Use Among Women Who Become Pregnant: Historical, Current, and Future Perspectives, 1178221819852637 Subst. Abus.: Res. Treat. *13*. https://doi.org/10.1177/1178221819852637.

Korthuis, P.T., McCarty, D., Weimer, M., Bougatsos, C., Blazina, I., Zakher, B., Grusing, S., Devine, B., Chou, R., 2017. Primary Care–Based models for the treatment of opioid use disorder. Ann. Intern. Med. *166* (4), 268–278. https://doi.org/10.7326/M16-2149.

Krans, E.E., Cochran, G., Bogen, D.L., 2017. Caring for Opioid Dependent Pregnant Women: Prenatal and Postpartum Care Considerations. Obstet. Anesth. Dig. *37* (2), 89–91. https://doi.org/10.1097/01.aoa.0000515760.42651.7a.

Krans, E.E., Bobby, S., England, M., Gedekoh, R.H., Chang, J.C., Maguire, B., Genday, P., English, D.H., 2018. The Pregnancy Recovery Center: A women-centered treatment program for pregnant and postpartum women with opioid use disorder. Addict. Behav. *86*, 124–129. https://doi.org/10.1016/j.addbeh.2018.05.016.

Krans, E.E., Kim, J.Y., Chen, Q., Rothenberger, S.D., James, I.I.I., Kelley, D, A.E., Jarlenski, M.P., 2021. Outcomes associated with the use of medications for opioid use disorder during pregnancy. Addiction *116* (12), 3504–3514. https://doi.org/10.1111/add.15582.

Krawczyk, N., Rivera, B.D., Jent, V., Keyes, K.M., Jones, C.M., Cerdá, M., 2022. Has the treatment gap for opioid use disorder narrowed in the U.S.?: A yearly assessment from 2010 to 2019. Int. J. Drug Policy *110*, 103786. https://doi.org/10.1016/j.drugpo.2022.103786.

Lander, L.R., Gurka, K.K., Marshalek, P.J., Riffon, M., Sullivan, C.R., 2015. A comparison of pregnancy-only versus mixed-gender group therapy among pregnant women with opioid use disorder. Soc. Work Res. *39* (4), 235–244. https://doi.org/10.1093/swr/svv029.

Link, H.M., Jones, H., Miller, L., Kaltenbach, K., Seligman, N., 2020. Buprenorphine-naloxone use in pregnancy: A systematic review and metaanalysis. Am. J. Obstet. Gynecol. MFM *2* (3), 100179. https://doi.org/10.1016/j.ajogmf.2020.100179.

Lo-Ciganic, W.-H., Donohue, J.M., Kim, J.Y., Krans, E.E., Jones, B.L., Kelley, D., James, A.E., Jarlenski, M.P., 2019. Adherence trajectories of buprenorphine therapy among pregnant women in a large state Medicaid program in the United States. Pharmacoepidemiol. Drug Saf. *28* (1), 80–89. https://doi.org/10.1002/pds.4647.

Malhotra, A., Allison, B.J., Castillo-Melendez, M., Jenkin, G., Polglase, G.R., Miller, S.L., 2019. Neonatal morbidities of fetal growth restriction: pathophysiology and impact. Front. Endocrinol. *10*. https://doi.org/10.3389/fendo.2019.00055.

Martin, C.E., Terplan, M., Krans, E.E., 2019. Pain, Opioids, and Pregnancy. Clin. Perinatol. *46* (4), 833–847. https://doi.org/10.1016/j.clp.2019.08.013.

Mauro, P.M., Gutkind, S., Annunziato, E.M., Samples, H., 2022. Use of medication for opioid use disorder among US adolescents and adults with need for opioid treatment, 2019. JAMA Netw. Open *5* (3), e223821. https://doi.org/10.1001/jamanetworkopen.2022.3821.

Morton, J., Vignato, J., Anbari, A.B., 2023. Stigma experienced by perinatal women with opioid dependency in the United States: a qualitative meta-synthesis. West. J. Nurs. Res. *45* (9), 843–853. https://doi.org/10.1177/01939459231182495.

Mullins, N., Galvin, S.L., Ramage, M., Gannon, M., Lorenz, K., Sager, B., Coulson, C.C., 2020. Buprenorphine and naloxone versus buprenorphine for opioid use disorder in pregnancy: a cohort study. J. Addict. Med. *14* (3), 185. https://doi.org/10.1097/ADM.0000000000000562.

Muzik, M., Menke, R.A., Issa, M., Fisk, C., Charles, J., Jester, J.M., 2023. Evaluation of the Michigan clinical consultation and care program: an evidence-based approach to

perinatal mental healthcare. J. Clin. Med. *12* (14), 4836. https://doi.org/10.3390/jcm12144836.

National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Health Sciences Policy; Committee on Medication-Assisted Treatment for Opioid Use Disorder; Mancher M, Leshner AI, editors. Medications for Opioid Use Disorder Save Lives. Washington (DC): National Academies Press (US); (2019). Mar 30. 5, Barriers to Broader Use of Medications to Treat Opioid Use Disorder. Available from:.https://www.ncbi.nlm.nih.gov/books/NBK541389/.

NIDA, N.I. on D.. (2023, June 30). *Drug Overdose Death Rates | National Institute on Drug Abuse (NIDA)*. ⟨https://nida.nih.gov/research-topics/trends-statistics/overdose-death-rates⟩

Noormohammadi, A., Forinash, A., Yancey, A., Crannage, E., Campbell, K., Shyken, J., 2016. Buprenorphine Versus Methadone for Opioid Dependence in Pregnancy. Ann. Pharmacother. *50* (8), 666–672. https://doi.org/10.1177/1060028016648367.

O'Connor, A.B., Collett, A., Alto, W.A., O'Brien, L.M., 2013. Breastfeeding rates and the relationship between breastfeeding and neonatal abstinence syndrome in women maintained on buprenorphine during pregnancy. J. Midwifery Women'S. Health *58* (4), 383–388. https://doi.org/10.1111/jmwh.12009.

O'Connor, A.B., Uhler, B., O'Brien, L.M., Knuppel, K., 2018. Predictors of treatment retention in postpartum women prescribed buprenorphine during pregnancy. J. Subst. Abus. Treat. *86*, 26–29. https://doi.org/10.1016/j.jsat.2017.12.001.

Patrick, S.W., Schiff, D.M., Committee on substance use and prevention, 2017. A public health response to opioid use in pregnancy. Pediatrics *139* (3), e20164070. https://doi.org/10.1542/peds.2016-4070. Epub 2017 Feb 20. PMID: 28219965.

Pilarinos, A., Bromberg, D.J., Karamouzian, M., 2022. Access to Medications for opioid use disorder and associated factors among adolescents and young adults. JAMA Pediatr. *176* (3), 304–311. https://doi.org/10.1001/jamapediatrics.2021.4606.

Priest, K.C., McCarty, D., Lovejoy, T.I., 2020. Expanding access to medications for opioid use disorder: program and policy approaches from outside the veterans health administration. J. Gen. Intern. Med. *35* (Suppl 3), 886–890. https://doi.org/10.1007/s11606-020-06266-3.

Ray-Griffith, S., Tharp, E., Coker, J.L., Catlin, D., Knight, B., Stowe, Z.N., 2021. Buprenorphine medication for opioid use disorder: a study of factors associated with postpartum treatment retention. Am. J. Addict. *30* (1), 43–48. https://doi.org/10.1111/ajad.13084.

Rich, J.D., Boutwell, A.E., Shield, D.C., Key, R.G., McKenzie, M., Clarke, J.G., Friedmann, P.D., 2005. Attitudes and practices regarding the use of methadone in US State and federal prisons. J. Urban Health.: Bull. N. Y. Acad. Med. *82* (3), 411–419. https://doi.org/10.1093/jurban/jti072.

SAMHSA, (2016). A collaborative approach to the treatment of pregnant women with opioid use disorders. Substance Abuse and Mental Health Services Administration (SAMHSA). https://ncsacw.acf.hhs.gov/files/Collaborative_Approach_508.pdf.

SAMHSA, (2023). MAT Medications, Counseling, and Related Conditions. .https://www.samhsa.gov/medication-assisted-treatment/medications-counseling-related-conditions.

SAMHSA, (2024). Evidence-based, Whole-personcare For Pregnant Peoplewho Have Opioid Use Disorder..

Schiff, D.M., Nielsen, T.C., Hoeppner, B.B., Terplan, M., Hadland, S.E., Bernson, D., Greenfield, S.F., Bernstein, J., Bharel, M., Reddy, J., Taveras, E.M., Kelly, J.F., Wilens, T.E., 2021. Methadone and Buprenorphine discontinuation among postpartum women with opioid use disorder. Am. J. Obstet. Gynecol. *225* (4), 424.e1–424.e12. https://doi.org/10.1016/j.ajog.2021.04.210.

Schiff, D.M., Work, E.C., Muftu, S., Partridge, S., De, L., MacMillan, K., Gray, J.R., Hoeppner, B.B., Kelly, J.F., Greenfield, S.F., Jones, H.E., Wilens, T.E., Terplan, M., Bernstein, J., 2022. You have to take this medication, but then you get punished for taking it:" Lack of agency, choice, and fear of medications to treat opioid use disorder across the perinatal period. J. Subst. Abus. Treat. *139*, 108765. https://doi.org/10.1016/j.jsat.2022.108765.

Shah, S.K., Perez-Cardona, L., Helner, K., Massey, S.H., Premkumar, A., Edwards, R., Norton, E.S., Rogers, C.E., Miller, E.S., Smyser, C.D., Davis, M.M., Wakschlag, L.S., 2023. How penalizing substance use in pregnancy affects treatment and research: a qualitative examination of researchers' perspectives. J. Law Biosci. *10* (2), lsad019. https://doi.org/10.1093/jlb/lsad019.

Silang, K., Sanguino, H., Sohal, P.R., Rioux, C., Kim, H.S., Tomfohr-Madsen, L.M., 2021. eHealth interventions to treat substance use in pregnancy: a systematic review and meta-analysis. Article 19 Int. J. Environ. Res. Public Health *18* (19). https://doi.org/10.3390/ijerph18199952.

Soelberg, C.D., Brown, R.E.J., Du Vivier, D., Meyer, J.E., Ramachandran, B.K., 2017. The US opioid crisis: current federal and state legal issues. Anesth. Analg. *125* (5), 1675. https://doi.org/10.1213/ANE.0000000000002403.

Sordo, L., Barrio, G., Bravo, M.J., Indave, B.I., Degenhardt, L., Wiessing, L., Ferri, M., Pastor-Barriuso, R., 2017. Mortality risk during and after opioid substitution treatment: systematic review and meta-analysis of cohort studies. BMJ *357*, j1550. https://doi.org/10.1136/bmj.j1550.

Stein, B.D., Dick, A.W., Sorbero, M., Gordon, A.J., Burns, R.M., Leslie, D.L., Pacula, R.L., 2018. A population based examination of trends and disparities in medication therapy for opioid use disorders among Medicaid-enrollees. Subst. Abus. *39* (4), 419–425. https://doi.org/10.1080/08897077.2018.1449166.

Stone, R., 2015. Pregnant women and substance use: fear, stigma, and barriers to care. Health Justice *3*, 2. https://doi.org/10.1186/s40352-015-0015-5.

Strang, J., Volkow, N.D., Degenhardt, L., Hickman, M., Johnson, K., Koob, G.F., Marshall, B.D.L., Tyndall, M., Walsh, S.L., 2020. Opioid use disorder. Article 1 Nat. Rev. Dis. Prim. *6* (1). https://doi.org/10.1038/s41572-019-0137-5.

Stringer, K.L., Baker, E.H., 2018. Stigma as a barrier to substance abuse treatment among those with unmet need: an analysis of parenthood and marital status. J. Fam. Issues *39* (1), 3. https://doi.org/10.1177/0192513X15581659.

Suarez, E.A., Huybrechts, K.F., Straub, L., Hernández-Díaz, S., Jones, H.E., Connery, H.S., Davis, J.M., Gray, K.J., Lester, B., Terplan, M., Mogun, H., Bateman, B.T., 2022. Buprenorphine versus methadone for opioid use disorder in pregnancy. N. Engl. J. Med. *387* (22), 2033–2044. https://doi.org/10.1056/NEJMoa2203318.

Timko, C., Schultz, N.R., Cucciare, M.A., Vittorio, L., Garrison-Diehn, C., 2016. Retention in medication-assisted treatment for opiate dependence: A systematic review. J. Addict. Dis. *35* (1), 22–35. https://doi.org/10.1080/10550887.2016.1100960.

Townsel, C., Irani, S., Buis, C., Lasser, S., Menke, N., Preston, Y., Kountanis, J.A., Skoczylas, M., Menke, R., Getty, B., Stout, M., Muzik, M., 2023. Partnering for the future clinic: a multidisciplinary perinatal substance use program. Gen. Hosp. Psychiatry *85*, 220–228. https://doi.org/10.1016/j.genhosppsych.2023.10.009.

Treatment, C. for S.A.. (1997). Chapter 5—Specialized Substance Abuse Treatment Programs. In A Guide to Substance Abuse Services for Primary Care Clinicians. Substance Abuse and Mental Health Services Administration (US). https://www.ncbi.nlm.nih.gov/books/NBK64815/

Tsakiridis, I., Oikonomidou, A.C., Bakaloudi, D.R., Dagklis, T., Papazisis, G., Chourdakis, M., 2021. Substance use during pregnancy: a comparative review of major guidelines. Obstet. Gynecol. Surv. *76* (10), 634. https://doi.org/10.1097/OGX.0000000000000943.

U.S. Food & Drug Administration (FDA). (2002). Drug Approval Package: Subutex (Buprenorphine HCl) Suboxone (Buprenorphine HCl & Naloxone HCl Dihydrate).https://www.accessdata.fda.gov/drugsatfda_docs/nda/2002/20-732_20-733_subutex.cfm.

Velez, M.L., McConnell, K., Spencer, N., Montoya, L., Tuten, M., Jansson, L.M., 2018. Prenatal buprenorphine exposure and neonatal neurobehavioral functioning. Early Hum. Dev. *117*, 7–14. https://doi.org/10.1016/j.earlhumdev.2017.11.009.

Viera, A., Bromberg, D.J., Whittaker, S., Refsland, B.M., Stanojlović, M., Nyhan, K., Altice, F.L., 2020. Adherence to and retention in medications for opioid use disorder among adolescents and young adults. Epidemiol. Rev. *42* (1), 41–56. https://doi.org/10.1093/epirev/mxaa001.

Wachman, E.M., Saia, K., Miller, M., Valle, E., Shrestha, H., Carter, G., Werler, M., Jones, H., 2019. Naltrexone treatment for pregnant women with opioid use disorder compared with matched buprenorphine control subjects. Clin. Ther. *41* (9), 1681–1689. https://doi.org/10.1016/j.clinthera.2019.07.003.

Welle-Strand, G.K., Skurtveit, S., Jansson, L.M., Bakstad, B., Bjarkø, L., Ravndal, E., 2013. Breastfeeding reduces the need for withdrawal treatment in opioid-exposed infants. Acta Paediatr. (Oslo, Nor.: 1992) *102* (11), 1060–1066. https://doi.org/10.1111/apa.12378.

Wilder, C.M., Hosta, D., Winhusen, T., 2017. Association of methadone dose with substance use and treatment retention in pregnant and postpartum women with opioid use disorder. J. Subst. Abus. Treat. *80*, 33–36. https://doi.org/10.1016/j.jsat.2017.06.005.

William F., R., & Mozurkewich L., E. (2014, June 1). *Buprenorphine and Methadone for Opioid Addiction During Pregnancy*. Obstetrics and Gynecology Clinics. ⟨https://www.clinicalkey.com/#!/content/playContent/1-s2.0-S0889854514000126?scrollTo=%23hl0000418⟩

Young, L.B., 2012. Telemedicine interventions for substance-use disorder: a literature review. J. Telemed. Telecare *18* (1), 47–53. https://doi.org/10.1258/jtt.2011.110608.